ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
Tome V (Year 2012). FASCICULE 4 [October–December]. ISSN 2067-3809

[1.] Imre KISS

RE-UTILIZATION OF MOLDING SANDS PREPARED WITH SYNTHETIC RESINS BY CLAY ADDITIONS, WITHOUT COMPLEX RECLAIM OPERATIONS

[1.] UNIVERSITY POLYTECHNIC TIMISOARA, FACULTY OF ENGINEERING HUNEDOARA, HUNEDOARA, ROMANIA

ABSTRACT: *There is poor information in the literature written on this theme, regarding the re-utilization without regenerating operations of the moulding sands prepared with synthetic resins. In practice, these methods have a lot of difficulties regarding the separation of moulding sands with organically bonding agents in comparison with the sands prepared with non-organically agents. The re-utilisation of moulding sands based on resins without technological regenerating processes is not to be applied in the practice of the preparation with resins. Therefore is intended a re-utilisation of these moulding sands, with non-organically bonding agents (clay), replacing thus, partly, with new sand. The industrial foundry practice showed that this method could be applied with good results to any type of mould based on the organically bonding agents.*
KEYWORDS: *foundry processes, molding sands, synthetic resins, non-organically bonding agents (clay), re-utilization*

INTRODUCTION

In the specialty literature there are just a few articles regarding the re-utilization without reclamation of molding sands with synthetic-resins. This situation cannot be explained through the hardships regarding the separation of the molding sand with organic binder from the molding sand with inorganic binder, because all the references regarding the thermal reclamation processes confirm that the two qualities of molding sand are separable at rapping.

To adopt some complex reclamation installations, used for all kinds of molding and core sands, in our foundries with medium modernization and partially mechanized, would be conditioned by the economical and financial problems. From these aspects we can start any calculus regarding the efficiency and profitability in foundries, this being precisely the reason that experts in these arias try, in any way, to utilize and re-utilize all the starting materials they have, in order to obtain the highest efficiency for the installations, equipments and aggregates existing in foundries, with a minimal financial effort and without decreasing the quality of cast pieces.

The re-utilization of molding sand prepared with organic binder, especially with synthetic resins, without any reclamation operation, is not particularly used in practice for a new resins molding preparation. For these reason it is attempted, in our foundries, as a new technological method, the re-utilization of these molding sands, using the inorganic binders (clay, bentonite and/or sodium silicate) instead of the synthetic resins. Practically, it is attempted to obtain a sample of molding sands re-used with synthetic resins and an inorganic binder, the molding used replacing the new sand from the composition of the freshly prepared mixture.

PRESENTATION OF THE WORKING METHOD

The most common flaws in foundries are adhesions that occur in the ferrous alloys pieces, which require more manual labor in the cleaning sectors for their removal. In order to prevent adhesion appearances, especially the chemical ones, predominantly at the steel pieces cast, there are two technological possibilities:

- *To add, at the preparation of the molding sand, some materials that create a decreasing atmosphere at the metal – mould contact surface, in this way preventing the formation of basic oxide in liquid metal or even the reduction of the already formed oxides. As a reduction material one can use coal, mazout or Diesel oil*
- *To use some basic refractory or neutral materials in the sample molding sand, materials that don't interact with the basic oxides from the cast liquid alloy.*

Due to the fact that basic refractory materials are more expensive, their purchase by the foundries is only a technology foresight for the future. In these conditions, the first method remains as a possibility to avoid the appearance of adhesion, explicitly the utilization in the prepared moldings of the organic materials that produce a film with reduction gases at the metal – mould contact surface.

In the performed researches used molding sands, binders with synthetic formaldehyde resins were utilized. Such molding sand has in its composition, if it is well sorted, only acid refractory material (SiO_2) and a quantity of synthetic resin that didn't burn during the previous cast, but it is still sufficient to produce the reduction gas film. It can be stated that the used molding with synthetic resins has a superior quality than the new sand, because the used mould also contains the organic material necessary to produce the reduction gas film.

Research were done regarding the re-utilization of molding sand with synthetic resins, adding as a binder organic material (clay), witch is an classic binder and is normally found in any of our foundries. In this paper are presented the data regarding the laboratory experiments performed in order to realize this study, as well as a series of graphic representations of the permeability of the analyzed molding sands.

Also, tests were done in order to determine the compressive strenght resistance of the molding sands bound with various clay, bentonite or sodium silicate percentage. The tests take into consideration the various degrees of the humidity for the laboratory prepared molding sands.

MOLDING SANDS WITH SYNTHETIC RESINS RE-UTILISED AFTER CLAY ADDITIONS

The material obtained from moulds with synthetic resins, degraded before casting (that are not introduced in the casting process), as well as the moulds that participated in the casting, served as support for the pieces obtained in this way. These used mixtures were re-used in the casting processes, without any reclamation operation necessary, only a simple addition of organic binder, in different percentages and at a certain humidity degree, after an initially crushing. All operations are realized with the equipment already existing in the foundry, regardless of the mechanization level.

During experiments, resins molding sands were prepared, mechanically degraded (crushed) before the cast, witch haven't been introduced in the casting process. This unburned moulds have been crushed in a mixer, and clay with binder was added to the sand resulted from this operation, in order to prepare a sample mixture. There were also used molding sands ready for casting, but unused in it, because at the laboratory analyses they presented a higher content of binder and didn't meet the plasticity conditions.

METHODS

The clay content influence over the molding properties was studied on separate laboratory prepared mixtures, in witch the clay content was gradually increased. In this way, there were prepared experimental mixtures with 5%, 10%, 15%, 20% and 25% clay as a new binder. For every different content of the clay there were tests performed with 3…15% water content.

In order to comparatively study the results there were also performed studies regarding the properties of the molding sands based on the new sand bound with clay.

RESULTS AND DISCUSSIONS ON THE COMPRESSIVE STRENGHT STRENGTH

In Figure 1 the graphics of the resistance variation at the compressive strength is presented in green (undried) state, for the molding sands based on crushed moulds, for different clay percentage.

Figure 2 render the graphics of the resistance variation at the compressive strength, in wet state, for different clay percentage.

For comparison, in Figure 3, respectively in Figure 4 the graphics of the resistance variation at the compressive strength are presented in green (undried) state and in dried at 200° C for the mould sands based on new sand bound with different clay percentage.

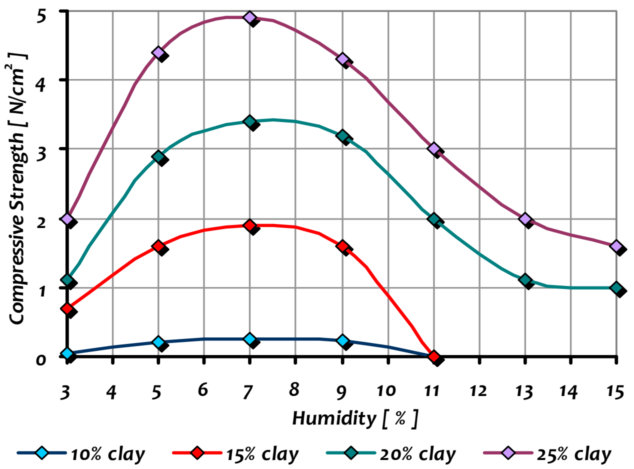

Figure 1. The resistance variation at the compressive strength, in green (undried) state, for the molding sands based on crushed moulds, for different clay percentage (5%, 10%, 15%, 20% and 25% clay)

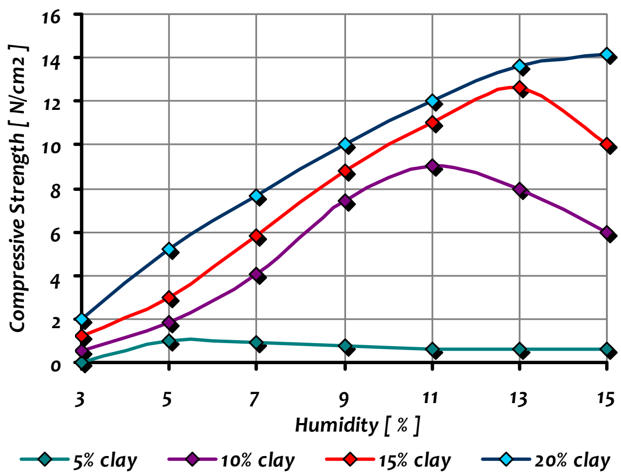

Figure 2. The resistance variation at the compressive strength, in wet state (3…15%), for different clay percentage (5%, 10%, 15%, 20% and 25% clay)

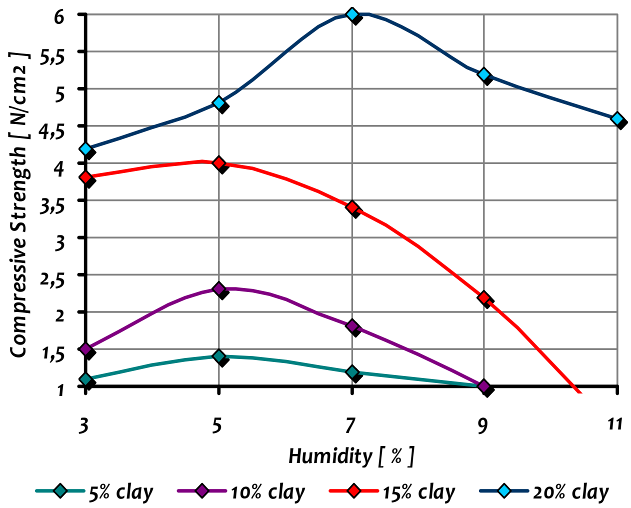

Figure 3. The resistance variation at the compressive strength in green (undried) state for the mould sands based on new sand bound with different clay percentage (5%, 10%, 15% and 20% clay)

In Figure 5 the graphics of the resistance variation at the compressive strength is presented, in green (undried) state, for the mould sands based on used mould sand (totally burned), for different clay percentage.

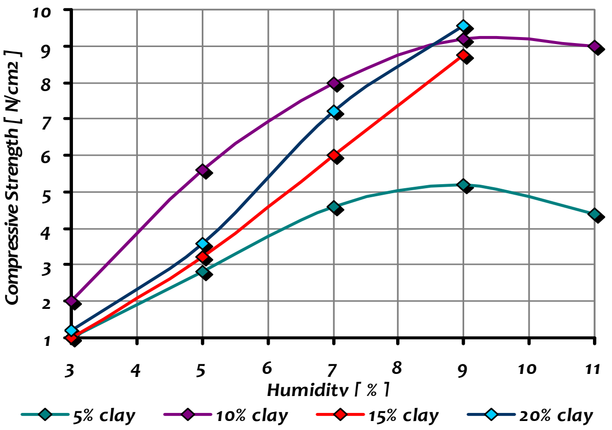

Figure 4. The resistance variation at the compressive strength are presented in dried at 200° C for the mould sands based on new sand bound with different clay percentage (5%, 10%, 15% and 20% clay)

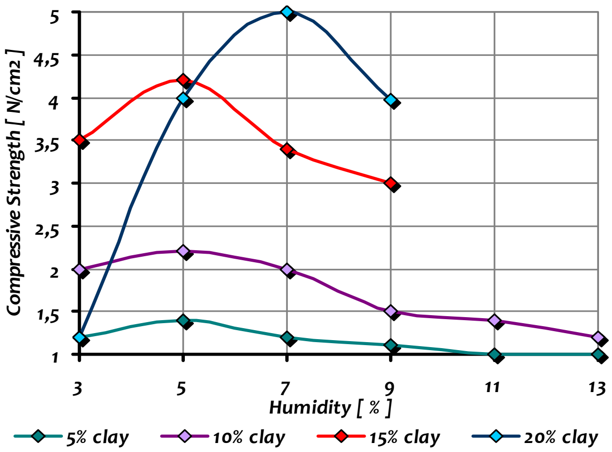

Figure 5. The resistance variation of the compressive strength, in green (undried) state, for the mould sands based on used mould sand (totally burned), for different clay percentage (5%, 10%, 15% and 20% clay)

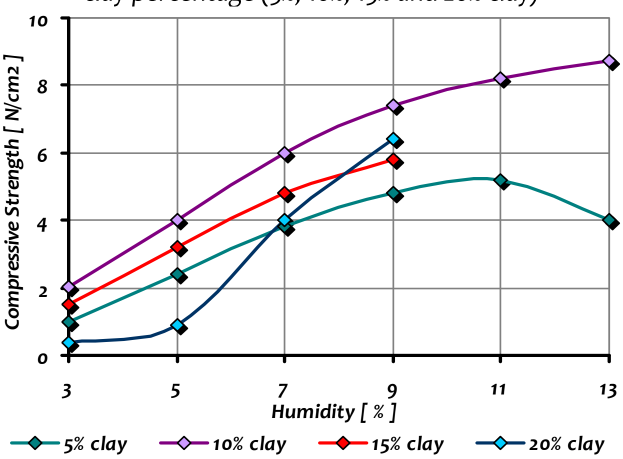

Figure 6. The resistance variation at the compressive strength, in dry state, for different clay percentage (5%, 10%, 15% and 20% clay)

Figure 6 render the graphics of the resistance variation at the compressive strength, in dry state, for different clay percentage.

RESULTS AND DISCUSSIONS ON THE PERMEABILITY

In Figure 7 the graphics of the permeability variation is presented in green (undried) state, for the molding sands based on crushed moulds, for different clay percentage.

The Figure 8 renders the graphics of the permeability, in wet state, for different clay percentage.

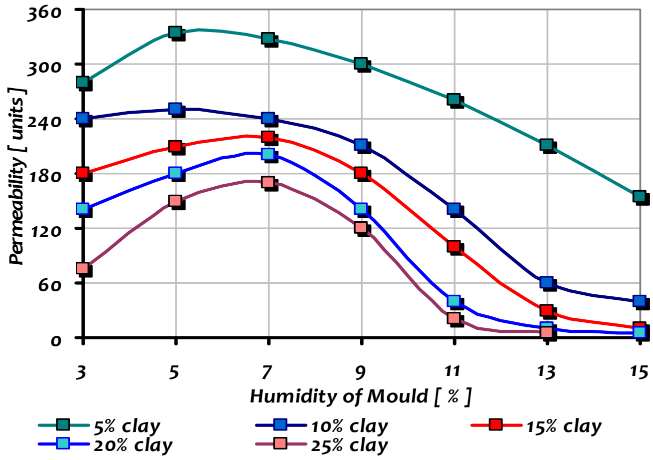

Figure 7. The permeability variation in green (undried) state, for the molding sands based on crushed moulds, for different clay percentage (5%, 10%, 15%, 20% and 25% clay)

For comparison, in Figure 9, respectively in Figure 10 the graphics of the permeability are presented in green (undried) state and in dried at 200° C for the mould sands based on new sand bound with different clay percentage.

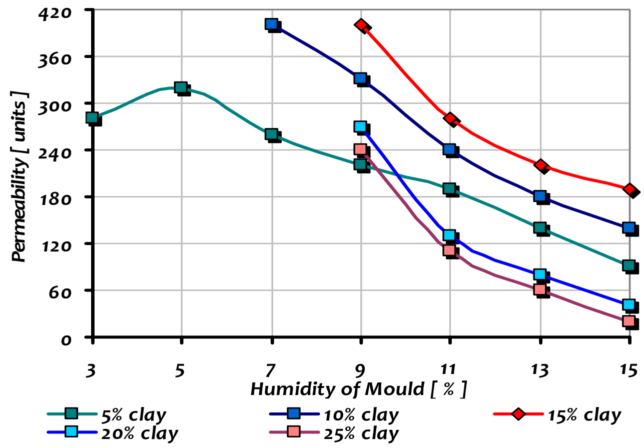

Figure 8. The permeability, in wet state, for different clay percentage (5%, 10%, 15%, 20% and 25% clay)

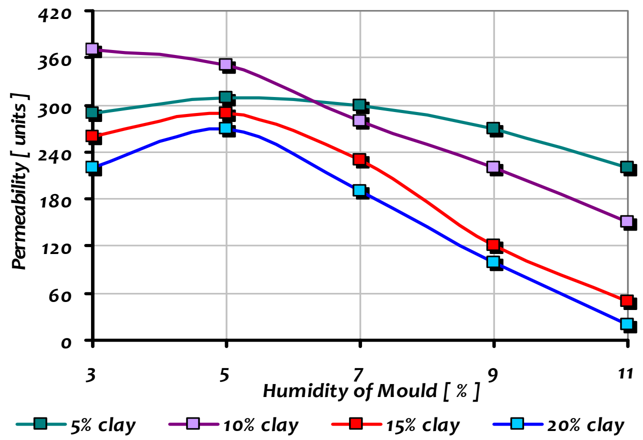

Figure 9. The permeability in green (undried) state for the mould sands based on new sand bound with different clay percentage (5%, 10%, 15% and 20% clay)

The Figure 11 renders the graphics of the variation of the permeability is presented, in green (undried) state, for the mould sands based on used mould sand (totally burned), for different clay percentage.

The Figure 12 renders the graphics of the permeability, in dry state, for different clay percentage.

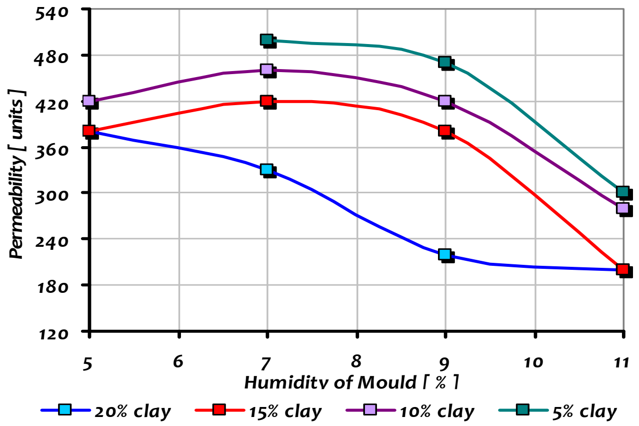

Figure 10. The permeability in dried at 200° C for the mould sands based on new sand bound with different clay percentage (5%, 10%, 15% and 20% clay)

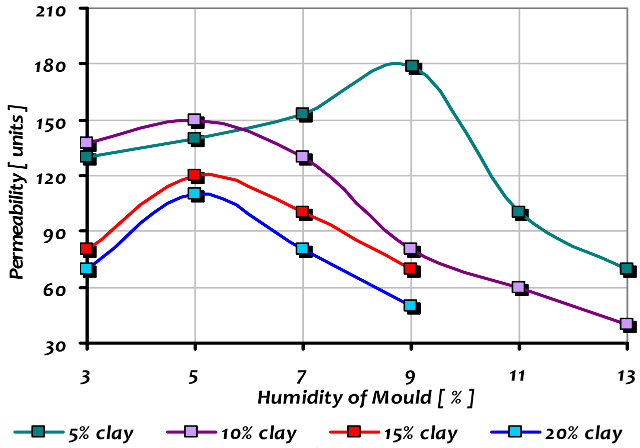

Figure 11. The variation of the permeability in green (undried) state, for mould sands based on used mould sand (totally burned), for different clay percentage (5%, 10%, 15% and 20% clay)

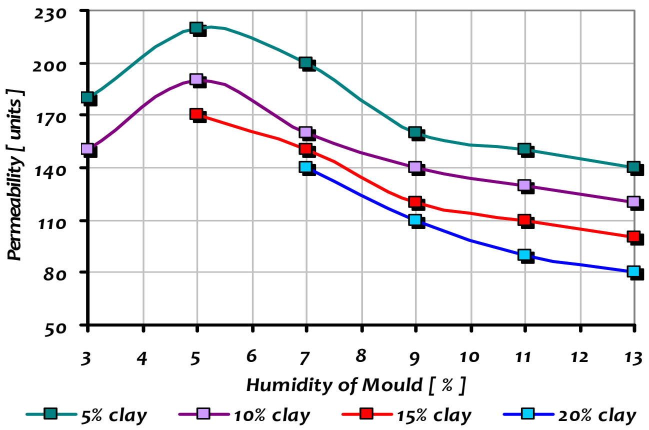

Figure 12. The permeability, in dry state, for different clay percentage (5%, 10%, 15% and 20% clay)

CONCLUSIONS REGARDING THE RESULTS

We can conclude the following:

- *Researches performed in order to obtain a sample mixture, starting from a mould sand based on synthetic resins and bound with clay at the re-utilization, were extremely conclusive regarding the compressive strength resistance, in both green (undried) and dry state;*
- *Results were also conclusive regarding the second characteristic studied – mould sand permeability;*
- *Mould sands, based on granular material obtained fro moulds with synthetic resins, as a basic refractory material and an organic binder (clay) can be used as a sample mixture for both green (undried) moulds, as well as for dry moulds for steel, iron and non-ferrous alloys castings;*
- *Starting from the economical calculation performed in our foundries, the cost of the studied molding mixture is lower then the one obtained from the mixture based on new sand and inorganic binders;*
- *The good results obtained in the laboratory stage recommended these experimental processes for the industrial practice of the molding sectors from our foundries, as well;*
- *The industrial practice proved that the surface of the cast iron pieces in the moulds made from these mixtures is superior to those cast in moulds based on new sand and inorganic binders;*
- *Mould sands, based on granular material obtained fro moulds with synthetic resins, as a basic refractory material and other classic organic binders (bentonite or sodium silicate) can be used in steel, iron and non-ferrous alloys foundries.*

All these lead to the successfully implementation in our foundry practices of these molding technologies, without any used mixture reclamation operation necessary.

REFERENCES

[1.] CERNAT, C-tin., Bazele fizico-chimice ale lierii nisipurilor de turnătorie, ET – Bucureşti, 1998

[2.] MĂRGINEAN, I. Manual pragmatic de turnătorie", Bucureşti, 2001

[3.] BUZILĂ, S., DRĂGOI, Fl., Cercetări privind posibilitatea de refolosire a amestecurilor de formare cu răşini sintetice, fără regenerare, Metalurgia, 5, 26/1974

[4.] DANKO, R. S., Experiences gathered during reclamation of used water glass and bentonite sands in extra low and ambient temperature, International Journal of Cast Metals Research, Volume 23, Number 2, 2010, pp. 92-96(5)

[5.] BONNEMASOU, R. FILHO, H.J.d.; da COSTA, L.; BICKFORD, K.; DiNUNZI, A., Foundry sand core removal and recycle, Journal of Cleaner Production, Volume 3, Number 4, 1995 , pp. 244-244(1)

[6.] GIJO, E.V. SCARIA, Johny, Application of Taguchi method to optimise the characteristics of green sand in a foundry, International Journal of Business Excellence, Volume 4, Number 2, 2011, pp. 191-201(11)

[7.] FAN, Z.T. Huang, N.Y. Dong, X.P., In house reuse and reclamation of used foundry sands with sodium silicate binder, International Journal of Cast Metals Research, Volume 17, Number 1, 2004 , pp. 51-56(6)

[8.] LEMMOUI A., BACCOUCHE M. HADJI A., Improvement in the aptitude to discharge and to unstop of sands binded with sodium silicate and hardened by carbon dioxide, Annales de Chimie Science des Materiaux, Volume 24, Number 1, 1999, pp. 75-85(11)

[9.] CHONG-LYUCK PARK, BYOUNG-GON KIM, YOUNGCHUL YU, The regeneration of waste foundry sand and residue stabilization using coal refuse, Journal of Hazardous Materials, Volumes 203–204, 2012, pp. 176–182

[10.] M.C. ZANETTI, S. FIORE, Foundry processes: the recovery of green moulding sands for core operations, Resour. Conserv. Recycl., 38 (2003), pp. 243–254

[11.] U. LAHL, Recycling of waste foundry sands, Sci. Total Environ., 114 (1992), pp. 185–193

[12.] KISS, I. Research regarding the re-utilization of molding sands prepared with synthetic resins without any complex reclaim operations, Annals of Faculty Engineering Hunedoara – International Journal of Engineering, Fascicule 2/2012, 227...230