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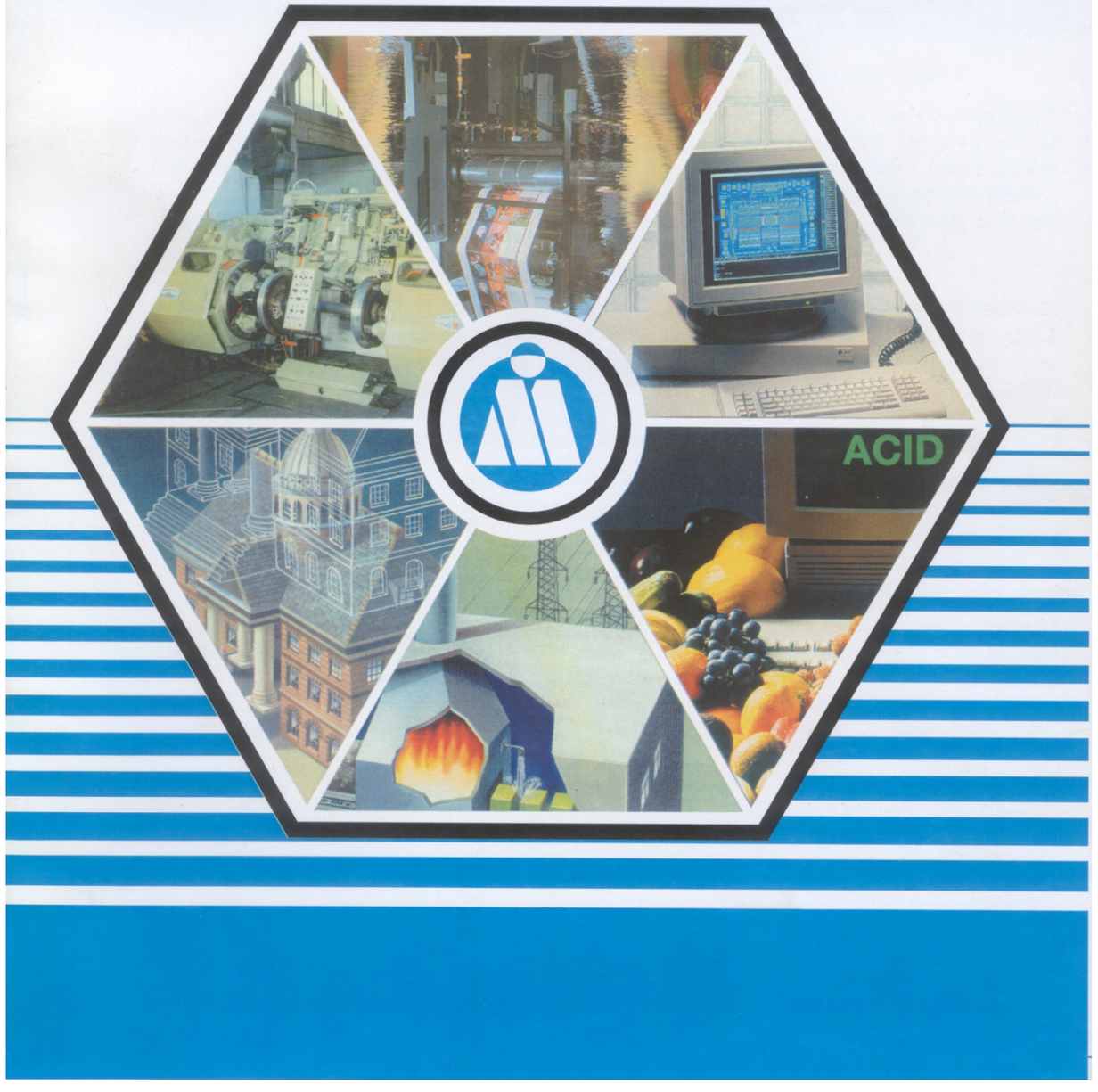

CALENDAR – ANNIVERSARIES

9 October, 1879 - Max Theodor Felix von Laue (9.10.1879 – 24.04.1960) was a German physicist who won the Nobel Prize in Physics in 1914 for his discovery of the diffraction of X-rays by crystals.

10 October, 1914 – King Carol I, born Prince Karl of Hohenzollern-Sigmaringen was the ruler of Romania from 1866 to 1914. He was elected Ruling Prince of the Romanian United Principalities on 20.04.1866. After the defeat of the Ottoman Empire (1878) in the Russo-Turkish War, he declared Romania a sovereign nation.

11 October, 1989 - James Prescott Joule (24.12.1818 – 11.10.1889) was an English physicist and brewer, born in Salford, Lancashire. Joule studied the nature of heat, and discovered its relationship to mechanical work (see energy). The SI derived unit of energy, the joule, is named for James Joule.

14 October, 1914 - Raymond (Ray) Davis, Jr. (14.10.1914–31.05.2006) was an American chemist, physicist, and Nobel Prize in Physics laureate. He shared the Nobel Prize in Physics in 2002 with Japanese physicist Masatoshi Koshiba and American Riccardo Giacconi for pioneering contributions to astrophysics.

20 October, 1884 - Paul Adrien Maurice Dirac (8.08.1902–20.10.1984) was an English theoretical physicist. Dirac shared the Nobel Prize in Physics for 1933 with Erwin Schrödinger, "for the discovery of new productive forms of atomic theory".

23 October, 1944 - Charles Glover Barkla (7.06.1877 – 23.10.1944) was a British physicist, and the winner of the Nobel Prize in Physics in 1917 for his work in X-ray spectroscopy and related areas in the study of X-rays (Roentgen rays).

2 November, 1929 - Richard Edward Taylor (2.11.1929) in Medicine Hat, Alberta. In 1990, he shared the Nobel Prize in Physics with Jerome Friedman and Henry Kendall "for their pioneering investigations concerning deep inelastic scattering of electrons on protons and bound neutrons".

20 November, 1889 - Edwin Powell Hubble (20.11.1889 – 28.09.1953) was an American astronomer. Hubble is known for showing that the recessional velocity of a galaxy increases with its distance from the earth, implying the universe is expanding. Known as "Hubble's law".

28 November, 1954 - Enrico Fermi (29.09.1901 – 28.11.1954) was an Italian-American physicist, best known for his work on Chicago Pile-1 (the first nuclear reactor). Fermi held several patents related to the use of nuclear power, and was awarded the 1938 Nobel Prize in Physics for his work on induced radioactivity by neutron bombardment and the discovery of transuranic elements.

17 December, 1964 - Victor Francis Hess (24.06.1883 – 17.12.1964) was an Austrian-American physicist, and Nobel laureate in physics, who discovered cosmic rays. Hess and Anderson shared the 1936 Nobel Prize in Physics.

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C O N T E N T

REZUMATE

Herlea A. **Istoria tehnicii şi unităţii europene.** Acest document stabileşte în linii paralele naşterea şi evoluţia, în Europa, a unei discipline - istoria tehnologiei şi ca o idee care duce la construcţia Uniunii Europene. Acesta arată dependenţa istoriei tehnologiei şi ideii de unitate europeană de gândirea umană, pe contexte culturale şi spirituale. În acelaşi timp, evidenţiază o gamă largă de similitudini cronologice, un ritm similar de evoluţie, maturizare şi punere în aplicare.

Titu-Marius I. Băjenescu, **Câteva probleme de fiabilitate ale capsulelor electronice.** După o introducere a subiectului, sunt prezentate câteva din cele mai importante probleme de fiabilitate ale capsulelor electronice din material plastic. Articolul, scris pentru a informa nespecialiştii şi managerii, explorează diferite probleme ale încapsulării şi soluţiile microelectronice, în diferite domenii de aplicaţii.

Lvovsky E., Lvovsky N. **Ratingul specificat al prosperării populaţiei din toată lumea.** Autorii au găsit în Internet [1] ratingul ţărilor privind prosperarea generală a populaţiei. A fost întreprinsă o încercare de a preciza acest rating cu aplicarea a două pachete formidabile de programe statistice. Rezultatele obţinute deferă puţin de valoarea ratingului din Internet.

Derevjanko V., Nechitaylo N. **Factorii, care reduc permeabilitatea membranelor pentru filtrarea apei si a apelor uzate.** Lucrarea analizează factorii care conduc la obturarea elementelor de tip membrană în timpul funcţionării acestora. Membranele pot fi obturate cu particule coloidale anorganice sau organice şi cu organisme biologice. Articolul oferă o prezentare critică a factorilor ce determină reducerea permeabilităţii membranelor. Pentru a asigura o bună funcţionare a staţiilor de ultra-filtrare este necesar să se realizeze în prealabil îndepărtarea compuşilor ce conduc la formarea mâlului. Cel mai mare interes îl prezintă membranele ale căror suprafeţe nu interacţionează cu substanţele care formează mâluri. În acest sens, realizarea unor noi materiale sau modele de membrane este de mare perspectivă. De asemenea, este necesar să se ia în considerare posibilitatea de a modifica suprafaţa membranei prin utilizarea de reactivi. Membranele modificate trebuie să îndeplinească următoarele cerinţe: minimizarea costurile de eliminare a contaminării, asigurarea accesibilităţii şi uşurinţa proceselor de modificare; scădere minimă a permeabilităţii membranei în timpul funcţionării. Este necesar să fie dezvoltate metodologii şi modele care să prevadă modul de obturare a membranei în funcţie de condiţiile de utilizare.

Dekanskiy V., Zavialov V., Bodrov V., Misyura T., Zaporozhecz Y., Popova N. **Schema tehnologică de producţie a extractelor de malţ, folosind cereale şi leguminoase.** Este propusă şi descrisă schema tehnologică fundamentală de producere a malţului din grâne şi leguminoase, care reprezintă un ciclu tehnologic nou compus din şase mari etape tehnologice şi conţine 22 de operaţii tehnologice fundamentale.

Popovici C., Tatarov P. **Evoluţia acizilor graşi şi conţinutului de peroxizi în uleiul de nuci (*Juglans regia* L.) la păstrare.** Nucul este o cultură de importanţă economică mare pentru industria alimentară. Un obiectiv major în producţia nucilor este de a găsi o metodă adecvată pentru a stabiliza lipidele acestora. Scopul acestui studiu a fost de a evalua influenţa tehnologiei de fabricare şi timpului de depozitare asupra indicilor de calitate privind stabilitatea oxidativă a uleiului de nuci. Evaluarea hidrolitică a fost efectuată prin determinarea indicelui de acid şi acumularea produşilor primari ai oxidării prin măsurarea indicelui de peroxid. Probele de ulei de nuci presat la rece au fost examinate imediat după presare până la 180 de zile de depozitare. Datele obţinute sunt menite sa ajute de a descrie mecanismul de oxidare a uleiului de nuci presat la rece.

Chiricuţă I., Rusu I. **Îmbunătăţirea proprietăţilor de Fly Ash prin amestecare cu diferite substanţe**. Cenuşile de termocentrală (sau cenuşi fine - CF) sunt utilizate pe scară largă, pe plan mondial, în amestecuri de tip beton pentru structuri rutiere. Adăugarea lianţilor imbunătăţeşte semnificativ proprietăţile CF. Chiar şi o cantitate foarte mică de liant adăugată în cenuşă (1 - 2%) poate activa şi accelera reacţiile de cimentare. Cei mai importanţi lianţi sunt diferite tipuri de var şi ciment, ca şi deşeurile industriale cum ar fi zgura de furnal, gipsul, cenuşile reactive şi RDG (reziduu de la desulfurizarea gazelor de ardere). Efectul conţinutului de apă asupra creşterii rezistenţei la compresiune şi compactităţii CF este, de asemenea, semnificativ. Proprietăţile ce ţin de utilizarea pe timp de iarnă a CF pot fi îmbunătăţite cu ajutorul clorurii de calciu, $CaCl_2$.

Cosovschi P. **Prezentarea rezultatelor de deformare plastică a suprafeţei materialului din fontă cu grafit lamelar.** În acest articol sunt prezentate datele experimentale pentru un proces de

deformare plastică a suprafeţei care au fost obţinute folosind echipamentul modern. Acestea rezultate descriu procesele desfăşurate în procesul prelucrării. Rezultatele obţinute sunt necesare pentru înţelegerea specificului materialului în condiţiile descrise şi asigură un volum necesar de date pentru următoarea folosire a computatorului şi efectuarea controlului corectitudinii datelor primite în procesul de proiectare.

Marina V., Marina Viorica. **Metodologia de prezentare matriceală a tensorilor de ordin superior.** Ecuaţii constitutive neliniare a materialelor anizotrope sunt examinate în domeniul reversibil. Sunt analizate detailat ecuaţiile constitutive de ordinul doi, în care este studiat tensorul elastic de ordinul patru. Este dată reprezentarea matriceală a acestor tensori şi analiza constantelor independente de elasticitate în funcţie de simetria materială şi tipul interacţiunilor dintre atomi.

Grosu C. **Halva din miez de nuci (Juglans Regia L.)** A fost studiat procesul de obţinere a halvalei din nucă. În calitate de materii prime pentru pregătirea halvalei au servit miezul de nuci parţial degresat Cogălnicenu, zahărul şi apa. Rezultatul cercetărilor constă în perfecţionarea tehnologiei de fabricare a halvalei prin reducerea procedeelor şi excluderea procesului de adaos în masa pregătită a uleiului. Halvaua din miez de nuci obţinută v-a fi de calitate superioară cu valoarea biologică deosebită şi sigură pentru consum, prin procesarea materiei prime – fruct de nucă Juglans regia L.

Evdochimov R. **Diverse resurse on-line pentru elaborarea materialelor didactice interactive, folosite în predare-învăţare-evaluare prin intermediul tablei interactive.** Diversificarea metodelor de predare-învăţare-evaluare are un efect benefic asupra celor ce învaţă. Recent, a apărut o nouă metodă de predare-învăţare-evaluare prin intermediul tablei interactive. La fel, ca în toate cazurile când apare ceva o tehnologie informaţională nouă de predare-învăţare-evaluare şi în cazul acesta au apărut dispute privind eficacitatea ei şi, mai cu seamă, probleme legate de crearea materialelor didactice interactive pentru utilizarea tablei în procesul de instruire. Principala problemă care încearcă să rezolve această lucrare este problema elaborării materialelor didactice interactive pentru table interactive de profesori de diferite discipline.

Zubrilina Ya., Lupaşcu T., Şamis E. **Tehnologii efective noi de producere a materialelor şi articolelor de construcţie.** Lucrarea include descrierea tehnologiilor noi a materialelor de construcţie în baza lianţilor minerali. Metodele au fost probate în producere pe gips şi lianţilor de gips-ciment.

Leonte P., Pleşca A. **Analiza armonicelor din cadrul redresoarelor de putere.** Analiza armonicelor de curent produse de convertoarele de putere statice implică obţinerea de informaţii exacte referitoare la forma de undă a tensiunii la bornele convertorului, configuraţia acestuia, tipul de control, impedanţa sistemului şi parametrii circuitului de curent continuu. În prezent, principala sursă de armonici de curent o reprezintă redresoarele controlate şi invertoarele. O serie de teste experimentale au fost realizate folosind un redresor trifazat semicontrolat în laboratoarele din cadrul *Dipartimento di Ingegneria Elettrica Industriale, Politecnico di Torino, Italia*. Ca parametri variabili s-au considerat inductanţa şi capacitatea sarcinii, precum şi unghiul de comandă.

Bostan I., V. Bostan, Dulgheru V., Ciobanu O. **Micro-hidrocentrală pentru conversia energiei cinetice a apei curgătoare cu rotor hidrodinamic modificat.** Creşterea eficienţei de conversie a microhidrocentralei elaborate se realizează printr-o poziţie optimă a paletelor cu profil hidrodinamic. Formularea folosită pentru calculul forţelor hidrodinamice este un model de strat limită nevâscos. Microhidrocentrala asigură conversia energiei cinetice a apei râurilor în energie mecanică sau electrică fără construirea barajelor. Creşterea eficienţei de conversie este asigurată de pale cu profil hidrodinamic şi orientarea lor optimă pentru conversia eficientă a energiei cinetice a apei.

Mocanu F., Bejan L. **Tratarea suprafeţelor materialelor compozite în vederea realizării îmbinărilor adezive.** Prezenta lucrare prezintă principalele metode mecanice, energetice şi chimice folosite pentru prelucrarea suprafeţelor materialelor compozite în vederea realizării îmbinărilor adezive.

Lunguleasa A. **Absorbţia de apă şi umflarea lemnului de molid după imersie în apă.** Aceasta lucrare prezintă câteva aspecte referitoare la dinamica absorbţiei apei si umflarea în grosime pentru specia de molid. Bazata pe metode clasice de cercetare aceasta lucrare încearcă sa gasească lucruri originale referitoare la umflarea lemnului si absorbţia de apă.

Decher E. **Utilizarea materialelor compozite polimerice în industria construcţiilor.** Apariţia compozitelor moderne a revoluţionat domeniul materialelor de construcţie prin ingeniozitatea fabricării lor, proprietăţile fizico-mecanice net superioare materialelor tradiţionale şi uşurinţei de punere în operă. Lucrarea prezintă o parte din avantajele acestor materiale compozite şi gradul lor de aplicare în diferite domenii ale vieţii sociale şi în divere ţări.

ABSTRACT

Herlea A. **The history of technology and the European Unity.** This paper sets into parallel lines the birth and the evolution, in Europe, of a discipline—the History of Technology—and that of an idea which leads to the construction of the European Union. It shows the dependence of the History of Technology and of the idea of European unity on human thought, on cultural and spiritual contexts. At the same time highlights a wide range of chronological similarities, of a similar rhythm of evolution, maturation, and implementation.

Titu-Marius I. Băjenescu. **Some reliability problems of electronic packages.** After a subject introduction, some of the most important reliability problems of electronic plastic packages are presented. The paper, intended to inform the non-specialists and decision makers, explores different packaging problems and solutions of microelectronics in different applications areas.

Lvovsky E., Lvovsky N. **The specified rating of the countries' population well – being all over the world.** The authors have found in the Internet [1] the rating of countries on the average well – being of the population. We have made an attempt to specify this rating using powerful statistical program packets. The obtained results somewhat differ from the Internet rating.

Derevjanko V., Nechitaylo N. Factors leading to a decrease in membrane permeability for water filtration and wastewater. This work analyses factors that lead to fouling of membrane elements during operation. Membranes are subject to fouling with colloidal particles, inorganic, organic and biological organisms. This article provides a critical overview of the factors causing the reduction of membrane permeability. To ensure smooth operation of ultra-filtration plants it is necessary to carry out preliminary removal of sludge forming compounds. The membranes whose surfaces do not interact with sludge forming substances are of greatest interest. In this connection development of new membrane materials or designs is of great perspective. It is also necessary to consider the possibility of modifying the membrane surface by use of reagents. Modified membranes must meet the following requirements: minimizing the costs of removal of contamination, securing of accessibility and ease of modification processes; minimal decrease in membrane permeability during operation. It is necessary to develop methodologies and models to predict membrane fouling depending on operating conditions.

Dekanskiy V., Zavialov V., Bodrov V., Misyura T., Zaporozhecz Y., Popova N. **Flow sheet of malt extracts production using malting of cereals and legumes.** There is proposed and described the fundamental technological scheme of production of malt extracts from grains and legumes which represents a new technological cycle of six major technological phases and contains 22 fundamental technological operations.

Popovici C., Tatarov P. **Evolution of fatty acids and peroxydes content in walnut oil (*Juglans regia* L.) during storage.** Walnut is a crop of a high economic interest for the food industry. A major goal in walnut production is to find an appropriate method to stabilize lipids from walnut kernels. The aim of the work was to evaluate the influence of manufacturing technology and storage time on quality indices related to walnut oil oxidative stability. Hydrolytic evaluation was assessed by measuring the acid number and primary oxidation products accumulation was determined by measuring peroxide number. Cold pressed walnut oil sample were investigated immediately after pressing up to 180 days of storage. Obtained data should help to describe oxidation mechanism of cold pressed walnut oil.

Chiricuţă I., Rusu I. **Improving the Properties of Fly Ash by Mixing with Different Substances.** Fly ash (FA) are widely used throughout the world in concrete mixtures type road structures. Binders can be added to significantly improve the properties of FA. Even a very small addition of binder (1 – 2 %) in a FA may activate and accelerate the cementation reactions. The most important binders are different types of lime and cement, as well as industrial residues like blast furnace slag, gypsum, reactive ashes and FGD (flue gas desulphurisation residues). The effect of the water content on the compression strength and the compaction of the FA is also significant. The winter-construction properties of FA can be improved with help of calcium chloride, $CaCl_2$.

Cosovschi P. **The publication of the results of surface plastic deformation for cast iron with lamellar graphite.** In the publication is presented experimental data for surface deformation of cast iron with lamellar graphite, obtained using modern

equipment and describing the processes for this treatment. The obtained results allow to understand the specific characteristics of the material in mentioned conditions and provide the necessary information for future use of computer and check the correctness of the results obtained in processing.

Marina V., Marina Viorica. **Methodology of matrix representation of higher order tensors.** The governing nonlinear equations of anisotropic materials are examined in reversible deformation area. The constitutive equations of the second order, in which the tensors of elastic constants of forth order listed, are detailed analyzed. The matrix representation of these tensors and analysis of independent constants of elasticity in function of material symmetry and type of atoms interactions are given.

Grosu C. **Walnut (Juglans Regia L.) halva.** It was studied the obtaining process of walnut halva (Juglans Regia L). As raw materials for the halva preparation served partially defatted Cogălniceanu walnut kernel, sugar and water. The result of the research is to improve the halva manufacturing technology by reducing processes and exclusion of oil addition process in the prepared mass. The obtained walnut halva will be of superior quality with great biological value and safe for consumption by raw materials processing.

Evdokimov R. **Various online resources for developing interactive teaching materials used in teaching-learning-evaluation with interactive whiteboard.** Diversification of methods of teaching-learning-evaluation has a beneficial effect on the learner. Recently has appeared a new method of teaching, learning and evaluation with interactive whiteboard. The appearance of new informational technology for teaching, learning and evaluation arose disputes of its effectiveness and, in particular, problems with creating interactive teaching materials for use with the interactive whiteboard. The main problem this paper is trying to solve is the problem of the creation of teaching interactive materials for interactive whiteboards by teachers of different disciplines.

Zubrilina Ya., Lupashku T., Shamis E. **New effective technologies of production of building materials and articles.** The work includes the summary data of new technologies of building materials and articles on basis of mineral bindings. The methods are tested in manufacturing environments on gypsum and gypsum-port land cement-active mineral admixtures binder.

Leonte P., Pleşca A. **Harmonic analysis at power rectifiers.** The derivation of the harmonic currents produced by static power converters requires accurate information of the AC voltage waveforms at the converter terminals, converter configuration, type of control, AC system impedance and DC circuit parameters. The main sources of harmonic current are at present the phase angle controlled rectifiers and inverters. Some experimental tests have been done using a semicontrolled three-phase bridge rectifier from the laboratory of *Dipartimento di Ingegneria Elettrica Industriale, Politecnico di Torino, Italy*. The parameters which could be varied were the load inductance and capacitance, and the firing angle.

Bostan I., Bostan V., Dulgheru V., Ciobanu O. **Micro-hydropower station for kinetic energy conversion of flowing water with modified hydrodynamic rotor.** Increased efficiency of elaborated micro-hydropower stations is achieved by an optimum position of the blades with hydrodynamic profile. The formulation used to compute the hydrodynamic forces is an inviscid – boundary layer model. Micro-hydropower station provides kinetic energy conversion of river water into mechanical or electrical energy without building barrages. Increased efficiency is provided by blades aerodynamic profile and their optimum position for efficient conversion of water kinetic energy.

Mocanu F., Bejan L. **Treatments of composite materials surfaces for adhesive bonding.** The present paper discusses in detail mechanical, energetic and chemical treatments of composite material surfaces for adhesive bonding.

Lunguleasa A. **Water absorption and wood swelling for spruce after total immersion.** This work-paper presents some aspect referring to dynamic of water absorption and wood swelling for spruce specie. Based on classical methods of research this work-paper tries to find original things about wood swelling and water absorption

Decher E. **Use of polymer composite materials in the building industry.** The appearance of modern composites revolutionized the materials of construction domain by their production's ingeniouzity, the net superior physico-mechanical properties in comparison with the traditional materials and by easiness of placement. The work presents some of the advantages of these composite materials and their applicability in various domains of social life and in different countries.

SOMMAIRE

décrites et fournit un volume nécessaire pour la prochaine utilisation de l'ordinateur et contrôle l'exactitude des données reçues dans le processus de conception.

Marina V., Marina Viorica. **Méthodologie matrix représentation d'ordre supérieur des tenseurs.** L'équation non linéaire directrice de matériaux anisotropes a examiné dans la zone de déformation réversible. Les équations constitutives du second ordre, dans lequel le constant élastique de tenseurs d'ordre Ci de suite, a détaillé analysés. La représentation de matrice de ces tenseurs et analyse des constantes indépendantes de l'élasticité de la fonction de symétrie du matériel et le type d'interactions Atoms est donné.

Grosu C. **Halva de noix (Juglans Regia L.)** Il a été étudié le processus d'obtention du halva de noix. Comme matières premières pour la préparation du halva on a utilise partiellement écrémées noix - variété Cogălniceanu, du sucre et d'eau. Le résultat de la recherche est d'améliorer les procédés de fabrication du halva en réduisant les procédures et excluant l'opération de remplissage d'huile dans la masse préparée. Halva de noix sera de haute qualité avec une grande valeur biologique et sans danger pour la consommation fourni par la transformation des matières premières.

Evdokimov R. **L'utilisation des diverses ressources pour élaborer des matériaux d'enseignement interactives utilisées dans l'enseignement-apprentissage-évaluation à l'aide de tableau blanc interactif.** La diversification des méthodes de l'enseignement-apprentissage-évaluation a un effet bénéfique sur les apprenants. Récemment est apparue une nouvelle méthode de l'enseignement-apprentissage-évaluation par le tableau blanc interactif. De même, comme dans tous les cas quand apparaît une nouvelle technologie de l'information d'enseignement-apprentissage-évaluation, en ce cas aussi ont apparues des disputes en ce qui concerne son efficacité, en particulier les problèmes liés à la création de supports pédagogiques interactifs pour l'utilisation de tableau blanc interactif en procès d'instruction. Ce travail essaye de résoudre le problème d'élaboration de matériel didactique interactif pour les tableaux blancs interactifs par les professeurs de différentes disciplines.

Zubrilina Ya., Lupascu T., Samis E. **Les nouvelles technologies des matériaux et de produits de construction.** Le travail inclut la description des nouvelles technologies des matériaux et des produits de construction. Les méthodes de production en gypse et gypse-ciment astringent pouzzolane.

Leonte P., Pleşca A. **Analyse des harmoniques à redresseurs de puissance.** L'analyse des harmoniques du courant qui sont dû aux convertisseurs statiques demande la nécessité d'obtenir des informations exactes regardant la forme d'onde de la tension aux bornes du convertisseur, cette configuration, le type de contrôle, l'impédance du système et les paramètres du circuit du courant continu. Au présent les redresseurs contrôlés et l'onduleur sont la source principale des harmoniques de courant. On a réalisé de testes utilisant un redresseur triphasé semi-contrôlé au Laboratoire de *Dipartimento di Ingegneria Elettrica Industriale, Politecnico di Torino, Italie.* Les paramètres variables sont considérés l'inductance et la capacité de la charge et l'angle de commande.

Bostan I., Bostan V., Dulgheru V., Ciobanu O. **Micro station hydraulique pour la conversion de l'énergie cinétique de l'eau qui coule avec rotor hydrodynamique modifiée.** Augmentation de l'efficacité de micro stations hydraulique élaborés est réalisée par une position optimale des pales à profil hydrodynamique. La formulation utilisée pour calculer les forces hydrodynamiques est un modèle de couche inter granulaire non visqueux. Micro station hydraulique fournit la conversion de l'énergie cinétique de l'eau de la rivière en énergie mécanique ou électrique sans construire des barrages. Une efficacité accrue est fournie par des lames avec profil hydrodynamique et leur position optimale pour une conversion efficace de l'énergie cinétique de l'eau.

Mocanu F., Bejan L. **Méthodes de traitement aux surfaces des matériaux composites pour assemblages collés.** L'ouvrage présente les mécaniques, énergétiques et chimiques méthodes destinées à préparer les surfaces des matériaux composites pour réaliser des assemblages collés.

Lunguleasa A. **Le absorbation d'eau et le gonflage de bois de Picea Abies après immersion dans eau.** Ce travail présentée quelque chose pour déterminer le dynamique à l'absorbation pour eau et pour gonflage au bois Picea Abies. Se baser sur classique procédé à l'étude ce travail faire un essai pour trouve quelque original choses au sujet de gonflage au bois et absorbation pour eau.

Decher E. **Utilisation des matériaux composites polymériques dans l'industrie de construction.** L'apparition des composites modernes a révolutionné le domaine des matériaux de construction par l'ingéniosité de leur fabrication, des propriétés physiques et mécaniques nettement supérieures aux matériaux traditionnels et la facilité de mise en production. L'article présente quelques avantages de ces matériaux composites et leurs applications dans des divers domaines de la vie sociale dans des divers pays.

РЕЗЮМЕ

Herlea A. **Истории техники и европейского единства.** Статья устанавливает в параллельных линиях рождение и эволюция, в Европе, такой дисциплины, как история техники, и как идея, которая ведет к построению Европейского Союза. Она показывает зависимость истории техники и идеи европейского единства от человеческой мысли, в культурном и духовном контекстах. В то же время подчеркивает широкий спектр хронологических сходств, аналогичный ритма эволюции, созревания и реализации.

Титу-Мариус И. Бэженеску. **Некоторые проблемы надежности электронных капсул.** После введения в тему, представлены несколько из самых самых важных проблем надежности электронных пластиковых капсул. Статья, написанная для информирования не-специалистов и менеджеров, исследует различные вопросы инкапсуляции и микроэлектронные решения в различных областях применения.

Львовски Е., Львовски Н. **Указанный рейтинг процветания населения во всем мире.** Авторы нашли в Интернете [1] рейтинг стран мира по общему благосостоянию населения. Была сделана попытка уточнить этот рейтинг с использованием двух мощных пакетов статистических программ. Полученные результаты несколько расходятся с рейтингом из Интернета.

Деревянко В., Некитайло Н. **Факторы, снижающие проницаемость мембран для фильтрации воды и сточных вод.** Приводятся результаты анализа факторов, которые приводят к уменьшению их проницаемости во время работы. Мембраны могут быть закрыты неорганическими или органическими коллоидными частицами и биологическими организмами. Статья содержит обзор факторов, определяющих снижение проницаемости мембран. Для обеспечения надлежащего функционирования ультрафильтрации станций необходимо проводить удаление соединений, приводящих к образованию осадка. Наибольший интерес представляют мембраны, поверхность которых не взаимодействуют с веществами, которые образовывают осадки. Поэтому разработка новых материалов или модели мембран является перспективной. Необходимо также учитывать возможность изменения поверхности мембраны с помощью реагентов. Модифицированные мембраны должны удовлетворять следующим требованиям: сведение к минимуму расходов на удаления загрязнений, обеспечивая доступность и легкость изменения процессов; минимальное уменьшение проницаемости мембраны во время эксплуатации. Необходимо разрабатывать новые методологии и модели для прогнозирования уменьшения проницаемости мембран в зависимости от условий эксплуатации.

Деканский В., Завялов В., Бобров В., Мисюра Т., Запорожец Я., Попова Н. **Технологическая схема производства солодовых экстрактов из зерновых и бобовых культур.** Предложена и описана технологическая схема производства солодовых экстрактов из зерновых и бобовых культур, которая, представляет собой сложный технологический цикл, с шестью основными технологическими этапами и содержит 22 основные технологические операции.

Попович К., Татаров П. **Изменение содержания жирных кислот и перекисных соединений в масле грецких орех (*Juglans regia* L.) в процессе хранения.** Грецкий орех представляет собой значительный интерес для пищевой промышленности. Главной задачей в производстве грецких орех является нахождение эффективного метода стабилизации липидов ядра грецкого ореха. Цель работы заключается в изучении влияния технологии получения и продолжительности хранения на показатели качества окислительной стабильности масла грецких орех. Оценку гидролитических изменений проводили при помощи измерения кислотного числа, накопление первичных продуктов окисления выражали перекисным числом. Образцы масла грецкого ореха холодного прессования анализировали сразу же после прессования и в течение 180 дней хранения. Полученные данные могут помочь в описании механизма окисления масла грецкого ореха, полученного холодным прессованием.

Кирикуцэ И., Русу И. **Улучшение свойств летучей золы в смеси с различными веществами**. Золы теплоэлектростанций (ЗТЭС) широко используются во всем мире в бетонных смесях для дорожных сооружений. Введение вяжущих значительно улучшает свойства ЗТЭС. Даже очень небольшое добавление вяжущего (1-2%) может активировать и ускорить реакции цементации. Наилучшими вяжущими для этой цели являются различные виды извести и цемента, а также промышленные отходы, такие как доменный шлак, гипс, реактивной пепел и ОДГ (отходы от очистки дымовых газов). Прочность на сжатие и уплотнение ЗТЭС в значительной степени зависит от содержания воды. В зимнее время использование ЗТЭС возможно введением противоморозной добавки хлористого кальция, $CaCl_2$.

Косовский П.Г. **Публикация результатов поверхностного пластического деформирования для чугуна с пластинчатым графитом.** В работе представлены экспериментальные данные для поверхностного деформирования чугуна с пластинчатым графитом, полученные при

использовании современного оборудования и отражающие происходящие процессы при данной обработке. Полученные результаты помогают понять специфические особенности материала в конкретных условиях и дать необходимый объём информации для дальнейшего использования ЭВМ и контроля правильности получаемых результатов при проектировании.

Марина В., Марина Виорика. **Методология матричного представления тензоров высшего порядка.** Нелинейные определяющие уравнения анизотропных материалов исследуются в необратимой области. Детально анализированны определяющие уравнения второго порядка, в которых изучен тензор четвёртого порядка. Дано матричное представление этих тензоров и анализ независимых констант упругости в зависимости от симметрии материала и вида взаимодействия между атомами.

Grosu C. **Халва из греческих орехов (Juglans Regia L.).** Был изучен процесс изготовления халвы из орехов (Juglans Regia L). В качестве сырья для изготовления халвы были использованы ядра грецкого ореха частично обезжиренное сорта Когэлничану, сахар и вода. Новизна исследований состоит в улучшении технологии производства халвы посредством уменьшения количества технологических операций и исключения процесса добавления масла. Халва, полу-ченная из ядер грецкого ореха, будет характеризоваться высоким качеством, особенной биологической ценностью, а также будет безопасна для употребления в пищу, благодаря первичной обработке сырья.

Евдокимов Р. **Различные интернет-ресурсы для разработки интерактивных дидактических материалов, используемых в процессе преподавания-обучения-оценивания посредством интерактивной доски.** Диверсификация методов преподавания-обучения-оценивания оказывает благотворное влияние на учащихся. Недавно появился новый метод преподавания, обучения и оценки посредством интерактивной доски. Точно так же, как и во всех случаях, когда появляются новые информационные технологии в процессе преподавания-обучения-оценивания, так и в этом случае появилось много споров относительно ее эффективности, особенно проблемы, связанные с созданием интерактивных учебных материалов для использования интерактивной доски в учебном процессе. Основная проблема, которую пытается решить данная статья, это проблема разработки интерактивных учебных материалов учителями различных дисциплин.

Зубрилина Я., Лупашку Т., Шамис Е. Новые эффективные технологии производства строительных материалов и изделий. Работа включает описание новых технологий строительных материалов и изделий на основе минеральных вяжущих. Методы опробованы в производстве на гипсе и гипсоцементно-пуццолановых вяжущих.

Леонте П., Плешка А. **Анализ гармоник при расчёте силовых выпрямителей.** Анализ токовых гармоник производимых статическими силовыми выпрямителями позволяет получение точных информаций касающиеся формы волны напряжения в контактах выпрямителя, его конфигурация, тип контроля, импеданс системы и параметры цепи постоянного тока. А настоящее время основным источником токовых гармоник являются контролируемые выпрямители и инверторы. Были выполнены серия тестов на полуконтролируемый трёхфазный выпрямитель в лаборатории из *Dipartimento di Ingegneria Elettrica Industriale, Politecnico di Torino*.

Бостан И., Бостан В., Dulgheru В., Чобану О. **Микрогидроцентраль для конверсии кинетической энергии текущей воды с модифицированным гидродинамическим ротором.** Повышение эффективности разработанных микро-гидроцентралей достигается оптимальным положением лопастей с гидродинамическим профилем. Формулировка, используемая для расчета гидродинамических сил, является моделью с невязким граничным слоем. Микрогидроцентраль обеспечивает преобразование кинетической энергии речной воды в механическую или электрическую энергию без строительства плотин. Повышение эффективности обеспечивается аэродинамическим профилем лопаток и их оптимальным положением для эффективного преобразования кинетической энергии воды.

Мокану Ф., Бежан Л. **Методы обработки поверхностей композитных материалов для осуществления адгезионных соединений.** В настоящей работе приведены основные механические, энергетические и химические методы, используемые для обработки поверхностей композиционных материалов для реализации адгезионных соединений.

Лунгуляса А. **Впитание воды и разбухание сосновой древесины после утопления в воде.** В настоящей работе приведены несколько аспектов относительно динамики впитывания воды и разбухание в толщину для сосновой специи. Основанную на классических методах исследования в этой работе делается попытка нахождения оригинальных методов разбухания древесины и впитывания вляпи.

Декер Е. **Использование композитных полимерных материалов в строительной промышленности.** Появление современных композитов привело к существенному прогрессу в области строительных материалов благодаря прогрессивным методам производства, физико-механическим свойствам значительно выше традиционных и лёгкости промышленного освоения. В работе приведены часть преимуществ этих композитных материалов и степень их применения в различных областях социальной жизни в различных странах.

THE HISTORY OF TECHNOLOGY AND THE EUROPEAN UNITY

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This paper sets into parallel lines the birth and the evolution, in Europe, of a discipline—the History of Technology—and that of an idea which leads to the construction of the European Union. It shows the dependence of the History of Technology and of the idea of European unity on human thought, on cultural and spiritual contexts. At the same time highlights a wide range of chronological similarities, of a similar rhythm of evolution, maturation, and implementation.

In the Middles Ages, Europe was united by the Christian faith and monasteries played an important role in the preservation of technological memory. During the Renaissance period, the first projects dealing with the European political unification appear at the same time as the first technical publications: the "Theatrum Machinarum". In the second half of the nineteenth century, a debate emerges on the legal form of a united Europe and the evolution of technology ceases to be solely regarded as a genealogy of technology and is integrated in economic, social, historical analyses. Between the two world wars, Aristide Briand's project for a federal Europe, in which the syntagma "*European Union*" is used for the first time, and Lucien Febvre's manifesto for the creation of a new branch of history, the History of Technology, were both launched. After the Second World War, the idea of European unity came to be implemented, the European Union to be established, and the History of Technology to reach maturity and to be fully recognized as an academic discipline.

The history of technology, as well as the idea of European unity and its implementation have, in different ways, relationships with the accelerating evolution of our world. The transition, in the last decade, from industrial society to information society is one of these aspects. The crises we are facing – in economics and finances, energy and the environment – are the components and the prelude of a global crisis with an important moral dimension.

This crisis shows the limits of our economic and technological systems and calls the whole into question. The answers coming, till now, are totally insufficient. Fortunately things are starting to move and the European Union is leading the way on several subject matters. This is the case for energy, environment and climate changes as the EU's strategy Europe 2000 is proposing. Here the history of technology is playing its role, namely, at the level of technological assessment and technological forecasting.

But outside its involvement in technology and economy, the EU has also to ensure that the values claimed to be promoted are fulfilled at political and social levels. This as well inside the EU, in the countries wishing to integrate it and in the entire world.

The technological, economical, financial, social, political choices should be based primarily on moral values rather than on efficiency. The return to fundamentals is inevitable. By shedding light upon the past, history is in a privileged position and the European Union should ensure that all the values she is claiming to defend (peace, liberty, democracy, justice, solidarity) are rigorously considered. In a rapidly changing world burdened by crises, ethics must dominate efficiency.

This lecture is oriented, as reflected by the title, towards the history of technology and the unity of Europe. It will set into parallel lines the birth and the evolution in Europe of a discipline – the history of technology – and that of an idea and its implementation – the unity of Europe. It will show their dependence on human thought, on cultural and spiritual contexts and, at the same time, a wide range of chronological similarities. I divide my article chronologically into five parts: the Middle Ages; the Renaissance; the eighteenth and first half of the nineteenth centuries; the mid-nineteenth century to World War II; and, finally, post-World War II until the Treaty for the European Union signed in 1992. Each part deals with the evolution of European unity as well as with the history of technology in Europe.

Technology and its history, as well as the idea of European unity and the implementation of it, belong to the European culture and civilization. They emerged from two roots: Greek naturalism and rationalism on one side and Judeo Christian spirituality on the other side. It is in Greece that history defined as an inquiry about the past was born,

Figure 1. Carta Monastry founded in 1202.

and it is Christianity that provides the human being with liberty and responsibility.

1. The middle ages

The idea of the existence of a Europe based on Christianity and the possibility of its political unity appears as early as the first half of the Middle Ages. It was partially realised by Charlemagne, whose empire borders were the same as those of the Roman church. During the next centuries, Europe maintained a cultural unity thanks to religion and the Latin language.

The network of Cistercian monasteries (one of them is situated in Carta village, 80 km from Brasov (Fig. 1)) played a main role. They were places of technological innovation, of accelerating technical change and have been considered by a some scholars as the home of the technical revolution in the Middle Ages. Huges de Saint Victor, one of the major scholastics of the twelfth century wrote: 'human reason shines through invention of everything it is doing.' And, in addition to innovation, the Cistercians preserved technological memory, which is a primary goal of the history of technology. Thus in the Middle Ages, religion and its institutions ensured Europe a certain degree of cultural unity and technological memory.

2. The renaissance

In the fifteenth century, the Reformation and the birth of structured states weakened the unity of Europe, which had already been affected by the Schism of 1054 between Catholics and Orthodox Christianity. But Europe's cultural unity was maintained thanks to intellectuals, who often moved from one country to another and who kept tight links between each other. This was the case of the Bishop Johannes Honterus of Brasov. After a stay in Basel at the same time as Erasmus (Fig. 2) – symbol of Europe in this period – Honterus introduced both the Reformation and printing to Transylvania in 1535. He also authored *Rudimenta Cosmografica*, published in 39 editions in several major European cities.

Figure 2. Erasmus of Rotterdam 1466 – 1536.

It is during the fifteenth century, that the word 'Europe' started to be used frequently, and the idea of European unity generated various projects. These were based on two approaches: that of independent and sovereign states in competition, constantly searching equilibrium based on alliances, and that of an united Europe emerging from the ideas expressed by intellectuals and politicians. Erasmus advanced, at the beginning of the sixteenth century in his *Plaidoyer pour la paix*, the idea of a large European area comprised of Christian states and based on tolerance and peace. In the seventeenth century, one of the best known projects is that of the Duke of Sully, Louis XIII's minister. Named *Le Grand Dessein*, it called for the establishment of a 'Very Christian Republic' managed by a 'Grand Council of Europe'.

The invention of moveable-type printing by Gutenberg (Fig. 3), in the middle of the fifteenth century, was a technical innovation with unprecedented impact. It allowed, during the next century, the publication of the first books dedicated to technology, collectively known as the 'Theatrum Machinarum'. These books followed the engineer's notebooks, which gathered information concerning different arts and crafts – the notebooks of Leonardo da Vinci are a well-known example. Among the Theatrum Machinarum, are *De Re Metalica* by Georgius Agricola, published in 1556, and the *Theatrum Machinarum* of Jacob Leopold, the last publication under this name, nine volumes published in Leipzig between 1724 and 1734.

Figure 3. Gutenberg Printing Press.

The Renaissance saw the rebirth of Greek rational thinking, which resulted in the separation between theology and philosophy followed by the separation of science from philosophy. This gave birth, at the end of the sixteenth century, to Galilean science, defined as knowledge through concept – logically structured knowledge, validated by experimental or mathematical procedures. Francis Bacon specified the rules of the experimental method in his *Novum Organum* published in 1624, and he drew attention to the application of knowledge in the field of technology. Since then, new schools of thought emerged, such as positivism, and new relations occurred between science and technology. Leonardo da Vinci foresaw them when he stated: 'I see the light of science and its benefits.

All this is linked to deep changes in values. Science, which searches for truth, starts its relation with technology, whose main value is efficiency. Unfortunately, efficiency marginalises morality and deontology. A century earlier, Nicolas Machiavelli had already published his *Il Principe*, in which the pragmatism and the cynicism of efficiency are pushed into the spotlight. Fortunately, the ethic of humanism was also beginning to emerge.

From the Renaissance onward, innovation also relied on the opportunities created by scientific progress. To promote them, the creation of specific establishments was considered. In England, Francis Bacon described, in his ideal land *The New Atlantis*, the Solomon houses, where scientists lived and worked. A few years later, in 1648 in France, René Descartes argued for the establishment of large exhibition halls, where technical objects and processes could be presented. Finally, in this same period, Academies of Sciences were created (in England in 1660 and in France in 1666) as well as the first patent systems. The Statute of Monopolies, was established in England, in 1623, while, in France, the role of the examination of technical inventions was granted, in 1699, to the Academy of Sciences. Obtaining a patent required real novelty, which meant a search for precedence; this linked patent systems to the history of technology.

3. The eighteenth and first half of the nineteenth centuries

In the eighteenth century, the century of the Enlightenment, the idea of Europe continued to be discussed by prominent intellectuals. Jean Jacques Rousseau, for example, argued for the existence of a European society based on a public opinion aware of having a common history, sharing the same values and, therefore, belonging to the same cultural community. One of the best known projects of this time was that of the Abbot of St Pierre entitled '*Projet pour rendre la paix perpétuelle en Europe*' (Project for a perpetual peace in Europe), which was published in 1713, followed by an additional summary in 1728. It foresaw an alliance between the sovereigns who would submit to the decisions of a 'European senate' provided with legislative and judicial powers. Then, in the first half of the nineteenth century, Napoleon tried to unify Europe by conquest, which created a strong reaction: 'The Holy Alliance' of 1815 between Austria, Russia and Prussia and the politics of congresses which followed it under the watchful eyes of Klemens von Metternich.

Thus, the idea of the European unity persisted, and the Comte de Saint Simon, student of d'Alembert, particularly marked it with his seal. He pursued it personally as well as through his collaborators and disciples, among them, Augustin Thierry and Auguste Comte. In 1814, Saint Simon published, with Augustin Thierry, an essay

entitled "*De la réorganisation de la Société européenne ou de la nécessité et des Moyens de rassembler les peuples de l'Europe en un seul corps politique, en conservant à chacun son indépendance nationale*" (About the reorganisation of the European society, or about the necessity and means to gather the peoples of Europe within a single political body, preserving for each of them their national independence) – the title that needs no further explanation.

Also during the first half of the nineteenth century, the idea of the European unity was embraced by the people at large. The revolutionary and republican movements of 1830-1840, which were led by Giuseppe Mazzini and Alexandre Ledru-Rollin and in which Italian, French, Germans, Polish, Romanians and other nationalities took part are a testimony to this. The people fought, as Mazzini wrote, for: 'The moral unity of Europe through the democratic republic which should lead to the federation of the peoples.' And, at the end of this period, on the 21st of August 1849, Victor Hugo delivered in Paris his famous speech in favour of what he called 'the United States of Europe'.

But the Europe of the Enlightenment and that of the first half of the nineteenth century was also that of the Industrial Revolution, this major turning point in Europe that resulted from an unparalleled speed up in technological change. Following the technological evolution which occurred in the seventeenth century, this is the period when the integration of technology into European culture really begins. In Paris, several well-known works were published, including *Machines Approuvées par MM. de l'Académie des Sciences*, in six volumes the first collection of technical inventions, and the famous *Encyclopédie ou Dictionnaire Raisonné des Sciences, des Arts et des Métiers* by d'Alembert and Diderot (Fig. 4). The latter, published between 1751 and 1772, is the most representative book of the eighteenth century, concerns all fields – arts, science, philosophy, politics, religion – and emphasizes that technology is part of culture. Meanwhile, in Germany, the first books dedicated to the history of technology also appeared. Johann Beckmann's *Beiträge zur Geschichte der Erfindungen* (Contributions to the History of Inventions) was published at the end of the eighteenth century, and *Geschichte der Wissenschaften bis an das Ende des 18 Jahrhunderts* (History of Knowledge till the End of the 18th century), by Johan Heinrich Poppe, was published at the beginning of the nineteenth century.

Technical memory also started to be preserved through objects and establishments. 'Cabinets' were created in all the main European countries during the eighteenth century, which sometimes included machine models. The first significant cabinet in this last category was created by the Swedish mining engineer, Christopher Polhem, at the beginning of the century. Among the establishments specifically created at this time and dedicated to technology was the Hôtel de Mortagne, initiated in Paris in 1750 by Jacques Vaucanson, well-known French inventor and inspector of the Manufactures Royales. In 1794, the Conservatoire des Arts et Métiers was established as a successor of the Hôtel de Mortagne, and as did its predecessor, it sought to fulfil three main objectives: improvement of machines, demonstration of their use and conservation of them.

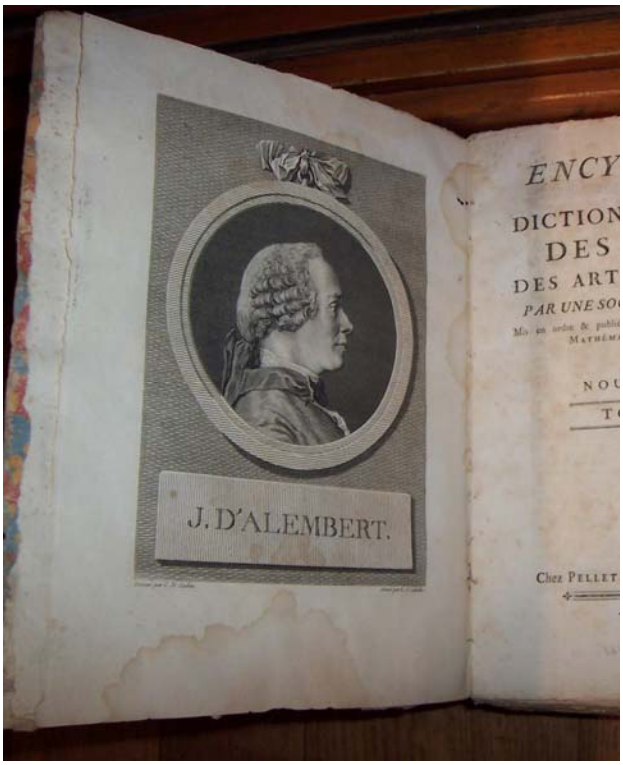

Figure 4. Encyclopedie de d'Alembert et Diderot.

Finally, during the first half of the nineteenth century, special attention was paid to technology, especially mechanics, through patents and patent offices. Created, on English and French models, new patent systems appeared in most of European countries: Prussia (1815), Netherlands (1817), Austrian empire (1820), Sweden (1834), Portugal (1837). Thus, the search for precedence expanded and thereby expanded the importance of the history of technology.

4. The mid-nineteenth century to world war II

The Revolution of 1848 spread of the idea of European unity during the last half of the nineteenth century. It was promoted by a few philosophers and thinkers of the time. The successors of Saint-Simon were on the front line, particularly Charles Lemmonier, the author of a book published in 1872 entitled *Les Etats-Unis d'Europe*, and Auguste Comte, the founding father of the Positivism, who argued for 'a Western Republic'. Comte's vision would gather together the five main European countries: France, Germany, England, Italy and

Spain to which the Netherlands, Belgium, Scandinavian countries, Portugal and Greece would be associated.

The philosopher Friedrich Nietzsche, who placed technology in the centre of his reflections, considered European unification as inevitable, and wrote in 1885: 'the small European states will become soon economically not sustainable, under the high pressure of the big trading and the large exchanges.' And, as the debate on the legal form of a united Europe expanded, the socialist Pierre-Joseph Proudhon, in France, and the philosopher Constantin Frantz, in Germany, argued in favour of federalism.

In another context and some years later, in 1906, the lawyer and Romanian politician, Aurel Popovici, proposed a project for the Austrian-Hungarian Empire entitled 'the United States of Great Austria'.

But, in fact, the second half of the nineteenth century is a time of unification in Germany, in Italy, and of the Romanian Principalities, all of which exacerbate nationalist feelings. After the war between France and Prussia in 1870 and until the end of the World War I, while the idea of European unity continues to be promoted by a few intellectuals, public opinion moves away from it under the influence of a romantic view of nationalism.

World War I marks the beginning of the decline of Europe, and it provides fodder for those who call for European unification. At the League of Nations in September 1929, France's President of Council of Ministers, Aristide Briand, delivered a speech proposing European unity. In the document concerning 'the organization of a federal union of Europe' that was written afterwards by Axel Léger (the future Saint-John Perse), the syntagma 'European Union' was used for the first time.

Meanwhile, from 1850 until World War II, the establishment of the history of technology as a discipline had a smoother path and advanced in several ways. An important one was through the establishment of large technical museums. The oldest one was the already mentioned Conservatoire des Arts et Métiers in Paris, which served as model for the Science Museum in London, founded in 1863 by Bennet Woodcroft, and the Deutsches Museum in Munich, founded in 1903 by Oscar von Miller. Several technical museums also were created in other European capitals, such as in Vienna and in Prague in 1908 and in Bucharest in 1909.

Technical skill and know-how also started to be conserved. For example, in the middle of the nineteenth century, the well-known French architect, Viollet-le-Duc, was using ancient know-how in the renovation of medieval buildings, such as the cathedral Notre-Dame in Paris and the city of Carcassonne, which are particularly notable.

Another way the history of technology advanced was via education and popularisation of technologies. Technical books often included large historical introductions and popular publications had an important historical dimension. An example is *Les merveilles de l'industrie* by Louis Figuier, published in 4 volumes in Paris between 1873 and 1876. Books dealing with the history of inventions and monographs of different branches of technology also appeared. For instance, in Germany, Franz Reuleaux, professor of mechanical engineering, published *Einfürung in die Geschichte der Erfindungen* (Introduction in the History of Inventions) in 1884, Ludwig Beck wrote a monograph on metallurgy, and Theodor Beck wrote one on building machines.

Real progress towards the creation of a history of technology, as it is defined today, took place with the integration of technology and its evolution within historical, economic, social, political and philosophical analysis. Technology became part of the general history. Indeed, as Bertrand Gille, one of the founding fathers of the discipline in France observed, the history of technology is nothing but history bounded by the material world.

The main philosophical systems of the nineteenth century, based on the history of reason left their mark on the history of technology. Positivism and Marxism were both influential. Positivism, developed and promoted by Auguste Comte in the second half of the nineteenth century, attributed the progress of the human mind to the development of hard sciences and took into account the totality of human knowledge. It argued that, thanks to science, everything could be explained and understood, and technology came to be considered as applied science. On its side, Marxism integrated technology into economic analysis and the explanation of historical evolution. One of the students of Auguste Comte, the sociologist Alfred Victor Espinas, published in 1897 a book entitled *Les Origines de la Technologie*, in which he emphasised the role of the history of technology in any historical and sociological analysis.

In this context, Paul Mantoux, professor of labour history at the Conservatoire National des Arts et Métiers published in 1906 his famous book *La Révolution Industrielle au 18ème siècle*, first introducing the concept of the Industrial Revolution. Three years later, the engineer Conrad Matschoss became professor at the Technische Hochschule Charlottenburg, where the first chair for the History of Technology was created. He was strongly supported by the society of German engineers, the

VDI, after having published in 1901 the book entitled *Die Geschichte der Dampfmachine* (The History of the Steam Engine), which is not only an internal history of technology but also deals with the impact of steam energy on the economy and society. Matschoss also founded the first periodical in the field: *Beiträge zur Geschichte der Technik und Industrie* (Contributions to the History of Technology and Industry).

Mantoux and Matschoss, represent the two roots of the history of technology: the one issued from the historical and sociological approach, filled with a left-oriented ideology, and the other issued from opening the black box of technology, close to the model of the history of sciences, especially that of the history of mathematics. These two approaches are promoted in the frame of Academic societies created in several European countries. In Germany, for instance, in 1901, the Society for Medicine, Science and Technology is founded, followed by the Georg Agricola Gesellschaft in 1926 and by establishment, in 1930, of a special section dedicated to the history of technology within the society of German engineers. Meanwile, in England, in 1920, the Newcomen Society was established; it is the oldest such society involved only in the history of technology.

While in Germany, scholars in the history of technology were often engineers, in France, they were mainly historians and sociologists. These last ones were gathered around the scientific journal *Annales d'Histoire Économique et Sociale*, created by Marcel Bloch and Lucien Febvre in Paris in 1929. Bloch's and Febvre's politically left-oriented Ecole des Annales promoted a history that turned towards the present, hence the interest in the history of technology. In a special issue of the Ecole des Annales journal, Lucien Febvre launched, in 1935, a manifesto for the establishment of a new branch of history: the history of technology. He identified three steps that had to occur to create this new branch: first, establishment of a technical history of technology, which needed to be done by engineers who have the necessary knowledge to open the black box of technology; second, construction of a history of science-technology relationships, which, for the same reasons, also had to be done by engineers and scientists; and, finally, the integration of these two histories into a global one, in which economic, social, and political histories would exist.

In the 1930s, in Europe, the history of technology was pushed ahead by its development in the United States. The book by Lewis Mumford, *Technics and Civilization*, published in 1932, enjoyed a great success in the old continent. It focused on two dominant technologies, energy and materials, through which Mumford identified three historical periods of *eo*, *paleo*, and *neo* technologies. He also proposed a new periodisation based on technologies that would be developed in Europe after World War II.

Finally, the philosophers of the first half of the twentieth century were just as concerned by technology and its evolution as their predecessors. Standing out among them was the German Oswald Spengler, who published *Der Mensch und die Technik* (The man and the technology) in 1931. His work is one of the most representative of the time, in which he considered that technology, the expression of the Faustian will of power which characterises the European culture, was transforming man into a slave of machines and would create an ecological disaster.

5. Post-world war II

In the climate of the Cold War, which starts immediately after World War II, the idea of European unity became a matter for political movements and an essential aspect of European nations' policies. After several events and achievements, such as Churchill's speech in Zurich in 1946, the creation of the Western Union Defence Organisation and of the Organisation for European Economic Cooperation in spring 1948, the establishment of NATO and of the European Council in spring 1949, the Robert Schuman declaration of the 9th of May 1950 and the European Coal and Steel Community treaty that was signed in Paris in April 1951. The latter was the first supranational European structure, and its High Authority is independent from all interventions by European governments.

Since then and until the signature, in Maastricht, of the Treaty for the European Union (TEU) in February 1992, Europe followed a difficult path, one filled with doubts, scepticism and even failures. But, unity finally was successful, thanks to the pragmatism of the policy of small steps initiated by Jean Monnet. This process brought forward the values of peace, liberty, democracy, justice, and solidarity – values which were promoted by Christian democrats who were leaders in building European unity, such as Robert Schuman, Konrad Adenauer and Alcide de Gasperi. And, they were joined by socio-democrats, such as the Belgian Paul-Henri Spaak.

On the way to the Maastricht treaty, the road to unity was marked by a series of milestones dates, such as the Treaty of Rome (1957) and the Single European Act (1986). During the two first decades

following the European Coal and Steel Community treaty, focus was on deepening the construction of European Communities but, starting with the end of 1960, the enlargement of the communities became important. After the fall of the Berlin wall, a large debate occurred about the definition of the European Union (EU) and its borders. It was agreed that to be a member of the EU, states had to belong geographically to Europe and their policies and actions had to be based on the values of peace, liberty, democracy, justice and solidarity.

But since so much has been written on the creation of the EU, I will leave the story at this point to focus on history of technology in Europe during the post-war years, a time when it became an academically recognized field.

The position that the history of technology attained in Europe is due to European academics and researchers as well as to their collaboration with American colleagues. Today American scholars play a particularly major role in the development of the discipline and are at the forefront of progress, as evidenced by the Society for History of Technology and its quarterly journal *Technology and Culture*. But several European scholars played a prominent role in defining and structuring the field. They included, in England, Charles Singer, first president of the International Union of History and Philosophy of Sciences, who directed the well-known treatise *A History of Technology*, and Rupert Hall, professor at the Imperial College - London; in France, Maurice Daumas, professor at CNAM and director of the Musée National des Techniques and Bertrand Gille, research director at the Ecole des Hautes Etudes en Sciences Sociales, professor at College de France; in Germany, Friedrich Klemm, director of the Library and of the Research Center in History of Science and Technology of the Deutsche Museum and professor at Munich University. Many other European scholars also contributed, and they are attached to the establishments already mentioned as well as to technical universities in Munich, Berlin, Aachen, Darmstadt, Eindhoven, Stockholm, Vienna and elsewhere. They also are found in universities such as Oxford, Paris-Sorbonne, Nantes, Bochum, Hamburg, Barcelona and to technical museums such as the Science Museum London, and Technisches Museum Wien. And they are in the universities and museums of East European countries, such as those in Prague, Dresden, Budapest and Bucharest.

In the post-war period, debates on a large number of topics concerning the history of technology have taken place, and I should like to comment briefly on some of them, particularly those concerning the field's identity and methodology and those of its relations with the history of science and economic history.

Prior to the fall of the Berlin Wall, the question of whether or not to focus on the internal or external history of technology received different answers in Western Europe and in communist countries. In Western Europe, the question of which to focus on melted away, with everybody agreeing that both need to be closely integrated. Yet, the ongoing question remained as to how deeply one should explore the black box of a technology when its history is studied. The answer now seems to be to adapt the black box analysis to the needs of the history being studied. Meanwhile, in eastern European countries, it is the internal history that often made a real contribution to the development of the field, even though it was sectarian and often out of context. Some remains of this approach are still there, as in Romania, where the history of technology *per se* is not on the list of the disciplines in which a PhD can be obtained.

Regarding conceptualisation and methodology, structuralism became prominent. This theory states that the elements, the structures, have no separate existence and take on full significance only in their relationships to the other elements existing in the frame of the system. It was very popular in economics, and at the beginning of 1970, Bertrand Gilles proposed its use in history of technology. It is an important European contribution to the development of the field. The concept of the technical system, defined as the totality of the technical networks and of structures, simple and complex, coherent and compatible to each other, is a central concept in history of technology.

This concept also leads to that of periodisation in history. The classical division is usually maintained and the evolution of the technical system of each period is analysed and explained, an approach used by Bertrand Gilles and a few European historians of technology. But other scholars promoted a new periodisation that takes into account the dominant technologies as: energy, materials and information.

Maurice Daumas, for example, emphasised throughout history five technical systems or technical complexes, as he called them, and insisted on the interdependencies and coherences which existed between the technologies constituting the technical complex. He considered also that technological change occurs without ruptures and revolutions; it accelerates throughout history, following a curve that has had only one real turning point – at the time of the Industrial Revolution. A large number of historians (especially economic historians but also historians of technology) disagree

with this point of view, and consider that there are several turning points, if not breaking points, such as the one of the end of the nineteenth century or the one of the present time linked to information technologies.

Science technology relationships were also reconsidered in the post-war years. I must emphasize that, until the end of the nineteenth century, technology, with a few exceptions, preceded science. That even if, starting with the beginning of the twentieth century, technology and science are intimately linked, technology is far from being only applied science. Moreover, the field of science technology relationships gets richer and becomes more and more complex as new technologies emerge in different areas.

The relations between technology and economics after World War II are as rich and substantial as those between science and technology and continue to occupy the same privileged place they have had since the middle of the nineteenth century. The study of the innovation process strongly tied the history of technology to economic history, and I should emphasize that the acceleration of the technical change is related to growing investments. François Caron, professor of History of Economics at Sorbonne University considers that it is impossible to analyze separately the technical system and the economic one and proposes the concept of a 'model' which should bring together, in a single unity, the two systems. He emphasizes that several concepts used in the history of technology and economic history converge, such as 'bottle neck' and 'request of invention'. Economic history is a driving force for the history of technology.

Conclusion

In conclusion let me emphasise that the history of technology, as well as the idea of European unity and its implementation have, in different ways, relationships with the accelerating evolution of our world. The transition, in the last decade, from industrial society to information society is one of these aspects. The crises we are facing – in economics and finances, energy and the environment – are the components and the prelude of a global crisis with an important moral dimension.

This crisis shows the limits of our economic and technological systems and calls the whole into question. The answers coming, until now, are totally insufficient. Fortunately things are starting to move and the European Union is leading the way on several subject matters. This is the case for energy, environment and climate changes as the EU's strategy, Europe 2000, proposes. Here the history of technology is playing its role at the level of technological assessment and technological forecasting.

But outside its involvement in technology and economy, the EU has also to ensure that the values claimed to be promoted are fulfilled at political and social levels. In this respect the EU has had successes, but also failures. This is the case concerning the integration of the Central and Eastern European Countries. The adopted strategy was only focused on efficiency, without sufficiently taking into account their post-war history. In this way, the real power remained in several of these countries mainly in the hands of those who had it during the communist era. Besides the inacceptable moral aspect, it is a major cause of corruption and of the faulty operation of justice.

I am convinced that technological, economic, financial, social and political choices should be based primarily on moral values rather than on efficiency. The return to fundamentals is inevitable. By shedding light upon the past, history is in a privileged position, and the European Union should ensure that all the values she is claiming to defend (peace, liberty, democracy, justice, solidarity) are rigorously considered. In a rapidly changing world burdened by crises, ethics must dominate efficiency.

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SOME RELIABILITY PROBLEMS OF ELECTRONIC PACKAGES

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1. INTRODUCTION

During the last few years the use of electronic-based devices has been playing an increasingly relevant role in our day-to-day life. In order to hinder the strong competition in this market, the performance requirements have been following the same trend. The competitive pressure to produce "*smaller, faster, cheaper*" microelectronic devices means that reliability must be achieved using only the minimum amount of material, and also the minimum amount of testing. Actual testing of complete devices is the most definitive means to find out whether a design is reliable, and also the slowest and most expensive. That is why failure[1] of microelectronic devices has become in this last decade a prominent field of research. A "*physics of failure"* approach based on a scientific determination of the dominant failure mechanisms and failure sites within the component is generally accepted. The results of this physics of failure analysis allow a designer to choose package geometries and materials which reduce the risk of failure by the identified mechanisms. This makes reliability assessment a part of the design process rather than just a tool for predicting the useful life of an existing product. A technically and economically relevant branch of electronic devices is constituted by the so-called electronic packaging that is when the circuitry is permanently plastic encapsulated or inserted in a ceramic housing. The introduction of new equipment and techniques in the assembly process has had a tremendous impact on device reliability. Automated wire bonding machines have produced more consistent wire bonding quality and improved productivity.

2. IC PACKAGE

The IC package was born of the IC, which, though it had great potential power within, did not have the ability to easily communicate with the World beyond owing to the fine and seemingly random pitch of its contacts. Chip scale packaging (CSP) represented the next step in the evolution of packaging. It was fundamentally an effort to obtain the benefits of flip chip assembly (smallest form factor, highest performance, etc.), but without all of the risks and challenges, and with the benefit of standards, which is virtually impossible with flip chip. However, CSP technology has not replaced flip chip technology but has instead augmented it. The last stop in chip scale packaging is chip size, and that has been accomplished. The need to move large quantities of data at high speeds continues to increase, pressuring component manufacturers to improve their technology and, simultaneously, to reduce costs. One of the key factors in both cost and performance is packaging. Wireless IC and component packaging is undergoing substantial changes in response to these pressures. Reliability aspects are of extreme importance for assembly and packaging, which has become a limiting factor for both cost and performance of electronic systems. On the one hand reliability can be negatively influenced by modern front-end and packaging technology, on the other hand new applications and corresponding field requirements can result in the need for new reliability tests e.g. for mobile devices. Today the three main package trends for mobile devices towards ongoing miniaturization and higher system integration are ball grid array type packages, leadless packages, and wafer level type packages. For the future it is necessary that test conditions must follow the field requirements to guarantee optimum reliability results. The value of a packaging solution - in both cost and performance - increases as the frequency of operation increases, becoming a dominant factor for product success at frequencies above 2 GHz. Failure to obtain a packaging solution that meets both performance and cost criteria can contribute to late product introduction or even total market failure [1].

2.1 IC packaging technologies

The new *IC packaging technologies* evolves towards packaging at wafer level including wafer-level burn-in and test, and system-in-package (SIP)

[1] Failure consists of a transition from reliable to failed states. Irrespective of the specific mechanisms, failure virtually always begins through a time-dependent movement of atoms, ions, or electronic charge from benign sites in the device or component to harmful sites. If these atoms or electrons accumulate in sufficient numbers at harmful sites, damage ensues.

or three-dimensional packaging of ICs, respectively.

Systems packaging to system on package (SOP) developed more or less from the traditional board packaging with discrete components assembled by surface-mount technology (SMT) processes. Now the predictable future trends are towards nano-packaging for nano-systems [2]. The transition is towards nano chips, with less than 100 nm features.

To control a manufacturing process means to keep in time the quality of this process, to assure the reliability of the process. The operations that must be made are evaluation, optimization, qualification and monitoring. An optimal process is first qualified and then, with the aid of the monitors, the process can be kept under control.

Packages typically include a chip (called also die), which contains the primary circuit elements; the chip is composed by many elementary cells. Other elements are die attach, lead frame, leads, wires, substrate, passive elements, substrate attach, wire bonds, interconnection wiring and case (Figure 1A). The die is attached to substrate by a die attach composed usually of gold, epoxy, polyimide or solder alloy. The substrate provides the mechanical support to the die and acts as heat carrier to the package case. Failure occurs typically when the intermediate dielectric cracks, thus allowing for leakage currents. These latter's are measured by applying a voltage bias across bond pads of structure of interest [3].

2.2 Polymers

Among various materials, polymers are widely used in microelectronics as different product constituents, such as encapsulants, conductive or non-conductive adhesives, underfills, moulding compounds, insulators, dielectrics, and coatings. The behaviour of these polymer constituents determines the performance, such as functionality and reliability of the final products. Therefore, the successful development of microelectronics depends to some extend on the optimal design and processing of polymer materials. Due to the development trends of microelectronics – characterized mainly by ongoing miniaturization down to nano scale – technology and functionality integration, eco-designing, shorter-time-to-market, the development and application of polymers becomes one of the bottlenecks for the microelectronic industry. With the development and introduction of new packaging materials there are many new requirements to packaged device reliability. Most of these new materials require extensive characterization, due to the lack of historical reliability data [4].

2.3. Passivation in plastic packages

Passivation is the final layer on the die.
Passivation has two main functions:

(i) Moisture barrier

• Moulding compound is not a moisture barrier.
• Silicon oxides are not good moisture barriers.
• Plasma-enhanced chemical vapour deposition (PECVD) silicon nitride or silicon oxynitride film is a good barrier.
• Film must be thick enough to avoid pinholes, coverage defects.

(ii) Mechanical protection

• Silicon nitride films are brittle.
• Polyimide compliant film protects silicon nitride.
• Polyimide can react with moisture (depending on formulation).

2.4 Reflow soldering

Reflow soldering such as vapour phase (VP) soldering or infrared (IR) soldering for soldering surface mounted devices (SMD) onto printed circuit boards (PCBs). During the process, packages are heated up above solder melting temperature. If the plastic encapsulant has absorbed moisture, package cracking may occur during reflow soldering. Cracking must be prevented to guarantee the reliability of mounted devices. Cracks are caused by vapour pressure generated inside the package causing excessive stress in the plastic [6]. Package cracking occurs as follows: *(i)* Moisture absorption process: Atmospheric moisture dissolves and diffuses in the plastic encapsulant. *(ii)* Vaporization process: Moisture at the interface between the chip pad and the plastic is vaporized by heating during reflow soldering. The vapour pressure deforms the plastic below the chip pad and causes stress in the plastic. If the stress is excessive, package cracking occurs [7].

2.5 Package cracking

For the evaluation of package cracking which occurs in SMDs that have absorbed moisture, a moisture diffusion analysis in the plastic, a deformation and stress analysis of the package and measurement of the some properties of plastic of high temperature were performed in [7]. The validity of the analysis is confirmed by a measurement of deformation of packages which

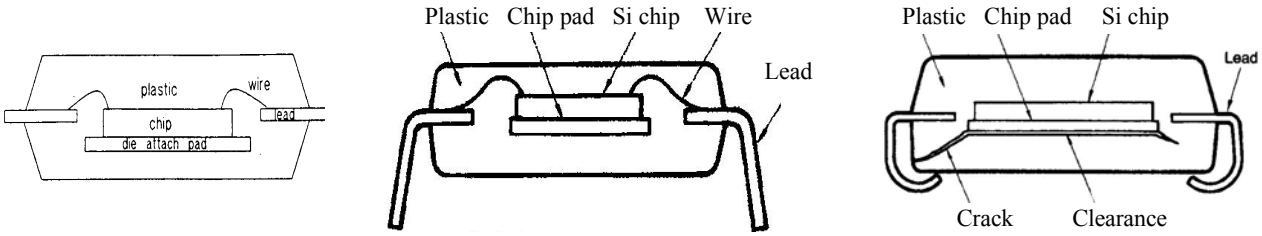

Figure 1. a) Scheme of a plastic encapsulated device [5]. **b)** Structure of insertion type [7]. **c)** Package cracks (after [7]).

area heated by IR. Vapour pressure and distribution of moisture content are calculated with the aid of the analytical model represented in figure 2 which have permitted to evaluate quantitatively package cracking.

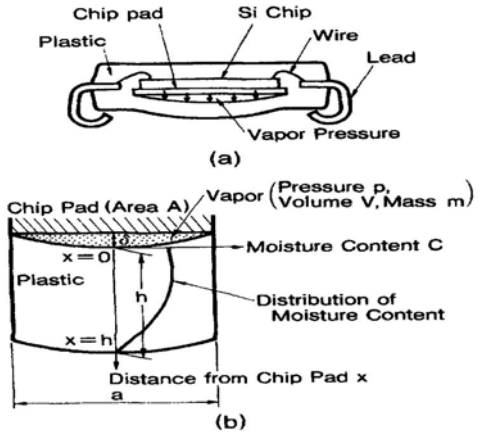

Figure 2. Analytical model (after [7]).

3. CLASSIFICATION OF FAILURES

Failures in microelectronic devices are often classified into electrical, mechanical, and corrosion failures. The mechanical ones normally cause the loss of device functionality well before the visible breaking of the device. In Figure 3 is given a detailed summary of possibly failure-affected parts in electronic devices and the related mechanisms. One can see that in the majority of cases the failure is clearly due to fatigue and/or fracture. Heat generated by Joule's effect during transient and steady-state conditions causes a mismatched thermal dilatation between the many different materials fit together and the repeated on-off operation originates thermo-mechanical fatigue and a subsequent cracking phenomenon. Furthermore, in plastic encapsulated devices initial residual stresses are induced by the packaging resin shrinkage after cooling due to assembly-resin mismatch. The same kind of problem can be found in the reflow soldering process, where hot (up to 250°C) air is used to melt the solder.

3.1 How to accelerate failure

Specification of the product testing or operating conditions is essential in predicting reliability. For example elevating temperature is the universal way to accelerate failure. It therefore makes a big difference whether the test temperature is 25°C, -25°C, or 125°C. Similarly, other specifications might be the level of voltage, humidity, etc., during testing or use. A key quantitative measure of reliability is the failure rate[2]. This is the rate at which a device or component can be expected to fail under known use conditions. Such information is important for both manufacturers and purchasers of electronic products. Each failure mode could, in principle, be caused by one or more different failure mechanisms. The latter are the specific microscopic physical, chemical, metallurgical, environmental phenomena or processes that cause device degradation or malfunction.

3.2 Failure mechanisms

The dominant failure mechanisms are a function of the package geometry, architecture and materials, and of accelerating environmental (temperature, relative humidity, pressure and static charge and their cycles, gradients and transients) and operational stress (voltage and current). Failure mechanisms occurring predominantly at the die level include slow trapping, hot electrons, electrical overstress, electrostatic discharge, dielectric failure, oxide breakdown, and electromigration. First level failure mechanisms generally arise from corrosion, differential thermal expansion between bonded materials, large time-dependent temperature changes, and large spatial temperature gradients, all

[2] Because failure rate is not a precise engineering parameter, it is important to be aware of the severe limitation of a reliability prediction based upon a 'parts count' model. The measured failure intensity of a component is seldom due to a single repeatable process. It is most frequently attributable to many physical, chemical and human processes and interactions.

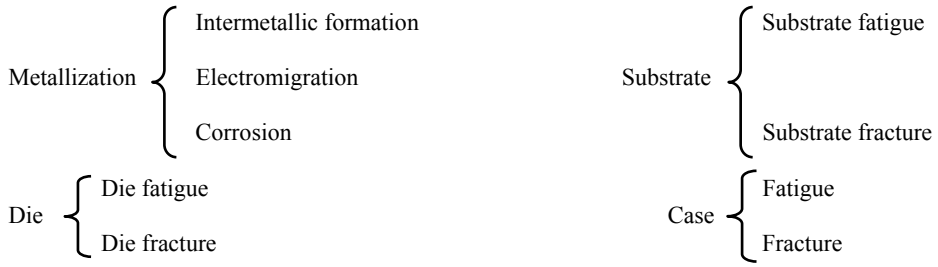

Figure 3. Possible failure-affected parts and the related failure mechanisms in microelectronic packaging.

3.3 Packaging related failure mechanisms (FMs) (see too Tables 1 and 2)

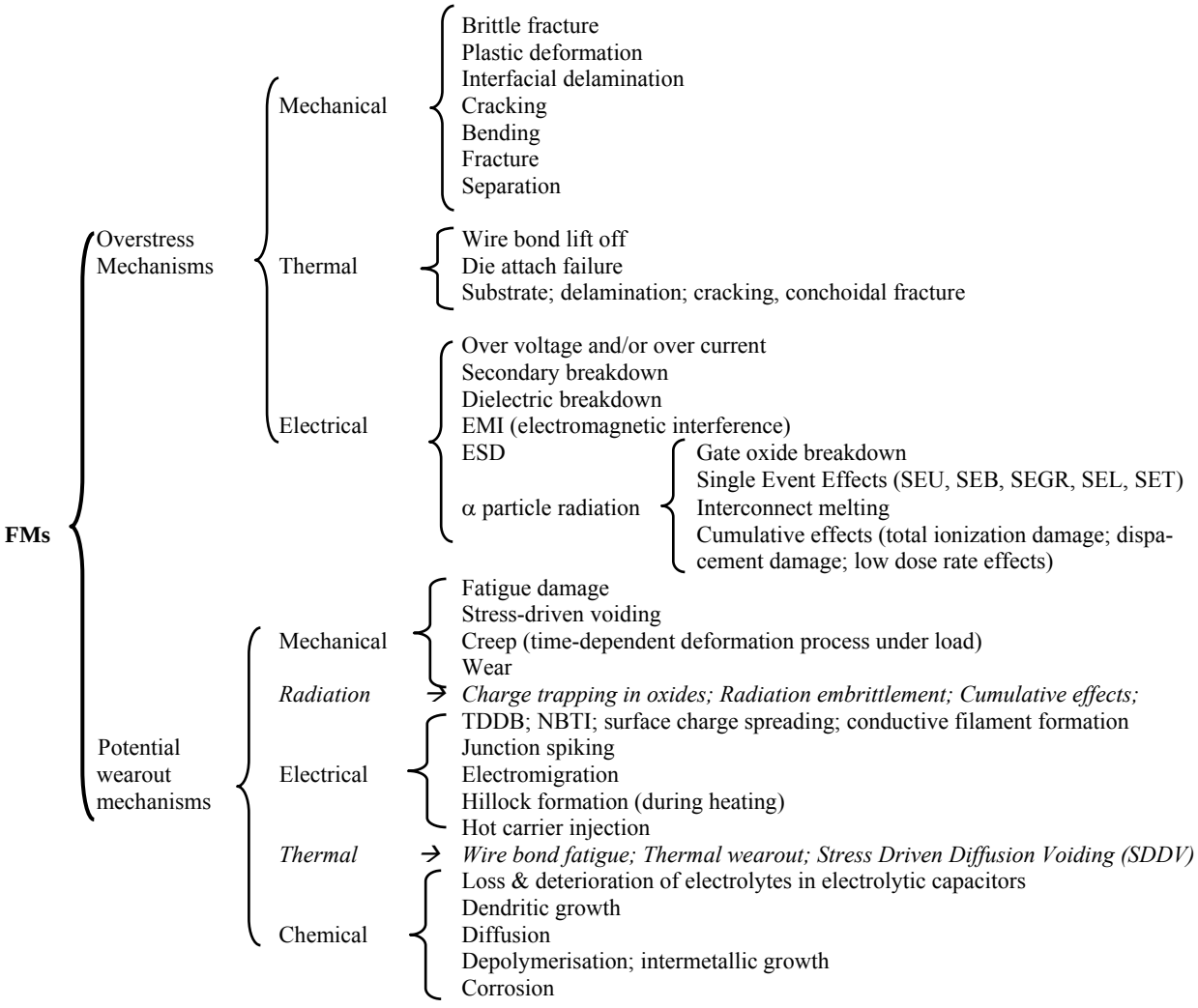

Figure 4. Taxonomy of failure mechanisms in microelectronics packaging.

of which can cause tensile, compressive bending, fatigue, and fracture failures.

4. CORROSION

The corrosion is the most prevalent mechanism since polymers have non-zero moisture uptake. It consists of *(i)* anodic reactions (oxidation reactions in which a metal loses electrons) and *(ii)* cathodic reactions (reduction reactions in which the lost electrons combine with another species). It depends on the thermodynamic stability of the metal (Au is the most stable of metals relevant to packaging).

Moisture-induced cracking during solder reflow is a critical reliability problem with plastic-encapsulated microcircuits (PEMs). Such cracking,

referred to as “popcorning” occurs from the evaporation and expansion of moisture absorbed by the moulding compound. The study [8] is aimed at establishing a rule-based system to address reliability problems related to popcorning such as interfacial delamination, mold compound moisture sensitivity, and mold compound fracture toughness.

4.1 Corrosion influence

The interfacial shear (IS) force of copper ball into Al-based bond pad depends on the formation and growth of Cu-Al intermetallic. Surface analysis of ball-peeled bond pad using XPS indicated that the cracks were due to stress corrosion cracking at Al that have been stimulated by Cu. The results of study [9] indicated that the Cu-Al bonds have been weakened by stress corrosion cracking at outer bond interface and reduce the IS force.

4.2 Corrosion mechanisms in microelectronic packaging

Microelectronic packaging systems are constructed from a wide range of materials. They make use of almost all major kinds of materials, such as metals, alloys, polymers, ceramics and fibres. Corrosion-induced failures in microelectronic packaging become more significant when the feature sizes become smaller and smaller, because small features are more sensitive to corrosion-induced failure. Corrosion involves essentially electrochemical processes except for those oxidised at the elevated temperature and in the dry environment. The basic requirements for electrochemical corrosion include electrically conductive anode, cathode, interconnecting electrolyte (humidity environment) and driving force. The driving force for electrochemical corrosion is the difference of electrochemical potentials between anode and cathode. The driving force can result from coupling of two dissimilar materials, concentration gradient or externally applied electrical bias. Any corrosion reaction must be analysed from two aspects: its thermodynamic feasibility and its kinetics. Driving force gives the thermodynamic feasibility, and kinetics is determined by the variables of the system. The electrochemical corrosion kinetics (rate) depends on a number of factors which include the area ratio of anode to cathode, the polarisation resistance of anode and cathode, conductivity of electrolyte solution, solution pH value, temperature, contamination, and driving force. Small anode and big cathode system corrodes much faster than big anode and small cathode. This is the case for the active metal coated with noble metal. For instance, gold is deposited onto aluminium pad to prevent aluminium from corrosion. If defects of deposit gold layer exist and small area of fresh aluminium is exposed to the corrosive environment, aluminium is corroded much faster because of small anode of exposed aluminium and big gold deposit layer around. Another example is paint coated aluminium wire. Polarisation occurs when a current passes through an electrochemical system. There are three types of polarisation phenomena such as resistance polarisation, concentration polarisation and electrochemical activation polarisation. For those metals or alloys with stable protective oxide/hydroxide layers formed on their surface, the resistance polarisation is very significant and their corrosion rate may be very low due to the high resistance (R) in the electrochemical cell. This is basically how corrosion resistant metals and alloys such as stainless steels, nickel and its alloys, copper and its alloy, work well in some corrosive environment. Halide ions such as chloride, bromide are good depolarisers to break the stable oxide/hydroxide layer and reduce resistance polarisation. The resistance polarisation can also be caused by poor conductivity of the electrolyte solution. Concentration polarisation occurs when there exists concentration difference between around electrode and inside the solution or concentration difference at difference sites of the electrode. The consequence of concentration polarisation will yield potential difference due to concentration gradient.

4.3 Concentration gradient corrosion

Corrosion due to concentration gradient is controlled by diffusion of reacts and products in the electrolyte. For electrochemical activation polarisation, it relates to the rate determining step for an electrochemical reaction process. For example, Al-Au galvanic couple in the electrolyte solution, Al acts as anode and Au acts as cathode. Aluminium loses electrons to be oxidised and these electrons are transferred to gold cathode. Electrons will be accumulated at the cathode, if the cathode reduction reaction is very slow because it needs higher activation energy. The consequences of the activation polarisation in this case will change the cathode reduction potential to more negative and slow the corrosion rate.

Hydrogen evolution reaction and oxygen reduction reaction are two-cathode-depolarisation reactions. In microelectronic devices

Table 1. Packaging related failure mechanism and countermeasures (after [10]).

Failure mechanism	*Countermeasures*
Brittle fracture	Minimise stress defects and/or flaws
Plastic deformation	Minimise stress and use better materials
Interfacial deformation	Improve adhesion
EMI (el. magn. interference)	Apply shielding layer
ESD (el. static discharge)	Improve circuit design, use ground tools
Gate oxide breakdown	Lower voltage and improve oxide layer
Interconnect melting	Reduce current density
α particle radiation induced signal error	Use better material
Fatigue fracture	Minimise stress/strain/temperature and use alternate materials geometry and dimensions
Creep	Minimise stress and use refractory materials
Wearout	Minimise stress and use harder materials
Stress-induced voids	Minimise stress
Open- or short-circuit caused by electromigration	Reduce current density and use alternate material, i.e. copper
Short-circuit caused by junction spiking	Improve process and use metal buried layer
Corrosion	Provide sealing and encapsulation
Diffusion	Lower temperature and use diffusion barrier
Dendritic growth	Increase thickness and reduce humidity

and their packaging, there are three major types of corrosion.

They are galvanic corrosion, pitting and stress corrosion crack. Since aluminium and its alloys are the most widely used metal and corrosion of aluminium is one of the commonest problems in microelectronic devices and packages, aluminium is used as an example material for describing and discussing corrosion mechanisms.

4 .4 Galvanic corrosion

Galvanic corrosion is also called dissimilar metal corrosion. Basically it refers to a corrosion phenomenon induced when two different metals or alloys are coupled in a corrosive electrolyte. When two dissimilar metals or alloys are brought into electrical contact under electrolyte such as water with ions, one of the metals or alloys with lower electrochemical reduction potential acts as anode and corrodes faster than its natural corrosion while the other one with higher electrochemical reduction potential acts as cathode and corrodes slower than its natural corrosion or even is stopped from corrosion. Galvanic corrosion can also occur in an alloy with multiple phases such as aluminium-copper alloy. Different phases have different electrode potentials, which results in one phase with lower electrode potential acting as anode and being selectively corroded. In the microelectronic packaging, the commonly used metals or alloys are aluminium, copper, gold, silver, tin, lead, nickel and their alloys. There are lots of places involving two-dissimilar metals electrical contact together such as die pad (Al/Cu), wire to die pad bond (Au/Al), bump metallisation (Al/Ni/Cu, Al/Ti/Cu, Al/Pd/Cu, Al/Zinc/Ni) for flip chip. Aluminium is more active than tin; if aluminium and tin contact together in an electrochemical system, aluminium acts as anode and tin acts as cathode.

5. POPCORNING

Popcorning during solder reflow is driven by evaporation of absorbed water into interfacial defect void. Due to lack of data, the steam pressure during popcorning has been assumed as a single value, normally some fraction of the steam saturation pressure at a convenient temperature in popcorning models. A new experimental and analysis methodology to determine the engineering rate of water evaporation from polymer is described in paper [11]. Using the proposed method, evaporation rate from immersed epoxy is measured. Comparison of the measured rate with a conventional approximation of water evaporation, the conventional approach was found to overestimate the measured rate by nearly two orders of magnitude. To prevent popcorning, the actual evaporation rate can be used in process design as well as material selection of polymer materials.

The study [12] analyses the popcorning effect of PBGA packages using the method of fracture mechanics. The following three specific problems are studied: *(1)* crack initiation in the die attach of

the package, *(2)* crack growth in the die attach, and *(3)* crack growth at the interface between the solder mask and copper. Two different methods (crack tip opening displacement and virtual crack closure technique) are used to determine the crack-tip parameters such as the strain energy release rate, stress intensity factors, and phase angle for different crack lengths and temperatures.

6. PRESENCE OF HUMIDITY

All polymers are permeable to moisture and hence some water will inevitably be present at the surface of the IC (Figure 5). However this moisture does not automatically result in damage to the IC. Other constituents such as ionic contamination and high temperature must be present to enable known failure modes.

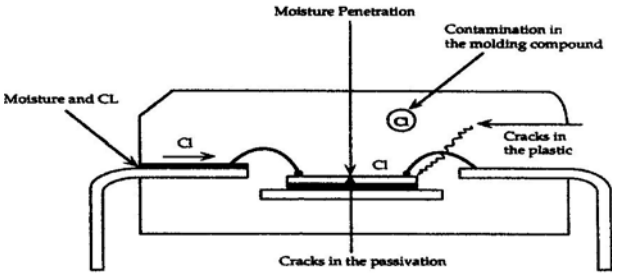

Figure 5. Mechanism of moisture related problems (after[19]).

6.1 High humidity environment

Lead frame is the primary package metallurgical bond pad interface in microelectronic devices which provides external interconnection. The most predominant lead frame material is copper with tin plating. Over the years, galvanic corrosion and copper oxidation are two main reliability concerns for any microelectronics packages with copper lead frame, when operating under high humidity environment; often, this observation is correlated to the rise in drain-to-source on-resistance. Failure analysis result revealed that non-homogeneous tin plating is the contributing factor. In the past, the operators utilised conventional cleaning method, that is, polished leads backside with sandpaper followed by acetone rinse. Nevertheless, this could not remedy the problem effectively. The author of paper [13] has performed research study to prove that solder dip is a better solution to eliminate corrosion and oxidation away from the leads.

7. HIGH MECHANICAL STRESS

Another concern in commercial IC packaging is the occurrence of high mechanical stress at the IC surface as a result of differential thermal contraction of mould compound and IC die as the part cools from the moulding and curing temperatures to ambient. Excess stress can produce cracking or damage to metal conductors on the IC surface. In addition, some circuits such as analog are susceptible to stress induced shifts in certain circuit parameters. The measurement and control of packaging related stresses is a major issue in some areas of packaging. Table 2 resumes the package related failure modes and mechanisms; Table 3 summarizes the die-related failure modes and mechanisms.

8. NEW FAILURE MECHANISMS

New failure mechanisms affecting the packages arise due to internal mechanical stresses. Static low temperature levels cause the maximum electromechanical stress for TCE mismatches, because of residual stressing occurring after die packaging. This can result in brittle die cracking, especially in GaAs, if the critical crack length has been reached. Fatigue phenomena affect basically materials like metals or alloys with low melting temperatures [14].

9. HIGH DENSITY PACKAGES

Much of the mechanical evaluation done has focused on simple techniques such as wire pull testing with simple pass / fail criteria based on the failure force. The continued drive towards ever smaller, faster, and cheaper microelectronic devices driven by the market for mobile phones, PDA, laptops and MP3 players has lead to the development of very high density packages. At the same time, environmental legislation is driving changes in some of the established materials e.g. lead free solders and process redesign to reduce process waste. A cross section of a typical high density ball grid array (BGA) package is shown in Figure 6.

10. PACKAGE RELATED DEFECTS

The package provides the physical support for the microdevice and enables electrical connection to be made to the external circuitry; it serves also to

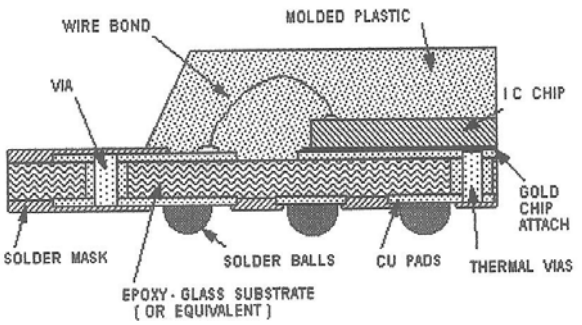

Figure 6. Cross section of BGA package showing interfaces between dissimilar materials (after [15]).

provide electrical and mechanical protection for the microdevice, and hence must be present an inert and dry atmosphere to the surface of the semiconductor, and must give protection against mechanical and thermal shock. Each element of the packaging process provides some form of protection for the device. The electrical failures are commonly due to some form of corrosion which may be related to the integrity of the surface passivation layer or the hermeticity of the external package. Mechanical failures arise from the mishandling of the device, or physical shock resulting in a breakage of the device [16].

11. GREEN PACKAGE INITIATIVE

With the push from semiconductor manufacturers for complete green IC packaging growing and becoming a global initiative, assembly and test providers must find the right combination of green IC package materials. For each package material component the green alternatives must be evaluated and the challenge of using these new materials must be overcome to meet the reliability demands of IC manufacturer.

Challenges: For substrate: Cost, supply, and standardisation. For mold compound: Survives delimitation of Pb-free reflow temperatures by increasing the adhesion of the mold compound. Make the optimisation of mold process and/or of material properties. Lead finish counter-measures: Post-plate reflow tin over nickel; optimising plating bath chemistry; annealing. Regarding the die attach, there are several considerations when choosing the best die attach material to match the other halogen-free components (low stress on the die, high thermal stability, minimal bleed-out, low moisture absorption) [17].

Findings from the laboratory tests include age related conditions (heat damage or burnt wire, evidence of arcing, chafing, delamination, and breaches at hot stamp areas). Based on frequency of findings, the most common wire condition anomalies are heat damage or burnt wire, vibration damage/chafing and cracked insulation.

In modern IC parts, ionic contamination is reduced to extremely lower levels in both the wafer fabrication and plastic moulding operations. As a result, corrosion of conductors in commercial ICs is extremely rare. However, it is possible to cause circuit damage and even failure by using very high temperatures, humidities, and bias voltages in accelerated temperature humidity bias (THB) test. A pressurized THB test run at a temperature above boiling point of water is referred to as highly accelerated stress test or HAST. On common commercial parts, a HAST at 160°C and 85% RH will produce measurable failures in 100's test hours. Hence THB tests cannot be used to "screen" PEMs although they are very useful as both sampling test and a method to evaluate materials and processes.

The focus of concern in commercial manufacturing has shifted to issues associated with sudden moisture release during high temperature solder reflow during mounting of the ICs to the PC board. This so called "popcorn" effect can cause cracking in the package or delamination of interfaces inside the package. Although cracking and delamination do not usually produce a functional failure of the device, they are potential long term reliability issues.

Table 2. Package related failure modes and mechanisms.

Failure mode	***Failure mechanism***
Open	- Disconnection of bond wire or peeling - Stress due to oxidation or absorbed moisture and heat stress; Lead dirtiness
Soldering defect	- Surface oxidation or contamination
Shorts or leaks, Package cracking	- Wire touching (contact between the wires, chip and lead frame) - Electrochemical migration between leads - Delamination between the chip or lead frame and mold resin

Table 3. Die-related failure modes and mechanisms.

Failure mode	*Failure mechanism*
Open	• Aluminium wiring disconnection (corrosion, migration, latch-up) • Bonding pad corrosion • Polysilicon wiring disconnection (melting) • Bond peeling (formation of Au-Al and other intermetallic compounds)
Shorts or leaks	• Oxide film breakdown or pinhole • Electrostatic breakdown • *pn* junction degradation • Interlayer insulator breakdown or pinhole • Conductive foreign matter • Contamination within the process • Chip cracking • Entry of moisture
IC function failure (characteristic fluctuations and function failure)	• Hot electron or hot carrier injection to the oxide film • Surface inversion • Crystal defect • Contamination within the process
Malfunction	• Soft error • Latch-up • Electromagnetic interference (EMI)

The presence of humidity in the moulding compounds of non-hermetic surface mounted devices before assembling may have catastrophic consequences; during solder reflow, moisture which is present at the interface between mold and die-pad vaporizes and expands creating an internal stress which can result in either a crack in the plastic (popcorn effect), in interfacial delamination, or even in die cracking. The problem is usually solved using dried devices or providing a short temperature storage of the device immediately before assembling.

12. EVALUATING THE RELIABILITY

Twenty-first-century reliability culture must adapt to the paradigm that states “if a system operates as required for a required period without failure, it has meet an acceptable target of reliability” [18].

Traditionally one of the methods of evaluating the reliability of an electronic component or assembly has been thermal cycling; however the nature of this method means that it is very time consuming and is ill-suited to the short product and process development cycles associated with the first moving world of microelectronics. Various types of mechanical test e.g. cyclic fatigue and creep-fatigue on solder joints and assemblies can be used to augment or even replace thermal testing.

Scanning acoustic microscopy has been successfully implemented for the non-destructive detection of cracks and delaminations in integrated circuit packages. The incorporation of scanning acoustic microscope inspections in reliability tests of moulded surface mount components has identified delamination at the mold compound/die interface as the primary cause of electrical failure during temperature cycling. The ability of the acoustic microscope to non-destructively image stress distributions prior to failure would greatly extend the impact of scanning acoustic microscopy on new package development and process control. This may be particularly important for the packaging of devices with fragile low-k (dielectric constant) layers in the device structure.

13. CONCLUSION

The last years have brought about revolutionary changes in electronics technology in general and plastic packaging in particular. Hundreds of studies have reported progress in plastic package integrity brought about by improvements in materials, increased purity of the plastics, high quality passivation layer processes, high shock resistance, greater availability, lighter weight, lower acquisition costs, and major device manufacturer's quality programs. Tests for plastic devices, to accelerate known and possible failure mechanisms of PEMs,

must be developed, validated, and standardized. Improvements in encapsulated materials such as: low ionic impurities, low moisture adsorption, better adhesion properties, matching of thermal coefficients to die/lead frame, high glass transition temperature, higher thermal conductivity; and advances in passivation such as: better adhesion to die, less pinholes or cracks, low ionic impurity, lower water vapour absorption, thermal properties better matched to substrate, have caused dramatic improvements in the reliability of PEMs over the last several years.

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THE SPECIFIED RATING OF THE COUNTRIES' POPULATION WELL – BEING ALL OVER THE WORLD

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The authors have found data on countries' population well – being in the Internet [1]. It's clear from the Internet material that the rating was calculated in the following way: 7 factors were given points and then all points were summed up. The sums were put in increased order and in this way the countries rating was obtained. The authors have used two powerful program packets for calculation of the same points. The results of calculation for the second packet are given in table 2 [2,3]. The results for the 1st packet are given in other tables. It is clear from the tables the data coincide up to the second symbol after comma, which means that the calculation are correctly.

When passing to symbols, generally accepted in statistics the linear rating calculation model obtained by results of regressive analysis will look as follows:

$$Y= -48,5622 + 0,2299X_1 + 0,3695 X_2 + 0,2820 X_3 + 0,2573 X_4 +0,2316 X_5 + +0,2203 X_6 + 0,1803 X_7 \quad (1)$$

The analysis of the results shows, that the Internet rating does not completely coincide with that, obtained by the authors. There are differences. The comparison of the initial opening part of the rating is given in table 4. There are differences, that's why the rating proposed by authors is called specified.

The basic calculation results are given in table 6. There are 11 columns in this table.

In the first column there are countries.

In the second column there are the Internet rating.

In the third column there's the authors rating.

In the 4th column the differences are given between the Internet and the authors ratings.

In the 5th column there are points for science and technologies.

In the 6th column there are points for culture.

In the 7th column there are points for inner calm and security.

In the 8th column there are points for public order.

In the 9th column there are points for the planet climate.

In the 10th column there are points for prosperity and equality.

In the 11th column there are points for health and well – being.

It's clear from the table that Moldova occupies the 66 place, Russia occupies the 91st place, the Ukraine – 86th place. The authors think that Russia's rating visibly lowered.

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Recommended for publication: 04.09.2014.

Table 1. The calculation results on the first complex of programs.

Regression Summary for Dependent Variable: VAR1						
R= ,97394660 RI= ,94857198 Adjusted RI= ,94549509						
F(7,117)=308,29 p<0,0000 Std.Error of estimate: 8,4580						
	St. Err.		St. Err.			
	BETA	of BETA	B	of B	t(117)	p-level
Intercpt			-48,5622	3,204766	-15,1531	,0000
VAR2	,22991	6,035484	,2299	,035484	6,4795	,0000
VAR3	,36952	5,038725	,3695	,038725	9,5423	,0000
VAR4	,281997	,024756	,2820	,024756	11,3909	,0000
VAR5	,257311	,029669	,2573	,029669	8,6727	,0000
VAR6	,231567	,023846	,2316	,023846	9,7110	,0000
VAR7	,220259	,022422	,2203	,022422	9,8233	,0000
VAR8	,180254	,024004	,1803	,024004	7,5093	,0000

Table 2. The calculation results on the second complex of programs.

		Unstandardized Coefficients		**Standardized Coefficients**	**t(117)**	**p.**
Model		**B**	**Std. Error**	**Beta**		
1	(Const.)	-48,562	3,205		-15,153	,000
	VAR2	,230	,035	,230	6,479	,000
	VAR3	,370	,039	,370	9,542	,000
	VAR4	,282	,025	,282	11,391	,000
	VAR5	,257	,030	,257	8,673	,000
	VAR6	,232	,024	,232	9,711	,000
	VAR7	,220	,022	,220	9,823	,000
	VAR8	,180	,024	,180	7,509	,000

a Dependent Variable: VAR1

Table 3.The twin correlation coefficients

Correlations (new111.sta)								
	VAR2	**VAR3**	**VAR4**	**VAR5**	**VAR6**	**VAR7**	**VAR8**	**VAR1**
VAR2	1,00	,78	-,47	,55	,20	,30	,39	,71
VAR3	,78	1,00	-,48	,65	,36	,25	,40	,79
VAR4	-,47	-,48	1,00	-,21	-,15	-,13	-,27	-,17
VAR5	,55	,65	-,21	1,00	,40	,24	,42	,78
VAR6	,20	,36	-,15	,40	1,00	,23	,26	,57
VAR7	,30	,25	-,13	,24	,23	1,00	,18	,49
VAR8	,39	,40	-,27	,42	,26	,18	1,00	,55
VAR1	,71	,79	-,17	,78	,57	,49	,55	1,00

Table 4. Partial correlation.

Variables currently in the Equation; DV: VAR1 (new111.sta)						
	Partial	Semipart				
Beta in	Cor.	Cor.	Tolernce	R-sq	t(117)	p-level
VAR2 ,229916	,513881	,135846	,349103	,650897	6,47946	,0000
VAR3 ,369525	,661550	,200059	,293109	,706891	9,54226	,0000
VAR4 ,281997	,725148	,238817	,717201	,282798	11,39089	,0000
VAR5 ,257311	,625546	,181828	,499348	,500652	8 ,67269	,0000
VAR6,231567	,66805	,203598	,773019	,226981	9 ,71104	,0000
VAR7,220259	,672298	,205952	,874310	,125690	9 ,82333	,0000
VAR8 ,180254	,570279	,157437	,762855	,237145	7 ,50929	,0000

Table 5. Comparison of ratings.

Rating	**The countries' order by the Internet rating**	**Rating**	**The countries' order by the authors rating**
1	**2**	**3**	**4**
1	Ireland	**1**	Ireland
2	Finland	**2**	Finland
3	Switzerland	**3**	New Zealand
4	Netherlands	**4**	Netherlands
5	New Zealand	**5**	Switzerland
6	Sweden	**6**	Norway
7	United Kingdom	**7**	Sweden
8	Norway	**8**	United Kingdom
9	Denmark	**9**	Denmark
10	Belgium	**10**	Belgium

Table 6. The basic calculation results.

				VAR2	VAR3	VAR4	VAR5	VAR6	VAR7	VAR8	
Overall Rankings	**Observed**	**Predictd**		**Science and Technology**	**Culture**	**Int'l Peace and Security**	**World Order**	**Planet and Climate**	**Prosperity and Equality**	**Health and Wellbeing**	
Overall Rankings	**Value**	**Value**	**Residual**								
1	2	3	4	**5**	**6**	**7**	**8**	**9**	**10**	**11**	13
Ireland	1	-18,77898979	19,77898979	20	7	33	4	45	1	9	119
Finland	2	-16,20201683	18,20201683	7	18	53	12	14	3	12	119
Switzerland	3	-6,814902782	9,814903259	6	32	71	10	16	2	10	294
Netherlands	4	-8,110424042	12,11042404	18	2	97	3	23	8	2	306
New Zealand	5	-8,500864029	13,50086403	10	25	37	17	7	41	17	
Sweden	6	-5,171638489	11,17163849	8	14	111	8	3	4	8	
United Kingdom	7	-5,063624859	12,06362534	1	12	94	9	30	9	6	
Norway	8	-5,44603014	13,44602966	40	24	58	7	4	14	16	
Denmark	9	-1,284317613	10,28431797	14	9	88	5	26	35	5	
Belgium	10	2,182544947	7,817455292	15	1	100	16	56	5	3	
France	11	5,56645298	5,43354702	12	26	92	18	10	28	15	
Canada	12	6,551851749	5,448148251	28	20	106	14	2	30	4	
Germany	13	4,038008213	8,961992264	11	5	109	1	29	33	18	
Austria	14	4,049488068	9,950511932	2	4	104	2	43	24	31	
Australia	15	9,44340992	5,55659008	16	38	89	13	6	36	14	
Luxembourg	16	10,45602703	5,543972969	55	10	101	19	12	19	13	
Iceland	17	12,51063251	4,489367485	24	37	27	15	1	101	44	
Cyprus	18	16,79265785	1,207342148	3	35	86	21	22	37	49	
Spain	19	24,98937035	-5,989370346	37	23	120	24	24	49	1	
Italy	20	27,82883263	-7,828832626	38	22	102	11	44	65	19	
United States of America	21	33,8850708	-12,8850708	26	41	114	28	39	53	7	

Costa Rica	22	32,76486206	-10,76486206	61	64	35	25	19	42	76	
Malta	23	26,57137108	-3,571371078	64	3	66	6	36	99	50	
Chile	24	31,09754181	-7,097541809	52	47	42	27	18	31	114	
Japan	25	38,53017426	-13,53017426	46	44	77	56	11	71	33	
Kenya	26	42,53965378	-16,53965378	47	84	20	48	98	16	28	
Singapore	27	40,99978638	-13,99978638	21	39	80	121	20	7	58	
Slovenia	28	36,96205139	-8,962051392	17	17	87	23	68	111	26	
Guatemala	29	42,53778839	-13,53778839	91	57	29	76	42	21	39	
Greece	30	38,74957275	-8,749572754	34	36	65	33	32	87	71	
Colombia	31	49,96009445	-18,96009445	57	83	43	107	15	29	29	
Bulgaria	32	41,18177795	-9,181777954	19	27	79	36	80	70	55	
Panama	33	43,5657959	-10,5657959	81	43	70	30	37	44	66	
Estonia	34	45,14673996	-11,14673996	31	6	107	80	66	66	21	
Portugal	35	45,89251328	-10,89251328	42	19	116	44	48	61	51	
Mauritius	36	44,56435776	-8,564357758	69	33	40	32	122	27	63	
Israel	37	48,25457764	-11,25457764	5	40	81	68	35	63	103	
Ghana	38	48,29005051	-10,29005051	59	62	12	71	72	6	115	
Ecuador	39	53,09901428	-14,09901428	105	79	10	39	38	90	38	
Zambia	40	51,19264984	-11,19264984	90	85	21	47	21	11	124	
Uruguay	41	48,0361824	-7,036182404	104	58	5	35	13	94	95	
Slovakia	42	50,89561844	-8,895618439	43	21	110	49	51	69	62	
Czech Republic	43	50,11741257	-7,117412567	4	8	121	34	77	100	67	
South Africa	44	52,84883118	-8,848831177	29	60	15	31	102	121	56	
Jamaica	45	54,98135757	-9,981357574	65	59	23	62	87	51	72	
Croatia	46	52,742939	-6,742938995	35	30	62	73	52	85	84	
Republic of Korea	47	57,40904236	-10,40904236	30	34	119	45	71	60	65	
Namibia	48	54,03770828	-6,037708282	74	52	30	89	34	25	120	
Brazil	49	57,33729172	-8,337291718	75	49	83	37	5	123	52	
Jordan	50	61,05234909	-11,05234909	39	78	2	101	99	81	25	

Trinidad and Tobago	51	53,76924133	-2,769241333	76	42	25	64	110	22	86	
Poland	52	53,10938263	-1,109382629	32	16	105	26	83	83	81	
Thailand	53	61,66532516	-8,665325165	66	67	73	22	97	80	22	
Paraguay	54	56,99351501	-2,993515015	120	56	8	60	31	125	27	
Macedonia	55	60,30566025	-5,305660248	33	55	82	41	119	20	85	
Tunisia	56	64,20718384	-8,207183838	58	86	31	82	59	54	68	
Argentina	57	55,91693115	1,083068848	67	46	55	29	25	105	112	
Malaysia	58	62,81220245	-4,812202454	49	28	113	87	73	10	91	
Uganda	59	70,78005981	-11,78005981	71	108	41	66	9	91	69	
Republic of Moldova	60	66,53362274	-6,533622742	44	65	46	51	115	84	54	
Hungary	61	61,16276932	-0,162769318	9	13	123	59	76	78	101	
Serbia	62	63,60486984	-1,604869843	23	31	98	52	124	52	79	
United Republic of Tanzania	63	66,44377899	-3,443778992	113	74	3	43	93	102	32	
Botswana	64	65,72209167	-1,722091675	107	66	67	54	41	12	113	
Romania	65	62,40365601	2,596343994	48	29	75	53	69	114	74	
Mexico	66	73,13482666	-7,13482666	70	73	91	69	84	47	30	
Morocco	67	74,07474518	-7,074745178	68	90	76	50	85	57	40	
Egypt	68	69,5816803	-1,581680298	45	80	1	85	111	88	61	
Lithuania	69	64,85449982	4,145500183	25	11	125	58	57	109	90	
Bosnia and Herzegovina	70	67,8084259	2,191574097	22	61	63	40	106	75	109	
Mozambique	71	68,75086212	2,249137878	103	81	14	75	55	26	122	
Armenia	72	73,80202484	-1,802024841	50	98	39	72	95	15	110	
Albania	73	71,51673126	1,483268738	101	54	95	65	50	18	99	
Kyrgyzstan	74	79,53579712	-5,535797119	72	103	47	84	114	17	47	
Malawi	75	79,92845154	-4,928451538	94	113	48	38	67	67	64	
Lesotho	76	71,43512726	4,564872742	114	93	4	20	46	98	116	
Georgia	77	77,86352539	-0,863525391	63	77	51	102	105	13	87	
Sri Lanka	78	79,51521301	-1,515213013	87	97	54	55	90	23	94	
Turkey	79	80,64913177	-1,649131775	51	50	112	111	60	97	20	

Kazakhstan	80	84,2813797	-4,2813797	109	105	26	105	86	48	23	
India	81	76,93844604	4,061553955	56	53	44	91	107	117	37	
Belarus	82	81,57685089	0,423149109	36	63	108	63	118	74	46	
Latvia	83	73,50598907	9,494010925	27	15	124	88	62	89	104	
Lebanon	84	79,90260315	4,097396851	53	51	115	100	64	39	88	
El Salvador	85	79,65106964	5,348930359	99	75	11	109	63	106	48	
Peru	86	84,10644531	1,893554688	88	87	96	81	17	62	82	
United Arab Emirates	87	79,59797668	7,402023315	82	45	74	122	61	76	53	
Bolivia (Plurinational State of)	88	82,85392761	5,146072388	116	100	22	42	78	115	41	
Cameroon	89	82,89547729	6,104522705	73	120	13	70	70	45	125	
Senegal	90	86,76091766	3,239082336	78	114	32	83	91	59	60	
Bangladesh	91	86,4046402	4,595359802	100	94	52	67	117	55	34	
Saudi Arabia	92	92,13101196	-0,131011963	86	99	85	119	79	43	11	
Kuwait	93	84,61565399	8,384346008	85	70	18	108	104	72	83	
Honduras	94	85,14264679	8,85735321	92	72	19	99	75	110	75	
Russian Federation	95	91,26428986	3,735710144	41	68	90	106	88	112	42	
Republic of the Congo	96	95,65837097	0,341629028	83	123	49	115	47	40	92	
Togo	97	89,10883331	7,891166687	84	89	6	110	112	58	93	
Madagascar	98	85,94116974	12,05883026	80	71	17	113	49	116	106	
Ukraine	99	87,68383026	11,31616974	13	48	117	57	120	96	105	
Oman	100	91,74861908	8,25138092	110	88	24	125	58	64	89	
Dominican Republic	101	93,32752228	7,672477722	108	69	99	46	89	113	35	
Congo	102	96,7718811	5,228118896	121	111	60	103	8	46	117	
Nigeria	103	94,93494415	8,065055847	111	110	9	79	74	104	80	
Lao People's Democratic Republic	104	102,9194031	1,080596924	77	118	93	98	27	118	36	
Sudan	105	106,6149597	-1,614959717	118	125	118	96	54	32	24	
Pakistan	106	101,1792755	4,820724487	106	109	61	104	108	38	43	
China	107	96,94124603	10,05875397	54	91	59	94	96	108	70	

Rwanda	108	101,4082718	6,59172821	102	121	56	120	40	34	102	
Mongolia	109	97,42829132	11,57170868	62	96	38	114	101	50	121	
Qatar	110	104,550148	5,44985199	112	95	50	118	81	68	78	
Algeria	111	105,5274124	5,472587585	79	102	45	90	109	122	57	
Cambodia	112	104,3228683	7,677131653	119	101	28	117	53	92	98	
Syrian Arab Republic	113	107,812294	5,187705994	96	104	57	92	113	73	77	
Philippines	114	106,0271378	7,972862244	115	106	64	61	82	77	107	
Iran (Islamic Republic of)	115	111,4008408	3,599159241	93	119	72	97	103	56	73	
Yemen	116	112,3903275	3,609672546	98	122	69	86	100	93	45	
Venezuela (Bolivarian Republic of)	117	107,1969604	9,803039551	117	117	34	77	33	124	118	
Benin	118	107,1709518	10,82904816	97	115	7	78	121	107	96	
Indonesia	119	109,5557404	9,444259644	122	92	36	95	92	103	97	
Zimbabwe	120	111,9857788	8,014221191	60	82	68	112	125	82	119	
Angola	121	120,0538712	0,946128845	124	112	78	116	28	95	108	
Azerbaijan	122	124,998558	-2,998558044	95	107	122	74	94	86	100	
Iraq	123	130,754364	-7,754364014	125	116	84	124	65	120	59	
Viet Nam	124	126,5705566	-2,570556641	89	76	103	123	123	79	111	
Libya	125	129,2242432	-4,224243164	123	124	16	93	116	119	123	

FACTORS LEADING TO A DECREASE IN MEMBRANE PERMEABILITY FOR WATER FILTRATION AND WASTEWATER

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INTRODUCTION

Liquid separation with membranes is the perspective method in terms of ecology and economy. These methods make it possible not only to concentrate and fractionate fouling in wastewaters, but also to extract valuable components. However, the main factor to slow development of the processes of membrane treatment of water and wastewater is sharp productivity slowdown of membrane with irrational methods of water pre-processing or its absence.

Choice of proper method of separation with membranes and condition of preliminary water preparation makes it possible to prolong filter run and thereby to secure necessary technical and economic performance and ecological specifications. It is necessary to identify factors affecting membrane fouling in order to select appropriate technology of preliminary water preparation. In the previous article the author in details studied the biological fouling of membranes and its properties conditioning tendency to biological fouling. The main factors to affect the fouling rate of membranes are the following:

- nature and concentration of solutes and solvents,
- membrane type,
- pores distribution within size of membrane,
- characteristics of the membrane surface and its material,
- hydrodynamics of a membrane module.

Three main types of resistance are encountered in general case of mass transfer through a membrane: water solution resistance to mass transfer, membrane resistance and resistance of permeate. Resistance of permeate can be neglected in ordinary conditions of membrane separation process and then only two components of resistance remain to consider: water solution resistance (external resistance to diffusion) membrane phase resistance (internal resistance to diffusion). It is exactly the concentration polarization that creates external diffusion resistance. During treatment of natural water and wastewaters with ultrafiltration methods concentration of solutes increases on the membrane surface in comparison with its content in base solution due to transfer of solvent – water through a membrane. This phenomenon is called concentration polarization. Selectivity and specific duty of a membrane decrease due to concentration of soluble substances on the membrane surface. As correlation of concentration of soluble substances on the membrane surface and in the volume of treated solution exponentially rises with increase of specific duty, concentration polarization can be the factor to limit membrane permeability. With elevated concentration of soluble substances by separating surface of a membrane, the latter can partially deteriorate or modify. [1]

1. HUMIC AND FULVIC ACIDS SLUDGING ABILITY

Humic and fulvic acids are organic products, commonly found in water, readily soluble, impart a yellowish to red-brown colour to water. Fouling with humic and fulvic acids is primarily connected with its ability to fix multivalent salts. In the study [2] it is described that the most susceptible membranes to fouling are the ones with positive charge of material. Humic acids form chelates with polyvalent metals that leads to gel layer formation on the membrane surface.

In the study Schafer A.I.with co-authors [3] described the role of humic acids in the process of gel and concentration polarization. Using any kind of materials for membranes gave no opportunity to avoid irreversible consequences of sludge formation within high concentration of hardness salts. The key factor of formation of gel layer on the membrane surface is humic acids presence in solution. These researches are well correlated with the ones in the study [2].Schafer A.I. with co-authors discovered that complexes of calcium and humic acids form thick sludge on the membrane surface that also results in considerable flux decline of treated water

.Gel layer formation speeds up with rise of pH. At the same time concentration of humic acids increases in premembrane layer. Humic and fulvic acids have high molecular weight that promotes gel formation on the membrane surface due to low diffusion rate. Formation of layers of organic and inorganic fouling one above the other on the membrane surface has been studied in the research [4]. It was discovered that during formation of sludge layer conditioned with Fe-Si the main role is played by the reduction of membrane hydrophobic properties due to humic acids. In the study [4] it is showed that hydrophilic membranes are less susceptible to sludge formation including with colloids of humic acids. In the study [3]it is showed that hydrophobic membranes are susceptible to the heaviest formation of sediment of different kind on its surface. Also authors [5] compared sludge formation on the membrane surface in the conditions with and without sediment formative mineral salts. These researches led to the conclusion that with salts presence sludge formation is more rapid. These researches show that during the membrane treatment with the presence of humic acids water must be with minimal amount of hardness salts and low pH.

All these conclusions are corroborated in the study Tu S-C. [6] , that reaffirm membranes with negative surface charges and greater hydrophilicity are less susceptible to sludge formation due to fewer interaction between polar groups on the membrane surface and chemical substances of organic compounds.

2. EFECT OF INORGANIC COMPONENTS ON INCREMENT IN MEMBRANE RESISTANCE

Sahachaiyunta P. and colleagues [7] examined the influence of silicate solutions on the fouling of the reverse osmosis membranes in the presence of minute amounts of various metal cations such as barium, manganese, nickel and iron that are present in industrial circulating water and wastewaters. Experimental results showed that iron is the most active from the view of sludge forming.

If such a water is exposed to air or is chlorinated, Fe^{2+}, Mn^{2+} and sulfide are oxydized to $Fe^{3+,}$ Mn^{3+} and elemental sulfur, respectively, which form insoluble colloidal hydroxides and elemental sulfur as shown in the following equations :

$$4Fe(HCO_3)_2 + O_2 + 2H_2O \rightarrow 4Fe(OH)_3 + 8CO_2$$

$$4Mn(HCO_3)_2 + O_2 + 2H_2O \rightarrow 4Mn(OH)_2 + 8CO_2$$

$$2H_2S + O_2 \rightarrow 2S + 2H_2O$$

Iron fouling occurs more frequently than manganese fouling, since iron is present in the raw waters more abundantly than manganese and the oxidation of iron occurs at a much lower pH

3. EEFFECT OF PROTEINS AND COLLOIDS

Surface processes occurring during removing of the proteins are similar to film-formation processes described in the study [3]. For example, when filtering bovine serum albumin clogging of channels takes place with the formation of layer on the membrane surface. Further simple non-aggregated protein affiliates to film-formation process with forming of disulfide linkages that results in increase in membrane resistance. The researchers developed a mathematical model describing this dual mode process. In the study Yiantsios S. G. and Karabelas S. investigated the role of formation of stable aggregate films on the membrane surface with formation of colloids. Yiantsios S. G. and Karabelas S. showed that in the process of film-formation on the surface of the reverse osmosis and ultrafiltration membranes not only water velocity above a membrane, transmembrane pressure, size of particles and its quantity play an important role, but also colloids'resistanceto mechanical impact. The authors proved that standard tests carried out to determine fouling rate of membranes and also most used mathematical models do not allow defining the necessary parameters to a high precision. One of the main conclusions of this study showed that use of acids in order to prevent sludging of mineral impurities can result in formation of colloid film on the membrane surface. The explanation for this is to be that lowering of pH reduces the negative charge of colloids, causing more sludge formation on the membrane surface.

Colloidal fouling has also been modelled in the study [8]. Authors of the study [9] compared ultrafiltration and nanofiltration membranes fouling with interaction with various organic substances. This way colloids cause pore blockage of hydrophobic membrane dueto its hydrophobic properties. In particular, it was defined that ions of polysaccharides and amino sugars were found to play an important role in film formation.

Such dissolved natural polymer substances as proteins and polysaccharides are among the heaviest contaminants of ultrafiltration and nanofiltration and reverse osmosis membranes. They are found in natural waters and wastewaters and are the waste

product of microorganisms. These substances have considerable capacity to block the membrane surface as they can accumulate not only on the membrane surface but also enter the membrane pores. This was found by the authors during the tests of membrane bioreactors [10]. Proteins, polysaccharides and polysaccharide-like compounds were found to be the main cause of fouling formation on the membrane during filtration of biologically treated wastewaters [11]. Polysaccharides and proteins in water are found as high-molecular soluble compounds and also as colloidal forms.

As film-forming material, polysaccharides are neutral in character, they interact with the membrane surface either through hydrogen bonding or as colloids, so that results in the formation of multi-level gellayer.

Due to its amphoteric property protein interact with the membrane surface by forming a layer of colloidal gel [12]. Characteristics of soluble polymers and the degree of microbial adhesion to the membrane surface vary with species, the phase of sludge formation on the membrane surface, water chemistry, pH and temperature.

CONCLUSIONS

Membranes fouling is one of the factor that brings down appeal of this method of water and wastewater filtration.

For successful membrane ultrafiltration technology performance periodic sanitation or pretreatment is required.

One of perspective development path is using membranes, that have bactericidal properties and their design should prevent biofilm formation.

The most perspective development path is adding modifying components to membranes material or inoculating of modifying material with antifouling properties.

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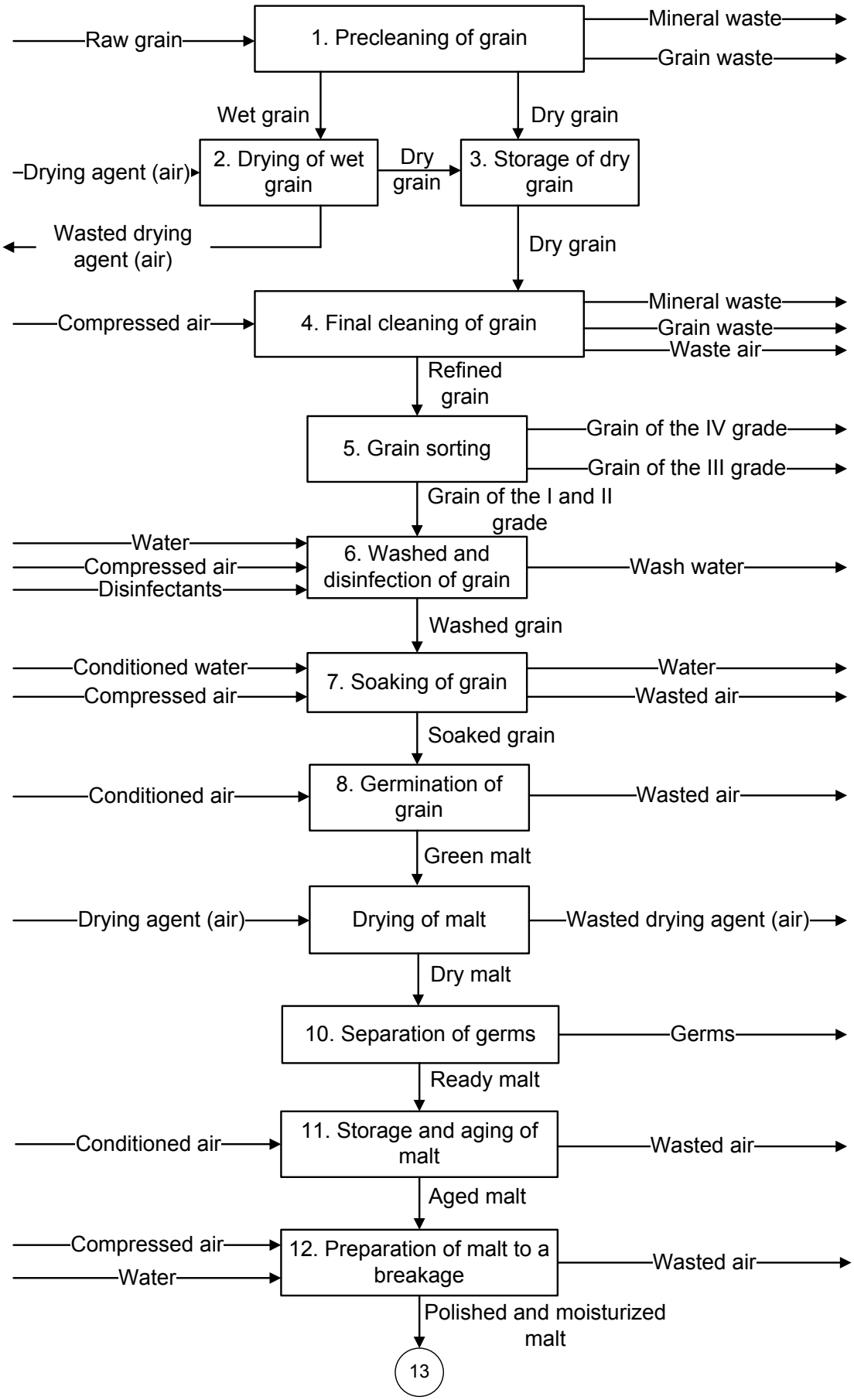
Raw grain
1. Precleaning of grain
Mineral waste
Grain waste
Wet grain
Dry grain
Drying agent (air)
2. Drying of wet grain
Dry grain
3. Storage of dry grain
Wasted drying agent (air)
Dry grain
Compressed air
4. Final cleaning of grain
Mineral waste
Grain waste
Waste air
Refined grain
5. Grain sorting
Grain of the IV grade
Grain of the III grade
Grain of the I and II grade
Water
Compressed air
Disinfectants
6. Washed and disinfection of grain
Wash water
Washed grain
Conditioned water
Compressed air
7. Soaking of grain
Water
Wasted air
Soaked grain
Conditioned air
8. Germination of grain
Wasted air
Green malt
Drying agent (air)
Drying of malt
Wasted drying agent (air)
Dry malt
10. Separation of germs
Germs
Ready malt
Conditioned air
11. Storage and aging of malt
Wasted air
Aged malt
Compressed air
Water
12. Preparation of malt to a breakage
Wasted air
Polished and moisturized malt
13

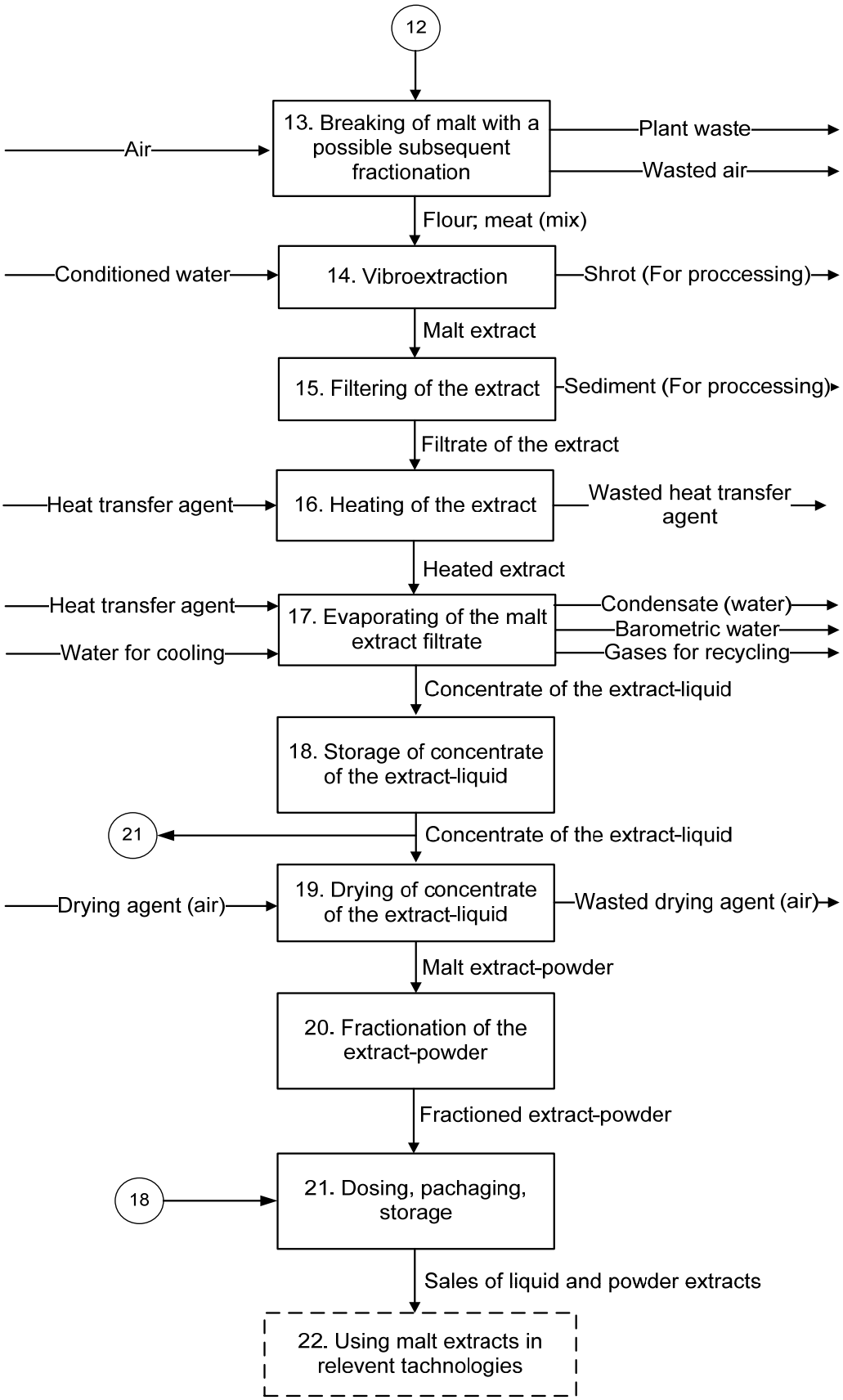

Figure 1. Fundamental technological scheme of malt extracts production.

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EVOLUTION OF FATTY ACIDS AND PEROXYDES CONTENT IN WALNUT OIL (*Juglans regia* L.) DURING STORAGE

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INTRODUCTION

Walnut oil (*Junglas regia* L.) is high-quality oil due to its important physical and biochemical properties. In addition, walnut oil has significant economical value and medicinal importance for human health because of its chemical composition. Walnut oil contains approximately 7% saturated, 20% monounsaturated and 73% polyunsaturated fatty acids [8, 13].

The cold-pressing procedure involves neither heat nor chemical treatments, and it is becoming an interesting substitute for conventional practices because of consumers' desire for natural and safety food products. Cold pressing is simple, ecological and does not require much energy. Such factors as geographical location, species and processing technique may influence the final chemical composition of oils [10].

A number of experiments have been carried out on the oxidation stability of walnut oil. Temperature, light, moisture and exposure to oxygen have been found to be the main contributing factors to oxidation [5, 9]. Stark et al. found that walnut oil stored at room temperature in the dark, in sealed bottles, showed only small rises in peroxide values after four months of storage and remained an acceptable product in terms of its organoleptic properties [11].

Oxidation of walnut lipids is linked to the appearance of unpleasant odors and flavors. Tocopherol isomers provide some protection against oxidation. Walnut oil, which is cold pressed from the dried walnuts, has a strong and distinctive walnut flavor [6]. If the cold pressed walnut oil is to be effectively used in the food industry and human nutrition, it is important to determine how long it can be stored for without any deterioration. *The objective of this study* was to investigate the changes of fatty acids and peroxides content in dependence of applied manufacturing technology and storage time of walnut oil.

1. MATERIALS AND METHODS

1.1. Sample preparation and extraction procedure

Walnut fruits (*Juglans regia* L.) were obtained from agency Moldsilva, which is the central public administration body on state policy in forestry and hunting in the Republic of Moldova (http://www.moldsilva.gov.md/). At full maturity, fruits were hand-picked directly from the trees. After harvest fruits were transported to the laboratory. Before oil extraction, the walnuts were manually cracked and shelled. Then, kernels were chopped in a KEM 36 mill. Walnut oil extraction was carried out essentially following the procedure presented in figure 1.

Figure 1. Extraction procedure of walnut oil.

In particular, walnut oil expression was carried out at 20±2 °C using an electrical press (Model PCU-125). The oil obtained was subjected to different technological treatments as centrifugation, dehydration, heat processing and their combination. Walnut oil without applied technological treatments was used as reference sample.

1.2. Chemicals

Ethanol (99.9%), chloroform, glacial acetic acid, potassium hydroxide, phenolphthalein, potassium iodide, sodium thiosulfate ($Na_2S_2O_3 \times 5H_2O$) and starch were supplied by Eco-Chimie (Chisinau, Moldova). All the chemicals used were of HPLC or analytical grade. Distilled water was used throughout.

1.3. Acid Value

Acid value was determined by potassium hydroxide titration as described in AOCS Official Method Cd 3d-63 (AOCS, 1999). The method was based on the number of milligrams of potassium hydroxide necessary to neutralize the free acids in 1 gram of oil sample. Results were expressed as milligram of potassium hydroxide per gram of walnut oil sample [1].

1.4. Peroxide Value

Oxidation rate was studied by determination of the peroxide value (PV). This was determined according to AOCS Official Method Cd 8-53 (AOCS, 2003). Peroxide value was expressed as millimoles peroxide per kilogram of walnut oil [2].

1.5. Statistical analysis

Variance analysis of the results was carried out by least square method with application of coefficient Student. Differences were considered statistically significant if probability was greater than 95% (p-value<0.05). All assays were performed by triplicate at room temperature. Experimental results are expressed as average ± SD (standard deviation).

2. RESULTS AND DISCUSSION

Today, vegetable oils are developed and subsequent production controlled with knowledge of their composition, structural and functional properties, and the expected reactions obtained through the application of scientific research. In this work walnuts as a perspective and valuable raw material were proposed for oil extraction. Prior to chemical analysis, the walnuts were manually cracked and shelled and then milled into a fine powder in an electric mill (Braun, Germany). Oil was extracted using cold pressing with an electrical lab press PSU - 125. General scheme of walnut oil extraction procedure is given in figure 2.

Walnuts → Cracking → Grinding → Oil pressing → Oil collection → Dehydration → Antioxidant incorporation → Nitrogen treatment of oil → Oil filtration → Oil Packaging → Oil storage in nitrogen.

Figure 2. Experimental scheme of cold pressed walnut oil extraction

Hydrolysis of oils is a major cause of their deterioration, and hydroperoxides formed by the reaction between oxygen and the unsaturated fatty acids are the primary products of this reaction. Hydroperoxides have no flavor or odor but break down rapidly to form aldehydes, which have a strong, disagreeable flavor and odor (figure 3).

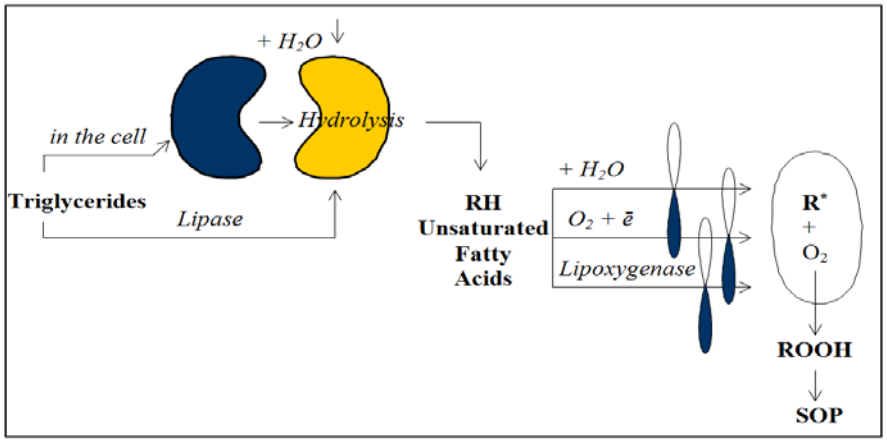


Figure 3. Autooxidation processes and enzymatic hydrolysis of the walnut oil.

The peroxide concentration is a measure of oxidation or rancidity in its early stages. But peroxide determination does not provide a full and unqualified evaluation of oils flavor because of the transitory nature of peroxides and their breakdown to nonperoxide materials.

Progress in the utilization of oils for the production of useful products is dependent upon a thorough knowledge of the characteristics of the raw materials, the changes effected by each process, and the requirements of the individually prepared food product. Physical, chemical, and performance analyses are the tools available to fats and oils processors for the purchase of raw materials, development of new products, and evaluation of the products produced. Statistical analysis of experimental data obtained for acid values of walnut oil during storage are given in table 1.

Table 1. Statistical analysis of the experimental data for walnut oil acidity

No	Parameters	Calculation Model	Calculation Value
1.	**Acid number of the experimental sample of walnut oil**	The average value of acid number: $\bar{X}$	$\bar{X}$ = 0.38 mg KOH/g oil
		Square deviation: $\sigma = \sqrt{\frac{\sum (X_m - x)^2}{n}}$	σ = 0.07
2.	**Error (ξ) reflects the limit in which the obtained AN value corresponds to real content of walnut oil acidity**	$\xi = \frac{\sigma}{\sqrt{n}}$	$\xi = \frac{0.07}{\sqrt{9}} = 0.023$
3.	**Confidence limit, 95% probability. Coefficient Student is t = 3 (from special tables)**	Square deviation σ = 3: $^{*}L_{max} = \bar{X} + 3\times\xi$ $^{**}L_{min} = \bar{X} - 3\times\xi$	$L_{max} = 0.38 + 3\times0.023 = 0.43$ $L_{max} = 0.38 - 3\times0.023 = 0.31$
4.	**Acid number of the walnut oil after 180 days of storage**	$X = \bar{X} \pm \sigma$	$X = 0.38 \pm 0.07$

$^{*}L_{max}$ – upper limit of acidity;
$^{**}L_{min}$ – lower limit of acidity.

Figure 4 shows the effect of storage time on evolution of acidity of walnut oil sample. The initial acid number of fresh walnut oil sample was 0.39 mg KOH/g oil. Changes in acid number were in the range from 0.39 to 0.53 mg KOH/g oil during 180 days of storage.

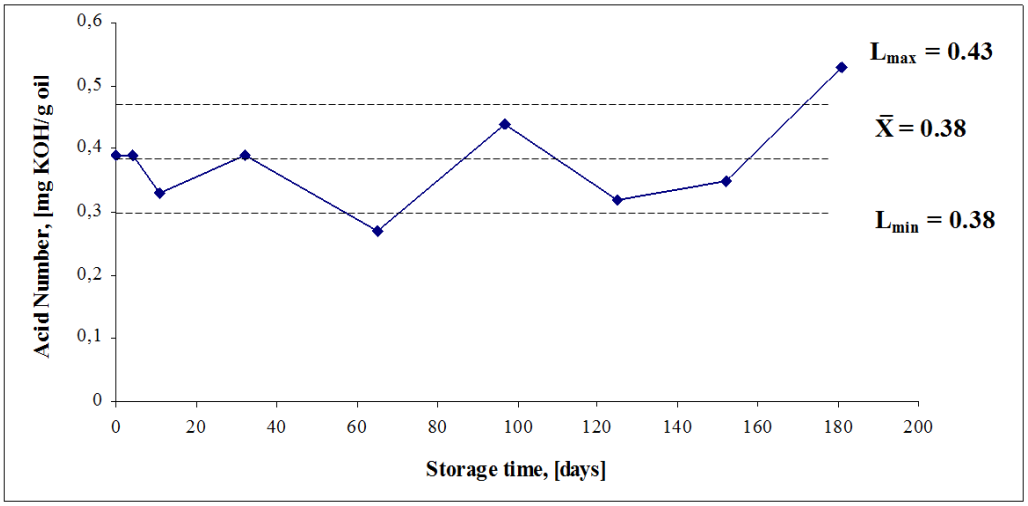
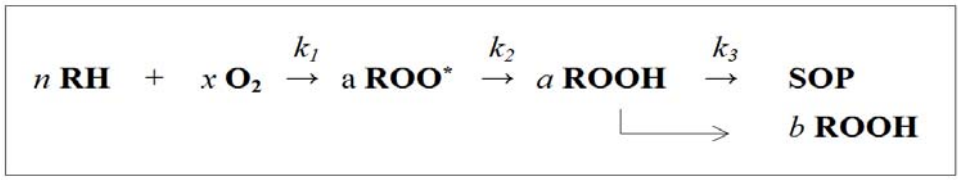


Figure 4. Numerical value of acid number for walnut oil sample
(X = 0.38 ± 0.07, $\bar{X}$ - average value of acid number)

Oxidation is a radical chain reaction. After an induction period, it may run very fast under certain circumstances. A chemical attack on the alkyl group is followed by a chain reaction, resulting in a hydroperoxide group (-OOH) in the chain. The chain reaction is started by peroxy-, alkoxy- and alkyl-radicals. The chain reaction proceeds by reaction with oxygen or RH. It is accelerated by branching of the chain.The chain reaction ends by combination of two radicals (figure 5).



Fifure 5. The kinetic model of the lipid oxidation process (**R**H – native lipids; **ROO*** - peroxides, hydroperoxides, primary oxidation products; **SOP** – secondary oxidation products; $\mathbf{k_1}$, $\mathbf{k_2}$, $\mathbf{k_3}$ – reaction rate constants).

It is well known, that primary oxidation products of oils are peroxides, which can be transformed induced by environmental factors such as humidity, temperature and oxygen content into secondary oxidation products such as aldehydes, ketones, oxidized fatty acids and other compounds. The oil quality data from walnut kernels pressed at cold indicated variations for all parameters evaluated, including peroxide values. It can be explained, that peroxides represent unstable intermediate compounds of lipid oxidation process.

The hydroperoxides formed react further to aldehydes, ketones and fatty acids, all of which represent secondary oxidation products and negatively influence on oil quality. Hydroperoxides content is determined by the reaction rate constants k_1/k_3. Secondary oxidation products can be determined as a function of primary oxidation products: **SOP** = f (**ROOH**).

Evolution of peroxides content in walnut oil has a variable character. Being primary products of oxidation process, the peroxides decomposition is observed up to a critical level during storage. Further, the rate of peroxides formation predominates in comparison with the rate of degradation. Therefore, the evolution of peroxides content is going in two stages: stage of formation and increase of peroxides content and stage of peroxides degradation. Overall, during oil storage process, the reaction rate of peroxides formation dominates, which generally leads to increasing of oxidation degree of walnut oil. For example, changes in peroxide concentration are shown in figure 6.

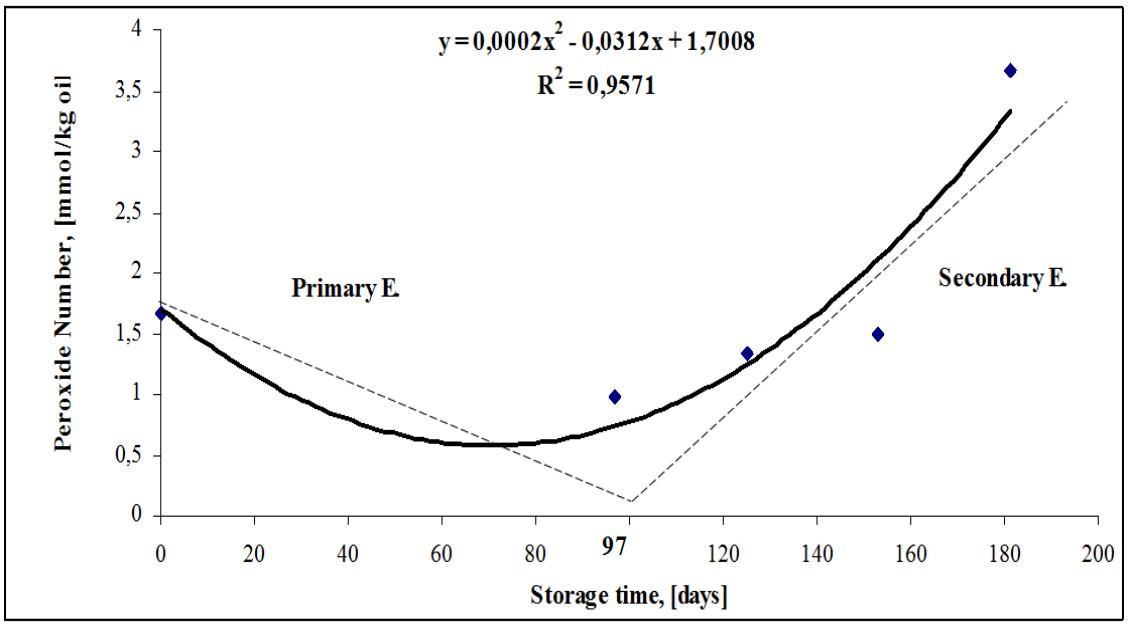


Figure 6. Dynamic changies of the peroxides content in walnut oil

Figure 6 shows the effect of storage time on primary oxidation products accumulation in walnut oil sample. The initial peroxide number of fresh walnut oil sample was 1.66 mmol/kg oil. Changes in peroxide concentration can be described in two steps. Changes in peroxide content were in the range from 1.66 to 0.99 mmol/kg walnut oil in first period of storage till 97 days. Second step includes storage time from 97 to 180 days. Peroxides concentration increases from 0.99 to 3.66 mmol/kg oil during this step. Rate of peroxides formation is 2.25 times more than the rate of their degradation.

CONCLUSIONS

Today, walnut oil has been extracted on a small scale to obtain edible vegetable oil in Europe. However, walnuts can be used to produce high quality oil. The results of this research showed the influence of manufacturing technology and storage time on the intensity of hydrolysis processes and primary oxidation products accumulation in cold pressed walnut oil. It was demonstrated that walnut oil retains acceptable quality after 180 days of storage. It is important to underline, that obtained results of this study are intermediate and could help authors to describe the scheme of walnut oil oxidation process and also to elaborate improved technology for walnut oil stabilization.

ACKNOWLEDGEMENTS

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IMPROVING THE PROPERTIES OF FLY ASH BY MIXING WITH DIFFERENT SUBSTANCES

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1. GENERAL ASPECTS

Fly ash (FA) are widely used throughout the world in concrete mixtures type road structures. Depending on the coal used to produce them, there are two major categories of ashes applicable in this field: bituminous ash (pozzolanic), originating from burning anthracite or shale coal and sub-bituminous or lignite (self-hardening) from burning lignite (or sub- bituminous coal).

Bituminous ashes are used with a chemical agent or activator (usually lime, Portland cement or blast furnace dust), aggregates and water. For most mixtures using aggregates with sorts precisely set the amount of ash normally varies between 8 and 20%. For sandy aggregates, the amount of ash can be increased from 15 to 30% of weight of the mixture [1].

Sub-bituminous or lignite ash, normally self-hardening, due to the high calcium oxide does not require a chemical agent or an activator but are just mixed with water and aggregate. However, due to the rapid setting of most of these ashes, the ash percentage of the total weight of the mixture may be as low as 5-15%. There are also situations when self-hardening ashes are used for road foundations without addition of aggregate [2].

2. IMPROVING THE FLY ASH

Binders can be used to significantly improve the geotechnical and environmental properties of FA. Even a very small addition of binder (1 – 2 %) as an activator for a dry FA may activate and accelerate the cementation reactions.

The strength development of FA is less the larger the Loss of incineration value (i.e. the noncombustible part of the FA) and the smaller the percentage of CaO in the FA. Even a very small (0,5-1,0 %) addition of active lime significantly improves the cementation [3]. However, there are differences between FA from different sources. (Figure 1) Additionally, it has been shown that the larger the specific surface of a FA the better its strength development [4].

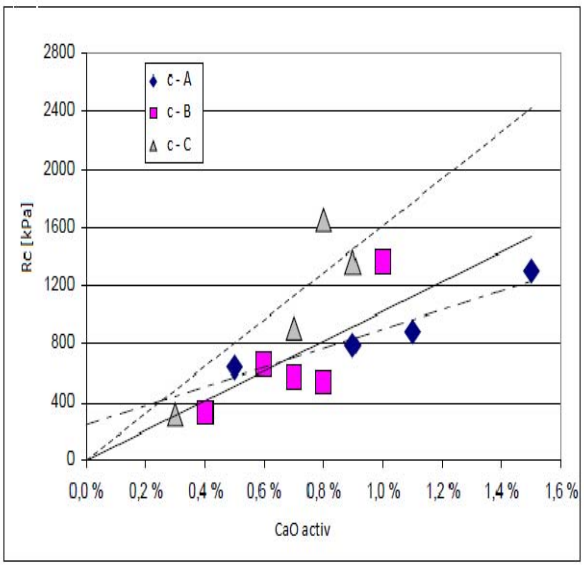

Figure 1. Rc (compression strength) as a function of the content of active CaO for 3 different ashes.

The strength development of a FA will depend considerably on the following factors as well:
- Binder or activator (quality, properties, quantity)
- Water content
- Compaction
- Homogeneity of the mixture
- Efficiency of mixing

The effect of the water content on the strength development and on the compaction of the FA is significant. Most importantly, the farther the water content of the FA is from the optimum water content the lower will be the resultant final strength. Figure 2 shows test results on some FA for the effects of water content on the strength. By using the tests showing the effect of different water contents it is possible to determine the tolerances for changes in water content in practice.

Likewise, it is possible to be determined the minimum relative compaction, D [%], by varying the relative compaction in the laboratory tests. The strength might fall significantly when relative compaction is less than 90-91 %. Therefore, the targeted relative compaction is 91-92 % for most of the FA structures [5].

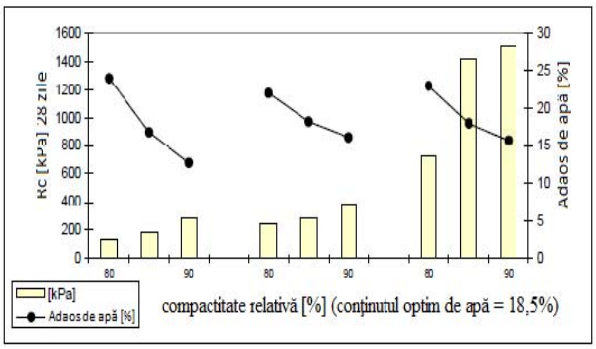

Figure 2. The effects of water content on the strength of some FAs

Binders can be used to significantly improve the geotechnical and environmental properties of FA. Even a very small addition of binder as an activator for a dry FA may activate and accelerate the cementation reactions in the FA. Even 1 – 2 % of activator might multiply the strength of a FA material. To obtain sufficient strength of the material, the required binder quantity is considerably larger in the cases of pile-FA or other originally weakly cementing ashes [6].

There are several binders or activators that can be used with FA. The most important binders are different types of lime and cement, as well as industrial residues like slag (especially the blast furnace slag), gypsum, reactive ashes and FGD (flue gas desulphurisation residues). Lime has proved to be a very efficient activator and cement is very versatile [7]. (Figure 3)

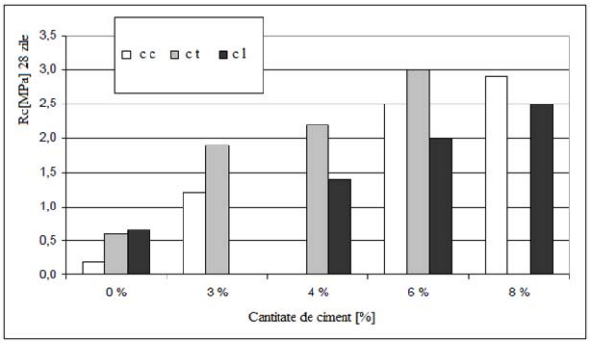

Figure 3. Effect of the quantity of cement on the Rc(compression strength) for 3 types of FA

The use of industrial residues is reasonable because of the environmental and economic benefits that can be obtained, and because it is also technically feasible. The strength of FA will be improved in an almost linear amount with an increasing amount of cement [8].

It is obvious that the effects of binders and binder mixes are different for various FAs.

Each binder has its characteristic reactivity and stabilisation time. Figure 4 indicates that it is worthwhile to test the different binder alternatives because of their significantly different effects. The studies indicate that FAs seem to have relatively good strength development with all types of binders.

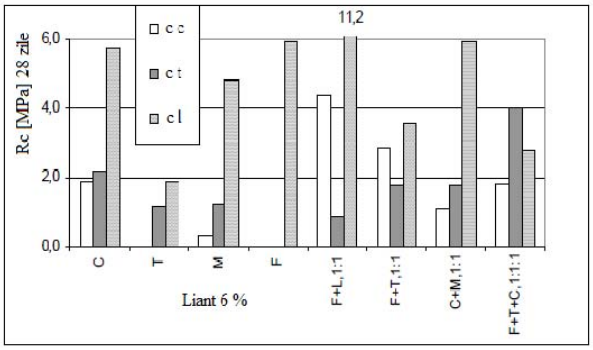

Figure 4. Effect of different binders on the strength of different FA (C= cement, L= lime [CaO], T= hydrated lime, M= blast-furnace slag)

The winter-construction properties of FA can be improved with help of calcium chloride, $CaCl_2$ (CC). The studies have been conducted on the improvement of FA with salt products like CC flakes or solution and the filterwaste (FW) [9]. FW is a byproduct of the production process of CC, and it consists of free lime, gypsum and 20-30 % calcium chloride. Figure 5 shows that the compaction and strength development of FA at – 5 ^{o}C will be clearly more effective with an addition of only 2 % FW or 1,2 % CC-solution than without any CC. The actual cementing will start only after the FA structure has thawed, though the compaction has taken place during the frost period [10].

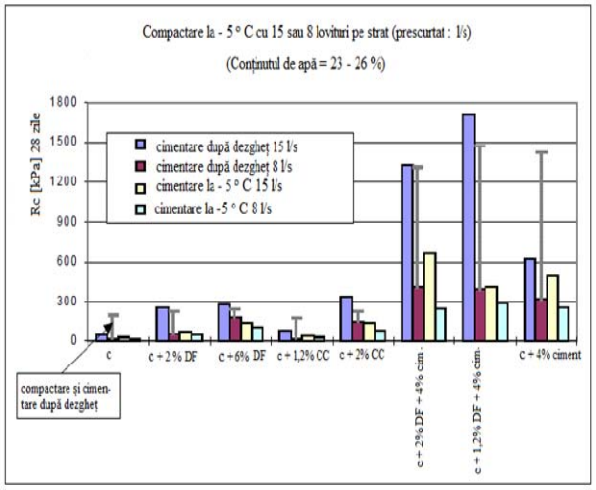

Figure 5. Improvement of FA properties with calcium chloride salt (CC) and filterwaste (FW).

Figure 6 shows the improvement of the compaction results of a certain FA (not frozen) when mixed with different salt products.

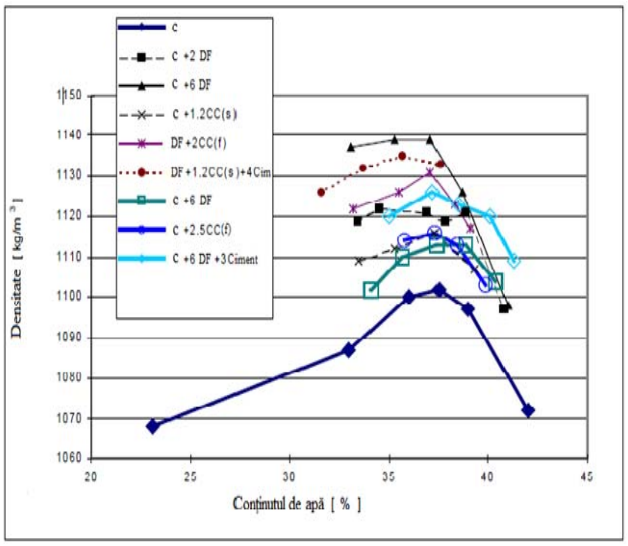

Figure 6. Bulk density depending on water content.

We can improve the compaction of a certain FA (not frozen) by mixing it with different salt products. The salt products also decrease the frost heave of frost susceptible materials. The most effective additive is 2 % of CC flakes. Research concluded that frost susceptible FA can be improved with a small addition of CC. However, these findings can be improved by additional research.

Binders can also be used to improve the environmental behaviour of FA. The effect of different binders on the solubility of heavy metals from a stabilised FA is significant. For example, the blast furnace slag significantly reduces the leaching of several heavy metals. A test was made in 1991 on a coal ash using the EP Tox Test that is designed to simulate leaching under natural disposal conditions. The leaching medium was diluted acetic acid.

3. CONCLUSIONS / RECOMMENDATIONS

1. The properties of FA can be significantly improved by adding different substances, like binders, salts etc. This way, FA becomes a quite valuable material for many road construction applications.

2. There is a significant variation in the quality of FAs from different power plants, despite the use of similar fuels or fuels from same supply source. FA quality variations among peat combusting plants is larger than variations among coal combusting plants. Accordingly, separate FA batches from individual power plants may differ considerably from each other. Therefore, it is important to have continuous control of the geotechnical quality parameters of FA.

3. During open-air pile storage of FA, a large part of the inherent and important geotechnical properties of FA will be lost because of excess moisture. A pile-FA cannot be recycled for use in as many applications as a dry FA, and the properties of a pile-FA application will be of lower quality than with a dry FA. Therefore, adequate dry storage arrangements for FA will be an essential precondition for the development of a controlled recycling system. This is also necessary because most FA is produced during the coldest season, when there are very little on-going road construction projects.

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PRESENTATION OF RESULTS FOR SURFACE PLASTIC DEFORMATION BY LAMINAR GRAPHITE CAST IRON

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INTRODUCTION

The process of cold plastic deformation by ball bearing roller aims to achieve active areas of workpieces of better quality surfaces and to increase surface hardness by hardening the superficial layer of material. These attributes give a workpiece a longer lifetime and greater mechanical properties in the interested area. Earlier was thought to be impossible to use this processing method for cast iron. Analysis of the literature and the experiments carried out in recent years in the Technical University of Moldova and Technical University of Iasi laboratories and machine workshop of the Chisinau Glass Factory showed promising method of diamond smoothing for laminar graphite cast iron used in glass industry for molds production.

1. METHODS OF MAKING EXPERIMENTS

The technological process of cold plastic deformation was conducted on a universal lathe KART E-2H. The blank (workpiece) of a cylindrical shape has been fixed by the jaws of the universal mounting. To achieve better coaxiality between the workpiece and the spindle lathe turnings it has undergone centering (of ~ 0.5 mm radius) on the active surface, the roughness Ra imposed (3.2 ... 6.3).

After centering turn device was removed from the knife lathe carriage and was fixed dynamometer 9257B KISTLER through screw holes that can be seen in Fig. 1.

On top of the dynamometer was taken by means of clamps and screws M8, Plastic Ball tool in Fig. 2.

Before the start of plastic deformation was conducted adjustment in the position of active surface plastic deformation of the tool relative to the part (position 0 - achieving tangency between the ball and the active surface of the piece).

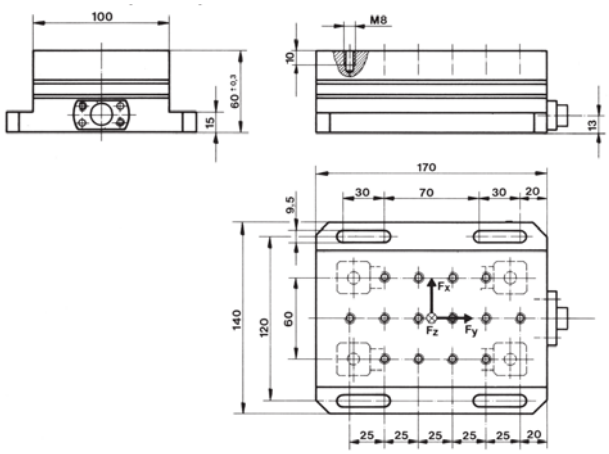


Figure 1. Dimensions and grip dimensions of the dynamometer KISTLER 9257B.

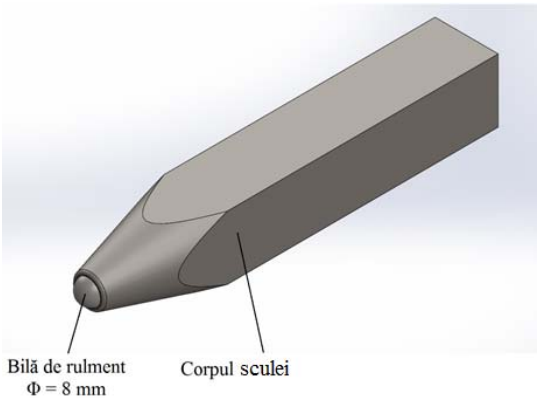


Figure 2. Tool for cold plastic deformation with ball bearing

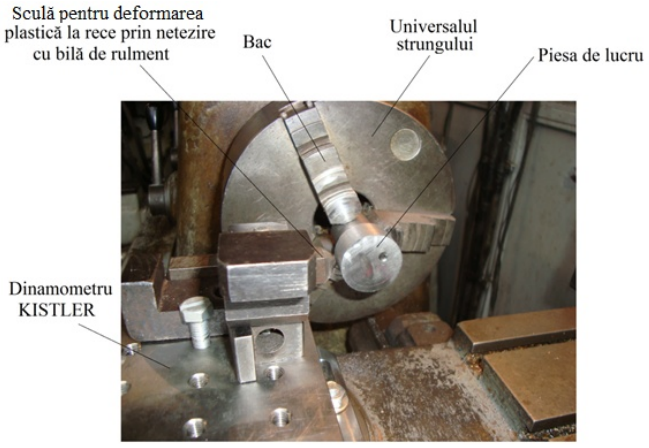


Figure 3. Making cold plastic deformation process by smoothing ball on a universal lathe KART E-2H.

During the application process of plastic deformation, the mandrel drives the workpiece in rotation with constant angular velocity. Tool that make plastic deformation must make two movements: a longitudinal feed axis and a radial feed lathe for carrying out depth of the material layer to be hardened Fig. 3.

In the case of cylindrical parts with the active surface is not required to be synchronized to the two movements. The workpieces with complicated shapes requires a synchronization of the two movements for the perfect tracking with ball of tool for deformation profile parts. During the course of cold plastic deformation process at the contact between the ball and the active surface of the workpiece is developing forces and moments in the three directions. Plastic deformation tool being connected jointly by the dynamometer makes it possible to transfer forces from sensors which are incorporated into this. Therefore they generate electrical signals through cables with connectors are captured by a signal amplifier "*Charge amplifier type 5070*" which filters and amplifies the signals from the dynamometer. Furthermore these signals are transferred to acquisition board installed in one of the slots of computer-desktop. After processing the information using the purchase card for each test result by an Excel file with the print screen. It captures during the process of plastic deformation evolution graphics forces in the three directions (file "*Notepad*" showing the time course of the same forces). For the test of work were preserved for study file for forces in the three directions, torques present no interest.

Operating mode parameters are:

- the speed of the lathe spindle;
- radial feed (depth);
- longitudinal feed.

Were tested on a blank, multiple operating modes obtained by varying the three parameters was obtained by an optimal working regime (Table 1). Also, to minimize the effort of forming a shell type oil used Omala F.

Optimum working regime used in cold plastic deformation process are summarized in Table 1. Were supposed to cold plastic deformation process by roller ball bearing two workpieces. In Fig. 4 is shown one of these parts after the cold plastic deformation b) compared with the turning parts). **T**

Table 1. Parameters for the optimum working carrying out the plastic deformation.

Speed [rev. / Min]	380
Longitudinal feed [mm / rev.]	0.09
Radial feed (depth) [mm]	0.2 (the radius)

Figure 4. Work pieces: a) turning and b) the workpiece after cold plastic deformation by roller with ball bearing.

Using a FLIR P660 infrared thermocamera were made of the thermal images of the two parts undergone plastic deformation by cold roller ball (Fig. 5).

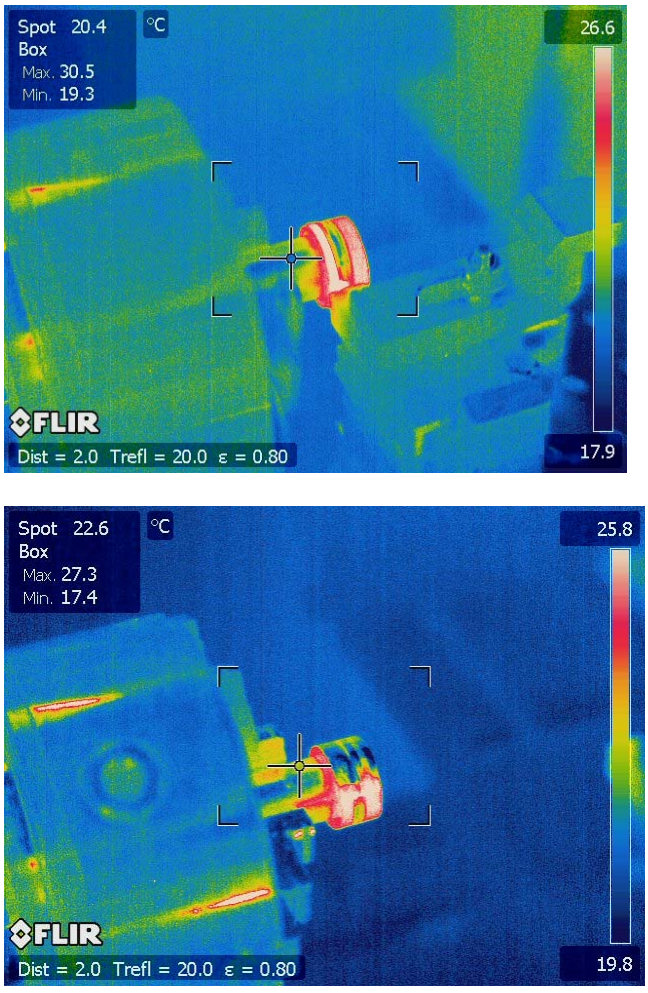
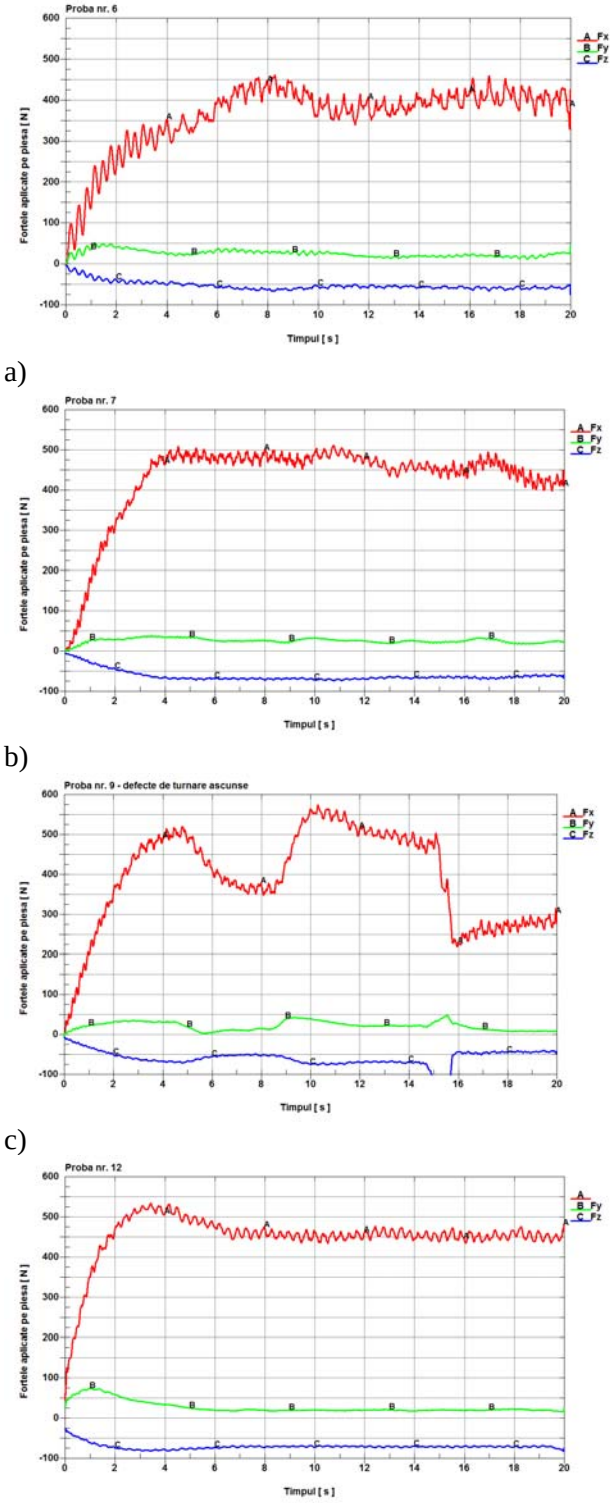


Figure 5. Images of the thermal regime during the cold plastic deformation process by smoothing with ball bearing.

In the tests conducted on the test bench shown above were acquired data on the forces (of the three directions x, y and z) occurring during the cold plasting polishing with ball bearing. Acquisition dates were selected for several representative samples (samples 6, 7, 9 and 12).



a)

b)

c)

d)

Figure 6. The graph forces that develop during the smoothing process: a) sample no. 6, b) sample no. 7, c) sample no. 9 and d) sample no. 12.

After processing the data was obtained graphs for forces that are developed during processing through the deformation of respective parts according to the three directions Figure 6.

CONCLUSION

1. The process of plastic deformation forces Fy and Fz can be ignored because their value does not exceed 10% of the results.
2. Fluctuations of contact force *Fx* are the cause deformation of the material because it represents the constant repetition strictly connected with machined surface roughness.
3. Numerical results similar in all samples is evidence that precision experiments is satisfactory.
4. Termocamera shows the lack of heating used in the process and as a result excludes modifications in material.

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METHODOLOGY OF MATRIX REPRESENTATION OF HIGHER ORDER TENSORS

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1. INTRODUCTION

With higher order tensors (four, six, eight, etc.) we meet in the study of relations between stress and strain. In the case of reversible processes constitutive equations are written in the form

$$t_{ij} = c_{ijnm} d_{nm} + c_{ijnmpq} d_{nm} d_{pq} + c_{ijnmpqkl} d_{nm} d_{pq} d_{kl} + \ldots \quad (1)$$

where - t_{ij}, d_{ij} are denoted stress strain tensors respectively, and by - c_{ijnm}, c_{ijnmpq}, $c_{ijnmpqkl}$ - the elasticity constants tensors of the order of the fourth, sixth and eighth.

From symmetry of stress, strain tensors and the laws of thermodynamics, for tensors of elasticity constants resulting the following symmetry relations

$$c_{ijnm} = c_{jinm} = c_{ijmn} = c_{nmij}, \quad (2)$$

$$c_{ijnmpq} = c_{jinmpq} = c_{ijmnpq} = c_{ijmnqp} = c_{nmijpq} =$$

$$= c_{pqnmij} = c_{ijpqnm} \quad (3)$$

$$c_{ijnmpqkl} = c_{jinmpqkl} = c_{ijmnpqkl} = c_{ijnmqpkl} =$$

$$= c_{ijnmpqlk} = c_{nmijpqkl} = c_{k\ln mpqij}. \quad (4)$$

Depending on the type of interactions among atoms or molecules, the relations (2), (4) the additional information can be added.

If, for example, interactions between atoms or molecules are central (ionic bonding), the elastic constant tensors of any order is totally symmetrical. Recall that a tensor is totally symmetrical if it is symmetric in relation to all pairs of indices. In the case of the fourth order tensors the relation takes place

$$c_{ijnm} = c_{injm}. \quad (5)$$

The material symmetry which is expressed quantitatively by the planes of symmetry and symmetry axes of different order, leads to a reduction in the number of independent constants of elasticity.

2. MATRIX REPRESENTATION OF FOURTH ORDER TENSOR

The experimental data for components of elasticity constants tensors shown in the crystallographic coordinate system, containing only independent sizes.

Calculation of elastic constants in an arbitrary coordinate system is simplified considerably if higher order tensors are represented by composed matrix [1]. The fourth order tensor can be presented in the form of

$$c_{ijnm} = (c_{ij})_{nm}, \quad (6)$$

where - $(c_{ij})_{nm}$ is a square composed matrix of the second order, each element of which is also a square matrix, i.e.

$$C := \begin{bmatrix} \begin{pmatrix} c_{11} & c_{12} & c_{13} \\ c_{21} & c_{22} & c_{23} \\ c_{31} & c_{32} & c_{33} \end{pmatrix}_{11} & \begin{pmatrix} c_{11} & c_{12} & c_{13} \\ c_{21} & c_{22} & c_{23} \\ c_{31} & c_{32} & c_{33} \end{pmatrix}_{12} & \begin{pmatrix} c_{11} & c_{12} & c_{13} \\ c_{21} & c_{22} & c_{23} \\ c_{31} & c_{32} & c_{33} \end{pmatrix}_{13} \\ \begin{pmatrix} c_{11} & c_{12} & c_{13} \\ c_{21} & c_{22} & c_{23} \\ c_{31} & c_{32} & c_{33} \end{pmatrix}_{21} & \begin{pmatrix} c_{11} & c_{12} & c_{13} \\ c_{21} & c_{22} & c_{23} \\ c_{31} & c_{32} & c_{33} \end{pmatrix}_{22} & \begin{pmatrix} c_{11} & c_{12} & c_{13} \\ c_{21} & c_{22} & c_{23} \\ c_{31} & c_{32} & c_{33} \end{pmatrix}_{23} \\ \begin{pmatrix} c_{11} & c_{12} & c_{13} \\ c_{21} & c_{22} & c_{23} \\ c_{31} & c_{32} & c_{33} \end{pmatrix}_{31} & \begin{pmatrix} c_{11} & c_{12} & c_{13} \\ c_{21} & c_{22} & c_{23} \\ c_{31} & c_{32} & c_{33} \end{pmatrix}_{32} & \begin{pmatrix} c_{11} & c_{12} & c_{13} \\ c_{21} & c_{22} & c_{23} \\ c_{31} & c_{32} & c_{33} \end{pmatrix}_{33} \end{bmatrix} \quad (7)$$

For the fourth order tensor which has the symmetry properties (2) the components of composed matrix are expressed only by 21 independent constants. The 21 independent constants can be presented as a 21x1 column

matrix, the elements which we will denote by a_I, where I=1,2,...,21.

Thus, the tensor of elasticity constants must be expressed as follows

$$C := \begin{bmatrix} \begin{pmatrix} a_1 & a_2 & a_3 \\ a_2 & a_4 & a_5 \\ a_3 & a_5 & a_6 \end{pmatrix} & \begin{pmatrix} a_2 & a_7 & a_8 \\ a_7 & a_9 & a_{10} \\ a_8 & a_{18} & a_{11} \end{pmatrix} & \begin{pmatrix} a_3 & a_8 & a_{12} \\ a_8 & a_{13} & a_{14} \\ a_{12} & a_{14} & a_{15} \end{pmatrix} \\ \begin{pmatrix} a_2 & a_7 & a_8 \\ a_7 & a_9 & a_{10} \\ a_8 & a_{18} & a_{11} \end{pmatrix} & \begin{pmatrix} a_4 & a_9 & a_{13} \\ a_9 & a_{16} & a_{17} \\ a_{13} & a_{17} & a_{18} \end{pmatrix} & \begin{pmatrix} a_5 & a_{10} & a_{14} \\ a_{10} & a_{17} & a_{19} \\ a_{14} & a_{19} & a_{20} \end{pmatrix} \\ \begin{pmatrix} a_3 & a_8 & a_{12} \\ a_8 & a_{13} & a_{14} \\ a_{12} & a_{14} & a_{15} \end{pmatrix} & \begin{pmatrix} a_5 & a_{10} & a_{14} \\ a_{10} & a_{17} & a_{19} \\ a_{14} & a_{19} & a_{20} \end{pmatrix} & \begin{pmatrix} a_6 & a_{11} & a_{15} \\ a_{11} & a_{18} & a_{20} \\ a_{15} & a_{20} & a_{21} \end{pmatrix} \end{bmatrix} \quad (8)$$

If the tensor is totally symmetrical relations may occur

$$a_8 = a_5, a_7 = a_4, a_{12} = a_6,$$
$$a_{19} = a_{18}, a_{13} = a_{10}, a_{14} = a_{11} \quad (9)$$

In the case of orthotropic materials the matrix of elasticity constants is expressed as

$$C := \begin{bmatrix} \begin{pmatrix} a_1 & 0 & 0 \\ 0 & a_4 & 0 \\ 0 & 0 & a_6 \end{pmatrix} & \begin{pmatrix} 0 & a_7 & 0 \\ a_7 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix} & \begin{pmatrix} 0 & 0 & a_{12} \\ 0 & 0 & 0 \\ a_{12} & 0 & 0 \end{pmatrix} \\ \begin{pmatrix} 0 & a_7 & 0 \\ a_7 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix} & \begin{pmatrix} a_4 & 0 & 0 \\ 0 & a_{16} & 0 \\ 0 & 0 & a_{18} \end{pmatrix} & \begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & a_{19} \\ 0 & a_{19} & 0 \end{pmatrix} \\ \begin{pmatrix} 0 & 0 & a_{12} \\ 0 & 0 & 0 \\ a_{12} & 0 & 0 \end{pmatrix} & \begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & a_{19} \\ 0 & a_{19} & 0 \end{pmatrix} & \begin{pmatrix} a_6 & 0 & 0 \\ 0 & a_{18} & 0 \\ 0 & 0 & a_{21} \end{pmatrix} \end{bmatrix} \quad (10)$$

For materials with cubic symmetry (11).

The relationships between the stress and strain in an arbitrary coordinate system in the linear approximation is determined from the relation (12)

$$C := \begin{bmatrix} \begin{pmatrix} a_1 & 0 & 0 \\ 0 & a_4 & 0 \\ 0 & 0 & a_4 \end{pmatrix} & \begin{pmatrix} 0 & a_7 & 0 \\ a_7 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix} & \begin{pmatrix} 0 & 0 & a_7 \\ 0 & 0 & 0 \\ a_7 & 0 & 0 \end{pmatrix} \\ \begin{pmatrix} 0 & a_7 & 0 \\ a_7 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix} & \begin{pmatrix} a_4 & 0 & 0 \\ 0 & a_1 & 0 \\ 0 & 0 & a_4 \end{pmatrix} & \begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & a_7 \\ 0 & a_7 & 0 \end{pmatrix} \\ \begin{pmatrix} 0 & 0 & a_7 \\ 0 & 0 & 0 \\ a_7 & 0 & 0 \end{pmatrix} & \begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & a_7 \\ 0 & a_7 & 0 \end{pmatrix} & \begin{pmatrix} a_4 & 0 & 0 \\ 0 & a_4 & 0 \\ 0 & 0 & a_1 \end{pmatrix} \end{bmatrix} \quad (11)$$

$$d_{in} = \sum_{k=1}^{3}\sum_{q=1}^{3}\left[\sum_{c=1}^{3}\sum_{l=1}^{3}\sum_{m=1}^{3}\sum_{j=1}^{3}\left[r_{ij}r_{nm}r_{kl}r_{qc}(C_{jm})_{lc}\right]t_{kq}\right], \quad (12)$$

where r_{ij} the matrix of rotation is denoted which is used to determine the position given by the coordinates system to the crystallographic system. Rotation matrix is obtained as a result of three successive rotations and are calculated according to the formula

$$\boldsymbol{r} = \begin{pmatrix} 1 & 0 & 0 \\ 0 & \boldsymbol{cos(\theta_1)} & \boldsymbol{sin(\theta_1)} \\ 0 & \boldsymbol{-sin(\theta_1)} & \boldsymbol{cos(\theta_1)} \end{pmatrix} \begin{pmatrix} \boldsymbol{cos(\theta_2)} & 0 & \boldsymbol{sin(\theta_2)} \\ 0 & 1 & 0 \\ \boldsymbol{-sin(\theta_2)} & 0 & \boldsymbol{cos(\theta_1)} \end{pmatrix} \boldsymbol{x}$$

$$\boldsymbol{x} \begin{pmatrix} \boldsymbol{cos(\theta_3)} & \boldsymbol{sin(\theta_3)} & 0 \\ \boldsymbol{-sin(\theta_3)} & \boldsymbol{cos(\theta_3)} & 0 \\ 0 & 0 & 1 \end{pmatrix}, \quad (13)$$

were $\theta_1, \theta_2, \theta_3$ - are Euler angles.

3. A MATRIX REPRESENTATION OF SIX ORDER TENSOR

In case of nonlinear relations between stress and strain the six and eight order tensors are intervened, and these tensors can be presented by composed matrix. In base of symmetric relations (2)-(4) is posible to pass from two indexs notations to one index after Viogt [2] convention

$11 \sim 1,22 \sim 2,33 \sim 3,23 \sim 4,13 \sim 5,12 \sim 6$.

Adopting this convention, we will write

$$c_{ijnm} = c_{KM}, \; c_{ijmnrs} = c_{KMF}$$

$$c_{ijmnrskq} = c_{KMFL},$$

where the small letters have the values 1,2,3, but big 1,2,...,6. In plus, the symmetric relations (1) – (3) give

$$c_{KM} = c_{MK}, \; c_{KMF} = c_{MKF} = c_{FMK} = c_{KFM}$$

$$c_{KMFL} = c_{MKFL} = c_{KMLF} = c_{MKLF} = c_{LFKM} =$$

$$= c_{LFMK} = c_{FLKM} = c_{FLMK} = c_{FKLM} = \ldots$$

Matrixes $c_{KM}, c_{KMF}, c_{KMFL}$ don't represent the tensor in obtained meaning. Therefore, in rule of components transformation at rotation of reference system doesn't directly given the rotation matrix *r*.

It can be demonstrated, that for these matrixes can be used the known rules of components transformation, so

$$c'_{KM} = R_{KI} R_{MJ} c_{IJ}$$

$$c'_{KMF} = R_{KI} R_{MG} R_{FT} c_{IGT}$$

$$c'_{KMFL} = R_{KI} R_{MG} R_{FT} R_{LU} c_{IGTU},$$

were *K,M,...,U=1,2,...,6.* *R* matrix is presented [3]

$$R = \begin{pmatrix} r_{11}^2 & r_{12}^2 & r_{13}^2 & r_{12}r_{13} & r_{13}r_{11} & r_{11}r_{12} \\ r_{21}^2 & r_{22}^2 & r_{23}^2 & r_{22}r_{23} & r_{23}r_{21} & r_{21}r_{22} \\ r_{31}^2 & r_{32}^2 & r_{33}^2 & r_{32}r_{33} & r_{33}r_{31} & r_{31}r_{32} \\ 2r_{21}r_{31} & 2r_{22}r_{32} & 2r_{23}r_{33} & r_{22}r_{33}+r_{23}r_{32} & r_{23}r_{31}+r_{21}r_{33} & r_{21}r_{32}+r_{22}r_{31} \\ 2r_{31}r_{11} & 2r_{32}r_{12} & 2r_{33}r_{13} & r_{32}r_{13}+r_{33}r_{12} & r_{33}r_{11}+r_{31}r_{13} & r_{31}r_{12}+r_{32}r_{11} \\ 2r_{11}r_{21} & 2r_{12}r_{22} & 2r_{13}r_{23} & r_{12}r_{23}+r_{13}r_{22} & r_{13}r_{21}+r_{11}r_{23} & r_{11}r_{22}+r_{12}r_{21} \end{pmatrix} \tag{14}$$

The matrix $(C_I)_{GT}$ we can present

$$C' := \left[\left[\begin{pmatrix} c_1 & c_2 & c_3 & c_4 & c_5 & c_6 \\ c_2 & c_7 & c_8 & c_9 & c_{10} & c_{11} \\ c_3 & c_8 & c_{12} & c_{13} & c_{14} & c_{15} \\ c_4 & c_9 & c_{13} & c_{16} & c_{17} & c_{18} \\ c_5 & c_{10} & c_{14} & c_{17} & c_{19} & c_{20} \\ c_6 & c_{11} & c_{15} & c_{18} & c_{20} & c_{21} \end{pmatrix}\right.\right.$$

$$\left.\left.\begin{pmatrix} c_2 & c_7 & c_8 & c_9 & c_{10} & c_{11} \\ c_7 & c_{22} & c_{23} & c_{24} & c_{25} & c_{26} \\ c_8 & c_{23} & c_{27} & c_{28} & c_{29} & c_{30} \\ c_9 & c_{27} & c_{28} & c_{31} & c_{32} & c_{33} \\ c_{10} & c_{25} & c_{29} & c_{32} & c_{34} & c_{35} \\ c_{11} & c_{16} & c_{30} & c_{33} & c_{35} & c_{36} \end{pmatrix}\right.$$

$$\left.\begin{pmatrix} c_3 & c_8 & c_{12} & c_{13} & c_{14} & c_{15} \\ c_8 & c_{23} & c_{27} & c_{28} & c_{29} & c_{30} \\ c_{12} & c_{13} & c_{37} & c_{38} & c_{39} & c_{40} \\ c_{13} & c_{28} & c_{38} & c_{41} & c_{42} & c_{43} \\ c_{14} & c_{29} & c_{39} & c_{42} & c_{44} & c_{45} \\ c_{15} & c_{30} & c_{40} & c_{43} & c_{45} & c_{46} \end{pmatrix}\right]$$

$$\left[\begin{pmatrix} c_4 & c_9 & c_{13} & c_{16} & c_{17} & c_{18} \\ c_9 & c_{24} & c_{28} & c_{31} & c_{32} & c_{33} \\ c_{13} & c_{28} & c_{38} & c_{41} & c_{42} & c_{43} \\ c_{16} & c_{31} & c_{41} & c_{47} & c_{48} & c_{49} \\ c_{17} & c_{32} & c_{42} & c_{48} & c_{50} & c_{51} \\ c_{18} & c_{33} & c_{43} & c_{49} & c_{51} & c_{52} \end{pmatrix}\right.$$

$$\left.\begin{pmatrix} c_5 & c_{10} & c_{14} & c_{17} & c_{19} & c_{20} \\ c_{10} & c_{25} & c_{29} & c_{32} & c_{34} & c_{35} \\ c_{14} & c_{29} & c_{39} & c_{42} & c_{44} & c_{45} \\ c_{17} & c_{32} & c_{44} & c_{48} & c_{50} & c_{51} \\ c_{19} & c_{34} & c_{44} & c_{50} & c_{53} & c_{54} \\ c_{20} & c_{35} & c_{45} & c_{51} & c_{54} & c_{55} \end{pmatrix}\right.$$

$$\left.\begin{pmatrix} c_6 & c_{11} & c_{15} & c_{18} & c_{20} & c_{21} \\ c_{11} & c_{26} & c_{30} & c_{33} & c_{35} & c_{36} \\ c_{15} & c_{30} & c_{40} & c_{43} & c_{45} & c_{46} \\ c_{18} & c_{35} & c_{43} & c_{49} & c_{51} & c_{52} \\ c_{20} & c_{35} & c_{45} & c_{51} & c_{54} & c_{55} \\ c_{21} & c_{36} & c_{46} & c_{52} & c_{55} & c_{56} \end{pmatrix}\right]\right]$$

So, the tensor of elastic constants of fourth order is expressed by 21 independent components,

but six order tensor by 56. These 56 components are presented by column matrix with 56x1 dimensions.

The number of independent constants of elasticity is reduced, if materials have and other elements of symmetry. For materials with cubic symmetry the number of elasticity constants of stress tensor of six order is decreased up to six.

The only non-zero constants of elasticity tensor of six order are

$$c_1 = C_{111} = c_{22} = C_{222} = c_{37} = C_{333},$$
$$c_2 = C_{112} = c_3 = C_{113} = c_7 = C_{122} = c_{23} = C_{223} = c_{12} = C_{133} = c_{27} = C_{233},$$
$$c_8 = C_{123}, c_{51} = C_{456}, \; c_{16} = C_{144} = c_{34} = C_{255} = c_{46} = C_{366},$$
$$c_{19} = C_{155} = c_{21} = C_{166} = c_{31} = C_{244} = c_{36} = C_{266} = c_{41} = C_{344} = c_{44} = C_{355}.$$

Therefore, the elastic behavior of material of cubic symmetry in approximation

$$t_I = C_{IN} d_N + (C'_I)_{NM} d_N d_M$$

$$C = \begin{pmatrix} a_1 & a_4 & a_6 & a_5 & a_3 & a_2 \\ . & a_{16} & a_{18} & a_{17} & a_{13} & a_9 \\ . & . & a_{21} & a_{20} & a_{15} & a_{11} \\ . & . & . & a_{19} & a_{14} & a_{10} \\ . & . & . & . & a_{12} & a_8 \\ . & . & . & . & . & a_7 \end{pmatrix}$$

is described by 9 independent constants; 3 components by forth order tensor a_1, a_4, a_7 and six independent components of six order tensor $c_1, c_2, c_8, c_{16}, c_{19}, c_{51}$.

In case of isotropic material, among independent constants of forth order tensor the relationship takes place

$$a_4 = \frac{a_1 - a_7}{2},$$

but for elasticity constants of six order tensor tree more relations are obtained

$$c_{16} = \frac{1}{2}(c_2 - c_8), \; c_{19} = \frac{1}{4}(c_1 - c_2)$$
$$c_{51} = \frac{1}{8}(c_1 - 3c_2 + 2c_8).$$

Therefore, the governing equations of second order in case of isotropic materials are expressed from only 5 independent constants.

If interaction among atoms is central, than the following relations exist

$$a_7 = a_4 = \frac{a_1}{3},$$
$$c_8 = c_{16} = c_{51} = \frac{7c_2 - c_1}{6},$$

so, in case of one isotropic material with central interactions, the governing equations of second order are expressed only by tree independent constants.

In case of governing equations of third order may appear the eight order tensors. These tensors are expressed by square matrix of six order, each element represents the six order matrix.

CONCLUSIONS

The possibility of matrix presentation of higher order tensors essentially simplifies the mathematical modeling of nonlinear behavior of anisotropic materials. It was found that the constitutive equations of the second order in the general case of anisotropy are expressed by 77 independent elastic constants.

For cubic symmetry materials the number of independent constants of elasticity is reduced up to 9, (3 independent elastic constants for forth order tensor and 6 independent constants for six order tensor). In case of isotropic materials the number of independent constants of elasticity is reduced up to 5, if interaction between atoms is central, than number of independent constants is reduced up to 3.

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WALNUT (JUGLANS REGIA L.) HALVA

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I. INTRODUCTION

Confectionery products enjoy a great demand from consumers and a rapid growth of sales values on national and international level. By their varied shape, flavor and color, these products create pleasant visual sensations, olfactory and tactile.

Confectionery products cause feelings of wellbeing and happiness [1, 2].

An Oriental Delight is halva. According to halva manufacturing technologies there are required three basic components: oilseeds, treacle toffee and a foaming agent, the total fat content in halva is 40% [3, 4, 6].

The principle of developed process for obtaining walnut halva consists of primary processing of walnut kernel by removing 25-35% of oil. Therefore it was obtained the oil cake with 30-40% fat, which then was used as a raw material in the halva manufacturing.

The research purpose – the improvement of manufacturing technology of walnut kernel halva (*Juglans Regia L.)*.

II. MATERIALS AND METHODS

For the development of manufacturing technology of the walnut kernel halva, it has been used walnut kernel (*Juglans Regia L.)* [7], which to comply with the recipe, was subjected to pressing to reduce the amount of fat to 40%, which was mixed with other ingredients [5].

Analysis of obtained halva samples were carried out in accordance with standards:

1. The lipid content, by Soxhlet method [9].
2. Ash content by standardized method [10].
3. Dry matter content by refractometry [11].
4. Microbiological indices by standardized method [12].

Developing the manufacturing technologies of walnut kernel halva is a major problem in scientific and practical terms.

First it is necessary to study the process of structure formation of halva product type and to examine the composition of the required components to form the final product.

For the manufacture of halva were used the following raw materials:

- Walnut kernels,
- Sugar
- Water.

III. RESULTS AND DISCUSSIONS

In the paper it was examined the required report of the components to obtain elastic and fibrous texture, which are the basic features of confectionery type halva.

It was found that positive results may be obtained by combining the basic components in the following ratio: caramel 50 to 60%, walnut kernel 50 to 40%.Texture formation was possible by heat treatment of required compositions under the action of high temperatures of 80-90^{0}C, the obtained mass turns from liquid in viscous condition.

Following the physicochemical interaction between proteins, lipids and carbohydrates existing in components, viscous mass turns into a texture characteristic of products type halva. It should be reasoned that the formation of texture is obtained by continuous stirring at 80-90^{0}C for 20-30 min.

After heat treatment, the obtained halva is pressed and packaged. The sensory properties and physicochemical characteristics obtained walnut halva are presented in table1.

Table 1. Sensory properties and physicochemical characteristics of walnut kernel (*Juglans Regia L)* halva.

Sensory properties	***Properties of obtained halva***		
	Sample 1	***Sample 2***	***Sample. 3***
Sensory properties of walnut kernel halva			
Consistency	Homogeneous	Homogeneous	Homogeneous
Color	Light brown	Light brown	Light brown
Taste and smell	Specific to	Specific to	Specific to walnut

	walnut kernel	walnut kernel	kernel
The physico-chemical properties of walnut kernel halva			
Humidity, %	4,0	3,9	3,8
Lipid content, %	15	15,75	16
Ash, %	1,8	1,76	1,9
Mesophilic aerobic and facultative anaerobic microorganisms, 1 g of product	not detected	not detected	not detected
Coliform bacteria 0.01 g of product	not detected	not detected	not detected
Fungi, 1 g of product	not detected	not detected	not detected

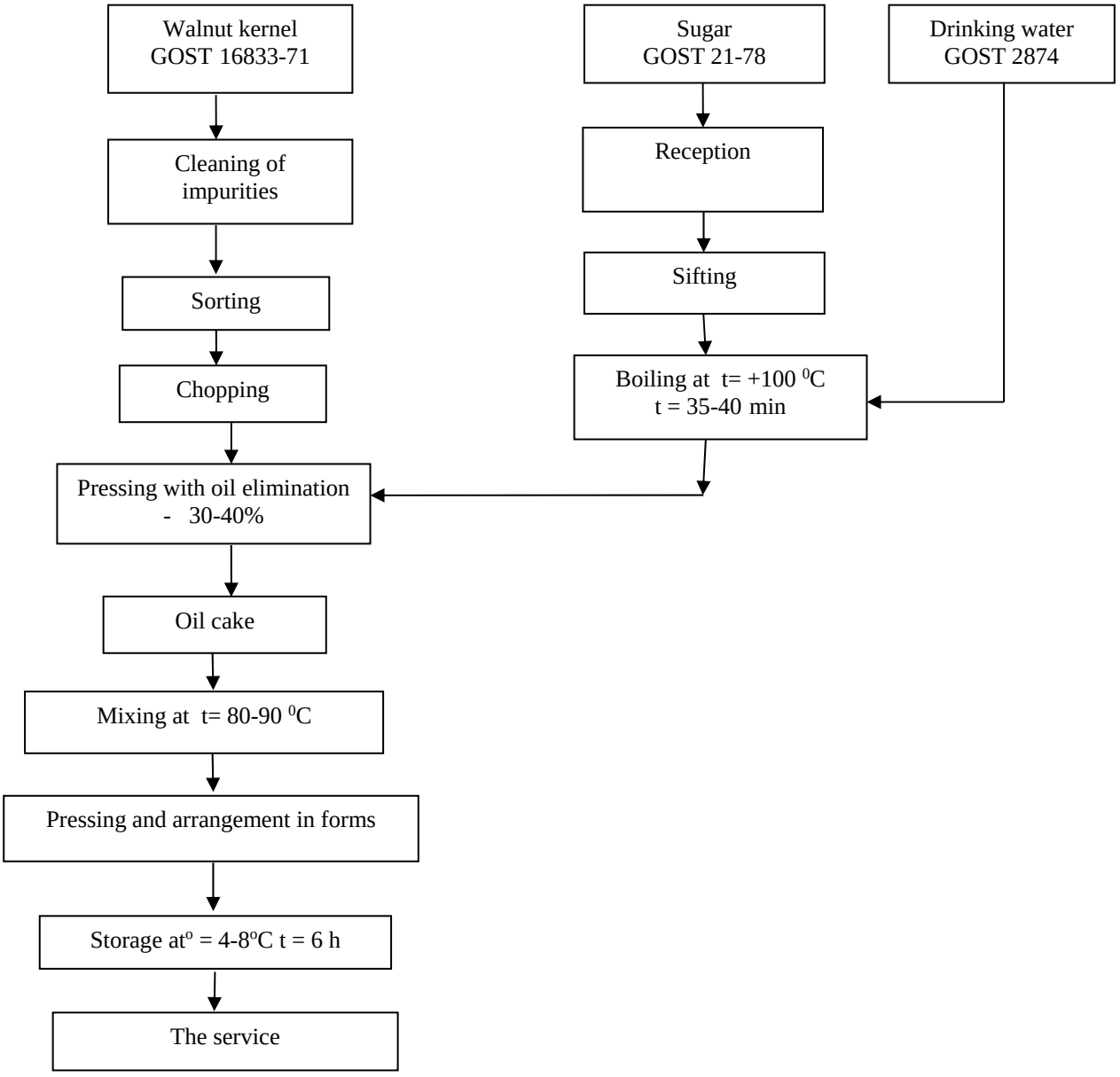

Figure 1. The flowchart of walnut (*Juglans Regia L)* halva.

The obtained data were used to develop the technological scheme for walnut kernel (*Juglans regia L*) halva which will be checked and materialized.Flowchart provides the use as raw material walnuts, sugar and drinking water which, according to the manufacturing technology are subjected to basic processes to form the product.

CONCLUSIONS

1. To obtain halva from walnut kernel is required to use raw materials containing 30-40% fats.
2. The basic process of halva obtaining presents texture formation and the product formation of halva type.
3. Following research was developed the process and the flow chart of halva manufacturing.

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VARIOUS ONLINE RESOURCES FOR DEVELOPING INTERACTIVE TEACHING MATERIALS USED IN TEACHING-LEARNING-EVALUATION WITH INTERACTIVE WHITEBOARD

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1. INTRODUCTION

Diversification of teaching-learning-evaluation process has a beneficial effect on the learner. Recently has appeared a new method of teaching, learning and evaluation with interactive whiteboards. This method has several advantages [3], but also difficulties in its implementing in various educational institutions. The appearance of new informational technology for teaching, learning and evaluation has provoked disputes of its effectiveness and, in particular, problems with creating interactive teaching materials for use with the interactive whiteboard.

Frequently, informational technologies in education are an obstacle for many teachers, both for those with teaching experience and young professionals. The basic problems in this regard are "fear" of computer, poor level of information and a relatively high degree of complexity of developing interactive teaching materials.

This study is trying to search for solutions to the problems above, by presenting to the reader the various online resources for easy developing training materials for the interactive whiteboard. So also are presented the stages of development of a lesson with interactive whiteboard use, selection criteria of information for interactive teaching materials, problems arising in the process of developing interactive teaching materials.

2. THE STAGES OF DEVELOPING OF A LESSON WITH INTERACTIVE WHITEBOARD USE

Interactive whiteboards increase the effectiveness of teaching material. The most important problems in implementation of interactive whiteboard in higher education institutions occur in the process of training the teachers in the use of this equipment. Most of the problems facing the teachers in designing of electronic materials are related to lack sufficient skills in information space design and a user interface which provides creating effective structures appropriate new methods of information representation. To facilitate the assimilation of such technologies as interactive whiteboard, it is necessary to assimilate technology itself (using a guidebook or attending training courses) and learn to use interactive materials existing, practically, in all specialized educational software, and to adapt them to own needs. Most of the interactive materials stored in galleries of specialized educational software can be adapted to personal needs. In addition, there are plenty of online resources used to create new interactive teaching materials based template, some of which will be proposed to the reader further.

Preparing an effective lesson with interactive whiteboard use requires a serious effort from the teacher. The elaboration of an effective lesson with interactive whiteboard use involves the following **steps**:

1. Identification of subject, purpose and type of lesson;
2. Lesson planning timeframes to achieve the proposed objective;
3. Making the stages of the lesson that require interactive whiteboard instruments (generally it is not mandatory to use the only interactive whiteboard during the lesson, it should be used when it is useful);
4. Selecting the resources of developing interactive learning materials;
5. Examining the appropriateness of their application compared to traditional means;
6. Selected materials are measured in time, as not to disturb the path of the lesson (step 2) and be consistent with sanitary norms;
7. In case of insufficiency of tools for developing interactive materials in specialized educational software and in a teacher's computer, their search is performed through Internet resources and services (some of which we list below);
8. Elaboration of the project of the lesson in a specialized software, as SMART Notebook;
9. Preparing the students to percept the material of the lesson to be taught by using an interactive whiteboard;
10. The lesson.

An interactive whiteboard can be used without specialized software; in this case, it can be used as an ordinary screen for projecting computer images.

Interactive teaching materials used with the interactive whiteboard must comply with some **requirements of selection of information**. Some of these are:

1. Content, depth and volume of scientific information must comply with the cognitive skills and the performance level of students, to consider their intellectual preparation features and age;
2. Selected or elaborated teaching materials should not contain small size details for more comfortable visualization by the students;
3. Images displayed on the screen must be logically related to accompanying text. They must appear in a logical, well thought consecutive order, at an affordable rate for. The accompanying text must be clearly and accurately;
4. Avoid the large fragments of text. To read the text should not be used scroll bars or buttons to navigate from page to page;
5. The user interface should be intuitive;
6. Highlighting the important text fragments, using different colors or bold and italic style.

The value of using interactive teaching materials in teaching, learning and evaluation:

1. Activization of cognitive activity of the students;
2. Evaluation with the feedback, detecting of errors through the occurrence of appropriate comments, according to the results of their work and marking them;
3. The training in the process of assimilation of study materials;
4. Enhancing motivation for learning;
5. Formation of culture of the training activity and information culture of society;
6. Activization of interaction of intellectual and emotional functions by means of common solving of research problems.

The problems that occur when designing interactive materials:

1. Insufficient knowledge of computers and information technologies or "the fear" of computers;
2. The gaps in knowledge of interface and working methods with specialized software which works with interactive whiteboards;
3. Insufficiency of models of interactive teaching materials in the gallery of specialized educational software used with interactive whiteboards;
4. Existing interactive teaching materials do not meet the requirements and needs of the teacher.

3. THE ONLINE RESOURCES FOR ELABORATION OF INTERACTIV TEACHING MATERIALS

In order to solve the problem of insufficiency of interactive teaching materials in the gallery of the specialized software designed for the interactive whiteboard and the problem of unsatisfactory of materials from the gallery the requirements and needs of the teacher, we shall propose a list of online resources that will help the teachers use interactive teaching materials in their activity and to elaborate them independently.

There are various **online resources** that facilitate the teacher's work on materials with interactive whiteboard lesson project [2]. Among them we can distinguish:

1. **HotPotatoes** – is an application used to create the visual, interactive exercises, just for elaboration of electronic test. The application is free, free to download from the website *https://hotpot.uvic.ca/* [1];
2. **ClassTools.net** (http://www.classtools.net/) – online service for creating of the interactive Flash resources and educational games. There is the possibility of saving of the games on the computer as a .htm file. Most of the educational games can be used with the interactive board. To get started the authorization is not required. The service is in English;
3. **BrainFlips** (http://www.brainflips.com/) – the online service for creating cards. Into a card, we can add video, audio and photo to activate all the channels of assimilation of information. The service is in English. To start working with him authorization is required;
4. **Flashcard Machine** (www.flashcardmachine.com) – the online service for the preparation of educational materials in a form of sets of cards. The materials on the cards can be in the form of text, images, audio and links. It requires the authorization;
5. **JeopardyLabs** (http://www.jigsawplanet.com/) – the online service designed to generate the thematic questionnaires. To work with him does not require the authorization, it is necessary only to enter the password for editing. After filling in data the service offers a link to the questionnaire;
6. **JigsawPlanet** (http://www.jigsawplanet.com/) – the online service for the generation of puzzles. Authorization is required. Can be created puzzles different by complexity and form that can later be merged into

one album. The author can provide the common and private access to the created materials;

7. **LearningApps** (http://learningapps.org/) – the online service designed to elaborate the methodological, teaching tutorials for different subjects. It is based on working with templates. This service requires authorization;

8. **PurpozeGames** (http://www.purposegames.com/) – the service for creating of the thematic games online. Authorization is required. Accordance with the results of the game is carrying out the evaluation;

9. **Study Stack** (http://www.studystack.com/) – the online service for development of teaching materials. Performs working with text and graphics. To start the work authorization is required. In addition to personal materials, there is the possibility of using collections of works developed by other teachers;

10. **SpiderScribe** (http://www.spiderscribe.net/) – the online service for creation of mind maps. Unlike other services to create mind maps (Mind Maps), SpiderScribe provide for the creation of maps of various forms with existing elements such as text, images, files, calendar events and geographic locations;

11. **Mindomo** (http://www.mindomo.com/) – the service to create mind maps, allows the creation of colored maps, containing the photographs, drawings, audio, video and links. Basic Features: unlimited number of users simultaneously; changes are observed immediately by all users; comments and possibility of voting and appreciation of ideas and proposals; chat archive; e-mail notifications about changing the map; auto save, restore; online and offline synchronization.

The working principle of previously presented services consists in:

1. Authorization;
2. Selecting the form/template of requests interactive material;
3. Completing the template with the required information;
4. The publication of the developed material on the web or joining them in the lesson's project developed in specialized educational software for the interactive whiteboard.

Most of the proposed online services provide for the creation of teaching materials based on templates, which facilitates the work of the teacher, for example, reducing it to mere replacement of text with other or something similar. After creating the teaching materials, they can be added to the project created for interactive board in one of the specialized educational software designed for working with interactive whiteboards.

Thus the development of interactive teaching materials becomes possible for people who have the minimal computer skills; the problem is reduced only to require the knowledge of online resources and minimal work habits on the Internet, using social networks.

The interactive materials created through online resources can be used, and without an interactive whiteboard in an electronic course on a learning platform like Moodle.

CONCLUSIONS

Using the interactive whiteboard in teaching, learning and evaluation has many advantages, but its implementation in an educational institution causes the problems in the design of lessons, accompanied by it. Some of these issues were mentioned in this study and are related to the elaboration of interactive teaching materials for the interactive whiteboard.

As shown in this study, some of the problems can be solved quite easily by using online services specially designed for elaboration of template-based interactive materials. Thus, any teacher can develop interactive learning materials for any field of study, by simply adaptation of existing models of teaching material for the needs of their own course, having the minimal skills of use of computer.

On the Internet there are many services of this type that accumulate experience in this domain of different teachers from around the world and we also have the opportunity to add our models in these world collections, sharing the ideas with other professionals from the whole world.

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NEW EFFECTIVE TECHNOLOGIES OF PRODUCTION OF BUILDING MATERIALS AND ARTICLES

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COMMON VIEWS

The present preposition includes not only one but several new technologies: building articles on basis of gypsum-cement- puzzolane binder (GCPB); semifinished products from extra-fine basalt fiber (EFBF), first of all basalt wool; quasi-composite building articles from GCPB and EFBF.

It is known that compositions of gypsum bindings and Portland cement are instable. Within the limits of 1-3 months after building mortar making strength decreases and the result of it is destruction.

This result from three-sulphate forming of calcium hidro-sulfo-alumenate on base of calcium sulfate and highly basic calcium aluminates, which contain Portland cement. Hence ettringite forms in composition, which is called “cement bacillus”.

A.V. Volzhenskij offered a composition on base of gypsum, Portland cement and active mineral (puzzolane) admixture comprising silica in active state.

Pozzolanic admixture permits to decrease strength of the calcium hydroxide and under existing conditions highly basic calcium aluminates cannot exist. So in opinion of researchers forming:

- mono- sulfate form $3CaO \cdot Al_2O_3 \cdot CaSO_4 \cdot 12H_2O$;
- hodro-granates $3CaO \cdot Al_2O_3 \cdot nSiO_2$ (6-2n) H_2O;
- hydro- aluminum-silicon $3CaO \cdot Al_2O_3 \cdot CaSiO_3 \cdot 12H_2O$;
- gypsum $CaSO_4 \cdot 2H_2O$ and theirs solid solutions.

Many years' experience in application of GCPB in building trade had confirmed deductions of researches. In recent years was produced improved form of quick-hardening binding on gypsum – composite gypsum binding (CGB), which also can be used in offered technologies.

Nomenclature of articles: elements of indoor and outdoor walls, dividers – slot-comice blocks and plates, elements of reinforced concrete monolithic overlaps – insert-blocks and plates for floor beds. All these elements are made from cellular GCPB having compression durability of 5,0 – 6,0 MPa, the density 800 – 1000 kg/m^3 with basalt-fiber inserts with density of 45 kg/m^3. From the above-enumerated elements it is possible to fully complete the whole constructive surface body of the building – incombustible, enough durable to resist the seismic, wind and other major exposures. The buildings from the above-enumerated elements are supposed to be erected in combination with metal and reinforced concrete monolithic constructions. The wall from the proposed elements by thickness of 300 mm assures the same heat shielding, as the wall from break with thickness up to 2450 mm.

By the result of the researches it was possible to receive from GCPB inclusively under production conditions, close-meshed rapid-setting for articles for heightened durability but without preliminary preparation of foam or input in forming mixture of gas-forming compounds.

Innovative technical solutions of the equipment and taking, that completely provide manufacturing of materials and articles with a preset predicted and higher performance were developed and tested in industrial practice. With density 1000kg/m^3 the actual compression strength made 17,2 MPa, bending strength – 4,7 MPa. Knauf offered by the company possesses the characteristic 4,5 MPa & 2,2 MPa.

Primary equipment includes kneading-and-mixing machine of continuous operation that effectuates cavitational-flush mixing of GCPB or another mineral biding material and water. Activation of mixture (build up of durability characteristics) is taking place during process of its preparation. This is reached due to the special regimes of production process allow in defined order to obtain materials of the programmed density and durability. Kneading-and-mixing machines moves above the forms of the articles, in which it discharges the newly prepared mixture. Gypsum articles are taken out from form in 15-20 minutes after the forms were supplied with mixture, due to natural rapid hardening without any thermal

processing or other artificial exposure. Further the articles are vectored to the chamber where excessive moisture evacuation is effectuated.

Major facts, defining significance of new building technologies complex, are as follows:

- ubiquitous abundance of the initial row material; natural origin of host materials with a high scale time-approved durability; optimum characteristics of the articles – fire resistance, heat-shielding, acoustical absorption, water-, biological-, cold-, weather resistance etc.; promptitude of development of production and construction of objects, inclusively in areas exposed to extreme effects (natural disasters, military operations, man-caused catastrophes, terrorist acts);
- versatility of articles for construction for buildings and structures of different purpose and of any constructive schemes; possibility of usage in buildings of the diverse architecture; simplicity and briefness of the new technologies of production of building articles; compact, parterre placement of the equipment of technological lines; high performance of usage building items in buildings and structures constructed in any climatic zones of the planet.

POTENTIAL USAGE OF TECHNOLOGIES

Offered building technologies and products are characterized as ecologically clear, energetically efficient, stable in extreme situations, economically efficient. They can be recommended for usage in construction of buildings of any constructive schemes and floor quantity practically in all climatic zones.

The complex of offered technologies is approved in trial manufacture in 90-‘s in Russia (Moscow) within the framework of the Federal program “*Energosberejenie Rossii*”, the Moscow city program of the Ministry of science and technologies in Russia.

As region of initial industrial realization of new building technologies the Republic Moldova is supposed. Here there is a necessary base, free capacities, relatively inexpensive and insufficiently loaded working and technological personnel, highly skilled scientists and the engineers participating in elaboration of offered technologies. The marketing researches have shown that in Moldova there is a steady demand for the offered building products, determined by their technical and economic advantages in comparison with analogues.

In Moldova offers have got the approval of the state authorities in the form of the Assignment of the president of Moldova # 05/5–100A from August, 8, 2001, Decision of the Government # 421 from April, 5, 2002, branch building programs.

The elaborated investment project including the marketing-plan and the business-plan, has confirmed expediency of the organization of such a manufacture in Moldova. The potential opportunity of realization of the presented technologies and their production in neighboring countries is also determined in this project.

Technologies can be of interest in regions with a cold climate (for example, the north Russia, the Scandinavian countries, Canada, Alaska). They represent special interest for regions with excess seismic activity.

In our opinion, offers can be recommended for the building market of USA, in particular, for construction of buildings of a little floor quantity. Here special value is got with opportunities of creation of enough strong structures, capable to resist to influence of fire, radiation, seismic loading, but to provide a minimum of costs in construction. Moreover, the important factor in support of offers is energy efficiency not only in production, but also during the operation of building.

ADDITIONAL INFORMATION

Elaboration of a complex of offered technologies was carried out 40 years in Moldova, Russia and Ukraine.

At the first stage of researches (60-70-s’) the technology of thin-walled volumetric blocks on GCPB was created, and for the first time in the world building practice in 1961 in Kishinau trial manufacture of volumetric blocks of sanitary-engineering units and engineering communications was organized. Then the technology was widely realized in USSR, now in Moscow two factories of a building industry make these products, providing needs of city construction.

At the second stage (70-s- the beginning of 90-s’) the general technology of modular construction with usage of rapid-setting materials on GCPB and aerostatic flying devices (dirigible balloons) was elaborated for transportation and installation of large volumetric blocks. Models of such volumetric blocks were made and tested in 1972 in Kiev with our participation, and the model of the specialized dirigible balloon was constructed and tested in 1991 in Ulyanovsk.

At the third stage (90-s and in present time) the elaborations were conducted in Moldova and Russia and in 1997-99 in Moscow trial manufacture

of effective building production offered technologies was organized.

Exhibits of the offered technologies were submitted and have got an approval on a number of the international exhibition:

- on the third International exhibition-congress "*High Technologies. Innovations. Investments"*. In Sank-Petersburg in 1998.
- on the International Exhibition "Dorogy-98" in Moscow in 1998
- on the exhibition "*Rosstrojexpo*" in Moscow in 1999
- on CEI Summit Economic Forum in Budapest (Hungary) in 2000
- on the International Exhibition "Moldconstruct'2001" and "Moldconstruct'2006".

At the present time elaborators carry out the preparation of a batch production of building products on the offered high technology technologies in Kishinau. Simultaneously technologies continue to be improved.

ECONOMIC PARAMETERS

Costs of creation and start – up of the unified process module UTM-1 with the annual capacity 20,0 thousand m^3 of building articles and 8,0 thousand m^3 of basal wool make up 1230,75 thousand $USD.

According to the business-plan data the annual receipts from sales of production at prices of Moldavian building market make up 2944,0 thousand $USD.

Total cost of this production represents 2240,0 thousand $USD.

Annual profit will make up 704,0 thousand $USD.

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HARMONIC ANALYSIS AT POWER RECTIFIERS

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INTRODUCTION

The commonest source of harmonics and harmonic problems in power systems is almost certainly the three-phase Graetz bridge. This is widely used in motor drives of all types as well as in HVDC transmission and such equipment as uninterruptible power supplies (UPS). The growing use of power electronic application has increased the fraction of nonsinusoidal currents and voltages in buildings and utility networks. Nonlinear loads have always existed and traditionally included such items as arc furnaces and fluorescent lamps.

As the fraction of nonlinear loads has increased, so has the anxiety over the effect of these loads and whether they should be limited. Several standards organizations have or plan to issue limits for these loads. The limits are based on the effects of these loads and the best judgement of the members of the standards organizations.

1. POWER CONVERTERS LIKE HARMONIC SOURCES

The derivation of the harmonic currents produced by static power converters requires accurate information of the AC voltage waveforms at the converter terminals, converter configuration, type of control, AC system impedance and DC circuit parameters. The main sources of harmonic current are at present the phase angle controlled rectifiers and inverters. These can be conveniently grouped into the following three broad areas of different harmonic behaviour:

- large power converters such as those used in the metal reduction industry and high voltage DC transmission;
- medium size converters such as those used in the manufacturing industry for motor control and also in railway applications;
- low power rectification from single-phase supplies such as television sets and battery chargers.

The waveforms from the first group are the closest to the ideal and will be used as a basis for the derivation of the characteristic harmonic content of the standard converter configurations. This information is often used as a reference in the harmonic assessment of less ideal waveforms.

Some experimental tests were done using a semicontrolled three-phase bridge rectifier from the laboratory of Dipartimento di Ingegeneria Elettrica Industriale, Politecnico di Torino, made by SITRA AUTOMAZIONE, Alessandria, Italy. The parameters which could be varied were the load inductance and capacitance, and the firing angle.

The values of characteristic parameters of bridge rectifier are the following: frequency, f = 50Hz; line voltage supply, V_{sLL} = 380V; secondary inductance, L_s = 0.18mH; secondary resistance, R_s = 60mΩ; DC inductance, L_{DC} = 13mH; DC resistance, R_{DC} = 0.7Ω; load capacitance, C_{load} = 3260uF; load resistance, R_{load} = 14Ω; load inductance, L_{load} = 48mH; resistance of load inductance, R_L = 1.7Ω; firing angle, α - different values.

Below, are shown the curves of secondary current waveform and the simulation results using OrCAD PSpice software. Using the both graphics, experimental data and simulation results, it can see how far or closer by the real data are the simulation results, and in this way it can conclude about model simulation of bridge rectifier in different operating condition.

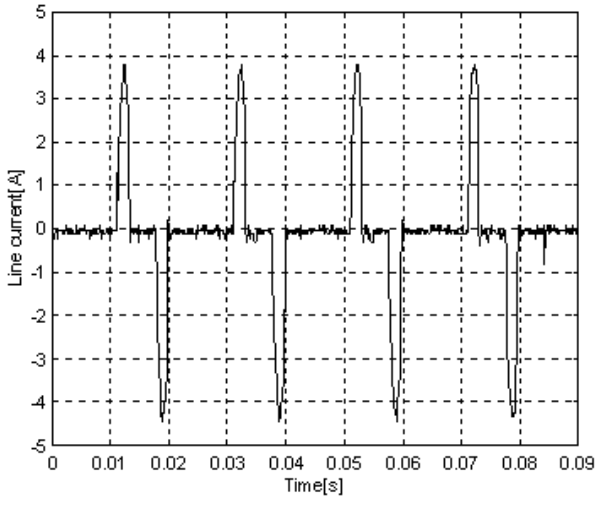

Figure 1. Experimental recorded waveform.

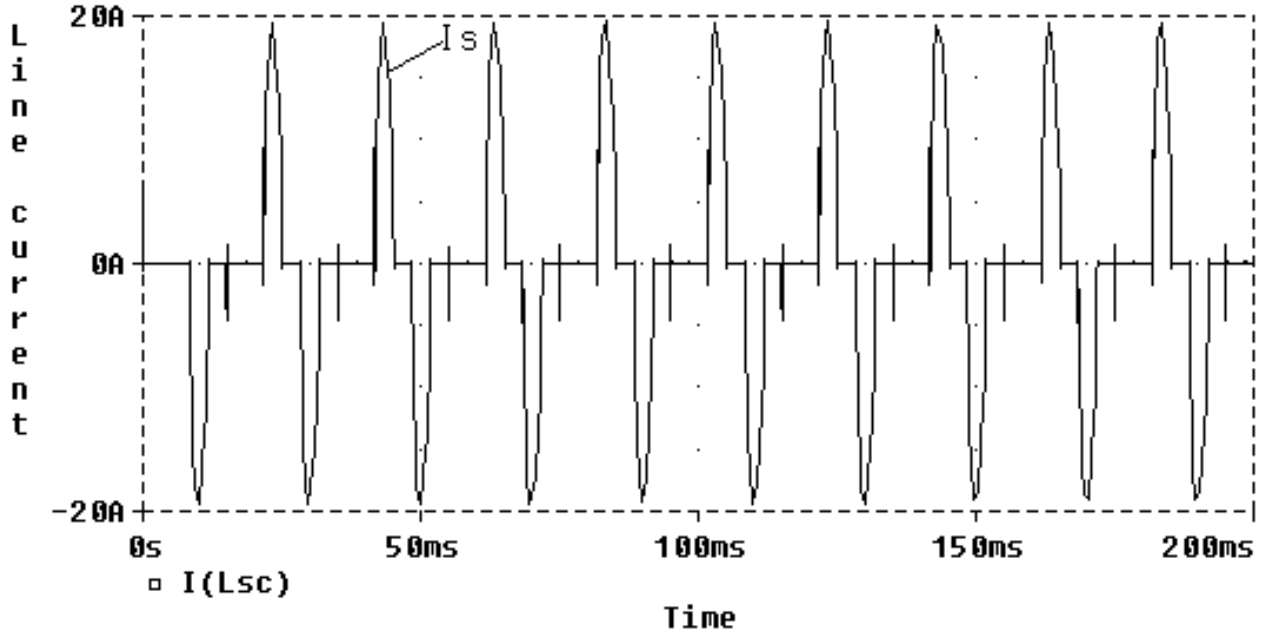

Figure 2. Simulation waveform.

The first case: $L_{load} = 0, C_{load} = 0;$ $\alpha = 150.66°$

- $\alpha = 106.38°$

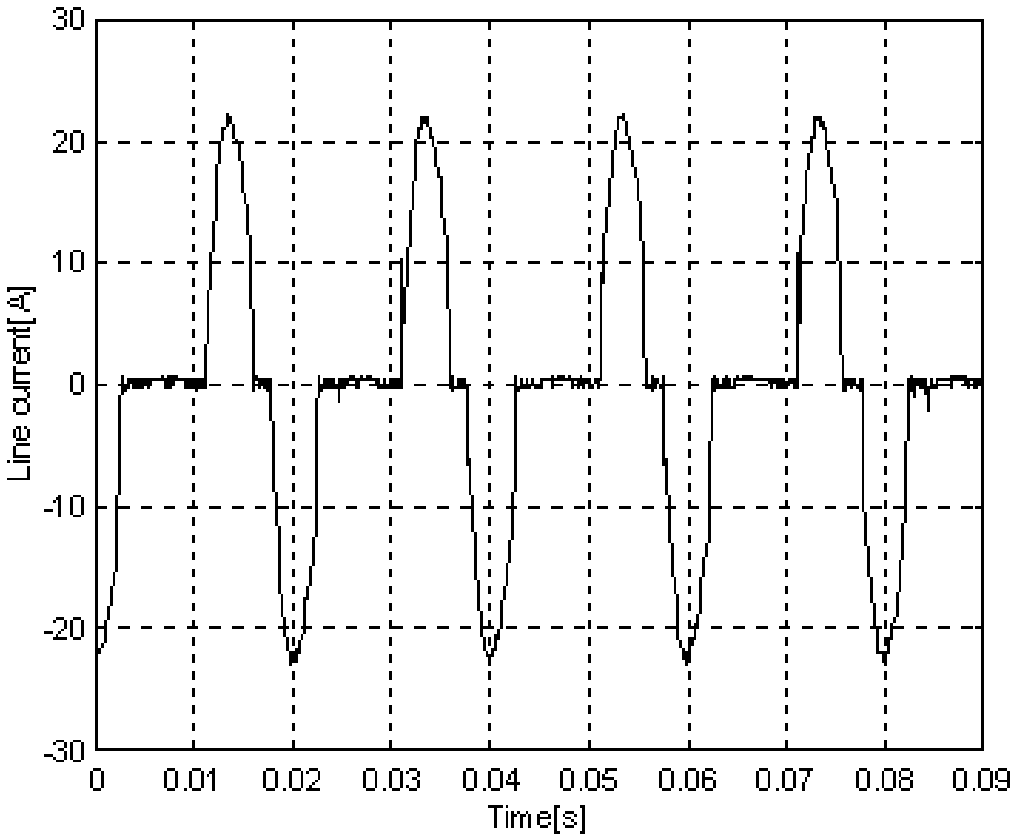

Figure 3. Experimental recorded waveform.

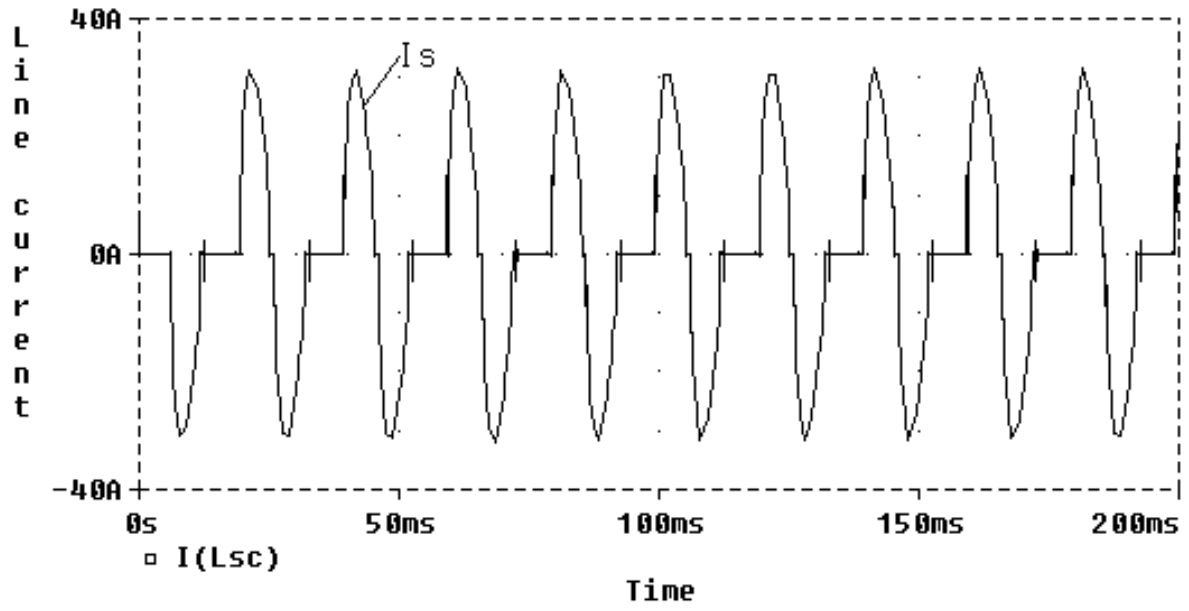

Figure 4. Simulation waveform.

The second case: L_{load} = 48mH and C_{load} = 3260uF.

- α = 150.66°

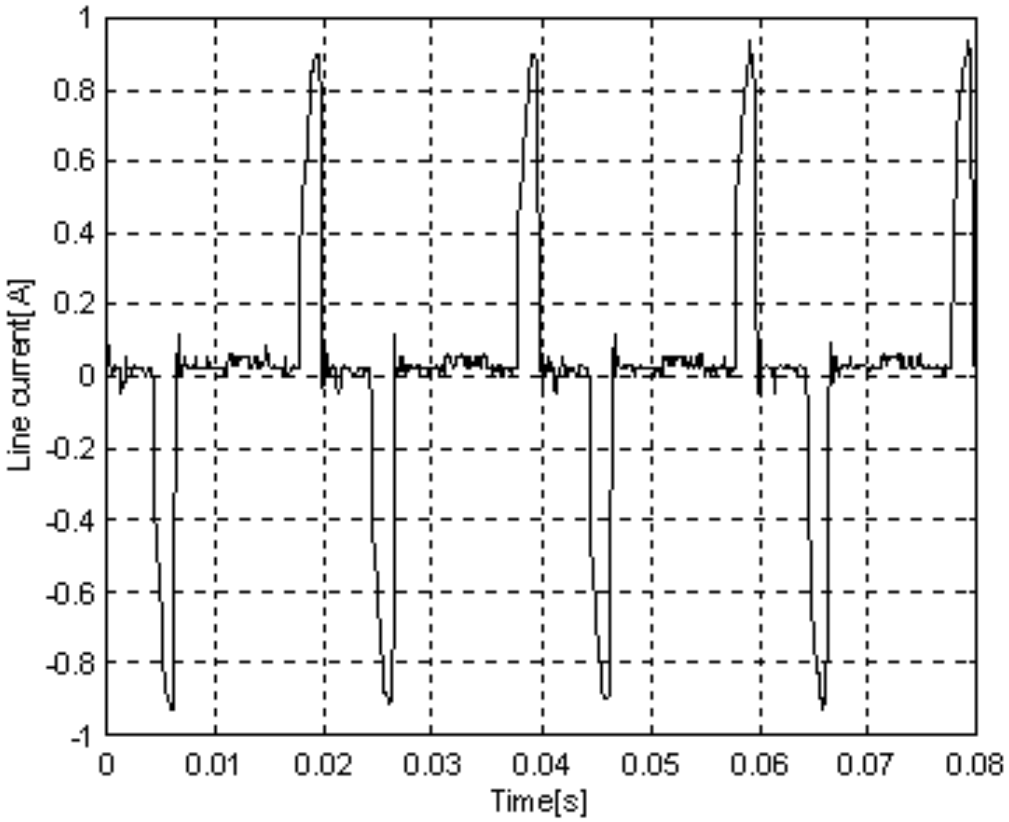

Figure 5. Experimental recorded waveform.

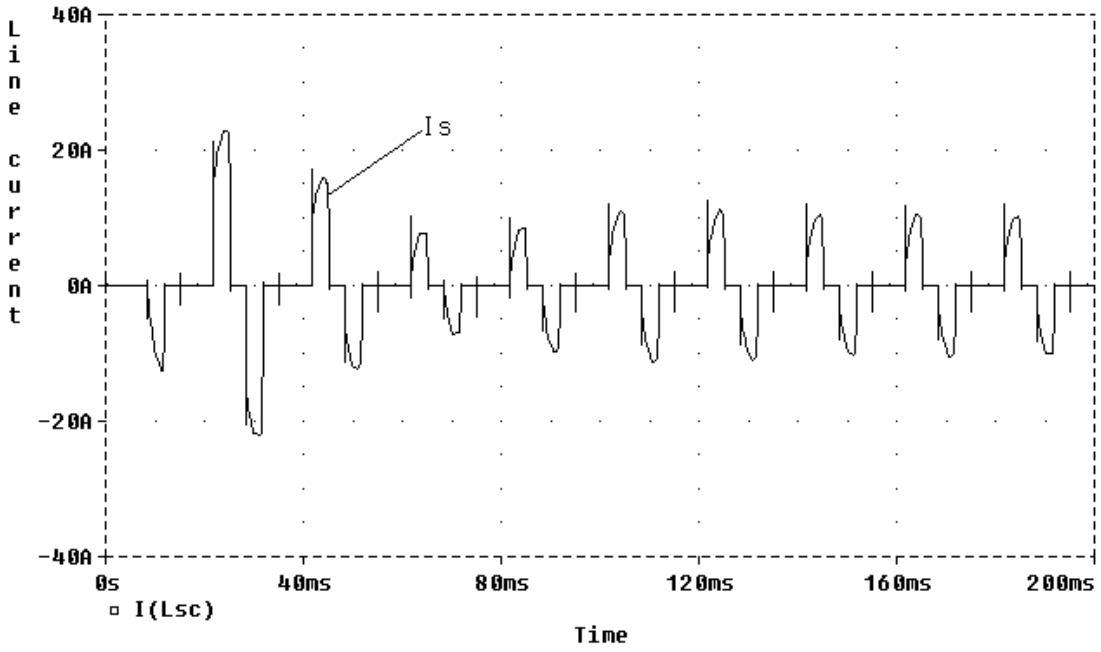

Figure 6. Simulation waveform.

- $\alpha = 106.38°$

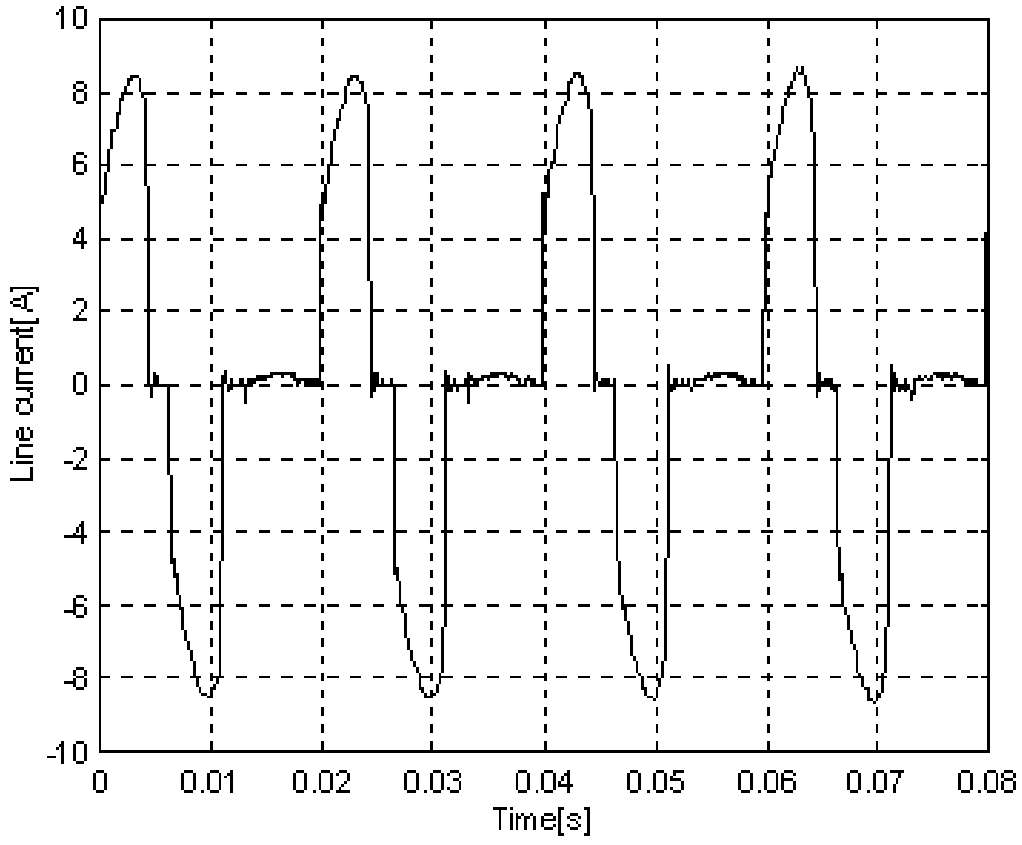

Figure 7. Experimental recorded waveform.

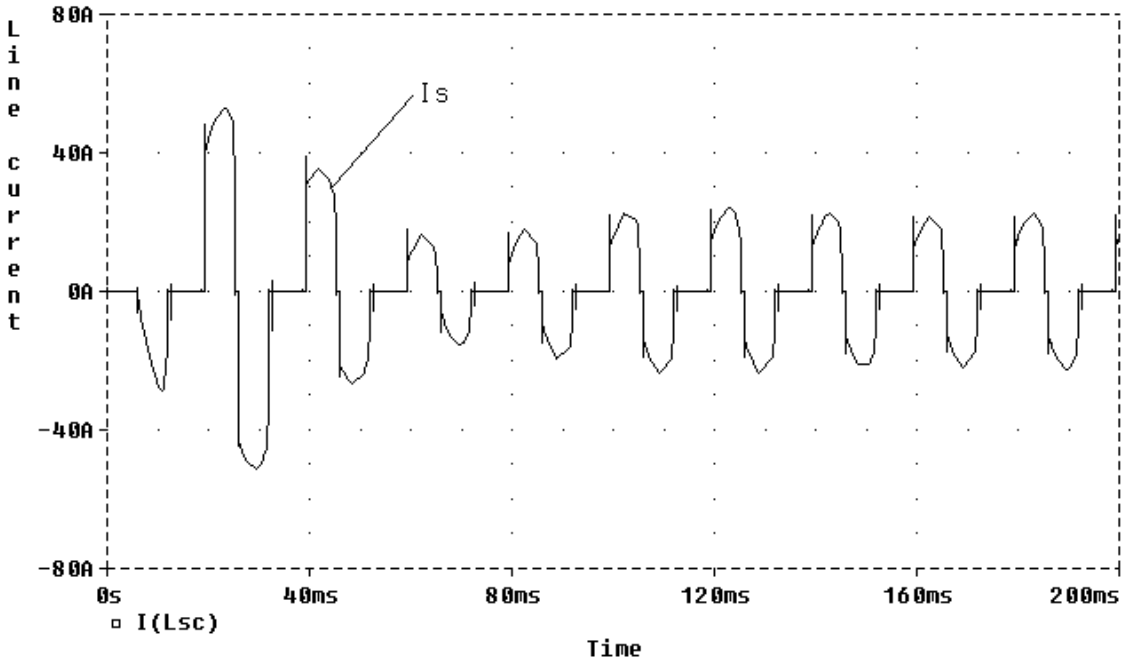

Figure 8. Simulation waveform.

CONCLUSIONS

From all this study which was done about the influence of firing angle and different kind of loads upon current harmonics at the input side of a three-phase semicontrolled rectifier it can conclude that the firing angle is the most important parameter which can influences very much the shape of current harmonics waveforms and the magnitude.

The nature of load influences a little the shape waveforms and more important is the magnitude influence. Knowing this kind of influences is very important in the case of fuses heating study, because the fuses are the current protection devices in the input side of power rectifiers and they have to be designed properly to protect in best condition the power semiconductor from rectifiers.

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MICRO-HYDROPOWER STATION FOR KINETIC ENERGY CONVERSION OF FLOWING WHATER WITH MODIFIED HYDRODYNAMIC ROTOR

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1. INTRODUCTION

The existence of water on the Earth has conditioned the emergence and development of life. From the times immemorial, man has chosen a place to live near rivers and lakes to meet their natural needs in water, but also for carrying out basic irrigation works. Floating or rowing led human thought by observation, to use water force and energy. Thus, the mechanical power of running water can be considered one of the oldest tools.

The means of water use and exploitation have evolved from a historical epoch to another, from one nation to another, in relation to the natural conditions, depending on the level of production relationships and forces. Thus, water energy uses has marked stages of development of the social systems from the primitive to modern society.

To avoid the construction of dams, the kinetic energy of rivers can be utilized by means of exploiting water stream turbines. This type of turbines is easily mounted, is simple in operation and maintenance cost is suitable. The 1m/s current velocity represents an energetic density of 500W/m^2 of the crossing section, but only a part of this energy can be drawn off and converted into useful electrical or mechanical energy. This fact depends on the type of rotor and blades. Velocity is especially important as a double increase in the water velocity can result in an eight times rising of energetic density. Prut river has a section equivalent to 60 m^2 and an average velocity in explorable zones of (1 – 1,3) m/s, which is equivalent to an approximate theoretical energy of (30 – 65) kW. Taking into account the fact that the turbine can occupy only a portion of the river bed the generated energy might be much smaller. There are various conceptual solutions, but the issue of increasing the conversion efficiency of water kinetic energy is in the view of researchers. The analysis of constructive versions of floatable micro-hydro power stations previously examined did not satisfy at all from the point of view of conversion efficiency of water kinetic energy. In a classical hydraulic wheel horizontal axle (Fig. 1) [1] the maximum depth at which one of blades is sunk makes approximately 2/3 of the blade height *h*. Namely, only this area participates in the transformation of water kinetic energy into mechanical one. As well, the prior blade covers approximately *2/3* of the blade surface sunk utmost in the water *(h''≈ 2/3h')*. This fact reduces significantly the water stream pressure on the blade. The blade that comes next to the blade that sunk maximally into water is covered completely by it and practically does not participate in the conversion of water kinetic energy. Therefore, the efficiency of such hydraulic wheels is small.

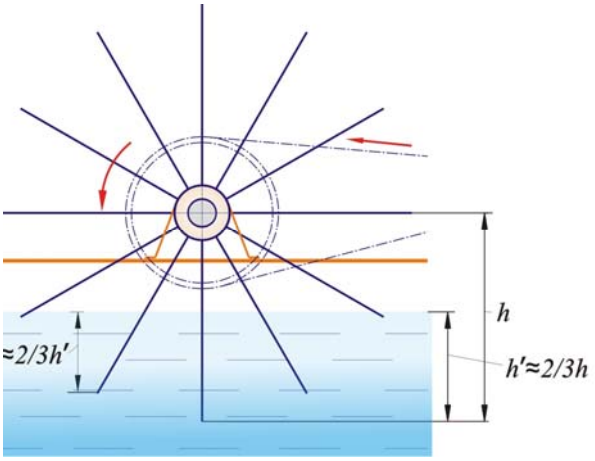

Figure 1. Conceptual diagram of the water wheel with rectilinear profile of blades.

The insistent searches of authors lead to the elaboration and patenting of some advanced technical solutions for floatable micro-hydro power stations, based on the hydrodynamic effect, generated by the hydrodynamic profile of blades, and their orientation at optimum positions concerning the water streams with account of energy conversion in each phase of the turbine rotor rotation (Fig. 2) [1,2]. Therefore it was necessary to perform a large volume of multi-criteria theoretical research concerning the selection of optimum hydrodynamic profile of the blades and the design of the orientation mechanism towards the water streams.

2. CONCEPTUAL DIAGRAM OF THE MICRO HYDROPOWER PLANT WITH HYDRODYNAMIC ROTOR

The results of the carried out research by the authors concerning the water flow rate in the location selected for the micro-hydro power stations mounting, the geological prospecting of the river banks in the place of anchoring foundation mounting, the energetic needs of the consuming potential, represent initial data for the conceptual design of the micro-hydro power stations and its working element.

Aiming at an increase of the conversion coefficient of the water kinetic energy (Betz coefficient), a number of structural diagrams of floatable micro-hydro power plants have been designed and patented [2-7]. They comprise a rotor with pintle and vertical blades, and hydrodynamic profile in normal section. The blades are interconnected by an orientation mechanism towards the direction of the water streams. The motion of rotation of the rotor with pintle is multiplied by a mechanical transmission system and is transmitted to an electrical generator or to a hydraulic pump. The mentioned knots are fixed on a platform, mounted on floatable bodies. The platform is linked to the bank by a hinged metallic truss and by straining cables.

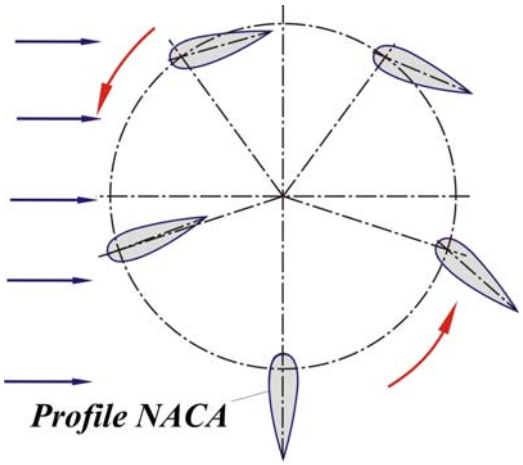

Figure 2. Conceptual diagram of the rotor with hydrodynamic profile of adjustable blades concerning the water streams.

A very important aspect in the functional optimization of micro-hydro power plants is the selection of optimum hydrodynamic profile of the blades which allows increasing the conversion coefficient (Betz coefficient). Due to the hydrodynamic upward forces the increase in the conversion level is reached by means of ensuring the optimum position of the blade towards the water streams in various phases of rotor rotation by utilizing blades orientation mechanism. Thus, practically all blades (even those which move opposite the water streams) participate simultaneously in the generation of summary torque moment. The blades which move along the water streams utilize both hydrodynamic forces and water pressure exercised on blade surfaces for the generation of the torque moment. The blades which move opposite the water streams utilize only hydrodynamic upward forces for the generation of the torque moment. Due to the fact that the relative velocity of the blades toward water streams at their motion opposite water streams is practically twice bigger, the hydrodynamic upward force is relatively big and the generated torque moment is measurable to the one generated by the water pressure. This effect forms the basis of all patented technical solutions.

The adopted technical solutions have resulted in an ample theoretical and experimental research carried out at the Centre for Renewable Energy Conversion Systems Design, Department of the Theory of Mechanisms and Machine Parts. To justify the constructive and functional parameters, supplementary digital modelling and simulation have been carried out by utilizing ANSYS CFX5.7 software. Subprograms developed by authors for the MathCAD, AutoDesk MotionInventor, etc. software, have been utilized, namely simulation of the interaction „*flow-blade*" of the floatable steadiness and also the optimization of blades hydrodynamic profile, with the purpose to increase the river water kinetic energy conversion efficiency for different velocities by using 3, 4 and 5 blade rotors. In the process of micro-hydro power plants design, the experience gained at research-design-manufacturing of the pilot plant was utilized.

The efficiency of micro-hydro power plant operation by private consumers for special purposes depend on the right selection of micro-hydro power plant constructive configuration and of the functional characteristics of the component aggregates participating in the process of flowing water kinetic energy conversion into useful energy. In order to satisfy the objectives and consumers demand for micro-hydro power plants, and also for the increase in the flowing water kinetic potential conversion efficiency in the certain zone of the river, the authors have designed various constructive and functional concepts based on modular assembling. The mentioned micro-hydro power plants, conceived as modular ones, allow the modification of destination and functional characteristics by replacing certain aggregates with other (generator, pump, blades with different hydrodynamic profile, 3-5 blades rotor).

Micro-hydro power plants have similar resistance structure as constructions calculated from the point

of view of resistance and rigidity at dynamic demands. Floatability and maintenance of the perpendicularity of micro-hydro power plant rotor spindle for a variable river water level are ensured by technical solutions protected by patents [3-7]. The instant orientation mechanism of blades for a constant entering angle concerning the direction of the water flow represents Know-How and it is not described. The main working element on which the quantity of kinetic energy converted into useful energy depends is the blade with the hydro-dynamic profile NACA 0016, developed on the basis of the performed digital modelling. Two types of rotors with 3 and 5 blades have been designed for the mentioned micro-hydro power plants. The installed capacity of micro-hydro power plants with diameter $D = 4\ m$, water-submersed blade height $h = 1,4\ m$ and the length of the blade cord $l = 1,3\ m$ for water flowing velocity $V = 1...2\ m/s$ can be within $P = 2...19\ kW$.

In micro hydro power plant (Fig. 3) [3] the turbine comprises blades 13, executed with the hydrodynamic profile and mounted on the axles 12, fixed by their upper part on the extreme ends of the bars 11, with the possibility to rotate around their axles. The position of the blades 13 at angle α to the direction of water flow is ensured by the controlling mechanism 15, 16. Platform 1 is consolidated additionally by a winch 5 fixed on the truss that is mounted unshiftable on the shore pillar. The rotor 9 with the blades 13 are placed in the river water flow. The floating bodies 7,8 and the hollow blades 13 themselves control the position of rotor 9 and blades 13 concerning the water level. The multi-blade rotor is connected cinematically and coaxially to the electric generator 24 and hydraulic pump 23 by the multiplier 19 and belts 20, 21, 22. The winch is used for turbine maintenance which fact requires its removal from the water (fig. 4,b). The blade 13 is positioned under angle α towards the water flow; it changes depending on the blade position to the water flow direction.

The components of force F, acting on the blade, are determined from the relationships:

$$F_x = C_x \cdot \frac{\rho \cdot v^2}{2} \cdot S\ ,\ F_y = C_y \cdot \frac{\rho \cdot v^2}{2} \cdot S\ , \qquad (1)$$

where: ρ is water density; v is the water flow linear velocity; s is the blade surface; C_x, C_y are lift and drag (resistance) coefficients of the blade profile. Coefficients C_x and C_y depend on the blade entering angle **α** (the angle between the blade and the water flow direction) and on the profile shape. The angle is determined either experimentally or by numerical calculations. The torque developed by one blade is described by the equation:

$$M = F_\tau \cdot \frac{d}{2} = (\cos\gamma \cdot F_y - \sin\gamma \cdot F_x)\frac{d}{2}, \qquad (2)$$

where F_τ is the projection of force F on the tangent drawn to the path of motion of the blade axis.

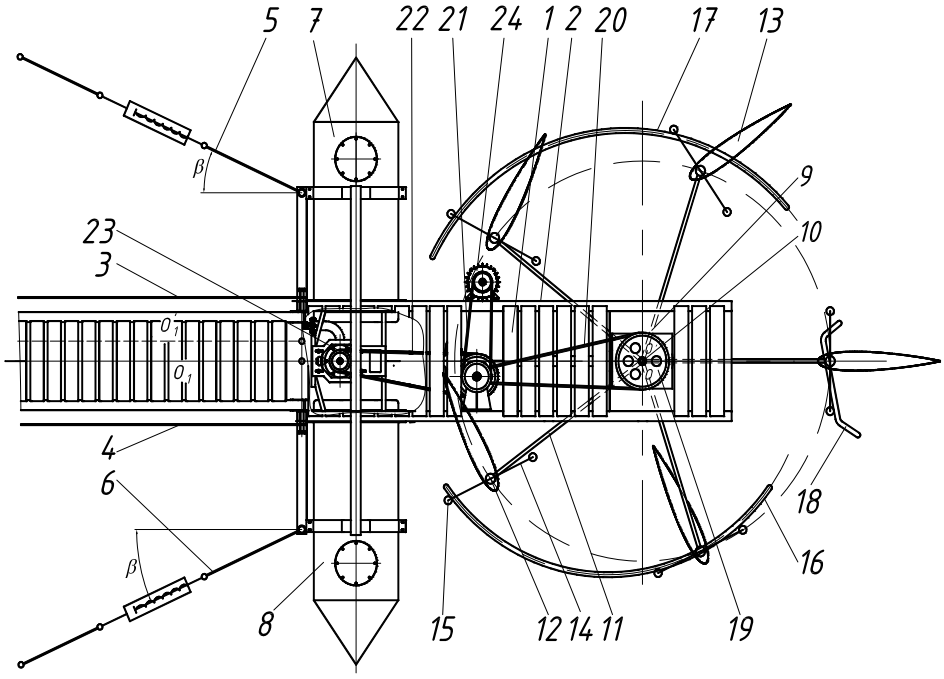

Figure 3. Floatable micro hydropower plant with blades orientation mechanism.

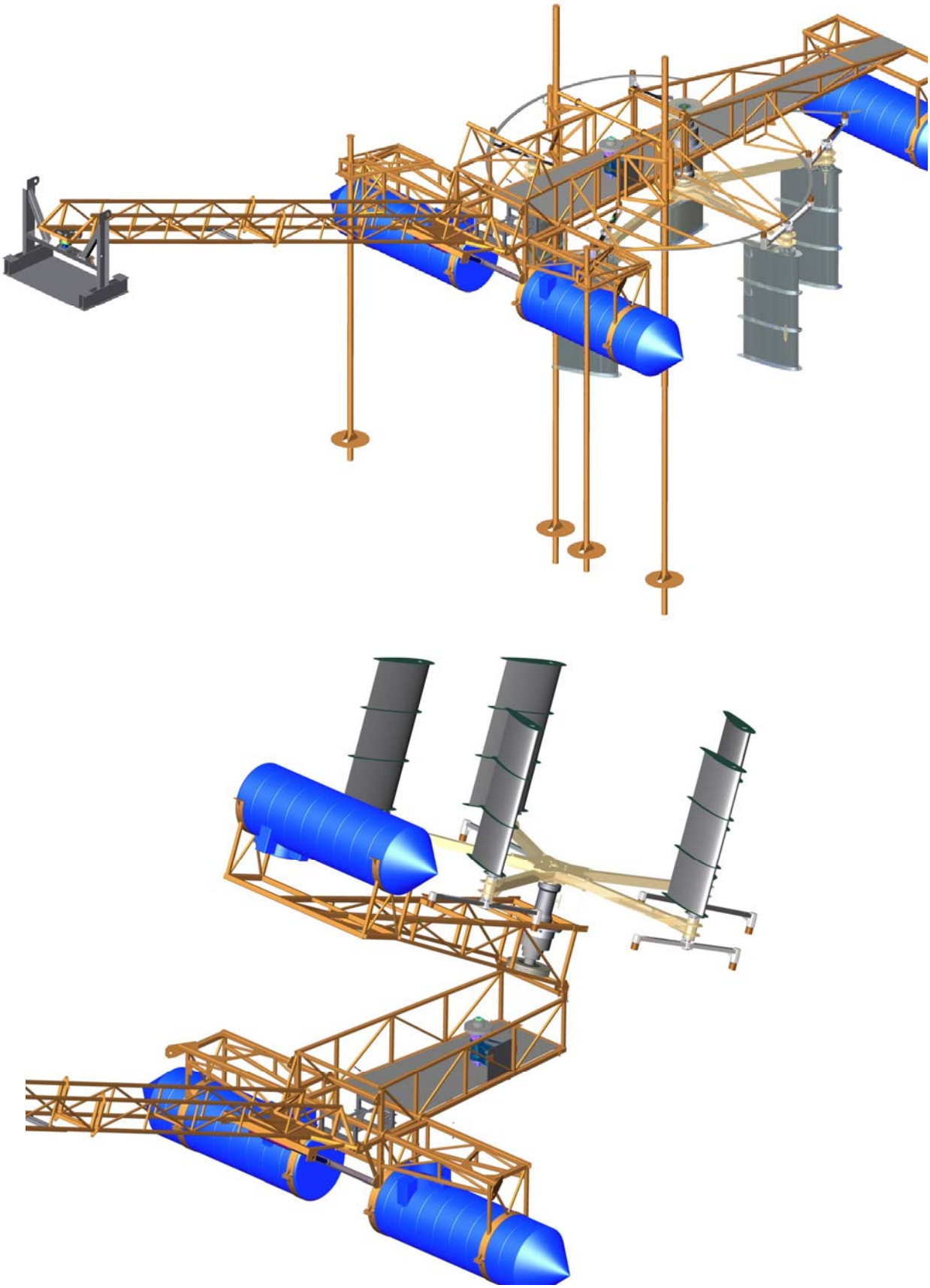

Figure 4. Micro-hydro power plant with modified hydrodynamic rotor for river water kinetic energy conversion into electrical and mechanical energy (rotor diameter $D = 4m$, water-submersed blade height $h = 1,6m$, length of the blade cord $l = 0,87m$.

The summary torque includes the general component of the resistance force F_h. The torque moment generated by the turbine consists of the torques generated by each separate blade. Currently only one blade will not generate positive moment (it will generate a negative moment – the resistance one). Thus, the torque generated by the proposed turbine will be essentially bigger than the torque produced by the existing turbines for the same geometrical (blades dimensions) and kinematical parameters of water. The proposed micro hydro power plant allows the transformation of the water flow kinetic energy into mechanical or electrical energy with an increased utilization coefficient of water energy.

III. INDUSTRIAL PROTOTYPE OF MICRO-HYDRO POWER PLANT WITH HYDRODYNAMIC ROTOR

The micro-hydro power plant for river water kinetic energy conversion into electrical and mechanical energy (Fig. 4) [1,2] is polifunctional and can be utilized for street illumination, heating, water pumping for irrigation by weeping, for drainage of agricultural areas adjacent to rivers. The assembling of blades 13 with NACA 0016 profile in hydrodynamic rotor 9 and its mounting on the inlet shaft of the multiplier 19 are done in the same manner as for micro-hydro-power plant. The kinematics and constructive peculiarities of micro-hydro plant are the following: rotation motion of hydrodynamic rotor 9 with angular speed ω_1, by means of multiplier 13 and of belt drive 20 having an effective multiplying coefficient $i = 212,8$, is being multiplied up to angular working speed of the generator 24 with permanent magnets with small rotations 5:

$$\omega_3 = \omega_1 \cdot i_1 \cdot (s^{-1}). \quad (3)$$

Torque moment T_3, applied to rotor 5, is:

$$T_3 = \frac{T_1 \cdot \eta_1 \cdot \eta_2 \eta_r}{i}, (Nm), \quad (4)$$

where: η_1 is the mechanical efficiency of the multiplier ($\eta_1 = 0,9$);

η_2 - mechanical efficiency of the belt drive ($\eta_1 = 0,95$);

η_r - mechanical efficiency of the hydrodynamic rotor bearings ($\eta_1 = 0,99$).

i – effective multiplication coefficient equal to the composition of multiplying ratios of the planetary multiplier and of the belt drive.

The electric energy produced by the generator with permanent magnets 24 (fig. 3) can be utilized for private consumer needs. The mechanical energy of pump 23 can be utilized for water pumping into irrigation systems by means of weeping or drainage of agricultural areas adjacent to the rivers. On the basis of the conceptual diagram designed above, technical documentation was developed industrial prototype of micro-hydro power plant for river water kinetic energy conversion into electrical and mechanical energy was manufactured (fig. 5).

CONCLUSIONS

In conclusion, we state that micro hydropower plants ensures the transformation of 70…86 % of the flowing water potential energy into useful electrical energy transmitted to the hydrodynamic rotor.

The basic advantages of micro-hydro power stations are as follows:

- small impact on the environment; it is not necessary to carry out civil constructions;
- the river does not change its natural course; the possibility to utilize local knowledge in order to produce floatable turbines;
- the possibility to mount a series of micro-hydro stations at small distances (approximately 30-50 m) because the influence of turbulence provoked by the adjacent installations can be excluded.

Figure 5. Industrial prototype of the micro-hydro power plant with modified hydrodynamic rotor for water kinetic energy conversion into electrical and mechanical energy.

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TREATMENTS OF COMPOSITE MATERIALS SURFACES FOR ADHESIVE BONDING

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INTRODUCTION

The use of advanced composite materials has increased significantly in the last 30 years. A variety of composite materials are now commonly used in the aircraft, automotive, marine and other industries. Adhesive bonding of composite materials is a joining method, which is attractive as an alternative or as a complement to more conventional methods like spot welding, riveting or bolting. The present paper discusses in detail mechanical, energetic and chemical treatments of composite material surfaces for adhesive bonding.

1. ADHESIVE JOINTS WITH COMPOSITE MATERIALS

The adhesive bonding technique has been used successfully in engineering designs in which structural components with similar/dissimilar material properties are bonded to each other. Adhesive bonding has been extensively studied over the last 40 years but principally for aeronautical and automobile applications, for which the adherents tend to be less than 2mm thick. Adhesive joining was an attractive joining technique because it saves weight up to 20% compared to conventional methods, does not create stress concentration and generally produces longer fatigue life in comparison to joints bonded using the other techniques. Adhesive bonding provides a smooth surface along which the load is transferred and removes probable high stress concentration around holes, stress raisers in the case of conventional methods [1].

An adhesive is defined as a polymeric substance with viscoelastic behavior capable of holding together by surface attachment to produce a joint with high shear strength. Some thermoplastic and termosetting polymers are used as adhesives. The adhesives can be liquids, pastes and solids. The adhesive should wet the adherend and solidify under production conditions of time, temperature and pressure. The strength of the adhesive joints may be much less than that of the adherend materials; nevertheless, a strong joint may be produced if the adhesive layer is thin and continuous. If a good joint is formed the adherend material may fracture or rupture before the adhesive.

Advanced synthetic adhesives with a high strength have been developed as a result of intensive research in organic chemistry during the last decades and have been used in the bonding of polymeric and composite materials. Adhesives are normally epoxy resin, but could be acrylic, phenolic or polyurethane. They come in liquid, paste or film form and cure at room temperature or higher temperatures [1].

The composite materials are frequently manufactured as elements, which must then be joined to each other or to a metallic structure. Assemblies of elements using tapered lap joints of the some stacking sequence as the composite is the best method but it is long labour intense and expensive. Composite materials, be they metal matrix composites, polymer matrix composites, or ceramic matrix composites are joined by the same procedures that are well known for joining isotropic materials such as metals or polymers. This is to be expected since the process of transferring loads between joined components sets up stress patterns, which are more dependent on the component/joint configuration than on the material used to fabricate the article [2].

All forms of composite can be satisfactorily joined. Composite materials could be joining by adhesive bonding and by mechanical fastening. To utilize the full potential of composite materials as structural elements, the strength and failure of these bolted/bonded joints in laminated composites must be understood. Joining techniques used for metals, such as bolting and riveting, can be detrimental to the mechanical properties of the composite. Adhesive bonding is a convenient alternative way to joint these materials. Adhesive are often required when joining composite materials in order to make best use of their properties.

Is needed to prepare the mating surface by removing all traces of mold release agent or other contaminant from the composite. If the composite is to be bonded to a metal then the latter will also need

pretreatment to remove grease and any surface oxide layer. The failure of adhesive joints often takes place by cohesive fracture in the adhesive of by adhesive
fracture at the interface between the adhesive and the adherents. The fracture of an interface between two materials depends on the geometry, the constitutive properties of the adherents and the details of the bonding across the interface. The relationship between the normal cohesive stresses and the normal displacements across the interface dictates the failure of the joint loaded in an opening mode [3].

It is generally accepted that a bonded joint is stronger than a bolted joint and a well-designed bonded joint is stronger than a bonded-bolted joint.

2 TREATMENT OF COMPOSITE SURFACES FOR ADHESIVE BONDING

2.1. General considerations

The surface pretreatment of composite materials for bonding is very important in order to obtain good joint strength. Adherent surface treatment plays a critical roll in developing adhesively bonded joints Unsuitable surface preparation of substrates, such as inadequate surface roughening, environmental effects, peel ply chemical contamination and other factors mechanical and chemical can prevent adhesives from bonding properly to substrates, resulting in interfacial failures (failure between adhesive layer and adherent). There failures occur at loads well below those of properly bonded joints that fail cohesively (in adhesive layer).

A standard requirement for an adhesive to work is a clean surface. This simply reflects the fact that adhesion starts with interfacial interactions. If these interactions are too weak or screened the stress cannot be transferred at the interface, the adhesive layer cannot deform and the energy dissipation will be very small during the debonding process resulting in a low adhesion energy. However, the lower the stress at which the adhesive can deform extensively, the weaker the interactions needed for good adhesive properties. The common conception in surface preparation is that the only requirement for a good adhesive joint is a clean surface. Most adhesive work as a result of the formation of chemical bonds between the substrate surface and the layer adhesive. This chemical links are the load transfer mechanism between the adherents of the adhesive joint. Surface treatments often involve chemicals with produce surfaces with different chemical compositions and these morphological changes influence the nature of the chemical bonds [1]. Reasons put forward for improved joints performance due to a surface treatment include the following:

- the elimination of “weak boundary layers” at the surface such as contaminants, low molecular weight species and loose, friable, surfaces;
- improved wetting of low-energy surfaces (for complete wetting the surface energy of the adhesive must be lower than the surface energy of the adherend);
- chemical modification such as the introduction of polar chemical groups;
- increase in surface roughness giving rise to improved mechanical interlocking or increased bondable surface area [1].

Surface treatment increases the joint strength in following:

- increasing surface tension;
- increasing surface roughness (an increase in surface roughness which allows the adhesive to flow in and around the irregularities on the surface to form a mechanical joint);
- changing result in the formation of a chemical bond between the polymer molecules in the polymer matrix composite [3].

The primary function of a fiber surface treatment is to improve the fiber surface wettability with the matrix and to create a strong bond at the fiber-matrix interface. Both are essential for effective stress transfer from the matrix to the fiber and vice versa. To example, for glass fibers are used chemical coupling agents to improve the fiber/matrix interfacial strength through physical and chemical bonds and protect the fiber surface from moisture and reactive fluids. The interfacial bond created by coupling agents allows a better shear stress transfer between fibers and matrix, which in turn improves the tensile strength as well as the interlaminar shear strength of the composite. Carbon fiber surface are chemically inactive and must be treated to form surface functional groups that promote good chemical bonding with the resin matrix.

Surface treatments also increase the surface area by creating micropores or surface pits on already porous carbon fiber surface. Increase in surface area provides a larger number of contact points for fiber-matrix bonding. Surface treatments for carbon fibers can be: oxidative or nonoxidative. Oxidative surface treatments produce acidic

functional groups (carboxylic, phenolic and hydroxilic) on the carbon fiber surface.

The treatment improves the surface properties depends on the acid concentration, treatment time and temperature. In one of nonoxidative treatments, the carbon fiber surface is coated with an organic polymer that has functional groups capable of reacting with the resin matrix. The preferred method of coating the fiber surface is electropolymerization, in which carbon fibers are used as one the electrodes in acidic solution of monomers or monomer mixtures. Improved results are obtained if the carbon fiber surface is oxidized prior to the coating process.

Is needed to prepare the mating surface by removing all traces of mold release agent or other contaminant from the composite. If the composite is to be bonded to a metal then the latter will also need pretreatment to remove grease and any surface oxide layer (for aluminium and titanium). Solvent decreasing is important because it removes contaminant materials, which inhibit the formation of the chemical bonds and increase wettability and surface energy of the substrate. However solvent decreasing, whilst providing a clean surface, does not promote the formation of acceptable surface conditions for longer term bond durability. Contamination should be removed by solvent degreasing as the first step of the surface preparation process. Processing chemicals such as etchants require contact with the substrate and their effectiveness is diminished if the surface is contaminated. In many cases, surface modifying chemicals do not dissolve the contaminants and an ineffective bond result, if the solvent decreasing step is not performed adequately [1].

Authors, of this paper, considered the following three basic steps for adequate surface pretreatment:

1) the surface must be free of contamination (removing surface contamination) by decreasing;

2) the adherent surface must be a sufficiently fresh and chemically active to enable formation of chemical bonds between the adhesive and adherents (typically by chemical etching of surface abrasion);

3) the surface should be chemically modified to produce an interface resistant to environmental deterioration in service.

Some of special characteristics of composite materials need to be considered when treating their surfaces for adhesive bonding. Composite usually have very smooth, moulded surfaces composed mainly of the polymer matrix material. Surface energies of composites tend to be low, especially for the thermoplastic matrices such as polyether-ether-ketone and polypropylene, making wetting of surfaces by an adhesive difficult. There is a danger that some treatment may cause delamination defects just below the surface or damage to the relatively brittle fibers. These defects may result in poorer mechanical properties of the composite [3].

Perhaps the biggest problem with composites is the wide ranges of contaminants that can be found on the surface and by their nature form a weak boundary layer in a bond. These contaminants include silicones from release agents and bagging materials, fluorocarbon release sprays and films, machining oils, fingerprints and components in the composite itself which have migrated to the surface, such as calcium stearate from self-releasing formulations, water and plasticizers.

Surface treatments enable the nature of the chemical groups present at the surface to be modified and they may be used to modify the topography. A wide variety of chemical, mechanical and energetic surface treatments have been evaluated and reported in the literature for the treatment of plastics and metals adherents for bonding. Many of these techniques may also be suitable for the bonding pretreatment of composite materials as adherents. A selection of surface treatments on composite materials is shown in following.

2.2. Mechanical treatments

A mechanical treatment is used primarily to produce a clean macroscopically rough surface and remove some of existing oxide layer. The mechanical treatments are following:

2.2.1. Alumina grit blasting

The effect of alumina grit blasting is to modify the morphology of the surface and also to remove some surface contamination. The roughness introduced by treatment will also affect the wetting the composite. This method is far more effective in production of an active surface, mainly because it is a non-contact process with a clear visible measure of effectiveness. The variables in grit blasting are the size of alumina grit, the blast pressure, the treatment time, the blast angle and the distance from the blast nozzle to the surface. Alumina gri blasting has been suggested as a good mechanical surface treatment for carbon/epoxy composite. Silicon carbide paper abrasion can be carried out dry or, more usually, in conjunction with a solvent which aids removal of any debris and contaminants. As

with alumina grit blasting, silicon carbide abrasion also causes visible damage to carbon and glass fiber in the composite. The surface energy and adhesion characteristics of the surface of substrate are dependent by following factors: the substrate material, the grit-blasting media purity and contamination and the grit-blasting media particle size. The bulk mechanical properties of the composite material can be affected by abrasive surface treatments like alumina grit blasting and silicon carbide abrasion. Strength is very low for joint with glass/polypropylene composite for treatment with silicon carbide washing where the mode of failure is adhesive [3].

2.2.2. Cryoblast

The cryoblast technique may remove surface contamination without causing large changes to surface morphology or fiber damage.

2.2.3. Sodablast

Sodablasting, using a suspension of sodium bicarbonate in water, has been developed as a cleaning technique. The disadvantage of the technique is that it used water and will therefore raise the water content of the composite. This may mean that the composite has to be dried before any bonding process.

2.2.4. Peel ply

One of the more common surface treatments for composite bonding is the peel ply (a peel ply is a layer of nylon or polyester fabric incorporated in the surface of a composite during its manufacture and which is stripped off the surface immediately before bonding). The variables for a peel ply treatment are: type of material, size of ply, type of weave and whether any release agent applied to the peel ply [1]. Typically, three forms of peel ply are used:

- a thin fiber-glass layer which is difficult to remove and will cause delamination damage in thin laminates;
- a nylon product. Nylon forms good chemical bonds with epoxy adhesive so some form of release agent is applied to the fibers to enable the operator to remove the tear film without causing excessive damage to the laminates. The release agent is transferred to the joining surface and reduces the effectiveness of any adhesive joint formed with that now contaminated surface;
- polyester films. This forms uses heat setting or corona discharge treatment to glaze the surface of the fibers [3].

2.2.5. Tear-ply

Tear-ply exploits a laminate property and consists of a fabric, which is completely impregnated by the laminate matrix resin. It is mainly used for thermoset composites. The tear-ply must be carefully selected to enable it to be removed without any difficulty following the molding process. Superficially the surface of the laminates treated with either peel-ply or tear-ply appears very similar.

Abrasion and grit blasting techniques are not adequate methods of surface treatment but when combined with chemical or energetic treatment on can be obtained adhesive joints with good strength. Abrasion and solvent cleaning may be employed to degrease the surface and remove mold release agents from the adherend.

2.3. Energetic treatments

The energetic treatments are following:

2.3.1. Corona discharge

Corona discharge, namely exposing the substrate surface to excited atoms, ions and free radicals at atmospheric pressure has been widely used to treat composite materials surfaces for adhesive joints. The main effect of corona treatment is to introduce oxygen and nitrogen functionalities onto the composite surface, resulting in improved wetting of the surface. The corona treatments are often used to increase the number of functional groups on the surface available for bonding. This is especially important for the low surface energy thermoplastics such as polypropylene. Variables in corona treatment are the power output of the corona generator, the discharge medium, the geometry of the discharge apparatus, the treatment time and the distance of the sample from the corona. For polypropylene composite the formation of water soluble low molecular weight species on the surface may result in a weak boundary layer. For carbon/epoxy composite the best strength is obtained with corona treatment, which removes contamination and improves wetting without affecting the bulk properties of the composite. The corona discharge increases surface tension and some cases alters the surface chemistry by oxidizing the polymer matrix, which results in the increase in joint strengths.

2.3.2. Plasma

The plasma treatment involves a low-pressure plasma gas, which is electrically conductive and consists of excited atoms, ions and free radicals. After this treatment results an

improvement of the adhesion properties of the composite surface. Plasma treatments will cause chemical and texture changes to a surface. In the plasma process the surface is exposed to ionized gases, usually generated by radio frequency energy in low pressure chamber. The plasma region contains a high concentration of reactive species, such as ions and electrons, which are formed from the gas. Various studies have indicated that these energetic species interact with the surface and cause chemical changes (this changes are dependent upon the gas used to create the plasma). The plasma particles react not only with each other but also with the surfaces, which are exposed to the gas, giving rise to the following effects: surface cleaning, degradation of the polymer chains, removal of the material from the surface, formation of radicals on the surface, and respectively change of tacticity of the polymer chains. The main parameters in plasma treatment are the plasma medium, distance of the sample from the plasma and the exposure time. It was felt that the plasma treatment increases surface roughness and carbonyl, did not remove silicone release agent and was more controllable than acid etching because the chromic acid was very aggressive towards the resin and rapidly etched away the surface. Oxygen and nitrogen plasma will be effective bonding pretreatments for thermoplastic composites [2].

2.3.3. Flame

The treatment of a surface with a flame can oxidize the surface and if treated for long enough, the surface texture. An oxidizing flame is very similar to a gas plasma in that it contains excited species such as atoms, ions and free radicals, which oxidize the surface of the composite materials. The important variables in flame treatment are the type of gas, the ratio of gas to air or oxygen, the flow rate of the gas/air mixture, the exposure time and the distance from the surface to the flame. All types of flame gave similar improvements in shear strength and that the improvement was thought to be due to increased oxygen content at the surface.

2.3.4. Excimer laser

The variables in excimer laser etching are the energy density, laser wavelength and the number of laser pulses. This treatment has reported for the bonding of polyetherimide and polycarbonate. When applied to composite surfaces, excimer laser radiation preferentially etches the organic matrix and causes minimal fiber damage. Surface contaminations such as fluorocarbons and silicones are completely removed.

2.4. Chemical treatments

The chemical methods may occur following changes: removal of weak material, roughening, and introduction of functional groups into the polymer [1].

Perhaps the simplest method of removing contaminants from a surface is to tissue wipe with a solvent. The effectiveness of the treatment will depend on the contaminant and the solvent used. There is the possibility that, rather then removing the contaminant; the process will just spread the contamination over the surface [1].

Because joining relies on the chemical activity of the surface and the absence of contamination, solvent cleaning after abrasion only succeeds in partially dissolving contaminants and spreading them over the surface, reducing the effectiveness of the active surface.

Contamination on a composite surface can also be removed using a detergent in conjunction with some form of agitation. This technique might cause problems because of the use of water. For carbon/epoxy composite very low strength is obtained with solvent or detergent cleaning and this is associated with adhesive failure. Strength is also low for joint with glass/polypropylene composite for treatment with detergent washing where the mode of failure is adhesive. The most important chemical treatments are following:

2.4.1. Solvent cleaning

Solvent degreasing is important because it removes contaminant materials, which inhibit the formation of the chemical bonds and increase wettability and surface energy of the substrates; this must be performed in a controlled atmosphere to prevent surface to-contamination. Surface contamination should be removed as the first step in surface preparation as degreasing after abrasion or chemical treatment will result in a layer of partially solvent dissolved contamination remaining on the prepared surface, which may inhibit adhesion. The type of solvent is also important. Solvents with a rapid evaporation rate are best for hand degreasing, because any residual pools of solvent will spread partially dissolved contamination as the material evaporates.

Chromic/sulfuric acid is a widely used treatment for polypropylene and should also be effective for glass/polypropylene composites [1].

2.4.2. Primer

Primers may be applied to the composite surfaces for one or more of the following reasons:

to protect the substrate surface until joining is carried out, to increase surface wettability, to block pores of porous surface thereby preventing adhesive escaping, for corrosion inhibition, to form chemical bonds with the adherend and the adhesive. Commercial primers are usually chlorinated polylefins in a solvent such as toluene.

CONCLUSIONS

Analyzing and comparing all the surface treatments methods on can draw the following conclusions:

1) a variety of surface pretreatments have been used with various degrees of success to increase surface tension, increase surface roughness, change surface chemistry and increase bond strength and durability of composite adhesive joints;

2) the efficiency of a surface treatment depends on the nature of the adherend and on the depth of treatment. There is often a compromise between the functionalisation and the degradation of the surface. Selection of surface pretreatments for composite materials including: cost, environmental impact and stability of the treated surface in service;

3) the intention of surface treatment is to modify the chemistry or morphology of a thin surface layer without affecting the bulk properties. The effectiveness of any surface treatment is dependent upon the type of substrate and the extent of the treatment. For instance, solvent cleaning some substrates will remove surface contaminants but the same solvent on the other substrates may interact with the surface and bulk causing morphological changes. Etching treatments, such as with acid or by laser techniques, may cause chemical modification at low treatment levels, but at high treatment levels may introduce large surface texture changes. Electrical discharge treatment may result in a temperature rise on a surface and therefore can cause surface texture changes due to localized melting;

4) a clean surface is a necessary condition for adhesion but is not a sufficient condition for bond durability. Solvent decreasing does not promote the formation of acceptable surface conditions for longer term joint durability;

5) typical composite surface treatments include traditional abrasion/solvent clearing techniques for thermoset composites, while thermoplastic composites require surface chemistry and surface topographical changes to ensure strong and durable joint strengths;

6) for thermoplastic composites the primary aim of the surface treatment is to increase the surface energy of the composite substrate as much as possible. Surface treatments decrease water contact angle, increase surface tension and as a result increase joint strength;

7) with the abrasion and solvent wipe, grit blasting gave strong and durable joint strength for thermosets but very little degree of success with thermoplastic composites;

8) acid etching has produced similar results to abrasion and grit blasting, in that an increase in bond strength is recorder for thermoset polymer composites; little or no effect was recorded for thermoplastics;

9) on used an oxygen plasma surface treatment this gives a surface, which resulted in better bond strengths than alumina grit blasting, but similar strengths to chromic acid etching;

10) the flame treatment is widely used in the surface modification of thermoplastics;

11) peel ply following by the grit blasting offers the best overall mechanical performance and best durability for the composite adhesive joints and the dry peel ply is the worst (grit blast in addition to peel ply provides the most durable joins);

12) most thermosetting polymer matrix composite supports not need the chemical modification process as such a surface is not susceptible to hydration;

13) for thermoplastic composites the recommended surface preparation is a light aluminum oxide grit blast in dry nitrogen.

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WATER ABSORBTION AND WOOD SWELLING FOR SPRUCE AFTER TOTAL IMERSION

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1. INTRODUCTORY ASPECTS

Spruce wood is the best used specie from resinous species from our country and from easthen Europe. Its utilisation in wet field or in free air will conduct to water sorbtion and the swelling in thickness of wood. Therefore is necessary the quantitative knowleadge of the two phenomenons and especialy their dynamic, coresponding to the saturation moisture content and even after that.

When water entered the wood, water will be descomposed in its dipolous OH and H and dipolous H^+ will form inter-molecular links with free OH^- from wood (that confer a important negativ potential for wood), namely from celulose. In this way in the system of linking forces will be produced an disenpointing and for equilibrum the micelles will be going away and wood will swollen on ensamble.

Wood is an hygroscopic material that can recive or loose water into, respectively when the climatic conditions are change, the moisture content will be chenge too, and the wooden dimension will be change. Therefore is necessary to know the water absortion and the wood swelling (the best two phenomenom) especialy for spruce specie that is so known in all utilisations. Very important is to determine the dynamic of these phenomenons.

2. WOOD SAMPLES AND METODOLOGY OF TESTING

For studing these two phenomenons (dynamic of mass sorbtion and for thickness swelling) it were taked wooden samples from clean and sound wood (the average of annual rings were about 1.5 mm), with dimension of 20×20 ×100 mm which were conditioned to 12 % moisture content in laboratory chamber, with constant parametrs of air atmosphere. Then for each wooden sample were meassurenment the initial mass and their initial dimensions on thickness, respectively on tangential and radial direction (see fig 1).

Then, samples where introduced in water, keeping constatly the lever of sample under water to 5 cm and the temperature of water at 20 ^{0}C, by thermostation.

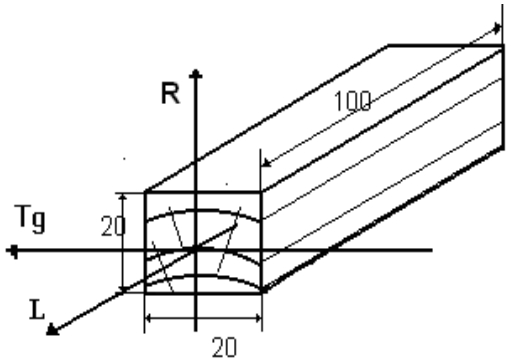

Figure 1. Wooden samples for experiments: R-radial direction; Tg-tangential direction.

At the time of 15 minutes in the first hour and from hour to hour after that, wooden samples where get out from water imersion and where weigtined to balance for mass and where meassured the two dimensions of thickness on tangential and radial direction. All values of weigths and thicknesses where centralized in tables for each samples and make on these results a lots of graphes.

For instance in the table 1 is presenting the variation of mass in time, for four samples and in the table 2 the dimension variation in time, specificing the phases of each two phenomenons.

3. ANALIZIS OF RESULTS FOR WATER MASS ABSORTION

Even if each wooden sample has a distinquish individuality (given by wood structure, number of annual rings, percentage of late wood, visible and un-visible defects, porosity and so on), in the time of experiments it will observ that the two phenomenons keep the same characteristics, valuable for all imerssed samples. In this way it will observ for water absortion, two distinguisg periods as fallows:

- **Phase I**- Period of rapidly absortion of water of the starting period (usualy first hour), when wood quickly absorb water because wood is absolutly dried and all cavities from wood are free of water. Velocity of water absortion in this period is very quickly. If we study the water absortion for 2 number of wooden sample, it will observ for all 10 hours taking in consideration for absortion, this

sample will increase its mass from 17.3 g to 22.1 g, namely 4.8 g, that mean the medium speed of water absortion is 0.48 g/h, for first hour is greater respectively from 17.3 to 19.8 g, respectively with a speed of 2.5 g/h nanely over 5 fold as medium one. The same analisis of water absortion for 2 number of wooden samples will show us a difference of mass from 13.0 to 16,9 g, namely an medium speed of absortion of 0.39 g/h, but for first hour we have an difference from 13.0 to 15.2 namely an velocity of 2.2 g/h, respectively over 5 fold as medium one. More visibily of phases and speed of absortion inside of the same phase will be sawn on the graph, as we see in fig 2.

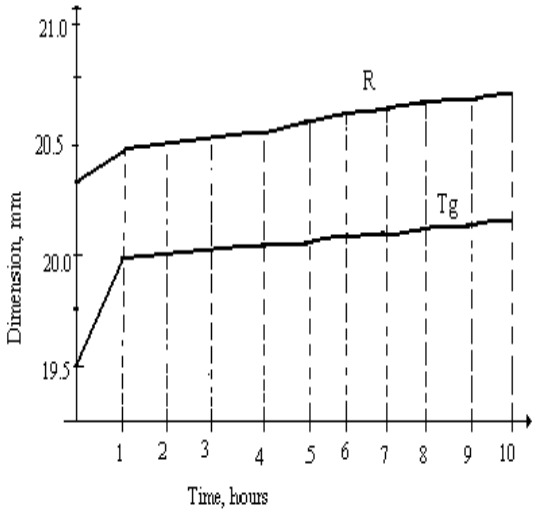

Figure 2. Mass variation for wood sample number.

- **Phase II** of water absortion named also period of concave curve when the speed is reduced and value are as medium ones. Thif form of curve show us that in tis time is hapenned the volumic contraction of water from capilaries; final phase is with concave form, respectively thereis a last spring of water absortion, after what will hapend a decreassing of speeed and a stabilising of water absortion speed.

4. ANALIZIS OF RESULTS FOR DIMENSIONAL VARIATION

If we study the dimensional increasings during water absortion and its dynamic it will observ two distinguish phases, namely:

- **Phase I** with rapidly increassing of diomension, the velocity of dimension increasing being the best one. If we make an calculus for wood sample number 1 it will observ an medium increassing of 0.08 mm/h, but in the first hour tis increasing is 0.26 mm/h, respectively we have a ratio for 3.2 time

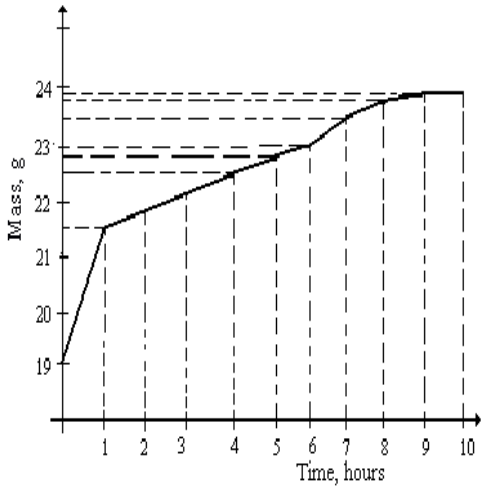

Figure 3. Variation of dimensions in time for wood sample no 2: R-radial; Tg-tangential.

related these. In this period the coefficient of swelling will be 4.03 on tangential direction and 1.84 on radial direction;

- **Phase II**, with lower increassing of dimension or phase of concave variation up to the increassing is apropiate to zero.

These aspects reffering to dimension variation are more visible on graph from figures 4 and 5. The two periods are found on all wooden samples which are imerssied. Quantity of water absorbed in all wooden samples are aproximatively equals in the field of 4.5-5 g., but diferent as each phases.

5. ANALIZIS OF RESULTS FOR COMBINED DIMENSIONAL AND MASS VARIATION

When we make combined analisis (for mass and dimensional variations) we can observ that graphs are proportionaly, respectively with increasing of water absortion in wood sample (velocity of water absortion is higher) the all dimensional increasing will be higher (velocity of dimensional increasing will be higher) in the field of 10 hours. This fact will creat us the image of both increasing in time as we see in nomograme from figure 6.

From this study we take a conclusion related to these phenomenons namely when dimension of wooden sample are equals and the structure of wood sample is the same the increassing of mass and dimension will be the same. Other condition of influencing can be about temperatue of water, position of wood samples under water but the main one is the above sais respectively width of annual ring for this spruce specie. Also from this diagram we can extract mass and dimension of wood sample

Table 1. Mass variation in time**.**

Nr.	Initial mass	Mass in time, g										
		Min 15	Min 30	Min 45	Min 60	4 hour	5 hour	6 hour	7 hour	8 hour	9 hour	10 hour
1	19.0	21.3	21.5	21.5	21.6	22.5	22.8	23.0	23.5	23.8	23.9	23.9
2	17.3	19.4	19.6	19.7	19.8	20.7	21.0	21.5	21.8	22.0	22.1	22.1
3	13.5	14.4	14.6	14.8	15.0	16.0	16.7	16.9	17.	17.1	17.3	17.4
4	13.0	14.3	14.7	15.0	15.2	15.6	16.5	16.7	16.8	16.9	16.9	16.9
Phases		Phase I				Phase II						

Table 2. Dimensional variation in time.

Sample		Dimensions in time, mm											
		Initial	Min 15	Min 30	Min 45	Min 60	4 h	5 h	6 h	7 h	8 h	9 h	10 h
1	R	20.56	20.64	20.64	20.65	20.68	20.83	20.85	20.87	20.90	20.93	20.95	20.96
	T	19.84	19.98	20.05	20.08	20.10	20.48	20.57	20.60	20.62	20.64	20.65	20.66
2	R	20.30	20.35	20.40	20.45	20.47	20.56	20.60	20.64	20.66	20.68	20.69	20.70
	T	19.72	19.75	19.82	19.92	19.94	20.04	20.07	20.10	20.19	20.22	20.24	20.26
Phase		Phase I				Phase II							

2 after a certain time. It can observe from diagram that after 5.5 hours for wood sample no 2, the mass would be 21.2 g and the dimension woiuld be 20.62 mm on radial and 20.09 mm on tangential direction.

If we go straith ahead on this way we can obtain the mass or dimension increassing at any times as we see in fig 7.

It can observ that for wood sample no 2, after 5.5 hours, the mass increasing is equal with 3.9 g and the dimension increasing is 0.32 on radial direction and 0.37 on tangential direction.

After analising the fig 7 we see general tendence of curves an can make an graph with general increasing for a lot of samples with characteriscs presented above and in the same condition of work, graph that is presented in figure 8 (in this graph we enlarge the division scale of dimensions and decrease the division scale of time for obtaining proportionaly scale on horizontal and verticale lines. It can observe that after 3 hours wood pieces will have an inreasing of mass with 3.1 grames and a dimensional inreassing with 0.23 mm on radial direction and 0.3 mm on tangential direction. In this way we can obtain value of mass or dimension increasing after any time.

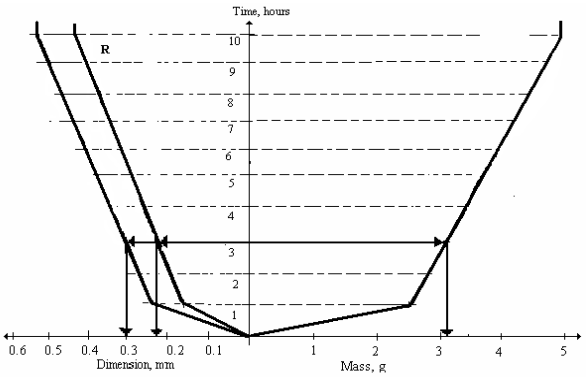

Figure 7. Increasing of mass and dimension of any wood sample after imerssion in water.

CONCLUSIONS

This work presented sopme researches about dinamic of water absortion and thickness swelling, respectively which are the tendency curves for both phenomenons, phenomenon which are in corelation each others.

The idea of mass knowing or dimension increasing after a certain period of time is good to know when wood is used under water.

These researches are preliminary ones because is studie a single specie as spruce and are do not keep into account a lots of factors. In the future rhe researches will study influence of species (groupa as resinous or broad-lived, or individualy vas beech, oak etc), of sample dimensions, nature of liquid and its temperature, etc.

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USE OF POLYMER COMPOSITE MATERIALS IN THE BUILDING INDUSTRY

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INTRODUCTION

An every probleme in world life is "*construction materials*". The origin of main materials used by people in different ages and with the development of specific technologies of processing, were determined the name of civilizations itself, starting with stone, bronze, iron, steel.

The last century experience shows that the new construction materials are concepted for responding to the specific requirements imposed by the new necesities of the civilisation and culture human developement. On the other hand, for compare the different materials between them intervenes all of factors which determine its operation value. In this context, composites materials enjoy by the future expectation just by the possibility of expert to confer them new and various properties by association of synthesis components with complementary specifications.

Composite materials require a great and tight involvement of fundamental and technical sciences.

1. CONCEPTION ELEMENTS CONCERNING POLYMERIC COMPOSITE MATERIALS

The polymeric composites can be included in "the unconventional materials" capable to confer building elements and structures new functional and architectural aptitudes.

The conception of "composite" synthesizes the new idea in the construction material engineering domain, which characterises the contemporary development degree of science and technics, of culture evolution, of civilization and humanity aspiration for a better quality of spiritual and material life.

The essential constituents from structure of composites are physical identifiable, with interface delimination which generally, determines those properties, fig. 1.

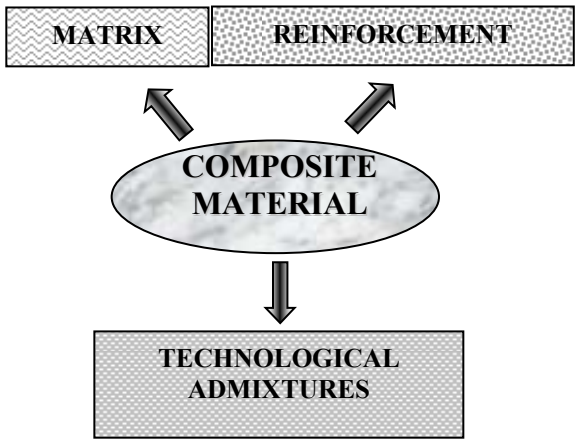


Figure 1. The structure of reinforced composite materials.

The structure of any composite involves [1]:

- **the matrix**, constituted by the one or more constituents which can be a synthetic polymer or other nature, being agent part, forming the composite and protecting the reinforcing fibres;
- **the reinforcing fibres**, made by one or more constituents insoluble in matrix, based on technical fibres which confer to composite the mechanic strengths and desired stiffness;
- **the technological admixture**, like the polymerization accelerators, the catalysts, varied inert fillings.

The distribution of tensiles in composite mass presumes the existence of transfer possibility of them among components by the "fibre–matrix interface", zone which can not be well-defined because the technical fibres are superficial treated with an agent at which sticks the matrix. Thus, the connection region fibre–resine can be treated like a third composite phase, this receiving the influences from exterior and exploitation factors, fig. 2.

The quality of composite performance and the decrease of rate of defacement of material realise by an initial proper adherence and than by the avoidance of interface zone destroying.

The domain of composites is very large and comprises a great diversity of groups, distinguished like structure, nature, performances

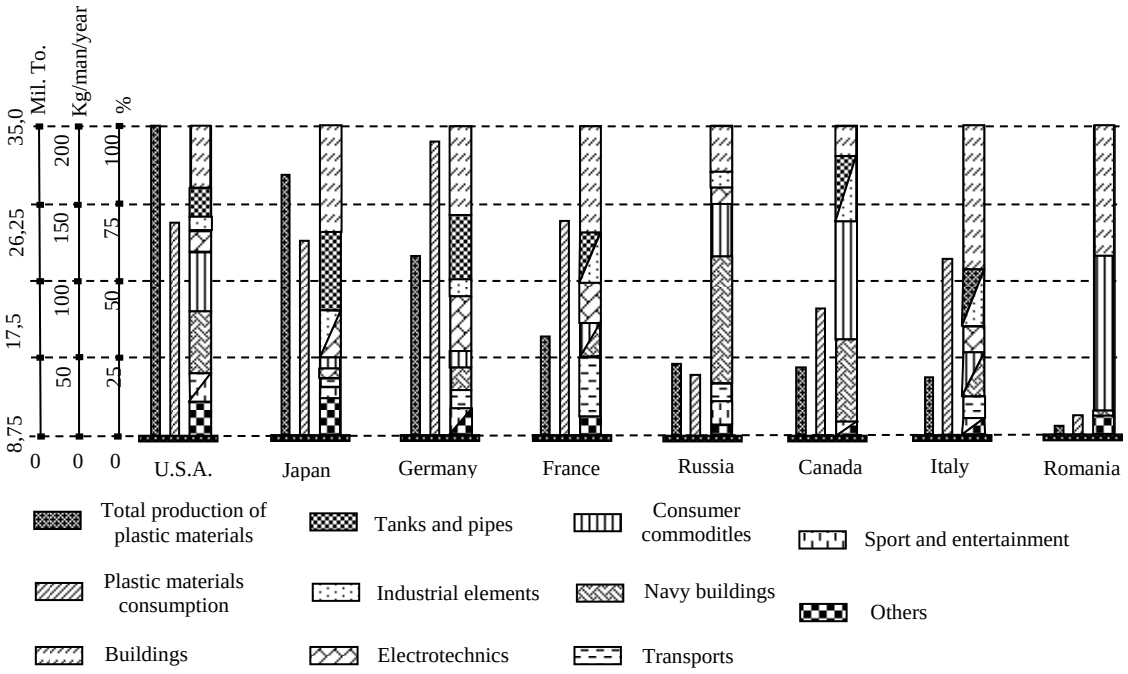
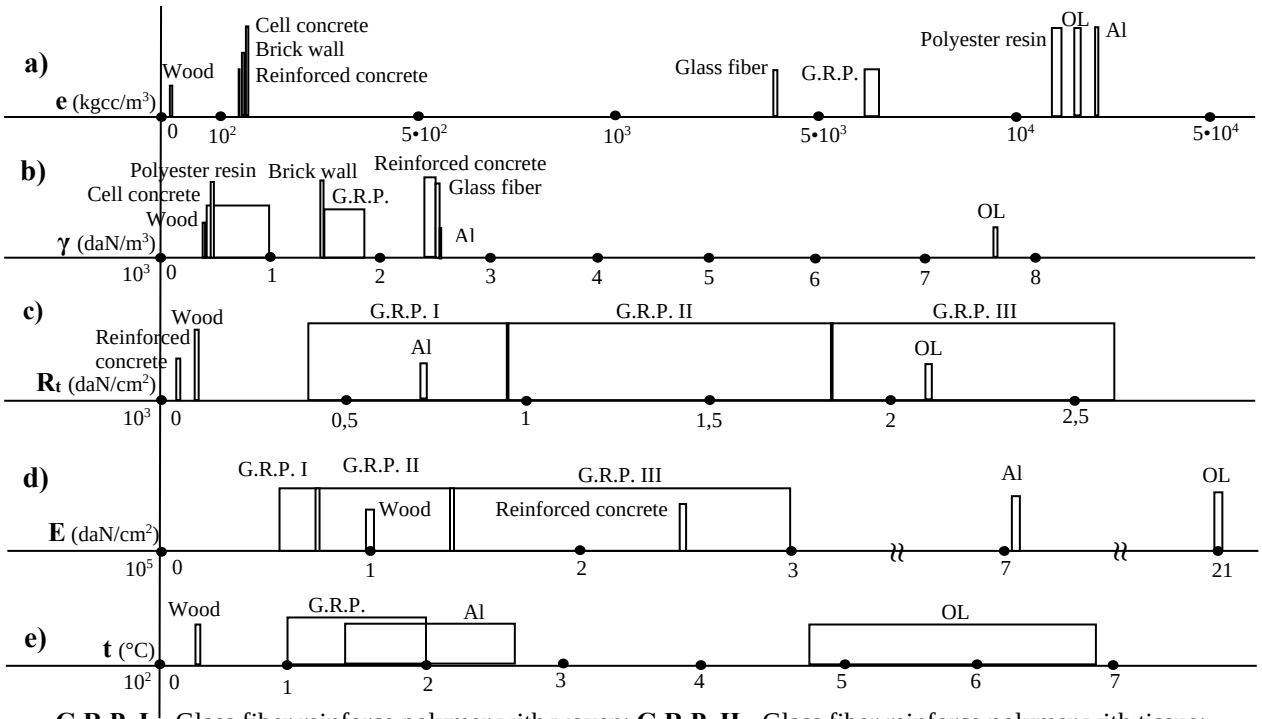


Figure 3. Plastic material production, consumption per man, per year and the weight of there use in different domains and countries.



G.R.P. I – Glass fiber reinforce polymer with woven; **G.R.P. II** - Glass fiber reinforce polymer with tissue; **G.R.P. III**- Glass fiber reinforce polymer with continuous fibers.

Figure 4. Place of prime materials and composite materials in comparison with traditional materials, function of some phisical and mecanical characteristics.

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Recommended for publication: 16.10.2014

engineer Dr. Ion Chichea, the book "*Agrophytotechnics on sandy soils" to which Romania's Academy awarded the "Ion Ionescu de la Brad*" prize on 11 July 1980. In 1986 he published at Ceres Publishing House, together with Valeria Marghitu, Victor Barnaure and Ion Chichea, the monograph "*The culture of groundnuts (peanuts)",* awarded by Romanian Academy with the "*Ion Ionescu de la Brad*" prize in 1990.

A great part of the research activity was devoted to adapting the peanuts for cultivation on the sandy soils in Oltenia region. In 1979 he introduced in the variety testing network several lines of peanuts, among which the line T 277, officially acknowledged for production in 1983 under the commercial name "*Târnăveşti variety*", for which he, together with engineer Dr. Valeria Marghitu and engineer Dr. Ion Chichea, obtained the Invention patent no. 89351. In 1995 the invention gained the Gold Medal at the International Salon of Inventions in Geneva.

The whole scientific and publishing activity carried out by Liviu Pop consists in 230 scientific papers, 7 books, 15 courses and handbooks, 16 articles of agricultural technique, 66 articles of scientific popularization, 99 articles of technical guiding.

He passed away in Craiova on 3.11.2010.

Column written by professor eng .Gheorghe Manolea, University of Craiova, Doctor Honoris Causa of Technical University of Moldova from Chişinău

THE PSYCHOLOGY OF CREATIVITY

"People should be more creative if they would be informed what is creativity"
(A. Haven)

1. OVERVIEW

Theories of creativity (particularly investigation of why some people are more creative than others) have focused on a variety of aspects. *„Creator must be aware of the psychological nature of human creativity, to understand how creativity works, to know how to intervene when necessary in its creativity, and its operation in progress by using stimulation techniques"* [1]. The dominant factors are usually identified as "*the four Ps*" - process, product, person and place (according to Mel Rhodes) [2]. A focus on *process* is shown in cognitive approaches that try to describe thought mechanisms and techniques for creative thinking. Theories invoking divergent rather than convergent thinking (such as Guilford), or those describing the staging of the creative process (such as Wallas) are primarily theories of creative process.

A focus on creative *product* usually appears in attempts to measure creativity (psychometrics, see below) and in creative ideas framed as successful memes [3]. The psychometric approach to creativity reveals that it also involves the ability to produce more [4]. A focus on the nature of the creative *person* considers more general intellectual habits, such as openness, levels of ideation, autonomy, expertise, exploratory behaviour and so on. A focus on *place* considers the circumstances in which creativity flourishes, such as degrees of autonomy, access to resources and the nature of gatekeepers. Creative lifestyles are characterized by nonconforming attitudes and behaviours as well as flexibility [4].

Most ancient cultures, including thinkers of Ancient Greece [5], Ancient China, and Ancient India [6] lacked the concept of creativity, seeing art as a form of discovery and not creation. The ancient Greeks had no terms corresponding to "to create" or "creator" except for the expression "*poiein*" ("to make"), which only applied to *poiesis* (poetry) and to the *poietes* (poet, or "maker") who made it. Plato did not believe in art as a form of creation. It is commonly argued that the notion of "creativity" originated in Western culture through Christianity, as a matter of divine inspiration [6]. According to the historian Daniel J. Boorstin, "the early Western conception of creativity was the Biblical story of creation given in the *Genesis* [6]. However, this is not creativity in the modern sense, which did not arise until the Renaissance. In the Judaeo-Christian tradition, creativity was the sole province of God; humans were not considered to have the ability to create something new except as an expression of God's work. A concept similar to that of Christianity existed in Greek culture, for instance, Muses were seen as mediating inspiration from the Gods [8]. Romans and Greeks invoked the concept of an external creative "*daemon*" (Greek) or "*genius*" (Latin), linked to the sacred or the divine. However, none of these views are similar to the modern concept of creativity, and the individual was not seen as the cause of creation until the Renaissance. It was during the Renaissance that creativity was first seen, not as a conduit for the divine, but from the abilities of "*great men*" [9].

The rejection of creativity in favour of discovery and the belief that individual creation was a conduit of the divine would dominate the West probably until the Renaissance and even later. The development of the modern concept of creativity begins in the Renaissance, when creation began to be perceived as having originated from the abilities of the individual, and not God. However, this shift was gradual and would not become immediately apparent until the Enlightenment [7]. By the 18th century and the Age of Enlightenment, mention of creativity (notably in art theory), linked with the concept of imagination, became more frequent [8]. In the writing of Thomas Hobbes, imagination became a key element of human cognition [6]; William Duff was one of the first to identify imagination as a quality of genius, typifying the separation being made between talent (productive, but breaking no new ground) and genius [7]. As a direct and independent topic of study, creativity effectively received no attention until the 19th century [7]. Runco and Albert argue that creativity as the subject of proper study began seriously to emerge in the late 19th century with the increased interest in individual differences inspired by the arrival of Darwinism. In particular they refer to the work of Francis Galton, who through his eugenicist

Outlook took a keen interest in the heritability of intelligence, with creativity taken as an aspect of genius [6].

In the late 19th and early 20th centuries, leading mathematicians and scientists such as Hermann von Helmholtz (1896) and Henri Poincaré (1908) began to reflect on and publicly discuss their creative processes.

Creativity is a central source of meaning in our lives. Most of the things that are interesting, important, and human are the result of creativity. What makes us different from apes—our language, values, artistic expression, scientific understanding, and technology—is the result of individual ingenuity that was recognized, rewarded, and transmitted through learning.

When we're creative, we feel we are living more fully than during the rest of life. The excitement of the artist at the easel or the scientist in the lab comes close to the ideal fulfillment we all hope to get from life, and so rarely do. Perhaps only sex, sports, music, and religious ecstasy—even when these experiences remain fleeting and leave no trace—provide a profound sense of being part of an entity greater than ourselves. But creativity also leaves an outcome that adds to the richness and complexity of the future.

Creative individuals are remarkable for their ability to adapt to almost any situation and to make do with whatever is at hand to reach their goals. If I had to express in one word what makes their personalities different from others, it's *complexity*. They show tendencies of thought and action that in most people are segregated. They contain contradictory extremes: instead of being an "*individual*," each of them is a "*multitude*."

Here are the 10 antithetical traits often present in creative people that are integrated with each other in a dialectical tension [9].

1. Creative people have a great deal of physical energy, but they're also often quiet and at rest. They work long hours, with great concentration, while projecting an aura of freshness and enthusiasm. This suggests a superior physical endowment, a genetic advantage. Yet it is surprising how often individuals who in their seventies and eighties exude energy and health remember childhoods plagued by illness. It seems that their energy is internally generated, due more to their focused minds than to the superiority of their genes.

This does not mean that creative people are hyperactive, always "*on*." In fact, they rest often and sleep a lot. The important thing is that they control their energy; it's not ruled by the calendar, the dock, an external schedule. When necessary, they can focus it like a laser beam; when not, creative types immediately recharge their batteries. They consider the rhythm of activity followed by idleness or reflection very important for the success of their work. This is not a bio-rhythm inherited with their genes; it was learned by trial and error as a strategy for achieving their goals.

2. Creative people tend to be smart yet naive at the same time. How smart they actually are is open to question. It is probably true that what psychologists call the "*g factor*," meaning a core of general intelligence, is high among people who make important creative contributions.

The earliest longitudinal study of superior mental abilities, initiated at Stanford University by the psychologist Lewis Terman in 1921, shows rather conclusively that children with very high IQs do well in life, but after a certain point IQ does not seem to be correlated any longer with superior performance in real life. Later studies suggest that the cutoff point is around 120; it might be difficult to do creative work with a lower IQ, but an IQ beyond 120 does not necessarily imply higher creativity.

Another way of expressing this dialectic is the contrasting poles of wisdom and childishness. As Howard Gardner remarked in his study of the major creative geniuses of this century, a certain immaturity, both emotional and mental, can go hand in hand with deepest insights. Mozart comes immediately to mind.

Furthermore, people who bring about an acceptable novelty in a domain seem able to use well two opposite ways of thinking: the convergent and the divergent. Convergent thinking is measured by IQ tests, and it involves solving well-defined, rational problems that have one correct answer. Divergent thinking leads to no agreed-upon solution. It involves fluency, or the ability to generate a great quantity of ideas; flexibility, or the ability to switch from one perspective to another; and originality in picking unusual associations of ideas. These are the dimensions of thinking that most creativity tests measure and that most workshops try to enhance.

Yet there remains the nagging suspicion that at the highest levels of creative achievement the generation of novelty is not the main issue. People often claimed to have had only two or three good ideas in their entire career, but each idea was so generative that it kept them busy for a lifetime of testing, filling out, elaborating, and applying.

Divergent thinking is not much use without the ability to tell a good idea from a bad one, and this selectivity involves convergent thinking.

3. Creative people combine playfulness and discipline, or responsibility and irresponsibility. There is no question that a playfully light attitude is typical of creative individuals. But this playfulness doesn't go very far without its antithesis, a quality of doggedness, endurance, perseverance.

Nina Holton, whose playfully wild germs of ideas are the genesis of her sculpture, is very firm about the importance of hard work: "*Tell anybody you're a*

sculptor and they'll say, 'Oh, how exciting, how wonderful.' And I tend to say, 'What's so wonderful?' It's like being a mason, or a carpenter, half the time. But they don't wish to hear that because they really only imagine the first part, the exciting part. But, as Khrushchev once said, that doesn't fry pancakes, you see. That germ of an idea does not make a sculpture which stands up. It just sits there. So the next stage is the hard work. Can you really translate it into a piece of sculpture?"

Jacob Rabinow, an electrical engineer, uses an interesting mental technique to slow himself down when work on an invention requires more endurance than intuition: "*When I have a job that takes a lot of effort, slowly, I pretend I'm in jail. If I'm in jail, time is of no consequence. In other words, if it takes a week to cut this, it'll take a week. What else have I got to do? I'm going to be here for twenty years. See? This is a kind of mental trick. Otherwise you say, 'My God, it's not working,' and then you make mistakes. My way, you say time is of absolutely no consequence."*

Despite the carefree air that many creative people affect, most of them work late into the night and persist when less driven individuals would not. Vasari wrote in 1550 that when Renaissance painter Paolo Uccello was working out the laws of visual perspective, he would walk back and forth all night, muttering to himself: "*What a beautiful thing is this perspective!"* while his wife called him back to bed with no success.

4. Creative people alternate between imagination and fantasy, and a rooted sense of reality. Great art and great science involve a leap of imagination into a world that is different from the present. The rest of society often views these new ideas as fantasieswithout relevance to current reality. And they are right. But the whole point of art and science is to go beyond what we now consider real and create a new reality. At the same time, this "escape" is not into a never-never land. What makes a novel idea creative is that once we see it, sooner or later we recognize that, strange as it is, it is true.

Most of us assume that artists—musicians, writers, poets, painters—are strong on the fantasy side, whereas scientists, politicians, and businesspeople are realists. This may be true in terms of day-to-day routine activities. But when a person begins to work creatively, all bets are off.

5. Creative people tend to be both extroverted and introverted. We're usually one or the other, either preferring to be in the thick of crowds or sitting on the sidelines and observing the passing show. In fact, in psychological research, extroversion and introversion are considered the most stable personality traits that differentiate people from each other and that can be reliably measured. Creative individuals, on the other hand, seem to exhibit both traits simultaneously.

6. Creative people are humble and proud at the same time. It is remarkable to meet a famous person who you expect to be arrogant or supercilious, only to encounter self-deprecation and shyness instead. Yet there are good reasons why this should be so. These individuals are well aware that they stand, in Newton's words, "*on the shoulders of giants*." Their respect for the area in which they work makes them aware of the long line of previous contributions to it, putting their own in perspective. They're also aware of the role that luck played in their own achievements. And they're usually so focused on future projects and current challenges that past accomplishments, no matter how outstanding, are no longer very interesting to them. At the same time, they know that in comparison with others, they have accomplished a great deal. And this knowledge provides a sense of security, even pride.

7. Creative people, to an extent, escape rigid gender role stereotyping. When tests of masculinity/femininity are given to young people, over and over one finds that creative and talented girls are more dominant and tough than other girls, and creative boys are more sensitive and less aggressive than their male peers.

This tendency toward androgyny is sometimes understood in purely sexual terms, and therefore it gets confused with homosexuality. But psychological androgyny is a much wider concept referring to a person's ability to be at the same time aggressive and nurturant, sensitive and rigid, dominant and submissive, regardless of gender. A psychologically androgynous person in effect doubles his or her repertoire of responses. Creative individuals are more likely to have not only the strengths of their own gender but those of the other one, too.

8. Creative people are both rebellious and conservative. It is impossible to be creative without having first internalized an area of culture. So it's difficult to see how a person can be creative without being both traditional and conservative and at the same time rebellious and iconoclastic. Being only traditional leaves an area unchanged; constantly taking chances without regard to what has been valued in the past rarely leads to novelty that is accepted as an improvement. The artist Eva Zeisel, who says that the folk tradition in which she works is "*her home*," nevertheless produces ceramics that were recognized by the Museum of Modern Art as

masterpieces of contemporary design. This is what she says about innovation for its own sake:

"*This idea to create something is not my aim. To be different is a negative motive, and no creative thought or created thing grows out of a negative impulse. A negative impulse is always frustrating. And to be different means 'not like this' and 'not like that.' And the 'not like'—that's why postmodernism, with the prefix of 'post,' couldn't work. No negative impulse can work, can produce any happy creation. Only a positive one*."

But the willingness to take risks, to break with the safety of tradition, is also necessary. The economist George Stigler is very emphatic in this regard: "*I'd say one of the most common failures of able people is a lack of nerve. They'll play safe games. In innovation, you have to play a less safe game, if it's going to be interesting. It's not predictable that it'll go well."*

9. Most creative people are very passionate about their work, yet they can be extremely objective about it as well. Without the passion, we soon lose interest in a difficult task. Yet without being objective about it, our work is not very good and lacks credibility. Here is how the historian Natalie Davis puts it:

"*I think it is very important to find a way to be detached from what you write, so that you can't be so identified with your work that you can't accept criticism and response, and that is the danger of having as much affect as I do. But I am aware of that and of when I think it is particularly important to detach oneself from the work, and that is something where age really does help*."

10. Creative people's openness and sensitivity often exposes them to suffering and pain, yet also to a great deal of enjoyment. Most would agree with Rabinow's words: "*Inventors have a low threshold of pain. Things bother them*." A badly designed machine causes pain to an inventive engineer, just as the creative writer is hurt when reading bad prose.

Being alone at the forefront of a discipline also leaves you exposed and vulnerable. Eminence invites criticism and often vicious attacks. When an artist has invested years in making a sculpture, or a scientist in developing a theory, it is devastating if nobody cares.

Deep interest and involvement in obscure subjects often goes unrewarded, or even brings on ridicule. Divergent thinking is often perceived as deviant by the majority, and so the creative person may feel isolated and misunderstood.

Perhaps the most difficult thing for creative individuals to bear is the sense of loss and emptiness they experience when, for some reason, they cannot work. This is especially painful when a person feels his or her creativity drying out.

Yet when a person is working in the area of his of her expertise, worries and cares fall away, replaced by a sense of bliss. Perhaps the most important quality, the one that is most consistently present in all creative individuals, is the ability to enjoy the process of creation for its own sake. Without this trait, poets would give up striving for perfection and would write commercial jingles, economists would work for banks where they would earn at least twice as much as they do at universities, and physicists would stop doing basic research and join industrial laboratories where the conditions are better and the expectations more predictable.

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Column written by professor Valeriu Dulgheru, Ph.D. Dr. Sc. from Technical University of Moldova

PERSONALITIES FROM THE MERIDIANS OF THE ENGINEERING UNIVERSE

Pop Liviu Emil was born on 10 December 1919 in Dragu commune, Cluj county (nowadays Sălaj county), situated in the Someşan Plateau.

Unfortunately, it so happened that he lost his father at the age of 4. In order to bring up her two children – Liviu Emil and Veturia Elvira – their widowed mother, Lucreția Pop, started to make clothes for the villagers by using a sewing machine. Furthermore, she also received the job of a substitute teacher at the village school. Liviu Pop attended the primary school in his native village. As a child, he actually used to enjoy participating in the field work. In the autumn of 1930, he was enrolled as a pupil at "*Emanoil Gojdu*" High Shool for boys, in Oradea, and he lived in the Greek-Catholic boarding-school where orphan children were offered a reduction in the livelihood taxes and where, owing to the strict discipline imposed on the students, he acquired the ability to efficiently organise his activity.

For health reasons, starting with the autumn of 1935, he moved to "*Simion Bărnuțiu*" High School for boys, in Şimleul Silvaniei. In 1938 he graduated and took the school-leaving examination in Oradea. At that time, the baccalaureat diploma offered the young people the opportunity to hold any position, and the admission to a number of faculties was gained on the basis of this diploma only. Liviu Pop easily decided to enrol in the Faculty of Agronomy in Cluj owing to the talks he had had with students of this faculty during their practical work, but also owing to the fact that his mother had obtained a bursar job and even accommodation at the teacher training school in Cluj.

Student at the Faculty of Agricultural Science in Cluj

Admission was attained on the basis of a contest, the result of which allowed him to receive a scholarship. He had the illustrious Iuliu Prodan as professor of Vegetable Systematics, Anatomy and Physiology and Alexandru Buia as assistant lecturer, the one who was later to become the rector of the Agronomical Institute in Craiova. He attended the third year in Timişoara, where the faculty in Cluj had moved to as a consequence of the Vienna Dictate through which Romania was forced to cede the north of Ardeal province. He took the graduation examination on 25 February 1943 and obtained the agricultural engineer diploma no. 230 on 20 April 1943, released by the Polytechnic School of Timişoara, being the second best of his series of graduates.

Assistant lecturer in Timişoara and Cluj.

Immediately after taking the diploma examination, he was summoned to resume his military training until 15 November 1943, at the Military Section of the Polytechnic School in Timişoara. At the same period, professor Amilcar Vasiliu proposed him a post of assistant lecturer at the chair of Agrology and beginning with 1 July 1944, Liviu Pop was appointed to this post by the Minister through Decision 132592/1943. The procedure in use at that time required that an assistant lecturer should have a three-year-period of probation, during which he was supposed to attend the course and the practical work, learn a foreign language and prepare a synthesis report on a given subject.

The subject prepared by Liviu Pop was "*Controversy about classification of soils*" depending on the content of sands, clay and argil. It was the first paper published by Liviu Pop in the Annals of the Faculty of Agricultural Science in Cluj, 1946, vol. 11. In the autumn of 1945, the Faculty of Agricultural Science returned to Cluj and Liviu Pop continued his activity of assistant lecturer. He assisted professor Amilcar Vasiliu in lithographing the course "*Soil research through physical methods*". As laboratories were not provided with the necessary equipment, the teaching staff engaged in creating laboratory apparatus by themselves. Liviu Pop designed and produced a sieves system for ascertaining the stability of soil aggregates under water influence and a device for determining the resistance of soil aggregates under pressure, called Pop balance. In October 1948 he won by contest a position of lecturer. He was involved in several subjects of research among which "*The influence of crop rotations and agricultural work on the soil structure*", "*The influence of the cultivator, the*

harrow and the hoeing machine on the lacunary space in the soil", "*The influence of drought on cultivated plants*". The results of the research were published by the end of the year 1949 in 8 scientific studies, 2 articles of technical guiding, 38 articles of scientific popularization, 35 articles of technical guiding, published in papers and in scientific journals such as "*The Annals of the Faculty of Agricultural Science in Cluj*", "*Agriculture*", "*Agricultural Problems", "Sciences Journal*".

Professor at the Agronomical Institute and the University of Craiova

On 25 April 1947 the University of Craiova was set up, which also included the Faculty of Agricultural Science. On 8 April 1949 Aurel Moraru, the Rector of the Agronomical Institute in Craiova sent Liviu Pop the following telegram: "*Through ministerial Decision no. 134/31/03/1949 you are appointed as professor at the Chair of Pedology. You are requested to present yourself there urgently*". The Superior Commission for diplomas within the Ministry of Education and Training, gathered on 2 March 1963, confirmed his professor status, the decision being set forth through the Order no. 191/21.03.1963.

Through the period of the years 1957-1967 he also worked as part time researcher at the Agricultural Station in Şimnic, being head of the Agrotechnics laboratory. In 1955 he took part in the setting up of Tâmbureşti Center of Research on turning the sandy soils to good account. It was the beginning of a long period of successful pioneer research activity conducted on the sandy soils of south western Oltenia, an activity which he carried out until his retirement and which resulted in many scientific papers. In his capacity as scientific Secretary of the Teaching council, he looked after the publishing of the scientific papers elaborated by the teaching staff. So, in 1957 the first issue of "*The Annual of the Scientific Papers of the Agronomical Institute in Craiova*" appeared, then, since 1958, "*Scientific Bulletin*" and since 1963 "The Annals of the University of Craiova. Biology-Agronomy and Horticulture Series" for which the General Management of Press and Printed Work gave the authorization no. 837.

On 1 October 1967 he was appointed Head of the Chair of Agrophytotechnics through the official letter no. 100587/1967 of the Ministry of Education. During 1968-1970 he was scientific Secretary of the Senate of the University in Craiova. On 1 March 1967, by Order no. 2571 of the Ministry of Education, he was appointed to the office of Dean of the Faculty of Agricultural Science which he held up to 15 May 1972.
In 1981, through the Order no. 6923 of 13.06.1981 the Ministry of Education and Training awarded him the title of "*Distinguished professor*". In 1991 he was designated as titular member of the Academy of Agriculture and Sylviculture Sciences.

Doctor of Science

He presented his PhD thesis on the subject "*Research on establishing the system of using the chemical fertilizers in the rye-maize rotation on the sands left of the Jiu river*" on 29 February 1968, thesis elaborated under the guidance of Prof. Dr. Ioan Safta. It was the first public PhD thesis presentation held in Craiova, within the Faculty of Agronomy. Liviu Pop was bestowed the mark "*summa cum laude*". The diploma no. 1/15.03.1971 was released by the University of Craiova. Starting with the academic year 1969-1970 he received the status of PhD supervisor (The Order no. 965/11.10.1969 of the Ministry of Education).

On 25 February 1974, in front of a Ministry appointed Commission, at "*Nicolae Bălcescu*" Agronomical Institute in Bucharest, Liviu Pop publicly set out a professional activity report, on the basis of which he was conferred the degree of senior lecturer, confirmed by the Superior Commission for Diplomas on 25 May 1974.

Teaching and research activity

In 1957 he elaborated the course of General Agriculture, in three volumes, lithographed during 1958-1959, the first course in lithographic form at the Agronomical Institute of Craiova. Over the academic years 1970-1971 and 1971-1972 he delivered the course "*The rational using of the sands*" to fourth-year and fifth-year students. Since 1972 and until his retirement in 1985, he delivered to the students the course of Agrotechnics and Experimental Technique at the Faculty of Agricultural Science. In 1976 he published this course in litographic form, in two volumes comprising 852 pages.

In 1965 he participated in CAER conference on using the light soils, held in Budapest, where he delivered the lecture "*The agricultural production increase on sandy soils by means of fertilizers*". In 1970 he took part in the International Symposium concerning basic agrotechnical work on the soil, with the paper "*Research into agrotechnical work on the sandy lands in the south-west of Romania*".

In 1977 he published at Ceres Publishing House, together with lecturer Dr. Ion Matei and

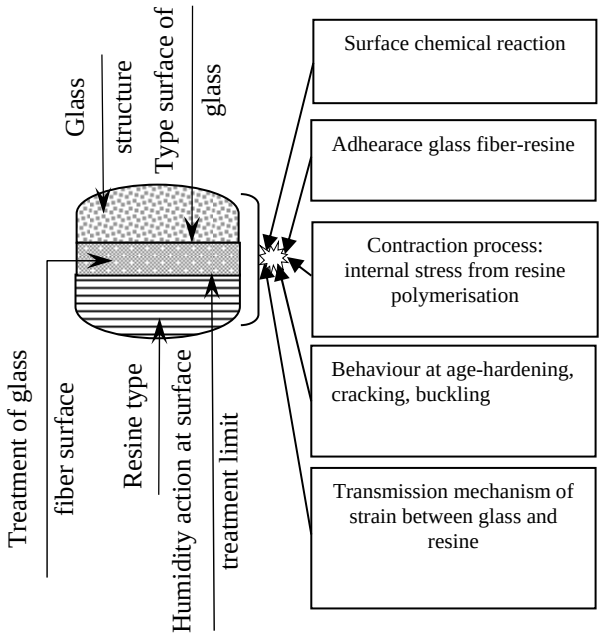


Figure 2. Influence factors over glass fiber – resine binding.

and possibilities of technic utilization, so that a classification with strict deliminations is difficult. The utmost peculiarity of new composite material family consists in the fact that their properties are apriori prescribed, relizing on mechanical, thermic, chemical, electrical stresses which these follows to be subdued.

The main interest which thermosetting polymer composites represent results by the fact that takeing over action:

- nature of essential constituent – matrix and reinforcing fibres;
- ratio between components;
- reinforcing fibres orientation after directions of stresses

on obtain the characteristics aimed by design.

3. COMPOSITE MATERIALS – THE XXITH CENTURY MATERIALS

The extension and diversification of utilization field transformed the polymer composite materials by simple substitute of overstressed traditional materials – wood, glass, iron – in structural materials. There is maintaing that today, any field of life appeals to the composite materials, so it's remarking following aspects, fig. 3:

- the highest production of composite materials is in U.S.A, followed by Japan and Germany;
- the highest consumption per year and man to this type of material is possessed by Germany, than U.S.A. and France;
- the highest share of composites utilization in building is in Italy, on the second place being Japan and than France.

The application of the polymer composite materials in the building field direct to a multitude advantages, so that:

- the energy consumption for obtaining these composite materials is considerable less than iron, aluminium, fig. 4.a;
- the reduced weight comparative with traditional structural materials, fig. 4.b, involves a reduce inertia which appears in the earthquarke time;
- the tensile strength of composites undergos major influences by reinforced material, fig. 4.c;
- this material sensibility is given by it elasticity modulus, low enough comparatively other materials, fig. 4.d;
- the maximum admitted temperature for the thermal stress, fig. 4.e, can be ameliorated by admixture of chlorine or bromide raw material in polymer resine;
- the recognized behaviour at atmospheric and chemical agents enables the using of polymer composites like building material for chemical industry or other industries with high degree of corrosion.

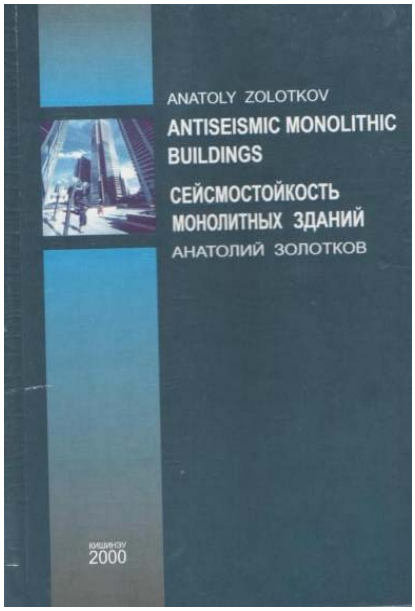
4. CONCLUSIONS

The brief presentation of some phisico-chamical properties of technic fibres reinforce of polymer composite materials, by comparison with other traditional materials for building using, locates the new family materials beside of its. These are now strong reason to declare that we are on the threshold of a new civilization, those of composite materials.

This material has the best phisico-technic properties which are determinated by scientific research of specialists from varied domains: chemistry, physics, mathematics, strength of materials, and engineering of building.

APPRECIATION

of monograph ***„Antiseismic monolithic buildings”,*** author Zolotcov A., edited by publishing house “*Cartea Moldovei*”, 2000, 284 p.



The monograph comprises the results of scientific research: theoretic, experimental, design and exploration ones, performed by Mr. Anatolie Zolotcov throughout many years of scientific work in the area of anti-seismic construction of buildings with reinforced concrete structural walls.

The author’s ideas are expressed with scientific competency, fact that proves a very solid specialized education; the presented monograph contains elements of scientific novelty, which are pertinently argued both with a rich theoretic support as well as with numerous examples of situations and practical cases.

The paper laconically describes the state of anti-seismic construction of buildings with reinforced concrete structural walls, their behaviour during severe earthquakes, as well as presents the results of examinations by the author of basic unsolved problems regarding the anti-seismic design of these buildings.

A particular interest of this research represents the natural scale dynamic tests on two fragments of buildings with a six levels height regime, until their destruction and further consolidation to resume the dynamic tests.

The static and dynamic scientific research performed by the author have allowed to:

1. Develop efficient systems of composing reinforced concrete structural walls for alternate oscillatory stresses;
2. Develop a calculation method for reinforced concrete structural walls for alternate oscillatory stresses, which takes into account the technologic peculiarities of raising buildings with reinforced concrete structural walls – separate concreting of walls and arranging technological points;
3. Develop an analytic calculation method to establish the bearing capacity of reinforced concrete buildings walls during seismic stresses.

The developed analytical calculation method to establish the strength of reinforced concrete structural walls at their breaking along inclined sections was used in the following construction norms in the Republic of Moldova:

1. NCM F.02.02-2006. Calculation, designing and composing of reinforced concrete and pre-compressed concrete construction elements. Chisinau: 2006;
2. PCH 13-87. Construction of monolithic buildings in seismic areas of the Moldovan SSR, Republican building norms (Part I), Chisinau, 1988.

The monograph complements the series of scientific works with distinct scientific value; its existence and possible publication will enrich the specialized literature with a necessary and welcome paper in this area.

All these aforementioned allow us to determine the fact that the monograph is a finalized work, which can be successfully used by scientists, engineers and planners that work in the area of anti-seismic constructions in the Republic of Moldova, as well as in other countries.

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