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THE TECHNOLOGY FOR RESTORATION OF USED FUSIBLE MATERIALS

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Abstract: *The parts casting with high precision is characterized by the following features: It is done in temporal moulding shell without boundary surface; the model extraction from the moulding shell it is done after the mould is chemically cured and it can be made in two ways: by melting the model made from fusible material and elapse from the moulding cavity or by gasification of the model during calcinations of the moulding shell; it is a long time process and requires expensive moulding compounds. Casting of parts that requires high accuracy it is favourable if the alloy is expensive and the part geometry is complex.*
Key words: *fusible compound, ceramic material, restoration*

1. INTRODUCTION

Production of the moulded parts by high precision casting process using the fusible models it is characterised by realisation of parts with very good accuracy, parts that requires any cleaning after the casting process, no other process is needed before part utilisation.

Method of casting high quality parts is described as a complex, expensive and time consuming process. Hence, the method is advantageous for parts with small weights and reduced dimensions, having the very complex geometry, made by expensive alloy (ferrous and nonferrous).

High accuracy cast parts have a wide use in production industry as: airspace, electronics, auto, textile, optical and medical equipment (Cernat & Simionescu, 2009).

Since the apparition of the precision casting process with easily fusible models in 50s, the process has not been modified to much. Some modification has been done regarding the quality of the material used to create the moulding compound.

The researchers are continuously trying to increase and improve dimensional precision and surface quality of the cast parts. The method is irreplaceable in the manufacture parts from very rough material or refractory material that can not be processed on machine tools.

During a manufacturing cycle of the high precision casting parts using moulded shells is about 5 - 7 days and does not constitute a nuisance of mass production.

The precision foundries are part of specialized foundries, their production focus especially on small weight and size parts, rather complex geometric configuration of made from expensive metals and alloys.

2. DESCRIPTION OF THE CASTING METHOD

The materials used for making the models for precision moulding must meet the following conditions:
- to have low melting temperature point (easy to make and easy to remove from the moulding box), this feature will allow that all the required operations to be performed with low energy consumption on the other part;
- to have sufficient mechanical strength after casting (or pressed) and solidification in moulding tools, to withstand the various processes during the technological process;
- to have a low specific mass, to have a lower contraction coefficient for solidification and cooling, to generate a small quantity of residuals (ash) or gas, to be cheap.

The models made from fusible materials made from non-metallic materials or by alloys. The chemical composition of easily fusible material within two main classes of organic compounds: hydrocarbons and esters. Some easily fusible materials also contain alcohols and fat acids.

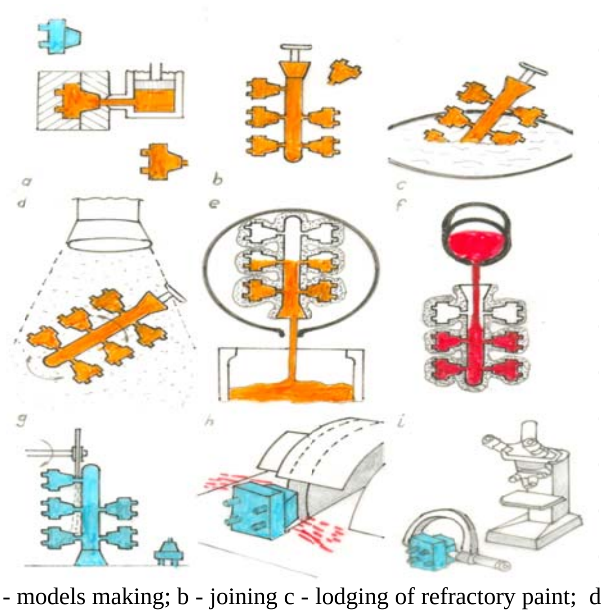
Many fusible materials such as "mineral wax" have in their composition hydrocarbon with a large number of carbon atoms in the molecule (17 ... 44). Vegetable waxes and animal waxes have a high concentration of esters. May also contain fat acids, free alcohols, hydrocarbons and resins. Hence, the natural fusible materials are combination of high molecular weight organic compounds.

The fusible synthetic materials are complex organic compounds with different chemical compositions.

Although they are different from the natural materials in terms of chemical composition, the melting temperature and their mechanical properties are close to those of natural materials (Simionescu & Cernat, 2000).

The difference between the fusible synthetic materials and the natural materials is given the higher purity of the synthetic materials. Figure 1 presents, the main phases of the technological process necessary to obtain high precision cast using easy fusible models.

In the following are presented the characteristics of materials used for making easy fusible models.



a - models making; b - joining c - lodging of refractory paint; d – fixation of refractory material, e - removing of the fusible models from the moulding shell, f – casting the alloy, g – removing the parts from the cluster; h - cleaning and finishing the parts, i – quality control of the final product.
Fig. 1. The main phases of the technological process

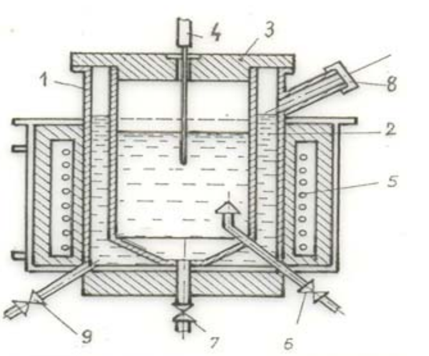


Fig. 2. Electrical heated melting bath for fusible materials

The stearin is a technical stearic acid with the structural chemical formula ($C_{17}H_{35}COOH$), contaminated with palmitic acid and oleic.

The stearic acid is a superior fatty acid, monocarboxylic, saturated. It is found in natural fats and vegetable as glycerides (esters of glycerol and fatty acids), from which is obtained by saponification.

The paraffin is a mixture of superior alkanes, having the chain unbranched. It is a solid product with white crystalline appearance, with no taste and no smell. The melting temperature varies between 45 and 62°C, depending on its chemical composition (Simionescu & Cernat, 2001).

The paraffin is obtained by crystallization or by help of some selective solvents resulted from distillation of fuel oil from paraffinic oils. Its structural chemical formula is C_nH_{2n+2}. Is a saturated hydrocarbon with a large number of carbon atoms (C_{28}, C_{20} ...).

The fusible mixtures based on stearin and paraffin are used for the following reasons: are cheap, are available and ensures an accurate enough models. Composition of compounds for easy fusible models can be made: 50%/50%, 40%/60%, 75%/25%, 65%/35%.

The compounds from nonmetallic materials used to make the fusible models are melted prior de process (Fig. 2). The melting bath 1 is made with double walls, with water between them. The bath is having a mobile cover 3, which has a thermometer 4. The metal is heated by the water, which is heated by an electrical resistance 5.

The melted compound is discharged through valve 6, then is poured into ingot blanks. The impurities (decanted on the bath bottom) obtained during the melting process are discharged through the valve 7. The water is inserted through the tap 8 and is discharged through the valve 9.

3. EXPERIMENTAL RESULTS

The fusible compounds recovered after removal of the models from the moulding shell are cleaned of larger ceramic pieces that were decanted at the bottom of collection container.

The collected solidified compound still contains small pieces of ceramic granules, for this reason is introduced into the filtration plant (Fig 3).

In filtration device 1 thought the loading door 2 is inserted the fusible compound block 3, which will be hold by the metal grate 4. The hot air (120°C), enter through the plant by pipe 5 and holes 6. The hot air warms the recovery vessel 7 and block 3, which need to be melted (Simionescu & Cernat, 2001).

The droplets resulted from ingot melting are guided by the funnel 7, pass thought site 8 (0.2 mm mesh size) and 9 (0.08 mm mesh size) and is collected in the recovery vessel 10. The fusible melt compound is maintained in the recover vessel to for 4 hours at temperature of 120°C to remove moisture. After the water is removed, the melted mixture is extracted through the exhaust pipe 11, by opening the valve 12 and let to cool in a tray.

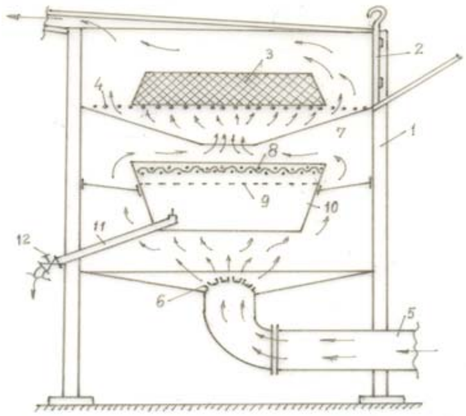


Fig. 3. Filtration device for used moulding compound

4. RESULTS AND DISCUSSIONS

If it necessary to obtain a more advanced purification the filtration process should continue till all the impalpable debris are removed. For this, the air temperature is gradually lowered to a value of 80 ... 85°C, the mixture being maintained at this temperature for about 12 hours.

The mixture is then discharged from the collector 10, through pipe 11 until the melting material level in the vessel 10 is 1 ... 2 cm above the top level of the pipe 11.

It must be mentioned the fact that heating for refurbishment leads sometimes to alteration of the mixture properties due to existence of some volatile constituents (Cernat et al., 2007).

Reintroduction into the production of reconditioned material should consider the following precautions: the refurbished compound must be mixed with new fusible compound; the remaining refurbished compound will be poured into moulds to obtain auxiliary elements of the cluster.

5. CONCLUSION

Moulds dies used in making fusible models must meet a number of technical and economic conditions, as follows:

- to duplicate perfectly the configuration and size of the fusible model, (is known that the part precisions depend by the dimensional precision of the model). The model precision depends by the moulding processing;
- to maintain their dimensions during the manufacturing process of model to avoid dimensional deviations from a piece to another, or between castings parts to the arrival of the mould and castings parts to the decommissioning of the mould;
- to have high thermal conductivity to enable rapid cooling and solidification of the casting patterns, this condition is important for mass production;
- to withstand the chemical and mechanical reaction of the materials that comes into contact, to be made with minimal cost for the number of pieces to be cast.

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