THE STUDY OF INFLUENCE CORE MATERIALS ON TECHNOLOGICAL PROPERTIES OF UNIVERSAL BENTONITE MOULDING MATERIALS

Matej BEZNÁK, Vladimír HANZEN, Ján VRABEC

Authors: ***Matej Beznák, Assoc. Prof. PhD., Vladimír Hanzen, MSc. Eng. Ján Vrabec, MSc. Eng.***
Workplace: ***Department of Casting, Institute of Production Technologies, Faculty of Materials Science and Technology in Trnava, Slovak University of Technology Bratislava***
Address: ***J. Bottu 23, 917 24 Trnava, Slovak Republic***
Phone: ***+421 918646051***
Email: ***matej.beznak@stuba.sk, vladimir.hanzen@stuba.sk, jan.vrabec@stuba.sk***

Abstract

The paper deals with influence of core materials on universal moulding material with bentonite used for mouldmaking. The experiments evaluated the influence of core sand content (10, 20, 30, 50%) in universal bentonite moulding material. The influence was estimated by measurement of technological properties of moulding material. The results proved that these contents influence technological properties of universal bentonite moulding material.

Key words

core materials, universal moulding materials, bentonite

Introduction

The development in foundry production improves many used methods. Their improvement increases castings quality and decreases probability of defects. So the quality of moulding material is very important. The Disa mouldmaking method uses universal bentonite moulding material, which is continuously recycled during production cycle. The new bentonite must be added after its use in certain number of cycles or after achieving certain level of wear. Also new sand is added into mopulding material. There is need of technological properties (humidity, permeability) measurements to use the binder and sand economically. These can be measured during production process by testers placed in moulding material processing workshop near muller to control the necessary adjustments. After large number of production cycles the technological properties of universal moulding material are influenced by some core material content. The core material is admixed into universal moulding material at high-frequency shakeout tables, vibration devices, etc.. Core material remains in moulding material as debris of cores. These debris can cause decreasing of some technological properties especially at mass production of box type castings. The measurements of humidity

and permeability are insufficient for such production and measurements of mechanical properties of universal bentonite moulding material are also necessary. The properties of moulding material are characterized by physical, chemical and technological parameters.

Bentonite moulding materials

The bentonite moulding materials are most used moulding materials for moulds used for cast iron castings production. Their basic composition is sand (usually silica sand), binder (bentonite) and additives (carbon containing, starch, graphite), water. Using these moulding materials in batch production causes progressive decreasing of their quality (change of technological properties) and because of this fact they must be improved by new binder addition and also water addition to achieve required humidity. The humidity of moulding material is adjusted for optimal compatibility 30 - 40 %. The optimal water content is determined from curves of compression strength and permeability (humidity). The properties of moulding material like mouldability, flowability and compatibility are very sensitive even on small change of water content. [3]

Experimental

Universal bentonite moulding material (its components shown in Table 1) was used for experimental measurements.

BASIC COMPONENTS OF UNIVERSAL BENTONITE MOULDING MATERIAL Table 1

Universal bentonite moulding material	
Binder	Sand
KERIBENT C30 (mixed bentonite) (pure bentonite 7% + graphite 3%)	Šajdíkové Humence SH34 (d_{50} =0,22 mm) +Grudzeň Las (d_{50} =0,16mm)

Moulding material was prepared by intensive mixer TECHNICAL SPM 70. The moulding material was sampled during its transport (by conveyor belt) before moulding. For its final conditioning laboratory vertical wheel batch type muller MK was used. The humidity of moulding material was adjusted before experimental measurements to achieve required compactibility 35 % for experiments. One batch in laboratory vertical wheel batch type muller was 10 kg of moulding material.

Core material with various binding processes was used. Cores were made from sand – Šajdíkové Humence SH33 (d_{50} =0,27 mm) from Kerkosand a.s.. Various content of core material was admixed into moulding material (10, 20, 30, 50 %). After addition of core material water was added moulding material to achieve required compactibility 35 %.

Fig. 1. *Devices for moulding material strength properties measurement LRU-D and permeability measurement LPiR-D* [2]

Fig. 1 shows universal device for moulding material strength properties measurement LRU-D and device for permeability measurement LPiR-D for experimental measurements. The test specimens were cylinders with diameter 50 and height 50 mm. They were made by sand rammer HVD-1 with impact energy 9,81 J. They were used to determine the moulding material technological properties (specimens were made with various contents of core material). Experiments measured mechanical properties like compression strength, splitting strength and permeability. Fig. 2a shows compression strength of moulding material influenced by increasing content of core material without addition of new bentonite and Fig. 2b compression strength of moulding material influenced by increasing content of core material with addition of new bentonite. The addition of new bentonite was 7 % of core material content. Simultaneously also carbon addition (fine graphite powder 3%) was admixed to improve technological properties of moulding material.

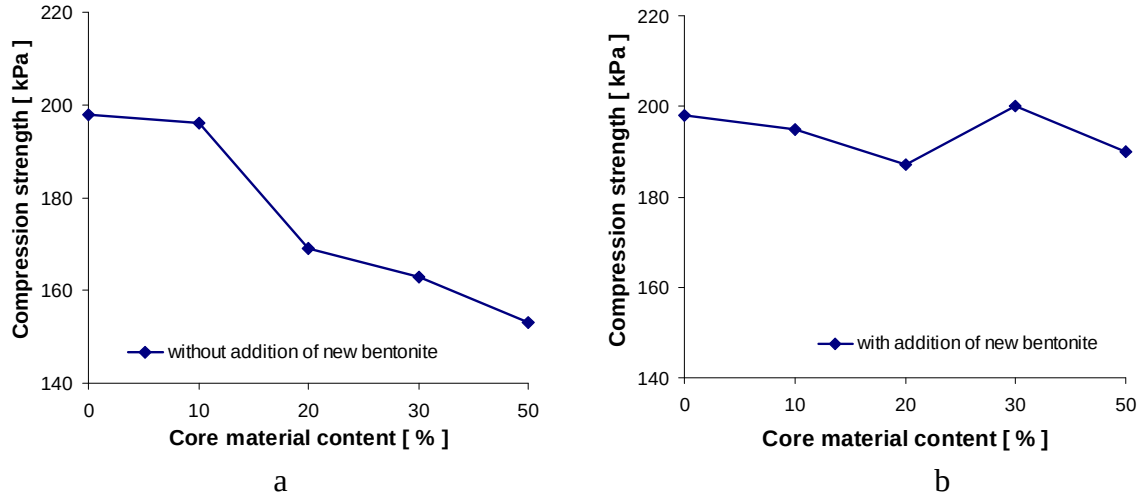
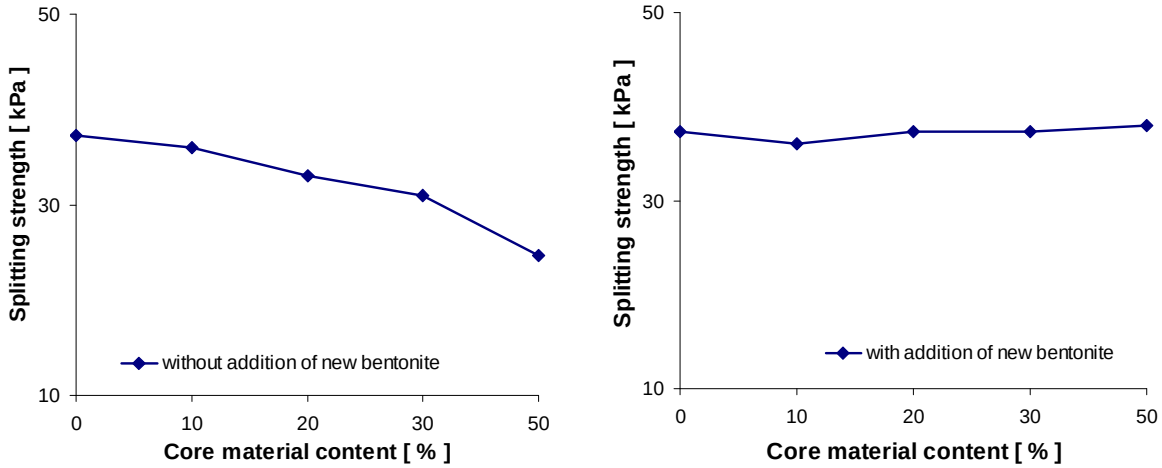


Fig. 2. *The dependence of moulding material compression strength on core material content*
a) without addition of new bentonite
b) with addition of new bentonite

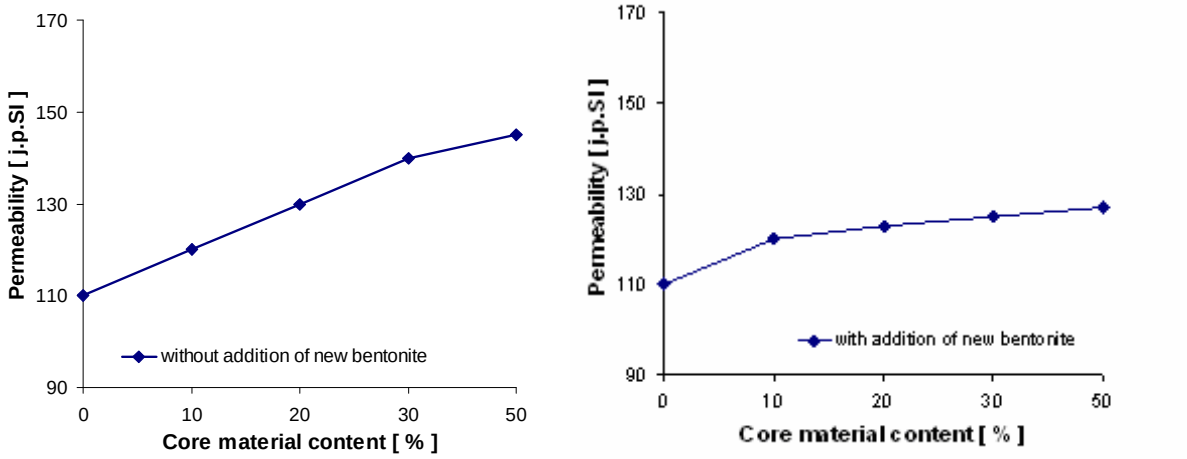
On fig.2 can be seen influence of core material content on moulding material compression strength. The splitting strength tests were also carried out. This test is good indicator of moulding material quality. Fig. 3 shows graphs of splitting strength and 3a) shows curves of moulding material splitting strength influenced by increasing content of core material without addition of new binder (bentonite). Fig. 3b) shows curves of moulding material splitting strength influenced by increasing content of core material with addition of new binder.



a b

Fig. 3. *The dependence of moulding material splitting strength on core material content*
a) without addition of new bentonite
b) with addition of new bentonite

Fig. 4 shows influence of increasing core material content on moulding material permeability. Fig. 4a shows influence of core material content on moulding material permeability without addition of new bentonite and Fig. 4b with addition of new bentonite.



a b

Fig. 4. *The dependence of moulding material permeability on core material content*
c) without addition of new bentonite
d) with addition of new bentonite

Discussion

The strength properties of moulding material depend on its humidity and compatibility. The measurement of compression strength shows that increasing content of core material cause decreasing of compression strength. The content of 50 % core material in moulding material decrease the compression strength about 50 kPa as can be seen on Fig. 2a. The addition of new binder (mixed bentonite with 10 % content) did not changed compression strength significantly as can be seen on Fig. 2b.

Fig. 3 shows dependence of splitting strength on core material content. From the splitting strength measurements can be concluded that increasing core material content decreases splitting strength. 50 % core material content in moulding material decreases splitting strength by 13,4 kPa. This decreasing can be eliminated by 10 % new bentonite addition when the decreasing is stopped and original values are reached. Thus can be concluded that core material content influences mechanical properties of moulding material. The decreasing of mechanical properties can be caused by lower binder content in moulding material.

Permeability is characteristics of moulding material that permits gases and vapour to pass through them. These are generated during pouring of molten metal into mould. Measurements of moulding material permeability established that addition of core material increases its permeability, due to decreasing binder content as can be seen on Fig. 4. The addtion of 10 % new mixed bentonite caused smaller increasing at same core material content. Thus can be concluded that binder content has great influence on moulding material permeability.

Conclusion

The obtained results enable to conclude, that presence of core sands significantly influence properties of universal bentonite moulding material. This influence can be observed on strength properties of moulding material (compression strength, splitting strength). The increasing content of core material decreases strength properties of moulding material. The increasing content of core material increases permeability of moulding material by binder content decreasing and mean grain size increasing because of using sand with higher d_{50} value for coremaking. It was also established that addition of new binder (mixed bentonite) into moulding material did not change moulding material`s mechanical properties and permeability significantly. From this can be concluded that it is necessary to monitor of technological properties during mouldmaking. It can be carried out by mechanical properties and permeability measurements. Subsequently the new binder and water is added into moulding material according to previously measured values.

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