BOOK OF ABSTRACTS

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ICMATE

Selection of molding sands for thin-walled cast iron castings based on their selected properties

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1. Introduction

Generation II molding compounds, i.e., compounds bound with binders, are most commonly used in casting processes. This is due to their high technological properties, but also to their versatility. They can be used for both molds and cores production. Due to their high technological properties they are appropriate for the production of thin-walled castings. The binders used in these technologies are mainly organic binders (based on synthetic resins) and inorganic binders, such as hydrated / solid [1] sodium silicate and aluminosilicates. The essence of the problem, however, is that technologically perfect synthetic resin-based binders have a harmful impact on the environment. On the other hand, ecological inorganic binders are characterized by poor knock-out properties and low mechanical regeneration capacity [2].

Two important events initiated pro-environmental activities in the EU: 1972 - the first United Nations Conference on the Human Environment (Stockholm), which approved the principles of sound environmental management, including the Stockholm Declaration; 1992 - the Earth Summit was held in Rio de Janeiro. Many important declarations were adopted at the summit, including Agenda 21 and the Rio Declaration. The above international activities led to the adoption of the following European treaties:

- 1972 - at the European Council meeting in Paris, the need for a Community environmental policy accompanying economic policy was announced.
- 1987 - The Single European Act introduced a new Title VII, “Environment,” which constitutes the first legal basis for a common environmental policy.
- 1993 - The Maastricht Treaty made the environment (Title XVI) an official area of EU policy.
- 1999 - Article 3c of the Treaty of Amsterdam required the integration of environmental protection into all EU sectoral policies.
- 2007 - Under the Treaty of Lisbon, climate change and sustainable development became priorities [3].

The need to comply with high environmental protection requirements is currently a dominant factor in the development of molding and core technologies. Compliance with these requirements is achieved even at the expense of reducing the technological properties of the compounds used in the production of molds and cores.

This paper shows the comparison of selected properties of molding sands with both organic – characterized by high hazardous substance emission, and inorganic binders – ecologically friendly but technologically challenging.

2. Materials and methodology

The following paper focuses on the influence of binder type on chosen molding sands’, dedicated to thin-walled castings, properties. Molding sands’ technological properties such as strength, permeability, friability and bench life as well as thermophysical properties (hot-distortion parameter) were tested. Both organic and inorganic binders have been chosen for the study. In Table 1 molding sands compositions are presented.

Table 1 Tested molding sands composition [2, 4]

Binder type	Matrix [p.p.w.]	Amount of binder [p.p.w.]	Amount of hardener [p.p.w.]
furfuryl resin	100	1.00	0.50
phenolic resin		2.00	0.50
aluminosilicate		2.00	0.20
sodium silicate		3.00	0.30

Quartz sand from the Sibelco Poland (Bukowno) was used in all of the conducted tests as the matrix. According to the Polish standard PN-85 / H-11001, it classifies the tested sand as medium. In the studied matrix, the value of the main fraction is 81.58%, which determines the sand as homogeneous.

3. Results

The influence of the type of binder on the thermal deformation (measured by hot distortion parameter) of the molding sands, as selected results of the research conducted as part of this work, is presented in Figure 1. The results showed that molding sands’ with organic binder are more stable in temperature. The best results were achieved for molding sand with phenolic resin. In case of inorganic binders molding sands with aluminosilicate is characterized with better thermal stability.

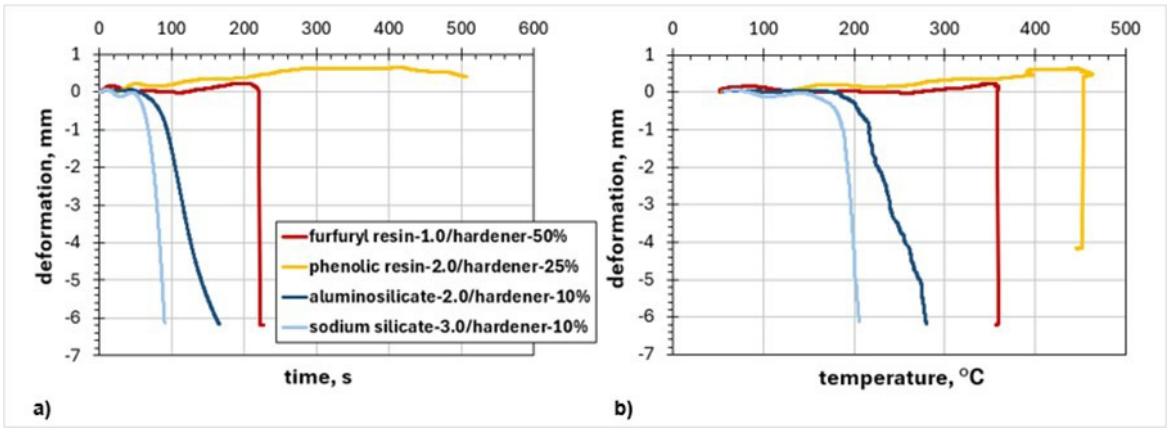

Figure 1 The influence of binder type on thermal stability of tested moulding sands; a) in the function of time, b) in the function of temperature [2, 4]

4. Discussion and conclusions

The thermal deformation tests of molding sands are conducted to assess the thermal stability of casting cores. When liquid metal is poured into the mold, both the temperature and the metal level rises, leading to intense heating of the cores. The one-sided nature of heating in the initial phase of the process promotes the formation of thermal distortions in the cores. These phenomena can lead to damage to the cores and the formation of casting defects, affecting its geometry, dimensional accuracy, and surface quality. The studies have shown that compounds with organic binders have better thermal stability compared to compounds with inorganic binders. According to literature data and own research [5-7], their bonding bridges are more flexible and resistant to deformation at ambient temperature.

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