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THE POSSIBILITIES TO EFFECT THE CASTING´S SURFACE LAYER BY ADDING METALLIC COMPONENT INTO THE MOULD´S COATING

A. POKUSA[1], R. ŠUBA[2], L. TOMAŠÍKOVÁ[3]
Department of Foundry, Faculty of Material Sciences and Technology,
Slovak University of Technology, Trnava

SUMMARY

There are often demands to coat the whole surface of produced parts or its fraction by thin metallic layers with special properties. These can be solved by simple and effective technology, which enables special surface layer creation on cast iron or steel castings from metal component of mould coating during the metal pouring.

Key words: coating, mould, metal powder

1. INTRODUCTION

There are demands to create thin metallic layers with special properties on selected surfaces or exceptionally on the whole surface of part. These are often fulfilled by methods of thermochemical treatment, electroplating and spraying or welding - on. The aforementioned methods are additional manufacturing operations, energy and time consumpting, which require preliminary surface treatment. The presented technology offers simple and effective solution to create special surface layers on cast iron and steel castings from metal component of mould coating during the metal pouring [1, 2].

[1] *Prof. Ing., CSc., pokusa@stuba.sk*
[2] *Ing., PhD., suba@stuba.sk*
[3] *Ing., tomasikova@stuba.sk*

2. MOULD COATINGS MODIFIED WITH METAL POWDERS

The functional component of coating, i. e. metal powder is admixed to special mixture and sprayed on the selected part of mould´s cavity before the metal pouring. The method of coating´s application is similar to the one for common mould´s protecting coatings. The latter are used for mould´s protection or modification of moulding sand´s properties for interaction with molten metal. The mixture can be applied by spreading on chemically hardened moulds and cores, but spraying gives better result. The application of mixture by spraying on surface of green-sand moulds is more suitable due to high content of carrier liquid.

The obtained coating protects the mould and supplies the metal component on the surface of solidifying casting for metal coating creation. The carrier medium of metal component, usually colloid solution of some resin, have to ensure the uniform distribution of metal powder in coating and its reliable binding to mould´s surface of after coating hardening (Fig. 1). The organic components of coating degrade and decompose gradually during metal pouring to enable the creation of metal layer from powder (Fig. 2). The released gas products and residual carrier liquid vapours escape partially to mould´s cavity but their main part escapes through permeable forming sand. The escaping gas can often cause surface voids on castings [3]. The value of mixture´s viscosity have to be great enough to do not seep during application. The coatings thicker than 0,5 mm have to be sprayed in several layers, the next after drying of the previous. The coating´s thicknesses more than 0,5 mm have to be carefully taken into account, because the creation of metal layer is ensured only by thermal capacity of poured molten metal.

The main criterion for suitability of metal powders for coating is material of casting and powder. These have to create such structural phases which ensure suitable strength of bond between the material of casting and created coating. Pure nickel powders and nickel based powders with additions of chrome, molybdene, boron or silicium are suitable for the corrosion and wear resistant coatings on cast iron and steel castings. The nickel based, copper based and brass (for peripheral surfaces of parts) powders are suitable for transparent layers. The particle size of used powders can be in range from 0,1 to 800 μm (small amount of fraction over 800 μm can be also used in some cases). However the usually used particle sizes are up to 300 μm. The using of larger particle sizes usually does not ensure the creation of homogenous coating with required thickness.

3. THE VERIFICATION OF BINDER SUITABLE FOR MULTILAYER MOULD COATINGS

Usually the rough surface of castings and the used material (cast iron) properties cause that the special coatings creation with usual methods is technically very complicated. The solution of these problems were proposed and verified by

creation of such coatings from the coatings of mould cavity. The mould coating is dispersion of solvent (carrier liquid) and filler (metal component – K type welding -on powders and bronze powders).

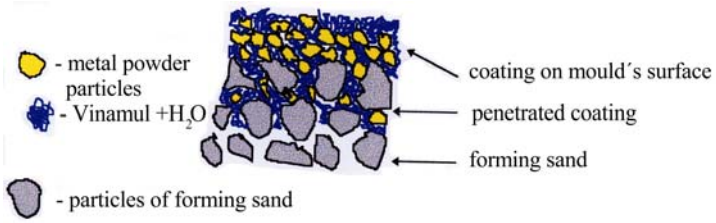

Fig. 1. The created mould´s coating

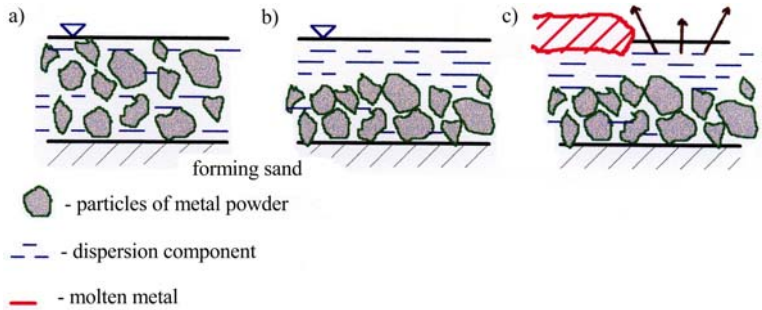

Fig. 2. The mould´scoating during casting a) mould´s coating after spraying, b) sedimentation of metal particles , c) molten metal pouring

The main problem is still the choice of binder´s type and the optimal composition of coating. The experiments with various compositions were focused on two resin based binders:

a) IM 3000 Maldaner - resin based coating used for surface preparation before electroplating. It hardens during 15 min at 90 °C.

b) VINAMUL 36/50 - polymer based dispersion used as component of coating.

c) UMAFORM – resin based coating used in forming sands with ESTEROL hardener.

The coatings were at first tested on test specimens from forming sand with diameter 50 mm and height 50 mm. The observations were focused on uniformity of obtained coating and its penetration into specimens surface. From the tested compositions were chosen the following two for further:

- 13,4 g K 60 (< 100 μm) powder + 5ml VINAMUL
- 7 g CuSn10 (< 100 μm) powder + 5 ml UMAFORM + 2 ml ESTEROL

The first coating was easily enough applied, even if it was the thickest from all tested. It was not trickle from vertical surfaces and even not penetrate. Its first applied layer was thick and almost continuous and resisted even to mechanical damage. The time of its drying was 40 min at room temperature.

The second coating dried very quickly and its application was easier. The coating was uniform and penetrated into specimen´s surface. It hardened during 5 seconds at 22 °C. The proper content of ESTEROL hardener was very important, its increasing content decreases the hardening time. These laboratory tests proved the applicability of used and chosen binders.

On the base of obtained results the VINAMUL 36/50 coating was chosen for tests with moulds. The moulds tests with cast iron showed, that the coating provide reproducible results. The thickness of metal coating on castings increased with the number of coating layers on moulds respectively. The thinniest layer suitable to create suitable metal coating was 50 μm. The uniformity of metal coating´s thickness depended on the method of its application on the mould´s cavity. The experimental results are shown on Fig. 3 and 4 of castings crossections.

The microstructural analysis of casting proved, that metal coating created from one layer mould´s coating with thickness of 0,4 ÷ 0,5 mm is not so compact as can be seen from Fig. 3. It can be established that K 60 powder (Ni, Cr, Fe, B, Si, W, C) was partially melted and this enabled to create required coating on the most of surface. The created metal coating and the adjacent base metal contains not only metal powder but also precipitated graphite and pores.

The Fig. 4 shows continuous, compact metal coating, not scaling off at mechanical stress, created from two or more layers of mould´s coating. The homogenity of created coating can be explained, that nonhomogenity of metal component in first layer of mould´s coating is reliably covered with next layer.

From obtained results can be concluded, that VINAMUL 35/60 coating gives reproducible results. The compact metal coating on observed specimens is not notably mixed with base metal. Its thickness depends on the number of mould´s coating layers. The boundary between metal coating and base metal is clearly visible although there is hardly noticeable transition zone.

4. CONCLUSIONS

Practical experiences shows, that this technology is not very sensitive on keeping of its precise parameters. These parameters can be in some range without influence on obtained results. The coating can be applied on selected parts of mould, it have not cover the whole cavity. The size tolerances of coated parts of casting does not exceed tolerances given by its production technology. The result depends on adherence of technological process, which is influenced by used forming sand, chemical composition and properties of used coating, shape and wall thickness of casting.

In this stage of the development of above mentioned technology is necessary to experimentally establish suitable mould´s coating thickness, content and granullometry of chosen metal component for each casting.

The surface quality of created metal coating can be enhanced by plasma - polishing technology [4] or the coating can be completely removed by it.

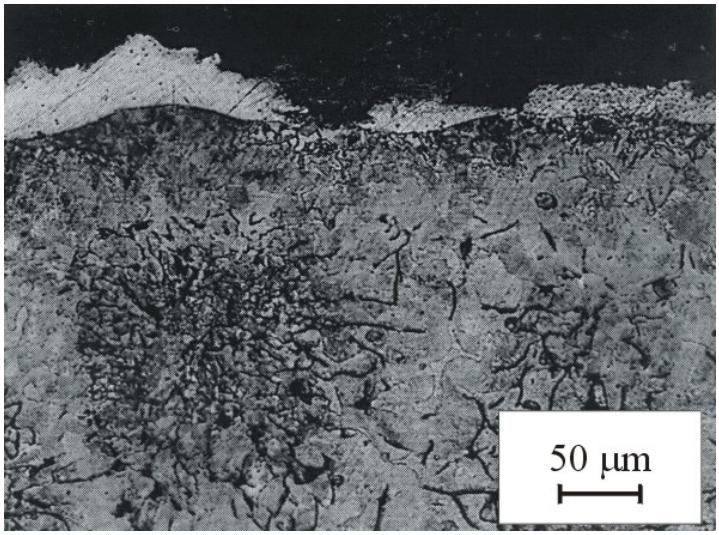

Fig. 3. Structure of casting´s surface with one layer of VINAMUL 36/50 coating

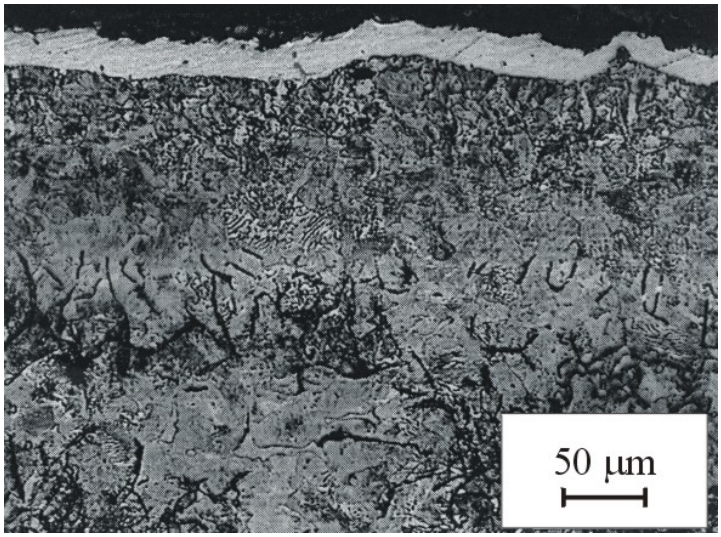

Fig. 4. Structure of casting´s surface with two layers of VINAMUL 36/50 coating

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MOŻLIWOŚCI WYTWARZANIA WARSTWY WIERZCHNIEJ ODLEWU Z DODATKAMI SKŁADNIKÓW METALICZNYCH W POWŁOCE OCHRONNEJ FORMY PIASKOWEJ

STRESZCZENIE

Często od metalowych detali żąda się specjalnych powłok metalicznych. Przedstawiona w pracy technologia jest prostym i efektywnym rozwiązaniem. Umożliwia wytworzenie powłok metalicznych, na odlewach ze stopów żelaza, poprzez domieszkę metalowego składnika do powłoki ochronnej na formie piaskowej.

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