

## ACOUSTIC PROPERTIES OF ROAD SURFACE CONTAINING CRUMB RUBBER

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### **ABSTRACT**

The results on acoustic properties of road pavement on the experimental section of road II/548 (Slovakia) are presented in the paper. The results were obtained from the measurements of noise levels which were carried out in 2014. The road surface of experimental section AC O 11 was prepared with the addition of crumb rubber (1,25%) from recycled tires as a substitute of aggregates in asphalt mixture. The measurements were carried out using the SPB (Statistical Pass-By) method and the maximum noise levels during the passage of the vehicle near the microphone were also detected. The SPBI index was calculated and the results were compared with those obtained for the reference pavement in order to determine the impact of innovative road surface (containing crumb rubber from recycled tires) on noise levels.

**Keywords:** noise, measurements of noise levels, Statistical Pass-By method, SPBI index

## AGGREGATES RECYCLING USED ON FOAMED BITUMEN ASPHALT LAYERS

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### ABSTRACT

It is known that the oil is not an inexhaustible resource and therefore the price increasing. Bitumen is a petroleum product and this is the reason for using foamed bitumen instead of pure bitumen when it needs a binder for pavement composite materials. Technology with foamed bitumen mix consists of mixing aggregates at ambient temperature, filler, possibly hydraulic binders and spraying hot bitumen as foam. Among the foamed bitumen using in pavement construction and maintenance, the pavement recycling using foamed bitumen technology occupies an important place. This paper presents a case study on flexible pavements containing a base layer made of foamed bitumen mixture resulted from "in situ" recycling of existing asphalt layers. Will be presented comparatively the results obtained on original pavement, damaged pavement and reinforced pavement, results to highlight the benefits of reuse and conservation of non-renewable natural resources and environment preservation.

**Keywords:** recycling, foamed bitumen mix, half-warm-mix technology, damaged pavement, reinforced pavement

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## BUFFERING CAPACITY OF SULFIDE MINE TAILING AMENDED WITH ALKALINE MATERIALS

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### ABSTRACT

The ability of sulfide mine tailing (SMT) treated with alkaline materials to buffer or neutralize anthropogenic acidity depends on several factors including the amount and types of acid-neutralizing compounds present in SMT matrix. The main objective of this laboratory experiment is to assess the acid buffering capacity of SMT samples after their stabilization with chicken eggshell residue (CES), commercial cement rich in calcareous products (CCM), dolomitic limestone (DOL), calcitic limestone (CAL) and magnesium oxide (MGO). The treatments were as follows: SMT without alkaline materials (AM); 2% CCM; 4% CCM; 10% CCM; 2% MGO; 2% DOL; 2% CAL; 2% CES; 4% CES; 10% CES; 10% CES + 2% CCM; 10% CES + 2% DOL; 10% CES + 2% CAL; 10% CES + 2% MGO. Two days after the addition of 0.5 ml of 0.05 mol/l sulfuric acid, the decrease in pH ranged over several orders of magnitude in SMT treated with CES and CAL. In general, the lowest values of pH were recorded in SMT amended with 2% and 4% CES (pH 3.3 and 3.5 respectively) and 2% CAL (pH 3.9). The pH of all acidified aqueous SMT samples increased gradually over time. Chicken eggshell residue mixed with MgO or cement was considerably more efficient in neutralizing sulfuric acid than CES alone. At the end of the equilibration period (56 days), the pH values of aqueous SMT+ 2% AM suspensions (solid:liquid ratio of 1:20, w/v) increased in the following order: SMT + 2% MGO (pH 9.0) > SMT + 2% CCM (pH 8.6) > SMT + 2% limestone (CAL or DOL) (pH 7.3 – 7.5) > SMT + 2% CES (pH 7.0). The study showed that sulfide mine tailing treated with magnesium oxide or cement was stable and well buffered to acidifying input. The results suggested that magnesium compounds and calcareous products rich in hydroxides, oxides and carbonates present in limed SMT would provide long-term protection against acid deposition or re-acidification of limed SMT.

**Keywords:** chicken eggshell, cement, calcareous materials, magnesium oxide, acidification.

## **CHARACTERIZATION OF THE EMULSIONS USED FOR COLD ROLLING STEEL STRIPS WITH THE VIEW OF THEIR VALORISATION**

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### **ABSTRACT**

Study of the degraded emulsions characteristics during rolling thin strips of steel, has an important role in determining the valorizations' methods of these waste and for reducing environmental pollution. The emulsion system is crucial in the production of cold rolled steel strips, having an important role in the process of lubrication, cooling and cleaning. The paper characterized emulsions depending on their wear degree. Were analyzed physical - chemical properties (viscosity, density, pH, turbidity, chemical composition) of different emulsions beginning the initial state and during use rolling technological process as well as impure products assimilated during rolling. Based on the experimental results have proposed some valorizations methods of the emulsions used in cold rolling steel strip.

**Keywords:** properties, emulsion, rolling, steel strip

## COMPRESSIVE STRENGTH OF SLAGS AS A RATE OF THEIR HYDRAULICITY

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### ABSTRACT

Hydraulicity is the property of a binder to harden in contact with water. This property is usually associated with lime or cement. Hydraulicity is produced by burning a limestone containing silica, alumina and iron oxides which above certain temperatures combine totally or partially. There are a lot of factors that can influenced the hydraulicity (chemical composition, temperature, pressure and grain size etc.). In this contribution the influence of chemical composition four kinds of metallurgical slags (blast furnace slag granulated and gravel and cupola furnace slag granulated and gravel) on compressive strength of slags were obtained. Theoretical hydraulicity of all slags was reated. Experimental hydraulicity was evaluated as a compressive strength of samples of slag after 1, 2, 24 48 hours, after 7, 14 , 21 and 28 days. Theoretical hydraulicity of all slags was low, the highest value achieved blast furnace slag – granulated, the lowest cupola furnace slag – granulated. The highest experimental hydraulicity in the very short time achieved blast furnace slag –gravel and samples from granulated cupola furnace slag was disintegrated after 46 hours.

**Keywords:** blast furnace slag, cupola furnace slag, hydraulicity, compressive strength

## **ECO-EFFICIENT RECOVERING OF VALUABLE IRON UNITS FROM METALLURGICAL WASTES**

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### **ABSTRACT**

Environmental Romanian national regulations, harmonized with European legislation, have imposed a new approach for solving the problems of wastes resulted from integrated steel mill plant. For the materials that have been historically disposed into a dump is imposed to find eco-efficient solutions to mitigate the environmental impact of waste and to them eliminating. Finally is possible to rehabilitate the landscape. An ecological management of these wastes may rely on opportunity to sort these materials and to recover them in function with their characteristics. The fractions of metallurgical slag as valuable iron units can be recycled in the sintering process as materials input for obtaining the ferrous agglomerate. The paper presents the properties of iron-containing materials that will be recycled in the sintering process. This recovered fraction was analysed by microscopy to establish the phase composition. Also the physical and chemical analyses were performed. The properties of valuable materials and its structural phases were discussed in relation with the quality of sintering product and the optimal operation of sintering machine.

**Keywords:** dump, iron-rich slag, recovery, sintering process

## EFFECTIVENESS OF EGGSHELL RESIDUES MIXED WITH ALKALINE AMENDMENTS IN ACID MINE DRAINAGE REMEDIATION

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### ABSTRACT

Liming is a prerequisite for sustainable stabilization and neutralization of acid - producing sulphide mine tailings. Lime is a compound of calcium or calcium and magnesium capable of neutralizing acid compounds in the soil. A laboratory experiment was conducted to investigate the possibility of utilizing chicken eggshells alone or mixed with five alkaline materials as a liming material on acidic sulphide mine tailing (SMT). Samples of air-dried SMT (pH 3.3) were treated with chicken eggshells (CES) alone or in combination with concrete residue rich in calcareous products (Portland cement) (CCM), dolomitic limestone (DOL), calcitic limestone (CAL) and magnesium oxide (MGO). The treatments were as follows: SMT without neutralizing agents; 1, 2, 4, 8 and 10% CES alone or in combination with 1 and 2% CCM, 1 and 2% MGO, 1 and 2% DOL or 1 and 2% CAL; 1, 2, 4, 8 and 10% CCM; 1 and 2% CAL; 1 and 2% DOL; 1 and 2% MGO. Acid tailing neutralization experiment was carried out by mixing 10.0 g of treated tailing samples with 25 ml of double distilled water. The tailing suspensions were allowed to equilibrate for 70 d at room temperature with occasional shaking. Tailing suspension pH ( $pH_{TS}$ ) was measured after 1 h, 7 d, 14 d, 21 d, 35 d, 56 d, and 70 d. Each treatment was replicated two times. Application of the highest rate of CES (10%) alone increased  $pH_{TS}$  from 2.61 (control) to 7.24 in 70 days. However, when adding 2% of cement or 2% MGO to the CES-amended tailing,  $pH_{TS}$  values increased from 7.24 (10% CES) to 8.78 or 8.54, respectively. The increase in  $pH_{TS}$  was generally greater for tailing samples receiving CCM alone (pH 8.35-11.52). The lowest  $pH_{TS}$  was obtained with CES-treated tailings (7.18-7.24). CES mixed with CCM or MGO are more efficient in maintaining alkaline conditions ( $pH_{TS} > 8$ ) in the tailing than CES + CAL or CES + DOL, due probably to the higher neutralizing capacity of magnesium oxide and cement. Aluminum, copper, iron, manganese and zinc were not detected in aqueous suspensions of treated-tailing samples, due probably to their chemical precipitation. These results may have practical implications in tailing management for the reduction of acid generation and trace metal mobility in sulphide mine drainage system and of water contamination risk. Alternative liming materials such as cement and magnesium oxide mixed with eggshells may be used as a calcitic amendment to neutralize acid-producing mine tailings.

**Keywords:** amendment, neutralization, pH, waste reuse, liming materials.

## **EFFECTS OF POST-CONSUMER TYRE RUBBER ON THE MECHANICAL PROPERTIES OF MORTARS**

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### **ABSTRACT**

Hundreds of millions of scrap tires are generated in developed countries all over the world and start posing a serious environmental problem as current disposal methods are wasteful and costly. One of the best methods of recycling used tires is to reuse them after rethreading. The resulting rubber crumbs can find their use concrete because, together with steel wires, they have a restraining effect on the crack propagation, leading to an increased ductility and energy absorption capacity. The paper presents the preliminary results obtained from a long series of experimental investigations on the suitability of using rubber aggregate as mineral aggregate substitute in Portland cement concrete mixes. The research focuses on determining the strength characteristics of rubberized mortar depending of the percentage of rubber crumbs present in the mix. It was found to possess smaller unit weight than traditional cement based mortar. A statistical analysis of the experimental data shows that the percentage by volume of rubber in the mix has a significant effect on strength. Unlike plain mortar, rubberized mortar did not exhibit the typical brittle failure but a more ductile one.

**Keywords:** rubberized mortar, tire rubber crumbs, flexural strength, compressive strength of rubberized mortar

## **ENERGY BUDGET OF PROCESSING OF METAL-BEARING WASTES BY THE PLASMA TECHNOLOGY**

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### **ABSTRACT**

This work represents preliminary metallurgical testing of the plasma equipment for recycling metal-bearing wastes. It is concentrated on determination of energy budget of experimental heats, measurement and record of chosen parameters, heat losses, efficiency of plasma energy transmission, interaction of metal smelt and slag former, technical documentation of electric measurement portion and control and assessment of air pollution in combustion fumes.

**Keywords:** energy budget, processing of metal-bearing wastes, plasma metallurgy

## **EVALUATION OF COMPOSTED WINERY WASTES REUSED AS FERTILIZER**

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### **ABSTRACT**

Nowadays, there is a growing interest in the exploitation of the residues generated by wine industry. Increasing demand for materials used as substrates in horticulture have led to the search of new high quality and low cost ones. As a result of the above mentioned, this research deals with the study of 4 variants of substrate composed from forestry compost (FC), leaves compost (LC), peat (P) in equal quantities and grape marc compost (GM) in different volumetric ratio proportions with emphasis on nutrients availability. These were percolated on columns with distilled water and Coïc nutritive solution in order to establish the cation exchange, retention and release of ions that occur after irrigation or fertilization with nutritive solutions. The agrochemical characteristics of substrates (pH, EC, soluble forms of main nutrients) were analyzed in the substrates. The exchangeable forms of nutrients were determined in  $\text{CH}_3\text{COONH}_4$  0.5M, pH=4.65, 1:3 v/v ratio. High potassium, calcium and magnesium levels have been identified in grape marc composts and this feature has received particular attention in our research.

**Keywords:** grape marc compost, substrate, cation exchange.

## HEAVY METAL REMOVAL USING GEOPOLYMERS – A MODERN APPROACH FOR POLLUTION CONTROL

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### **ABSTRACT**

Geopolymers are inorganic polymers compiled of  $\text{SiO}_4$  and  $\text{AlO}_4$  chains, bonded by a shared oxygen atom and balanced by cations. Because of their flame resistance, geopolymers are nowadays used as a construction material and fillers. Geopolymers used for heavy metal immobilization particularly consist of aluminosilicates and fly ash and their mixture. This study is focused on heavy metal removal using geopolymers, especially Cu, Cd, Pb and Cr. However late studies have proven, that geopolymers have a great potential for heavy metal removal, their alternative usage in field of pollutant control and immobilization from the environment requires further research and testing.

**Keywords:** aluminosilicates, fly ash, geopolymers, heavy metals

## **INFLUENCE OF GYPSUM-BASED CEMENTITIOUS MATERIALS ON THE EARLY AGE STRENGTH CHARACTERISTICS OF MORTARS**

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### **ABSTRACT**

Concrete is a mixture between two main components: cement paste and aggregates. While the aggregates and the water can be easily found in nature, cement needs special processing plants to be produced. Taking into account that the concrete industry is the largest consumer of natural resources in the world, one could only imagine the environmental burden it creates. The present paper brings its contribution to the investigation on the use of a new binder as partial or total replacement of the ordinary Portland cement in concrete. The anhydrous calcium sulphate based binder is obtained exclusively from industrial wastes and can be entirely recycled after its expiration date. The obtained results show a decrease in the flexural and compressive strengths of mortars with small replacing percentages of anhydrous calcium sulphate compared to the reference sample made with Portland cement. However, the flexural strength increases tremendously for higher percentages of anhydrous calcium sulphate.

**Keywords:** eco-material, anhydrous calcium sulphate, cement replacement, mechanical properties

**INFLUENCE OF OZONE ON SOLID CARBONACEOUS PRODUCTS  
OBTAINED BY PYROLYSIS OF POLYETHYLENE TEREPHTHALATE**

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**ABSTRACT**

Pyrolysis is considered one of the possibilities of conversion of waste polyethylene terephthalate, which is an important raw material used in the manufacture of packaging, especially PET bottles. The article describes the effects of ozone on the properties of the solid pyrolysis residue obtained by pyrolysis of pure colorless polyethylene terephthalate. Results have shown that ozone has a negative effect on the size of the specific surface of the carbon material and thus its sorption capacity.

**Keywords:** pyrolysis, polyethylene terephthalate, solid pyrolysis residue, ozone

## **INFLUENCE OF WASTE REFRACTORY BRICK ON THE THERMAL AND MECHANICAL BEHAVIOR OF MORTARS**

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### **ABSTRACT**

In recent years there in various high temperature applications to a gradual replacement of refractory shaped by monolithic materials (concrete). These have the advantage of being more flexible in their utilization and cooked directly on site during the initial startup of the facility. The development of efficient hydraulic binder allows heavier use of these monolithic materials. This study has allowed us, first, to enhance the waste in mechanical terms (20 % added) and to identify the optimal composition relative to the reference composition (0% added). According to the study on the thermal behavior of these mortars at high temperatures, there is a proportional increase in mass loss as a function of temperature. The sample containing 20% added shows good thermal stability since its mass loss is lower compared to other compositions. The test pieces in which the percentage of addition is less than or equal to 10 % do not exhibit heat resistance at high temperatures (chipping, cracking and splitting).

**Keywords:** Refractory brick waste; mortar, Fine aggregate replacement; Compressive strength, loss weight.

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## ISSUE OF DETERMINING THE AMOUNT OF CONSTRUCTION WASTE ON BUILDING SITE

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### ABSTRACT

The construction industry presents the third largest polluter of the environment. One of the significant aspects of environmental pollution is an origin of construction and demolition waste (C&DW) which present even  $\frac{1}{3}$  of total waste generation in the European Union. Given that, the European Union legislation and its subsequent implementation into the national laws is detailed focused on waste management. The relevant laws and regulations exactly define the obligations of construction waste producers (i.e. constructors or construction companies) in the field of C&DW disposal. One of the integral parts of this procedure is a detailed registry of wastes type and amount. On the other hand, currently in Slovakia is not any methodology that allows accurately and clearly determine of origin C&DW quantity and its identification according the European waste list already during the realization or reconstruction of buildings. Subsequently, the record system of C&DW is weakly controllable, thus are creating the area for the reporting of inaccurate (often skewed) data concerning the waste origin.

The submitted paper is focused on the analyses of foreign studies and ICT tools used in the field of C&DW quantification and classification on building sites and the mapping of the facts in the registration C&DW origin in the conditions of Slovak construction. Based on the obtained knowledge and the analysis of legislative requirements in field of waste management is proposal the system for determining of type and amount C&DW from particular construction processes. The key element of presented methodology is the processing of C&DW matrix, which is aimed at identifying the construction processes and type and amount of C&DW during its realization. The proposed matrix of C&DW can present the simple tool for the classification and quantification of C&DW on building site, which clarifies the data in field of C&DW registration. The matrix functionality was verified in several case studies.

**Keywords:** construction and demolition waste (C&DW), identification, quantification, matrix

## **LABORATORY EXPERIMENTAL STUDIES ON THE USE OF RUBBER POWDER IN BITUMINOUS ROAD LAYERS**

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### **ABSTRACT**

This paper deals with laboratory experimental study on 50/70 bitumen supplied by OMV Austria. This study aims to determine the characteristics of the bitumen in the mass of which different percentages of rubber powder were introduced ranking between 8...20%.

The rubber powder resulted in a proportion of 20 ... 80% from truck tires and up to 80 ... 20% from car tires waste, ground with a particle size not exceeding 1 mm.

Once the optimal percentage of rubber powder in the was determinated bitumen mass, the bitumen was used to obtain a dosage of type BA 16 asphalt mixture, we determined its mechanical and physical characteristics and compared it with the same asphalt mixture made with no added weight rubber powder in the asphalt mix.

The results obtained on asphalt-rubber binders lead to changes in the basic properties out of which we can mention the following: increasing the viscosity of the binder, higher resistance to cracking, lesser brittleness, better cushioning impact tire-pavement.

This paper presents the results of determining the common characteristics of bitumen and asphalt mixtures with the addition of rubber powder.

**Keywords:** bitumen 50/70, rubber powder, bitumen-rubber mixture

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**LIFE CYCLE ASSESSMENT FOR LANDFILLING, INCINERATION AND  
MECHANICAL-BIOLOGICAL TREATMENT OF RESIDUAL WASTE FOR  
KRAKOW CITY (POLAND)**

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**ABSTRACT**

The Life Cycle Assessment (LCA) methodology is considered one of the most effective management tools for identifying and assessing the environmental impacts related with waste management options. The aim of this study is the environmental assessment of three scenarios of municipal waste management system in Krakow city (Poland), limited to residual (non-selectively collected) waste. Under the first scenario residual waste is transferred to be landfilled at the modern, well equipped facility. Landfill gas is collected and converted into heat and electricity. Under the second scenario residual waste, without any pre-treatment, will be transferred to a planned thermal treatment plant, with energy recovery. The third scenario covers the mechanical biological treatment of residual waste with the biological stabilization (composting) of organic fraction and the production of the Refused Derived Fuel (RDF). After biological stabilization the compost is sent to be landfilled and RDF is combusted in a cement kiln. Other elements of the system for three scenarios: separate collection of recyclables, recycling of separately collected waste, dismantling bulky waste, composting garden waste are the same for the three scenarios and they are excluded from the system boundary. The modeling of the environmental impact is carried out with EASETECH model, developed by Technical University of Denmark, with employing EDIP 2003 methodology. The final results of modeling are presented as a normalized impact potential in the unit of person equivalent (PE).

Results of modeling show that the negative impact for incineration is much lower than for landfilling. For landfilling the significant impact categories are: photochemical ozone formation and global warming (due to landfill gas emission, treatment and combustion) and also eutrophication, human toxicity (due to leachate). For incineration significant impact categories include: eutrophication, photochemical zone formation, acidification and human toxicity, mainly due to emission of nitrogen oxides from a stack of an incinerator. The lowest environmental impact is indicated for the mechanical biological treatment (MBT) scenario. This scenario contributes negatively to photochemical ozone formation (on human health and on vegetation) and positively to acidification and global warming. The highest share in the negative effect has landfilling of the low quality compost. The process contributing mainly for positive effect is the RDF combustion.

**Keywords:** municipal waste management system, life cycle assessment, environmental impact, landfilling, incineration, mechanical biological treatment.

## METHODOLOGY FOR APPROPRIATE DISINTEGRATIVE TOOL SELECTION FOR WOOD BIOMASS DISINTEGRATION

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### **ABSTRACT**

Disintegration of biomass is one of various preparation processes for biomass processing before its final treatment (production of briquettes or production of pellets). Selection of suitable machine is same important as correct selection of the tool for disintegration. When we change the tool, we can rapidly decrease or increase load of machine, respectively decreasing or increasing of force which is necessary for material disintegration. The same is influence of material type, size of input and also output fraction. From this reason we should to know what are demands for material processing and what is the influence of parameters change and change of disintegrative tool geometry to disintegration process. The aim of following paper is to describe the method for selection of tool for wood biomass disintegration on two-rotor slow-running device. The presented results were achieved based on research which is realized on authors workplace.

**Keywords:** disintegration, shredding, wood biomass, tool,

## METHODS OF RECYCLATION IN WATER JET TECHNOLOGY

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### ABSTRACT

The cutting of materials by using of recycling abrasive water jet (AWJ) belongs to one of clean technologies, which utilize the possibility to divide or cutting the materials that are sensitive to pressure and temperature in material processing. At the same time there is also a need to decrease of waste process after finishing of cutting operation. The contribution deals with the recycling opportunities, possibilities and influence on the working environment.

**Keywords:** water jet technologies, recycling of material, waste

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## NEW VALUABLE PRODUCTS FROM WASTE PLASTIC RECYCLING BY THERMAL DEPOLYMERIZATION METHOD

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### **ABSTRACT**

Our study presents the results obtained in an industrial application of waste plastic recycling by thermal depolymerization. The recycling unit has as main equipment a rotary reactor where the waste plastic is decomposed in order to obtain valuable products: a gas and a liquid fraction. The liquid fraction is useful for many applications. For a better characterization we separated the liquid fraction in other two fractions, a light one (65-175°C) and a heavy one (>175°C). In order to obtain solvents used as cleaning agent or paint thinner we separated the liquid fraction by distillation in other three fractions. The heavy fraction was an excellent source for carbon foams used as insulating material in industrial applications.

**Keywords:** waste plastic, thermal depolymerization, distillation, solvents

**NUMERICAL EVALUATION OF PERIPHERAL CONSTRUCTIONS  
MOISTENING THE BUILDING AFTER THE APPLICATION OF  
POLYURETHANE PLASTER AND PLASTER BASED ON  
ALUMINOSILICATE**

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**ABSTRACT**

The article evaluates a moistened office building built before 1950 after the interval of three years, where a non-destructive moisture rehabilitation was performed using the developed hydrophilic plasters. The evaluation is carried out by means of Delphin software allowing you to take into account the moistening effects taking place in the construction over time and providing exact outputs in the form of specific values describing the moisture content achieved in the masonry. The simulation is based on the measured moisture parameters obtained during the three years of building monitoring, mutually comparing the so-called soft plaster rehabilitation methods according to the WTA with plasters based on polyurethane fillers and plasters based on aluminosilicate waste created during the production of cellular concrete.

**Keywords:** Polyurethane plasters, plaster based on aluminosilicate waste, simulation calculation in Delphin software, energy rehabilitation.

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## OLEFINS PRODUCTION BY STEAM CRACKING OF WASTE VEGETABLE OIL. PRELIMINARY STUDY

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### ABSTRACT

This work continues other authors' efforts to find renewable resources for the production of olefins, either by thermal cracking or by steam cracking. In this preliminary study, the waste frying oil was steam cracked in a micropilot plant containing a continuous flow reactor with controlled temperature and a section for the separation of products. The reaction took place at 650°C with a water-to-feed ratio 1:1 vol/vol. The composition of the cracked gas was determined by up-to-date chromatographic analysis methods: Refinery Gas Analysis developed by Wasson on Agilent 6890 N with multiple columns and different detectors and Sulfur Compounds Analysis on Agilent 7890 A with chemiluminescence detector. The gases total yield was 55.6% wt and the chromatogram confirmed good yields in ethylene (32 %) and propylene (9.8%) as well as other valuable components: hydrogen (7.2%), methane (18%), ethane (9.2 %) and propane (1.3%). A liquid by-product, representing 44.4% wt of the raw can be used as a component as burners fuel, having better burning properties than the vegetable oil. The preliminary study indicates that the steam cracking of waste vegetable oil is feasible with good results. This process can be an alternative to other methods for the recovery of waste vegetable oils.

**Keywords:** olefin production, steam cracking, vegetable oil

**PRACTICAL ISSUES RELATED TO THE PROCESSING OF FIBRE  
REINFORCED CONCRETE MADE WITH RECYCLED MATERIALS**

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**ABSTRACT**

Textile materials are used in the field of building for different applications, from civil engineering to hydrotechnics, mining, landscape engineering, etc. One of the most important problems is the diminishing of the ecological impact of the production of reinforced concrete. The solution is using recycled materials such as fly ash (replacing cement) and fibres (to give strength and improve failure).

The paper deals with problems that occur when the fibres are incorporated in the concrete mix containing fly ash. The paper identifies these problems - fibre floating in the mixing, fibre snagging and fibre clogging, all leading to non-homogenous mixes. The influence of fibre characteristics (length and percentage in the mix) is also pointed out. The adverse effects they have on the behaviour of the reinforced concrete is characterised and solutions are identified on how to eliminate them. Both the civil engineering aspects and the textile aspects of the problems are discussed.

**Keywords:** recycled materials, glass fibres, processability, mechanical behavior, homogenous mix.

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## PROPERTIES OF AGGREGATES OF STEEL-MAKING SLAG

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### ABSTRACT

During the latest period of time, a significant effort to fully use all kinds of by-products can be noticed both in our country and abroad. A lot of metallurgical and chemical production by-products that have hitherto commonly been piled up, are now tested for possible and effective use.

In building industry, conclusive factors for the use of waste materials are their general properties and chemical composition, which should comply with valid technical standards. It is therefore necessary to continuously monitor the properties of waste materials, including steel-making slag, are dealt with.

As in building industry it is possible to use waste materials and to build them in the road structure, it is important to know how particular waste materials will behave in particular structural layers and, of course, whether required criteria on particular pavement structural layers will be met when using waste materials. The use of steel-making slag for road structural layers requires a regular testing of its general and chemical properties. /Times New Roman, 12/

**Keywords:** steel-making slag, properties, chemical composition, use of waste materials

## **ROMELT TECHNOLOGY: NEW POSSIBILITIES FOR RECYCLING OF WASTES**

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### **ABSTRACT**

Major source of mining and metallurgical industrial wastes are considered. It is shown that wastes contain valuable components, and may be used as raw materials for metallurgy. But presence of non-ferrous metals and fine state of the majority of wastes makes their processing by conventional metallurgical technology difficult. Opportunities of smelting reduction technologies for processing wastes and extraction of useful components are shown. Some facts and brief history of Romelt technology and main stages of its development are presented. Operations of pilot Romelt furnace at metallurgical works with the use iron-containing materials including wastes are described. The potentialities of Romelt process for recycling of generated and current iron-containing industrial wastes and improvement of ecological conditions of regions are determined. Calculations of technological indices for iron-containing wastes using Romelt technology are carried out.

**Keywords:** Romelt technology, iron-containing wastes, BOF dust, red mud

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## SMELTING REDUCTION OF IRON OXIDES AS APPLIED TO RED MUD PROCESSING

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### ABSTRACT

Thermodynamic modeling of iron reduction process from liquid slag by carbon was performed in the context of smelting reduction process application for iron (hot metal) production. It has been shown that iron reduction from liquid slag is thermodynamically possible only in case of the absolute bivalent iron (FeO) domination. This stage is always preceded by dissolved trivalent iron (Fe<sub>2</sub>O<sub>3</sub>) reduction up to bivalent iron form.

Experiments pertaining to bivalent and trivalent iron reduction from slag by activated carbon were carried out. It has been shown that the rate of iron oxides reduction from slag with dominant trivalent iron is less compared to that of bivalent iron. This effect was noted for any types of carbon reductant. Because trivalent iron (Fe<sub>2</sub>O<sub>3</sub>) is the main red mud component, this effect is to be considered in the process of development of smelting reduction units intended for red mud processing.

**Keywords:** smelting reduction, bi- and trivalent iron, thermodynamic modeling, red mud, Romelt technology

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## STATISTICAL ANALYSIS OF PROTEIN RESIDUES ADDITIONS ON THE MECHANICAL PROPERTIES OF CONCRETES

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### ABSTRACT

Taking into account the multiple possibilities of using these wastes in the present paper is presented the capitalization of protein residues powder, obtained by their incineration, introduced as addition in cement concrete. The study of cement concretes obtained by using different types of wastes is an actual necessity because of the huge quantities of landfill wastes which pollute the environment. In the paper are presented the properties of cement concrete prepared with different types of organic wastes (hair, feather and wool). The wastes were used as addition in the concrete composition in a dosage of 10% from the cement quantity. Compressive strength and flexural strength were investigated and compared with that of control concrete without additions. Mechanical characteristics were generally under the values of control mix. The higher mechanical strengths were obtained for cement concrete prepared with hair and a combination of hair and wool. The statistical analysis such as Pareto chart for example was used on experimental data for determining the most influent parameter. By recovering and using of these materials in the cement concrete composition it can diminish the costs of concrete, even these concretes can be used only for non-structural elements.

**Keywords:** cement concrete, protein waste, statistical analysis, mechanical proprieties

## **SYSTEM OF RECYCLING THE SMELTER WASTE IN IRONWORKS**

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### **ABSTRACT**

The article is introducing characteristics the property, environmental impact, of waste incurred in the smelting production and analysis of possibility neutralizing them.

He ranks among dangerous waste:

- plumbing mineral oils - intended for the production machines,
- other oils - used to machines and devices,
- fluorescent tubes and lamps.

The second group of waste coming into existence in steelworks about the greater harmfulness are:

- slag from processes of smelting,
- slag from other processes.
- dusts from purifying off gass.

**Keywords:** recycling, steelworks, system, waste.

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**TECHNICAL SOLUTIONS FOR THE MODERNIZATION AND  
REHABILITATION OF THE LOCAL ROADS IN THE SOUTH-WESTERN  
ROMANIA**

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**ABSTRACT**

In spite of the significant efforts made by the local administrations for the modernization of the roads in their inventory, there are still over 75% of the local roads with road pavements in well-graded aggregate or earth. Also, a significant proportion of the roads with modern pavement present an expired life span and the thickness of their monolith layers is extremely reduced. Most of these roads are generally open to local and low traffic, but occasionally they can be randomly used by trucks with the axle load of about 115 kN.

In these circumstances the technical solutions adopted by the designers must take into account the variety of the local conditions, the existing road dowry as well as the real traffic to be carried on by the considered road sections.

On the other hand, the composition of the adopted resistance structures generally aim at preserving the existing road layers concomitantly with the realization of new natural aggregate layers and new bituminous pavements. The purpose is to adopt the better adapted resistance structures with minimum construction costs.

The paper presents the main technical solutions proposed by the designers to modernize well-graded aggregate roads or rehabilitate roads with expired bituminous pavements, by using to the maximum the existing dowry and by realizing road layers with high bearing capacity.

**Keywords:** local roads, local conditions, cold in-situ recycling, minimum construction costs

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## THE IMPACT OF FLY ASHES ON THE CHARACTERISTICS OF 50/70 BITUMEN

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### **ABSTRACT**

The paper presents a laboratory experimental research performed on 50/70 bitumen coming from OMV Austria. The research aims at pointing out the characteristics of the bitumen after having been used in the composition of two B.A.16 and B.A.D.25 type asphalt mixtures, with filler and fly ash as void filling material. The fly ash is supplied by the Timisoara Sud heating plant.

Practically, this research was realized following several discussions with different specialists in the field of road construction. The discussions were based on the higher physic-mechanical characteristics obtained through ordinary and dynamic testing performed on the mentioned mixtures. The realized asphalt mixtures were analyzed separately based on the percentage of filler initially established and based on its replacement with 7% fly ash.

After presenting the results of these analyses within different scientific communications, the proposal was made to follow the characteristics of the 50/70 bitumen during a period of 2...3 years after manufacturing the samples, in order to emphasize the effect of the chemical reactions which could take place, or not, between the components of the bitumen and those of the fly ash.

The paper presents the results obtained following the determination of the usual characteristics of the bitumen extracted from the analyzed asphalt mixtures, compared to the characteristics of the bitumen before using it in the mixture.

**Keywords:** 50/70 bitumen, fly ash, impact ash-bitumen

**THERMO AND ELECTRICITY GENERATING EQUIPMENT USING  
ALTERNATIVE BIOFUEL AND ORGANIC WASTES FROM UTG  
BIOENERGY COMPANY**

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**ABSTRACT**

The work presents the main technical, engineering and other characteristics for the industrial thermo and electricity generating equipment manufactured by UTG bioenergy company. The usage of the equipment and operation, shown on different examples and applications is reviewed in this paper. The paper also illustrates a comparative analysis of UTG and other manufacturers for the similar equipment. 12/

**Keywords:** alternative fuel, organic wastes, equipment, bioenergy

## USING RECYCLED COMPONENTS FROM POST-CONSUMER TYRES IN CONSTRUCTION MATERIALS INDUSTRY

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### **ABSTRACT**

The post-consumer tyres represent an important environmental concern, due to their enormous quantities resulted every year, which require important landfill spaces for disposal. To reduce this pressure on the environment, construction materials industry aims to find new products and applications, which can benefit from the useful proprieties of the main components of tyres (rubber, steel, and textiles). The first component which has been valorized is the recycled rubber extracted from tyres, used at present in various products like rubberized asphalt, roofing, traffic safety, playground surfacing, etc. Besides rubber, the current research activity is also referring to the recycling of steel and textile fibres. An extended research program was undertaken at the “Gheorghe Asachi” Technical University of Iasi, concerning the use of the recycled steel tyre-cord fibres as reinforcement in conventional concrete and roller-compacted concrete for transport pavements. The different pavement alternatives have been tested using the accelerated loading test facilities at the Civil Engineering Faculty of Iasi. The environmental performances of these alternative pavements solutions were also evaluated by life-cycle analysis, using the GaBi software. The paper presents the main results obtained in these studies.

**Keywords:** post-consumer tyres, recycling, environmental impact, pavements