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APPLICATION OF MODERN ECOLOGICAL TECHNOLOGY LOST FOAM FOR THE IMPLEMENTATION OF MACHINERY

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Summary. At Królmet Iron Foundry some research and experimental studies have been carried out to develop technical and technological guidelines for the manufacture of pilot castings for machinery applications. The castings should be characterised by good mechanical properties, specially by good hardnesss, high abrasion wear resistance and impact resistance. Pilot castings have been made by lost foam technology on a modern casting installation. The output of the research and experimental work was designing and making of pattern tooling, determination of technical and technological parameters of the process, and making a batch of pilot castings. The produced castings had the required utilisation parameters.

Key words: casting, pattern, pattern made of foamed polystyrene, evaporation.

INTRODUCTION

In the full form of model polystyrene, which fills a cavity forms in the course of its filling by the liquid metal is subjected to the influence of high temperature, passes from the solid through the liquid state, the gaseous state. Emit solid and gaseous products of thermal decomposition of polystyrene patterns. The kinetics of this process is significantly influenced by the gasification temperature, density and mass of the polystyrene patterns. One of the basic parameters is the amount and rate of gasses from the model polystyrene during its thermal decomposition. To ensure optimal conditions for obtaining a cast of the assumed shape and quality shall be the main characteristic parameters of the model making process, especially the chemical composition and density of the model. For the experimental trials were chosen cast rotor D8 - 11 / 2 (Figure 6). Models were made of polystyrene by Marbet. Were selected material pattern, its density, a method of forming and removing the model from the mold. Specified properties of polystyrene and a layer of ceramic used to do castings.

In order to reduce the maximum volume of gas separated in the process of gasification of the pattern assumes a constant density of 20 ± 2 kg/m3. Elements of the pattern: in the matrix will be made and then combined into sets of pattern.

Forming and pouring implemented by the following scheme: the preparation of pattern → incorporate a ceramic layer → drying molding sand in a box of sand compaction → creating a vacuum in the form of flooding → spiking cooling.

Made pattern kits, parts, flooding the form shown in Figure 6.

PROPERTY RESEARCH CERAMIC LAYER

Prior to research conducted tests of the ceramic layer including strength, permeability. Layers were studied by the manufacturer company and a film developed at the Foundry Research Instiutute. The results are shown in Figures 1, 2, 3 Developed liquid ceramic mass were checked for their rheological properties. These studies used rotational viscometer Bohlin Visco V88 manufactured by Bohlin Instruments Ltd. This is a rheometer with coaxial cylinders. Outer cylinder is stationary and is driven by an internal synchronous motor. The accuracy of measurements is - 3%.

The measurements are based on measuring the shear stress at a certain shear rate. Rheometer is controlled by a computer to analyze the results of the measurements used a computer program used to estimate the rheological parameters studied liquid adhesives and ceramic. The computer program also makes the necessary assessment of the quality estimation.

For the preparation of a liquid ceramic body used to ensure a small mixer agitator rotational speed (up to tens of revolutions per minute). To manufacturing molds - ceramic layer is used to cover:

- Disopast 4805,
- Kerrntop L87,
- Cyrkonar.

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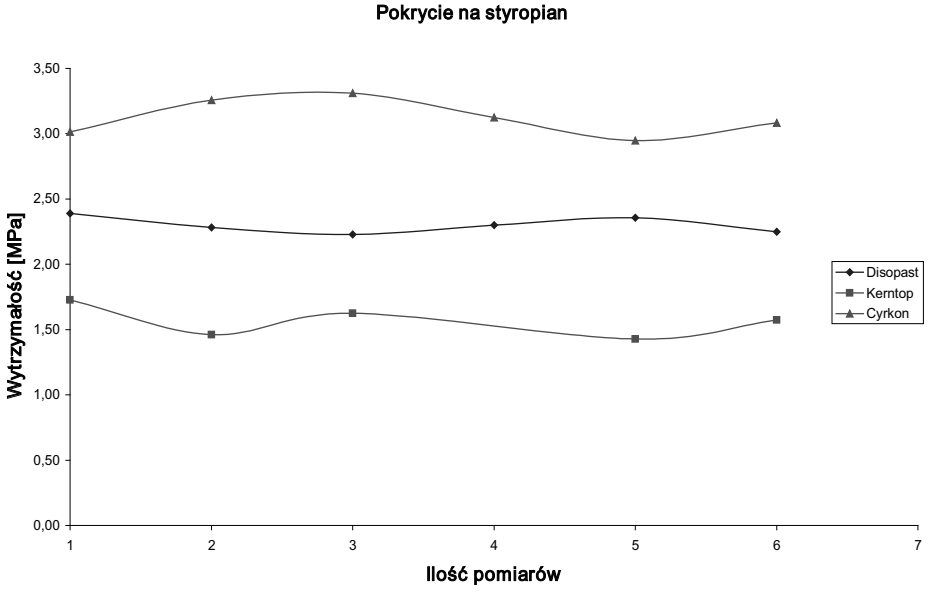

Fig. 1. Tensile strength for different layers of coverings

Such preliminary results of the technology resulted in the need to work on the development of the composition of the ceramic coating.

For oral liquid ceramic coating used to model the components used polystyrene similar to the method of lost wax models:

- as a solvent for adhesives - water,
- binder - colloidal silica - Sizol A30,
- composition, and butadiene latexes politetrafluoroetylenowego - sterynowego,
- composition of surfactants - anionic and nonionic active,
- an anti-foaming,
- meal ceramic refractory material - silicate or aluminosilicate molochite'u zirconia.

For test configurations to cover for serum resistance to tearing the thin ceramic layer and its permeability (Fig. 2, 3 and 4).

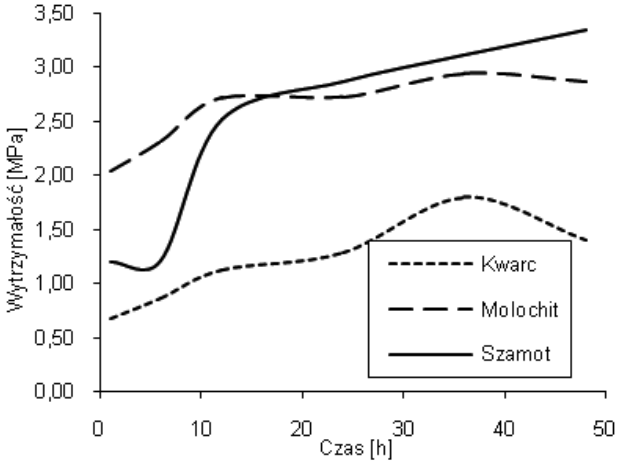

Fig. 2. Strength of thin ceramic layers made with different materials (raw sample) as a function of time

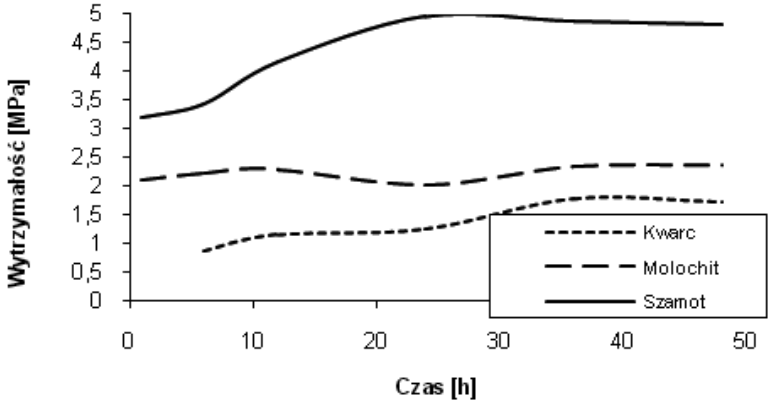

Fig. 3. Strength of thin ceramic layers made with different materials (sample annealed at 900^0C) as a function of time

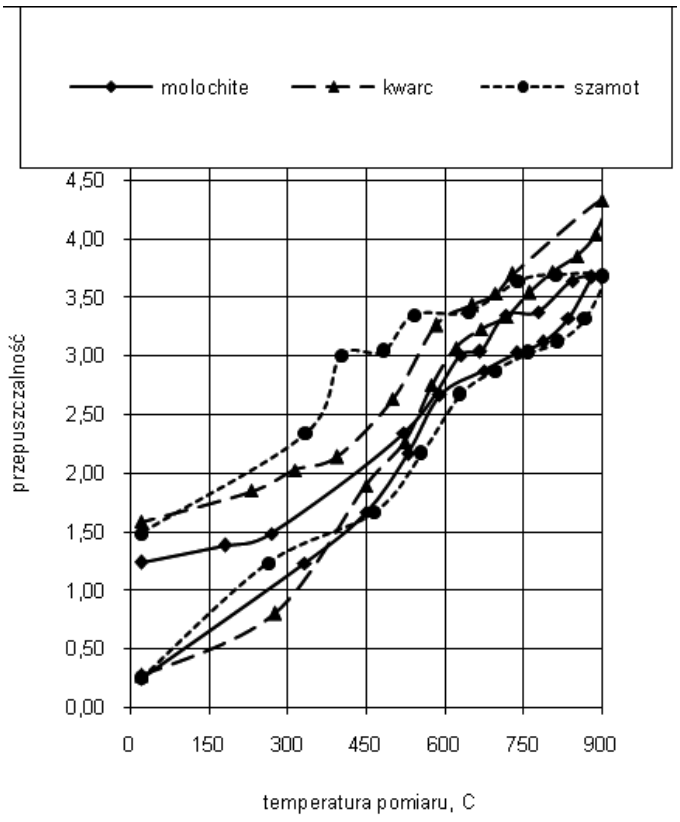

Fig. 4. Measuring changes in the permeability of the porcelain samples with different ceramic material used with changes in temperature

EXECUTION POLYSTYRENE PATTERN

For the production of cast pattern of different shapes and sizes of polystyrene is a property expansion at elevated temperatures. Properties of foamed polystyrene products depend on the species of the starting material and method of production. The most characteristic properties should include a very low density 15-60 kg/m3, and a low coefficient of thermal conductivity of about 0,024 kcal / m ^{o}C h.

Foaming polystyrene conducted preliminary and secondary treatment in an autoclave with bringing superheated steam at design pressure and temperature. It was found that the initial foaming time was dependent on the type of polystyrene. This time depends on the type of polystyrene, shape and weight of the pattern. The density of polystyrene made pattern ranged from 20 to 24 kg/m^3.

An important factor influencing the process of pouring liquid metal form is a pattern of the gasification kinetics of polystyrene. During the process of flooding under the influence of temperature of molten metal followed by thermal gasification of the polystyrene pattern. In the cavity mold, emit gases. Volume dedicated gas depends on temperature and the pressure from the gas permeable form. The pressure directly affects the flow rate of the metal. In order to learn these parameters

were carried out tests to determine the kinetics of gasification of the experimental pattern. Sample results are shown in Figures 5, 6 and Table 1 With the increase of temperature increases the volume of released gases and gasification time is reduced.

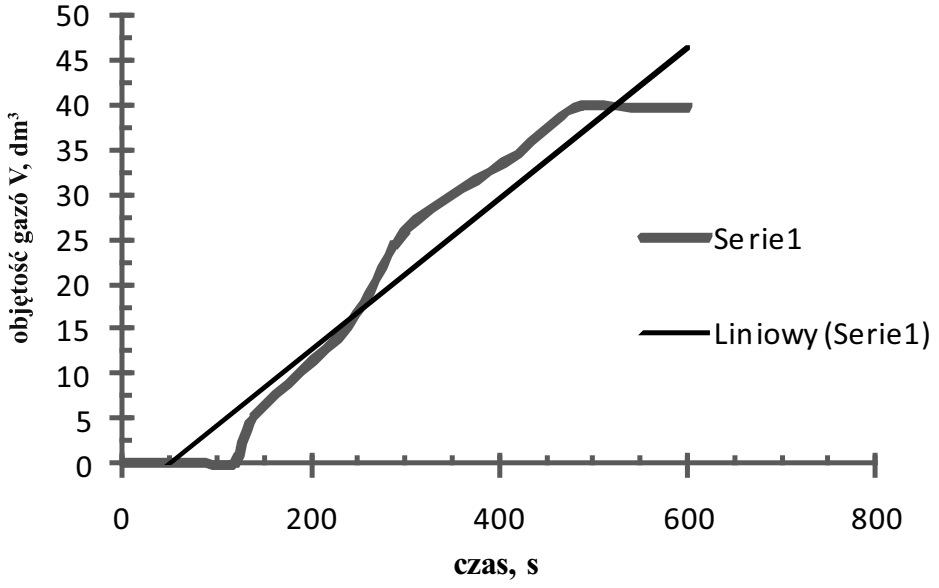

Fig. 5. The volume of gas separated from the EPS pattern, with a mass of 1 g at 400 °C, depending on the time, the density 20 kg / m ^{3} - Series 1

Table 1. The results of polystyrene

Property	Species polystyrene		
	Owipian 0308	Styrocell L830-3A	Styrocell L930-A
Relative viscosity η	1,81	1,94	2,17
Pentane content [%] according to the manufacturer's data	5,0	6,0	6,0
Pentane content [%] according to research	4,68	3,05	2,98
Ash content [%]	0,56	0,10	0,10

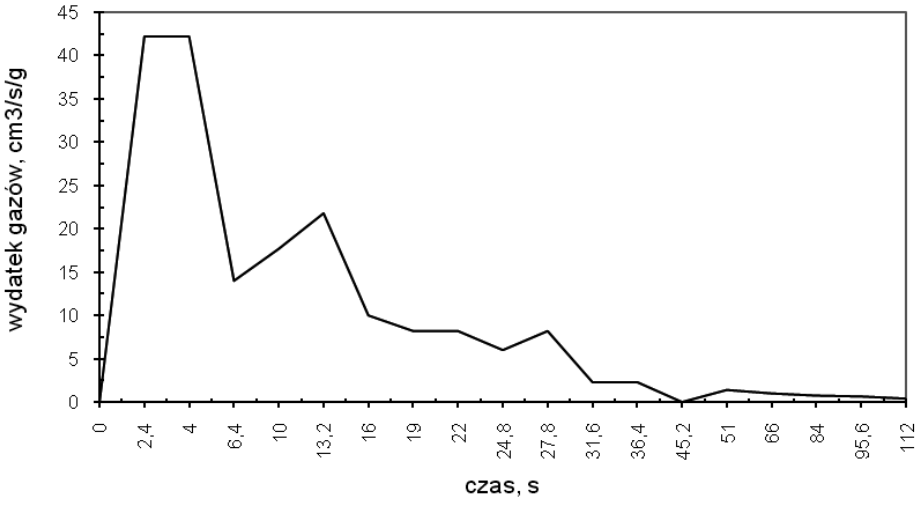

Fig. 6. Gas volume evolved from 1 g of the polystyrene pattern of 23 kg/m^3 density in function of time

The work undertaken was carried out measurements of compressive strength and tensile test samples cut from the models. The measurement was carried out in accordance with PN-B-20130. Results were as follows:

- compressive strength of 93 to 105 kPa,
- tensile strength of 115 to 140 kPa.

TECHNICAL IMPLEMENTATION OF TEST CASTINGS

The foundry KRÓLMET by heat EPS models, a series of experimental casting of rotor (Fig. 7, 8 and 9). Castings made of iron alloy.

During the study determined the optimal technological parameters of the process

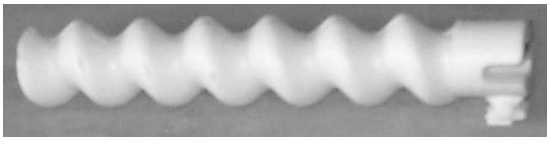

Fig. 7. Polystyrene pattern

a b

Fig. 8. Pilot castings, a - set of polystyrene patterns, b -in raw condition after pouring

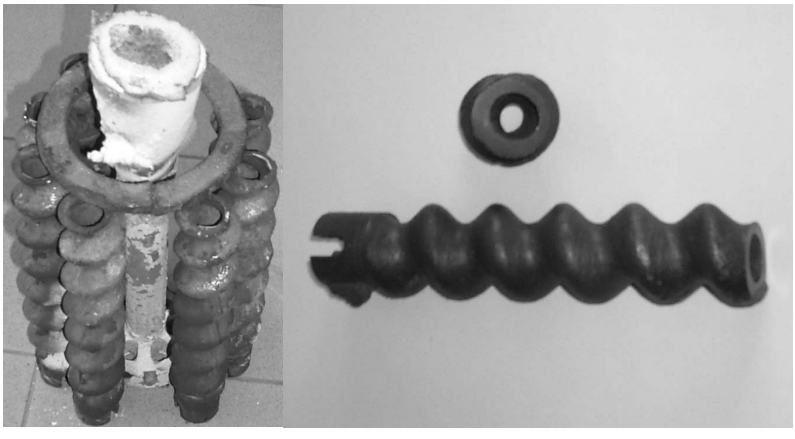

Fig. 9. Experimental rotor castings

CONCLUSIONS

As a result of experimental research can be concluded that the technology of heat EPS pattern, in foundry castings Królmet you can do:

- With complex shapes,
- The cavities and holes,
- About the thickness of the casting below 10 mm,
- Cast alloy,
- Casting of high hardness above 40 HRC,

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ZASTOSOWANIE NOWOCZESNEJ EKOLOGICZNEJ TECHNOLOGII LOST FOAM DO WYKONANIA CZĘŚCI MASZYN

Streszczenie. W odlewni żeliwa KRÓLMET w Zawierciu przeprowadzono prace badawczo doświadczalne związane z opracowaniem założeń techniczno technologicznych do produkcji odlewów części maszyn przy zastosowaniu metody zgazowanych modeli. Odlewy te charakteryzują się dobrymi właściwościami mechanicznymi, zwłaszcza twardością, odpornością na ścieranie i udarnością. Badania przeprowadzono w Instytucie Odlewnictwa a próby techniczne przeprowadzono w zmodernizowanym gnieździe odlewni KRÓLMET. W wyniku przeprowadzonych prac badawczych zoptymalizowano właściwości materiałów stosowanych w tej technologii oraz wykonano serię doświadczalnych odlewów. Otrzymano odlewy o założonych parametrach użytkowych.

Słowa kluczowe: technologia pełnej formy, odlewy, parametry.