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Properties Research of Ceramic Layer

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Abstract

In the method of full mould the polystyrene model, which fills the mould cavity in the course of filling by the liquid metal is subjected to the influence of high temperature and passes from the solid, through the liquid, to the gaseous state. During this process solid and gaseous products of thermal decomposition of polystyrene patterns occur. 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 gas from the polystyrene model during its thermal decomposition. Specific properties of ceramic layer used for lost foam castings are required. To ensure optimal process flow of metal in the form proper permeability of the ceramic layer is needed.
To ensure optimal conditions for technological casting method EPS patterns are tested and determined are the technological parameters and physical-chemical process in:

- material properties of the pattern,
- properties of the ceramic layer applied to the pattern,
- pattern gasification kinetics
- pouring process

In the course of the research the characteristics of polystyrene and ceramic layer were determined.

Keywords: Casting, Pattern, Foamed polystyrene pattern, Ceramic layer, Temperature

1. Introduction

Prior to research conducted tests included the ceramic layer strength and permeability.

The composition, method of application and the coating thickness - in the course of research - was unchanged. Similarly, constant permeability was taken as a shell during testing. The research conducted on specific composition of the coating, as its application, and the thickness, quartz sand grain size and equipment previously acquired by personal experience (Foundry Research Institute). Used binder developed at the Foundry Research Institute eg silicate-based binder called "Silwin" (Polish patent 164 293). It is the organic binder modified with polymer molecular weights. Constants were used as additives in ceramic zirconium powder, molochite and mullite. Layers were studied by the manufacturer company and a film developed at the Foundry Research Institute.
For the preparation of liquid ceramic coating used for the ingredients used Styrofoam models similar to the method of lost wax models

- as a solvent for adhesives - water
- binder - colloidal silica - Sizol A30,
- composition of surface - active anionic and non-ionic,
- an anti-foaming ,
- refractory ceramic powder - gl

For the test configurations were performed to cover signs of resistance to tearing of the thin ceramic layer and its permeability. 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 moulds - ceramic layer is used to cover:

- X1,
- X2,
- Cyrkonar.

The measurements were based on measuring the shear stress at a certain shear rate. Rheometer was controlled by a computer to analyse the results of the measurements used a computer program used to estimate the rheological parameters studied liquid adhesives and ceramic. The computer software enabled the necessary assessment of the quality estimation.

2. Research conducted tests of the ceramic layer

Studies has been carried out on ceramic layer strength and permeability. The composition, method of affixing, thickness coating-during the test-was stable. .

In conducted studies have been used: specified composition coating, way of its marking, and thickness, quartz sand sieve size and equipment according to own experience. Examined were the layer made of commercial material provided by the manufacturer and cover developed at the Foundry Institute. The test results are shown in Fig. 1 - 7. Liquid ceramic drawn up by weight-to cover on in terms of their properties. To draw up liquid masses for ceramic EPS models have been applied for the coating ingredients similar as in the case method evaporated models:

- as a solvent binders-water
- adhesive-silica colloid-Sizol,
- allowances,
- refractory ceramic material-molochite or silicate additions.

Thermo-physical parameters for the determination ceramic samples drawn up by weight of ash involving volatile manipulate the apparatus to the designation temperatures characteristic PR-25/1750 called the most by microscope. It may be used to designate temperatures of phase transformation (sintering, melting and yield) all ceramic materials which are sintered in temperature range 800-1750^{o}C.

For the measurement of ceramic strength applied was a method developed in Foundry Research Instiutute. The test sample was of dimensions 30 x 8mm, while its thickness was depending on the type of test plastic material.

Thin sample had thickness of 0,2 mm, should preferably less than 0,5 mm.

Layers were studied by the manufacturer company and a film developed at the Foundry Research Instiutute. The results are shown in Figures 1 – 7. Developed liquid ceramic mass were checked for their rheological properties.

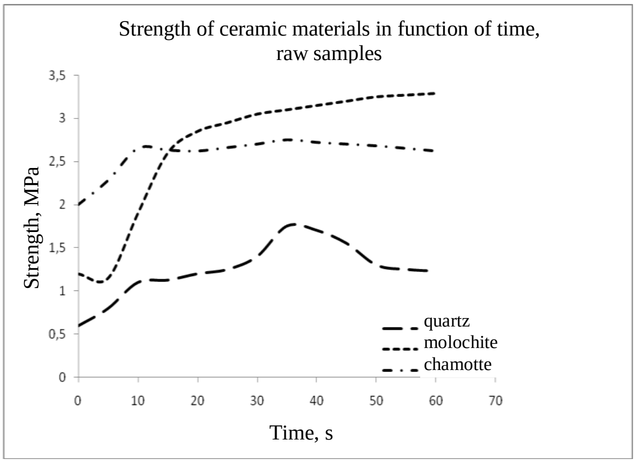

Fig. 1. Strength of thin ceramic layers carried out with different materials (sample crude) in function of time

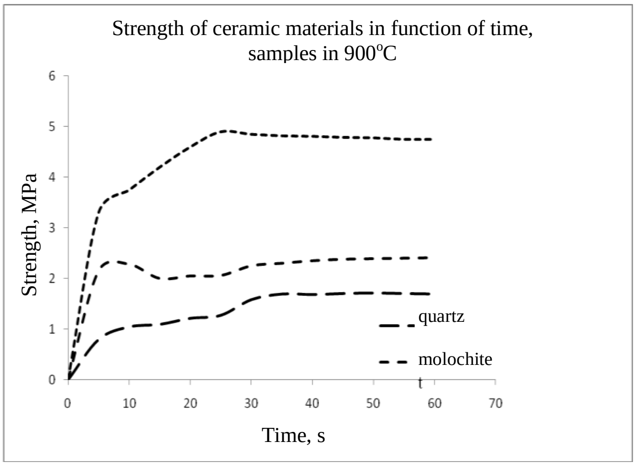

Fig. 2. Strength of thin ceramic layers made with different materials (sample annealed at 900^{0}C) as a function of time

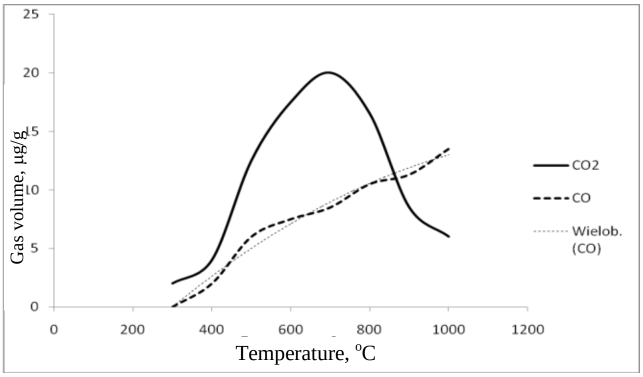

Fig. 3. Gas volume [µg/g] emitted in function of temperature T ^{o}C

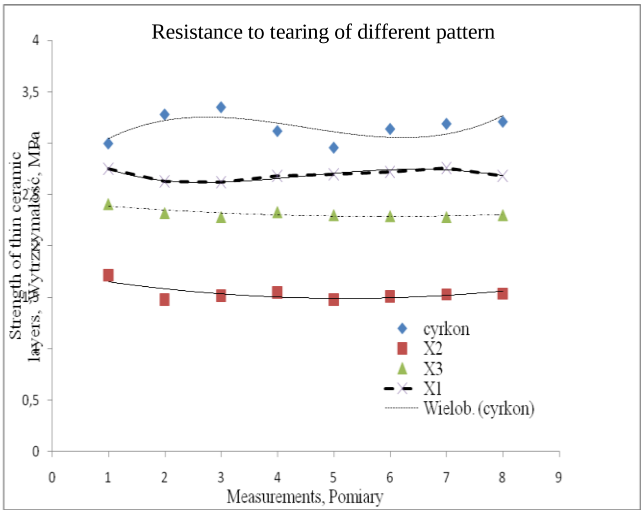

Fig. 4. Strength of thin ceramic layers made with different materials

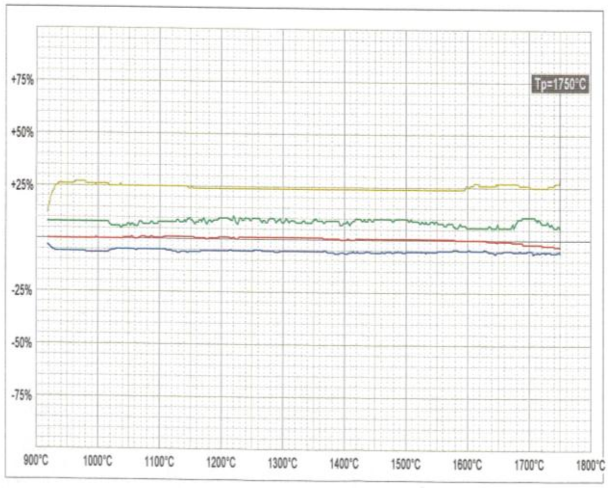

Fig. 6. The course of heating and the parameters for sample cover additions

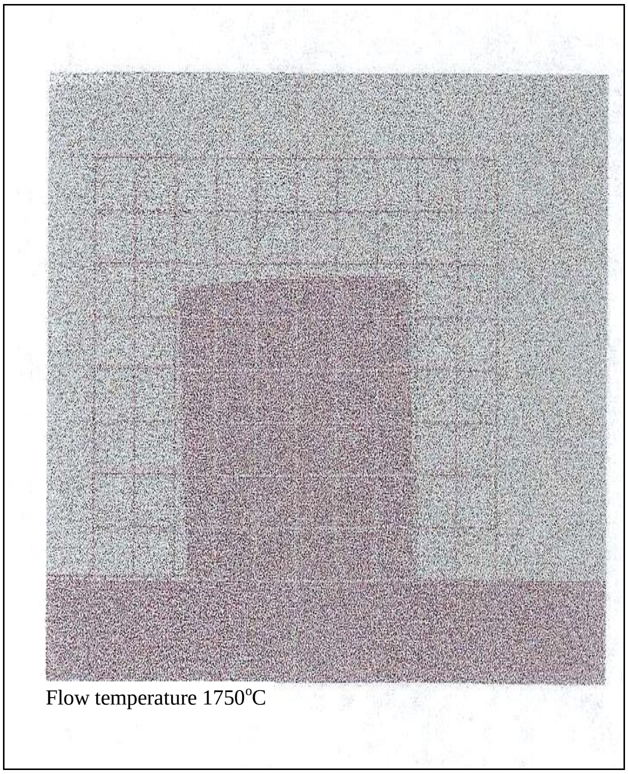

Fig. 5. Deformation of samples cover additions (drawn up at the Foundry Research Instiutute) by the temperature

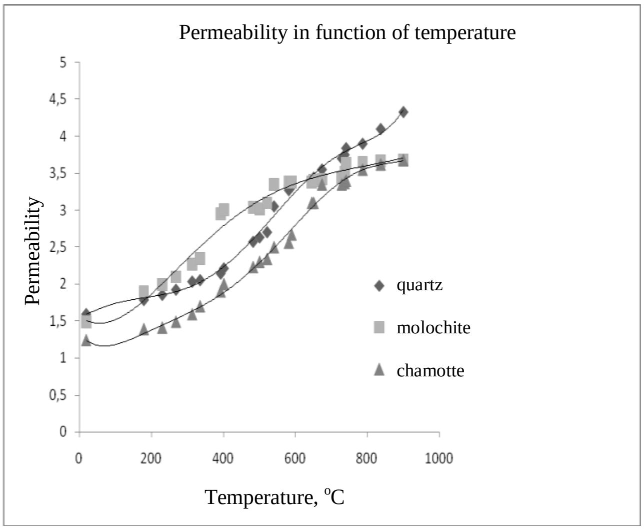

Fig. 7. Measuring changes in the permeability of the porcelain samples with different ceramic material used with changes in temperature

3. Conclusions

In Fig. 6 – 12 the results of comparative tests for commercial coating and the Cyrkokar coating developed at Foundry Research Institute are shown (the patent application).

Coatings are characterised by a similar resistance to temperature influence, but Cyrkokar has clearly higher mechanical strength. Such characteristics result in increased relevance of Cyrkokar applied to cast iron in lost foam method patterns.

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