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# Contents

## MATERIALS TECHNOLOGIES

### **Use and Environmental Impact of Substitute Fuels in the Iron Ore Sintering Process**

*Martyna Nowak*

## WELDING

### **Modelling of Welding Systems with Arc Controlled by the Magnetic Field – Part 1: Technological Effects of External Magnetic Fields**

*Antoni Sawicki*

### **Methods for Brittle-Fracture-Resistant Structural Material Selection Based on Polish and International Standards – Part 2**

*Marcin Graba, Mariusz Janusz-Bielecki*

## ELECTRIC DRIVES AND MACHINES

### **Agent-Based Modelling in the Operation of a Farm Equipped with Renewable Energy Sources and Electric Motors**

*Jerzy Bakalarczyk*

### **Selection of Parameters for the Hydrogen Power-Supply System of an Auxiliary Rail Vehicle**

*Maksymilian Cierniewski, Patryk Radziszewski, Karol Bryk*

### **Tightness Tests of Lamination-Bonded Electric Sheet Stacks**

*Łukasz Cyganik*

### **Modelling the Thermal Steady State of a Synchronous High-Speed Generator with Permanent Magnets Protected by a CFRP Sleeve**

*Szczepan Opach*

### **Analysis of the Energy Consumption of a Rail Passenger Vehicle Powered by a Hydrogen Fuel Cell**

*Patryk Radziszewski, Maksymilian Cierniewski, Karol Bryk*

### **System for the Safe Operation and Stabilisation of the Rotational Rate of Small Wind Turbines**

*Zdzisław Ząber*

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### Use and Environmental Impact of Substitute Fuels in the Iron Ore Sintering Process

Martyna Nowak

DOI: 10.32730/mswt.2024.68.6.1

**Key words:** iron ore sintering process, waste car tires, biochar, Refuse Derived Fuel, Solid Recovered Fuel

**Abstract:** The aim of the article is to present the results of the conducted research considering the application of substitute fuels in the iron ore sintering process and determination of RDF (*Refuse Derived Fuel*) potential as a substitute for part of the coke breeze in the sintering process. The tested substitute fuels were: biochars from sawmill sawdust, woodchips and sunflower husks, chars from waste car tires and “Blue Coal”. The results show, that there is a possibility to replace a part of the coke breeze in the sintering process with these substitute fuels. Thanks to the substitute fuels, it is possible to obtain higher production efficiency, better sinter strength and lower CO<sub>2</sub> and SO<sub>2</sub> emissions. The tests were performed in a unique semi-industrial installation to simulate the sintering processes equipped in an innovative exhaust gas neutralization system. The article also presents potential perspectives for Refuse Derived Fuels application in the sintering process. The metallurgical industry is constantly seeking for a new fuels, in order to meet the requirements of the European Green Deal in the field of circular economy and industry decarbonization.

### Modelling of Welding Systems with Arc Controlled by the Magnetic Field – Part 1:

#### Technological Effects of External Magnetic Fields

Antoni Sawicki

DOI: 10.32730/mswt.2024.68.6.2

**Key words:** magnetic field, welding arc, magnetic blowout, welding efficiency

**Abstract:** Today’s welders are in great need of knowledge concerning the magnetic field on the electric arc. On one hand, the aforesaid effect on welding arc is detrimental as it causes the so-called magnetic blowout and necessitates undertaking actions and measures aimed to counteract such a phenomenon. However, on the other hand, the magnetic field can be used to improve the quality and increase the efficiency of welding processes. The magnetic field effect on the arc leads to the deflection and changes in the shape of the latter.

### Methods for Brittle-Fracture-Resistant Structural Material Selection Based on Polish and International Standards – Part 2

Marcin Graba, Mariusz Janusz-Bielecki

DOI: 10.32730/mswt.2024.68.6.3

**Key words:** brittle fracture, materials, pressure equipment, construction products

**Abstract:** The article describes the phenomenon of the brittle cracking of steel as a component of structural elements of pressure equipment and construction products. The study presents several methods of analysis used by specialists responsible for the design, fabrication and testing of the aforesaid products. The article also indicates numerous international regulations, standards and recommendations used in the assessment of the strength of various structural elements and technical solutions. The methods discussed in the study were compared to enable the selection of sophisticated material assessment methods ensuring the superior functional properties and safe operation of finished products.

### Agent-Based Modelling in the Operation of a Farm Equipped with Renewable Energy Sources and Electric Motors

Jerzy Bakalarczyk

DOI: 10.32730/mswt.2024.68.6.4

**Key words:** operation of an RES farm, agent-based modelling (ABM), photovoltaic farm (PV farm), electric motors, inspections

**Abstract:** Presently, agent-based modelling is becoming increasingly widely used in various areas of science. The study contains an overview of various types of agent-based modelling applications and provides a modelling solution for a farm provided with renewable (electric) energy sources (RES) and electric motors. The final part of the study contains conclusions drawn during the performance of the research work discussed in the article.

### Selection of Parameters for the Hydrogen Power-Supply System of an Auxiliary Rail Vehicle

Maksymilian Cierniewski, Patryk Radziszewski,

Karol Bryk

DOI: 10.32730/mswt.2024.68.6.5

**Key words:** rail vehicle, hydrogen fuel cell, control system, emission-free drive system, traction characteristic

**Abstract:** The article presents a concept concerning a hydrogen power-supply system for an auxiliary rail vehicle. The selection of key component parameters was based on the expected energy consumption and power balance of the vehicle. The research work discussed in the article involved the identification of traction characteristics and the simulation of theoretical rides, constituting the basis for the development of optimum vehicle control algorithms.

### Tightness Tests of Lamination-Bonded Electric Sheet Stacks

*Lukasz Cyganik*

DOI: 10.32730/mswt.2024.68.6.6

**Key words:** tightness test, electric steel sheet, lamination bonding technology, tightness of electrical steel stack

**Abstract:** The article presents the results of tightness tests involving specimens of lamination-bonded electric sheet stacks exposed to water pressure restricted within the range of 2 bars to 14 bars. Cylindrical specimens were made of NO27 SURALAC 9000 electric sheets with adhesive, some of which were directly exposed to a pressure test after stacking, whereas some were additionally impregnated with resin prior to testing. The test results indicated that the specimens additionally impregnated with resin did not reveal any signs of leakage when exposed to a water pressure of up to 10 bar for 10 minutes. During the tests, the pressure in the measurement system remained constant throughout the entire 10-minute period (no pressure drop in the measurement system was observed).

### Modelling the Thermal Steady State of a Synchronous High-Speed Generator with Permanent Magnets Protected by a CFRP Sleeve

*Szczepan Opach*

DOI: 10.32730/mswt.2024.68.6.7

**Key words:** synchronous generator with permanent magnets, thermal calculations, Finite Element Method, Computational Fluid Dynamics, CFRP sleeve

**Abstract:** The article presents the possibilities of using the Finite Element Method (FEM) and Computational Fluid Dynamics (CFD) in the ANSYS Fluent software for modelling the thermal steady state of liquid-cooled electric machines. The FEM and CFD potential is illustrated with an example of a PMzK71-4 high-speed generator with permanent magnets having rated power  $P_N = 17$  kW and rated rotational rate  $n_N = 15000$  RPM, where the permanent magnets are protected against the adverse effects of centrifugal inertial force by a CFRP sleeve.

### Analysis of the Energy Consumption of a Rail Passenger Vehicle Powered by a Hydrogen Fuel Cell

*Patryk Radziszewski, Maksymilian Cierniewski,*

*Karol Bryk*

DOI: 10.32730/mswt.2024.68.6.8

**Key words:** hydrogen fuel cell, electric multiple unit, traction battery, emission-free drive system

**Abstract:** The article presents a proposal for the installation of components of a hydrogen power supply system in a rail passenger vehicle. The research work discussed in the article involved the analysis of various vehicle configurations and the determination of traction characteristics, which, subsequently, were used to perform a series of theoretical simulations of journeys on a specific route in relation to various assumptions. The tests led to the calculation of average energy consumption and the assessment of hydrogen consumption for a selected vehicle configuration.

### System for the Safe Operation and Stabilisation of the Rotational Rate of Small Wind Turbines

*Zdzisław Zqber*

DOI: 10.32730/mswt.2024.68.6.9

**Key words:** safety of small wind turbine units, PM synchronous motor in the safety system of a small wind turbine sets, safety as a priority in the design of small wind turbine units

**Abstract:** The article presents the nearly 30-year evolution of the design of a range of small wind turbine units having power restricted within the range of 3 kW to 100 kW (known under the commercial name of ZEFIR). The evolution was primarily triggered by difficulties in achieving the operational safety of the above-named machines without compromising the simplicity of design. The article also discusses the role of PM synchronous machines in achieving previously assumed safety parameters and satisfying the postulate of “fail safe philosophy design”.