



## THE EFFECT OF SODIUM CHLOROPHYLLIN ON POLYVINYL ALCOHOL ELECTROSPUN NANOFIBER DIAMETERS

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### ABSTRACT

The fiber diameter is the most important structural characteristic of electrospun nonwoven web and is crucial in the drug release process in medical applications. In order to make an electrospinnable solution using plant extracts, biocompatible polymers are used. Polyvinyl alcohol (PVA) is known as non-toxic biodegradable polymer, which is compatible with human tissues and widely used in biomedical applications. Sodium chlorophyllin (SChl) contains derivatives of "a" and "b" chlorophyll (chlorines, sodium salts of chlorophylline acids etc.), sodium salts of resinous acids (pimaric-, isopimaric-, abietic- and labdane types), sodium salts of fatty acids (mainly oleic-, stearic- and linoleic). Due to such composition SChl has bacteriostatic, regenerative and deodorant properties, which could be useful in biomedical applications. Several compositions of PVA solution in water (8 wt%) and different concentrations (1 – 5 wt%) of sodium chlorophyllin derived from spruce greenery were prepared. The viscosity and conductivity measurements of PVA/SChl solutions were performed before spinning. The diameters of electrospun fibers were evaluated quantitatively from atomic force microscope (AFM) images. PVA/SChl nanofiber composites with different concentrations of sodium chlorophyllin (1wt%, 3 wt% and 5 wt%) were analyzed in the research. Also pure PVA solution and nanofiber web were tested in order to evaluate the effects of added sodium chlorophyllin.

**Keywords:** needleless electrospinning, nanofibers, sodium chlorophyllin, polyvinyl alcohol



## SCREENING OF NANOPOWDERS FOR CATALYTIC PYROLYSIS OF BUCKWHEAT STRAW BY USING TGA-FTIR METHOD

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### ABSTRACT

Pyrolysis plays a vital role in the biomass conversion as one of the most promising thermal conversion routes. Solid, liquid and gaseous products are obtained from biomass pyrolysis. The liquid is considered as perspective fuel; however, the direct use of bio-oil as fuel may present many difficulties due to its high viscosity, poor heating value and relative instability. This creates a significant economic barrier for production of transportation fuel by pyrolysis process. Catalytic pyrolysis has been widely used as a convenient method for the direct conversion of biomass into higher quality liquid bio-fuels.

In this study, pyrolysis of buckwheat straw without and with nanopowders (Ni/MgO, Ni/Al<sub>2</sub>O<sub>3</sub>, Fe<sub>2</sub>NiO<sub>4</sub>, FeO·Fe<sub>2</sub>O<sub>3</sub>, NiO·Al<sub>2</sub>O<sub>3</sub>, NiO/MnO/Al<sub>2</sub>O<sub>3</sub>) was investigated using a thermogravimetric analyzer STA 6000 combined with a FTIR Spectrum 100 (TGA-FTIR). The non-catalytic and catalytic pyrolysis experiments were performed by ramp the temperature from 30 to 700 °C at the heating rate of 100 °C/min and held at 700 °C for 10 minute in a pure nitrogen flow of 20 ml/min. The mass of sample without catalyst was 32 mg and the mass ratio of mixed catalyst and sample was 1:1. The transfer line and gas cell were heated to an internal temperature of 230 °C to avoid condensation or adsorption of the semi-volatile products. FTIR spectrum was recorded every 9s in the spectral range between 4000 and 650cm<sup>-1</sup>.

All catalysts increased the yield of volatile products from 66.5% to 79.5%. Fe<sub>2</sub>NiO<sub>4</sub> provided higher relative yield of aromatics and carbon dioxide compared to the Ni/MgO, Ni/Al<sub>2</sub>O<sub>3</sub>, NiO/MnO/Al<sub>2</sub>O<sub>3</sub>, whereas by using Ni/MgO, Ni/Al<sub>2</sub>O<sub>3</sub>, NiO/MnO/Al<sub>2</sub>O<sub>3</sub> improved the relative yield of olefins and carbon monoxide. Fe<sub>2</sub>NiO<sub>4</sub> catalyst affected not only the relative yield and composition of volatile products but also their evolution profiles.

**Keywords:** buckwheat straw, catalytic pyrolysis, TGA-FTIR method, nanopowders



## **STUDY OF POWER TRANSFORMER MECHANICAL FAULTS DETECTION BY USING VIBRODIAGNOSTICS**

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### **ABSTRACT**

Power transformers are important elements of the electrical system and have a high degree of risk since in case of failure the generator connected to the damaged transformer cannot transfer energy to electrical system. Therefore, a generated power deficit may be formed and part of the consumers can be disconnected from power supply.

Power transformers can experience various types of faults that may be potentially dangerous and cause the failure of the device. Various diagnostic methods exist for the detection of these damages. Each of them designed for a specific transformer characteristic. For example, measurement of winding insulation resistance and dissolved gas analysis can be used to detect electrical faults, but thermography is used to identify thermal defects. It should be noted that these widely used methods are not intended to detect mechanical faults. However, one possible approach to detect them is based on analysis of vibration measurements on the surface of transformer tank. This method is discussed in this article.

In order to detect mechanical defects, certain difficulties occur. It is impossible to see what is happening inside the transformer tank without opening it, but vibration analysis can acquire information about transformer windings and core mechanical condition without doing so. This is because vibration sensors are mounted on the transformer tank surface. Consequently, it is possible to analyse the causes of mechanical defects, their location within the transformer's structure and their intensity while transformer is operating.

A case study is provided where data is analysed from a power transformer with increased vibration levels, which is installed in a power plant in Latvia. A method is proposed for graphical analysis of the results of vibration measurements. It allows obtaining more information about vibration amplitudes, their distribution and epicentres, as well as vibration changes within a specified time period caused by the transformer.

**Keywords:** Power transformers, fault detection, condition monitoring.



## **GENERATION OF A TEST REFERENCE YEAR FOR DOBELE, LATVIA**

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### **ABSTRACT**

Precise and reliable meteorological data are necessary for building performance analysis. Since meteorological conditions vary significantly from year to year, there is a need to create a test reference year (TRY), to represent the long term weather conditions over a year. In this paper TRY data model was generated by analysing every 3-hour weather data for a 30-year period (1984–2013) in Dobeles, Latvia, provided by the Latvian Environment Geology and Meteorology Centre (LEGMC). TRY model was generated according to standard LVS EN ISO 15927-4. The generated TRY contains from typical months that are included in TRY from a number of different years. The data gathered from TRY was compared with the climate data from the Latvian Cabinet of Ministers regulation No. 379, Regulations Regarding Latvian Building Code LBN 003-15. Average monthly temperature values in LBN 003-15 were lower than the TRY values that indicate on climate changes in this location. The results of this study may be used in building energy simulations and heating-cooling load calculations for selected region. TRY selection process should include the most recent meteorological observations and should be periodically renewed to reflect the long term climate change.

**Keywords:** test reference year; climate analysis, climate change



## THE INFLUENCE OF ACYL MOIETY OF CARBOXYLATE METHYL ESTERS ON RAPESEED OIL CHEMICAL INTERESTERIFICATION

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### ABSTRACT

In recent years much research has been aimed to improve biodiesel synthesis using interesterification reaction. In interesterification reaction of vegetable oil with short-chain aliphatic esters instead of glycerol short-chain triglyceride (triacylglycerols) are formed what can be considered a valuable additives for biodiesel and have not to be removed from the reaction mixture. Furthermore, it has been proven that the mixtures of fatty acid alkyl esters and triacylglycerols have no detrimental effects on fuel properties.

With the aim to ascertain the influence of the structure of acyl moiety of different methyl esters on the composition of obtained interesterification mixture in the present work rapeseed oil interesterification with methyl formate, acetate and propionate were studied using two different catalysts – the sodium methoxide in methanol (commercial catalyst) and the potassium *t*-butoxide in *t*-butanol solution. The second catalyst allows to minimize the side reactions, that usually occur when sodium methoxide in methanol are used.

To determine the influence of different acid moiety of carboxylate methyl esters reactions at assumed constant reaction conditions - 27 °C temperature, carboxylate methyl ester to oil molar ratio 18 and catalyst amount 0.12 (molar ratio to oil) were performed. In order to increase the yield of products, reactions at boiling temperature of aliphatic esters and modification of other variables also has been made. The reactivity of the acyl moiety decrease in order methyl formate, methyl acetate, methyl propionate. The highest FAME content (82.8 wt.% from theoretically predicted 84 wt.%) was obtained with methyl formate, when potassium *t*-butoxide was used as catalyst and reactant to oil molar ratio was increased to 36:1.

**Keywords:** renewable fuel, chemical interesterification, methyl formate, methyl acetate, methyl propionate



# EFFECTS OF HEMP FIBRES PRE-PROCESSING ON LINEAR LOW DENSITY POLYETHYLENE MATRIX COMPOSITE MECHANICAL PROPERTIES

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## ABSTRACT

Natural fibres show poor compatibility with hydrophobic polymers due to their hydrophilic nature. Compatibility with hydrophobic polymers could lead to weak interfacial adhesion. Research focused on improving mechanical properties of LLDPE composites reinforced with pre-treated hemp fibres.

Chemical pre-treatment of natural fibres used in this research are 2 % sodium hydroxide treatment, grafting with 5% maleic anhydride in combination with the sol-gel fibres pre-processing were used to obtain eleven composite variants. Composites were prepared by mixing of the components on two rolls mill.

Composites with fibres content in a range from 40 wt. % to 50 wt. % were evaluated by universal material testing machine UTS-100 (standard ASTM D 638 M – 93). Microhardness (HV) was examined by Vickers M41 at load 200 g.

Surface microhardness of composites is decreased by chemical pre-processing of fibres and varies in the range from 62.87 MPa ( $Zn(CH_3COO)_2 \cdot 2H_2O$  used as the modifier of the sol-gel system treated hemp fibres (40 wt. % composite) to 344.77 MPa (50 wt. % sample with silica sol pre-treated fibres).

The tensile tests of composites showed the increase of mechanical properties by chemical pre-processing of fibres. Elastic modulus varies in range from 117.68 MPa (40 wt. % sample with silica sol pre-treated fibres) to 700.06 MPa (40 wt. % sample sol-gel with  $Zn(CH_3COO)_2 \cdot 2H_2O$  fibres pre-treatment and 5 wt. % MA-g-PE additive).

**Keywords:** linear low density polyethylene, hemp fibres, composite mechanical properties, sol-gel method.



## COMPARISON OF COMMONLY USED MATHEMATICAL MODELS FOR LIGHTNING RETURN STROKE CURRENT WAVEFORM

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### ABSTRACT

In electrical engineering the return stroke is the most important event in lightning flash, because return stroke current causes most of the damage and disturbance in electrical network. Return stroke mathematical models help engineers to predict transient voltages and currents induced in electrical networks by return stroke electromagnetic fields. Return stroke models can be divided into three groups: the electro-thermodynamic models, the transmission line models and engineering models. This paper compares the most commonly used engineering return stroke models, including Heidler model which is used in International Electrotechnical Commission (IEC) standard and return stroke current model recommended by the International Council on Large Electric Systems (CIGRE).

Over-voltages induced by direct or indirect lightning strike in the electrical network are the main cause of damage in households, according to statistics of European insurer companies. In this paper Alternative Transient Program/Electromagnetic Transient Program (ATP/EMTP) is used to create model of the electric power distribution network and to perform simulations of the transient process during lightning discharge in network. Various lightning return stroke current peak values and waveforms in electrical network with or without surge arresters were simulated. Aim of the research is to compare lightning current models offered in ATP/EMTP by entering identical input parameters for different scenarios.

**Keywords:** lightning, return stroke, mathematical models, current waveform