Mathematical models for temperature-dependent viscosity of FAME and diesel blends

Daniel Trost, Adam Polcar, Martin Fajman, Jiri Votava, Jiri Cupera, Vojtech Kumbar

Fatty Acid Methyl Ester (FAME) is a potential alternative fuel for compensating the running out of fossil-based liquid fuels. FAME is produced from renewable sources by transesterification. It could be produced locally, in each region of usage. Furthermore, local production and no need for international fuel transportation, this method could be more ecological, and it also could bring significant savings. FAME has physical properties similar to common diesel at normal temperatures. In contrast, at low temperatures, the viscosity increases sharply. Therefore, is it mostly used in blends with diesel. The kinematic viscosity of FAME/diesel blends was investigated in this paper. Various temperature (from -10 °C up to 60 °C) and various ratios (0, 7, 10, 15, 20, 30, 85, 100 vol.%) were tested. In the experiment, the kinematic viscosity of blends was tested and compared. It was found, the Vogel model has the best result, according to the coefficient of determination R2 and sum of squares error SSE.

Keywords: mathematical models, Vogel, viscosity, FAME, Methyl Ester, diesel, temperature

Stability of intemetallic phases in the heat affected zone depending on shielding gases

Radim Smak, Jiri Votava, Jaroslav Lozrt, Adam Polcar

This contribution deals with the influence of shielding gases on the parameters of MIG and MAG welds. For the experiment purposes, steels S 235 JRG1 and C45 were chosen. In the research part, welding parameters and welding conditions were proposed; based on them, a series of experiments were performed. Weld beads were subjected to metallographic analysis (samples prepared according to ČSN ISO 4967), from which the heat-affected zone and metal structure were determined. The melting bath area was not analyzed. Furthermore, in the heat-affected zone there were hardness and microhardness measured. The macrohardness of the samples was measured using the Rockwell HRB method according to ČSN EN ISO 6508 standard. The microhardness measurement was performed using Hannemann microhardness tester according to ČSN EN ISO 6507-1 standard.

Keywords: **MAG, welding, depth of penetration, microstructure, hardness**

Alternative mechanical pre-treatment methods of hot-dip galvanising surface to increase of the organic coatings adhesion

Jaroslav Lozrt, Jiri Votava, Radim Smak

The content of this contribution is an evaluation of research on various mechanical pre-treatments of inorganic coating, which is part of the so-called duplex system applied to a steel sheet. In order to coating adhesion increase, the hot-dip galvanising surface was first pre-treatment using the standard light blast technology (synthetic brown corundum F40). Furthermore, pre-treatment was also carried out using alternative methods that can be used in conditions without blasting equipment – sandpaper regrinding (P40, P60, P80 and P100) and a corrosion-resistant steel brush (wire diameter 0.30 mm). Tools are designed e.g. for cleaning metal surfaces. Samples without mechanical pre-treatment and samples with blasted surface were used as a standard. The surface texture was evaluated based on the roughness height parameters Ra and Rz (according to ČSN EN ISO 4287 standard). The mechanical resistance of applied anti-corrosion protection was determined by means of a pull-of adhesion test (according to ČSN EN ISO 4624 standard). The experiment suggest results, that among the alternative methods, the use of P80 and P100 sandpapers and corrosion-resistant steel brushes seems to be the most suitable, as these tools are not as aggressive to the galvanised surface as P40 and P60 sandpapers.

Keywords: **carbon steel, zinc coating, surface texture, abrasive, sweeping**

The evaluation of selected mechanical and physical properties of pelletized compost

Aneta Sinkova, Patrik Burg, Vladimir Masan, Alice Cizkova

The production of compost and its use on agricultural land is now widespread and well known. With regard to the conditions of the changing climate (temperature fluctuations, unbalanced precipitation, etc.) and anthropogenic activities associated with soil degradation and environmental devastation, issues related to wider use of compost are being addressed within Europe. Special attention is paid to innovative modifications of compost into fertilizers with improved properties. A promising solution is also offered by the production of pellets from compost. The pellets have better utility properties, are easier and more accurately metered, and therefore it is easier to supply the required amount of organic matter to the soil. For the needs of experimental measurements carried out in 2021, connected with pelletizing, 3 variants of input raw materials were selected. These are compost itself, compost in combination with biochar and compost in combination with grape marc. Afterwards, selected mechanical-physical properties, such as bulk density (845–1 056 kg/m3), mechanical durability (85.1–97.3%) and compressive strength (16.3–18.4 MPa) of pellets samples were evaluated. The obtained results confirmed a statistically significant difference between the evaluated samples. In particular, the results of mechanical resistance indicate their qualities. These results may ultimately be useful in eliminating risks in mechanical distribution systems, in dust generation, and in handling, applying or storing.

Keywords: sustainable technology, shaped fertilizer, compost, pellet, pelletizing, bulk density

Hyperspectral imaging LED and incandescent light source comparison for food quality inspection

Robert Rous, Vit Ondrousek, Miroslav Juzl

Incandescent light sources are typical lighting types for Vis-NIR hyperspectral imaging. New broadband LED-based lights start to appear as a possible substitute for incandescent light sources due to the development of new LED dye types. Two light sources (Tungsten-halogen lamp and hyperspectral LED Effilux EFFI-Flex-HSI-100-SD-P2) for the Vis-NIR (400–1000 nm) hyperspectral imaging were compared on 15 samples of Gothajsky cooked salami slices. The goal was to compare these two light source technologies (old incandescent and new LED-based) in the matter of image quality. Images were scored using no-reference quality metrics (BRISQUE, NIQE, PIQE). There was a strong correlation between the mean values of the scoring metrics (BRISQUE R=0.9245, NIQE R=0.8933, PIQE R=0.9779). Results show the main advantage of the LED light is no heat stress of the samples resulting in more stable results with less glare. The main disadvantage of LED light was a lower illumination power resulting in higher exposition time needed.

Keywords: hyperspectral LED light, food quality analysis, Image Quality Assessment, machine vision

Comparison of stress action of real specimens and computer model during tensile testing

Jakub Pernica, Michal Sustr, Petr Dostal, Matej Vodal, Robert Sarocky, Martin Brabec, Jaroslav Zacal

The contribution focuses on the comparison of stresses in the specimen during tensile testing. The specimens were fabricated in two orientations in the printing area of a 3D printer. Digital Image Correlation method was used to measure the stress. The results were graphically evaluated and compared with each other. The graphical result of Digital Image Correlation was further compared with the computer analysis of stress action in the specimen in Autodesk Fusion 360. This comparison is very useful for realistic designing of 3D models for 3D printing of polymer materials by Fused Filament Fabrication (FFF) technology.

Keywords: **additive manufacturing, tensile testing, digital image correlation, mechanical properties, ASTM D638**

Comparison of fatigue behaviour of AlSi10Mg CT samples prepared by casting and by additive technologies

Jana Dvorakova, Karel Dvorak, Michal Cerny

The achieved mechanical properties influence the usability of parts prepared by additive technologies. Investigating the mechanical properties of parts and materials for additive technologies is currently one of the most up-to date topics. In this work, an electromechanical testing method is chosen, which analyzes the formation and propagation of a crack in the aluminum alloy AlSi10Mg prepared from metal powder by the additive technology DMLS (direct metal laser sintering). Testing is performed on CT (compact tension) samples according to ČSN ISO 12108 on test machine Instron Electropuls 10000, and the results are compared with values obtained by testing samples made by gravity casting from an aluminum alloy of comparable composition. 3D printing of CT samples is performed in various topologies to verify the dependence of fatigue behavior on the printing topology with the aim of applicability in determining suitable printing topologies depending on the shape of the part and the direction of stress in the practical use of parts. The research monitors the dependence of the crack formation time and its propagation speed on the print orientation of the test specimen. The results of testing determine the appropriate printing topology in order to find the ideal position of a sample during printing and assess the possible use of this 3D printed material for cyclic loaded parts.

Keywords: AlSi10Mg, additive technologies, fatigue, topology optimization, CT samples

Evaluation of the quality of material produced by additive production using acoustic emission

Robert Sarocky, Michal Sustr, Petr Dostal, Matej Vodak, Jakub Pernica, Michal Cerny

The article is focused on the evaluation of the quality of several types of material that have been produced by additive production. The samples differ from each other not only in the type of material, but also in the internal structure. The investigated samples were made by 3D Printing by FDM. The article further discusses the differences between the samples under tensile loading. It is important to produce the tensile load for the next part of the test, which deals with data acquisition using acoustic emission. The data obtained in this way are very useful for other purposes, such as predicting the destruction of the final product, which in practice is loaded by tensile loading.

Keywords: NDT, acoustic emission, additive manufacturing, tensile testing, mechanical properties, PLA, metal filament