12th International Research/Expert Conference
"Trends in the Development of Machinery and Associated Technology"
TMT 2008, Istanbul, Turkey, 26-30 August, 2008

CHARACTERISTICS OF ŠIPOVO BENTONIT CLAY DEPOSITE FOR CASTING PRODUCTION

Avdušinović Hasan
University of Zenica
Faculty for Metallurgy and Materials Science
Travnička cesta 1 72000 Zenica
Bosnia and Herzegovina

Mešić Anida, Mujezinović Nermin
University of Zenica
Faculty for Metallurgy and Materials Science
Travnička cesta 1 72000 Zenica
Bosnia and Herzegovina

ABSTRACT
Paper describes properties investigation of bentonite clay deposit near Šipovo for casting production. In laboratory conditions of Faculty for Metallurgy and Materials Science following properties were investigated: moisture, swelling volume and colloid behavior, mechanical properties and gas permeability of the bentonite/sand mixture. Experimental values were compared with same characteristics of bentonites that are usually used in our foundries.
Keywords: bentonite, water absorption, mechanical properties, sand mixture, gas permeability

1. INTRODUCTION
Bentonite is a clay generated frequently from the alteration of volcanic ash. There are a few types of bentonites and their names depend on the dominant elements, such as K, Na, Ca, and Al. Bentonite serves as an economical bonding material in the molding processes associated with the metal casting industry. Bentonite, when mixed with foundry molding sands, forms a pliable bond with the sand granules. Impressions are formed into the face of the bentonite/sand mixtures. Molten metal is pored into the impressions at temperatures exceeding 1200°C. The unique bonding characteristics of bentonite insures the durability of the mold during these high temperatures. Once the process is complete, the bentonite/sand mold can then be broken away from the casting face and reused
Besides in casting production there are several industrial application of bentonite

- Use as grouting material
- Use in drilling muds
- Use in cosmetic and pharmaceutical preparations
- Construction and Civil Engineering
- Environmental Markets

Extracted bentonite is distinctly solid, even with a moisture content of approximately 30%. The material is initially crushed and activated with the addition of soda ash (Na2CO3). Bentonite is subsequently dried (air and/or forced drying) to reach a moisture content of approximately 8 to 12%. According to the final application, bentonite is either sieved (granular form) or milled (into powder and super fine powder form).[1,5]

2. EXPERIMENT

Experimental part of the investigation was done in the casting laboratory of Faculty for Metallurgy and Materials Science. Experimental values for investigated properties were compared with same characteristics of bentonites that are usually used in our foundries.

Following properties were investigated:

- moisture
- swelling volume
- colloidal properties
- mechanical properties of bentonite/sand mixture
- gas permeability of bentonite/sand mixture.

2.1. Moisture investigation

Moisture of the activated bentonites is very important for its application in casting production. Usually values for good activated bentonites are in the range from 8 to 12%. For moisture investigation 9 samples from both, activated bentonite and bentonite from foundries (in the following text bentonite A and bentonite B) were prepared and tested. All 18 samples were heated in the GF furnace at 100°C for an hour and after that samples weight were measured. Bentonite moisture were calculated according following equation[1,2,6]

$$v = \frac{m_0 - m_1}{m_0} x100\% \qquad \text{.....(1)}$$

m_0- weight of the sample before heating
m_1- weight of the sample after heating
v- moisture percent

2.2. Swelling volume investigation

2 g of bentonite were divided in to 6 portions and put in to glass gauge feeler with 100 cm^3 of water. After 24 hours volume of created gel were measured. Minimal volume of created gel for high quality bentonite is 20 cm^3. [3,5]

3.3. Colloid properties of the bentonite

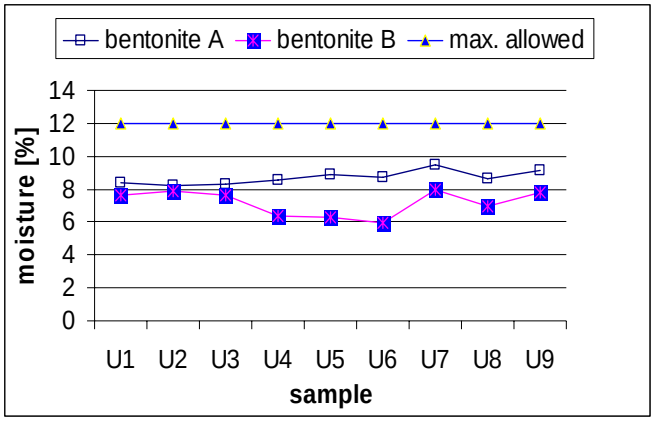
Investigation procedure for colloid behavior of bentonite is similar to swelling investigation. 2g of bentonite were put in to glass gauge feeler with 30 cm^3 of water, shake for five minutes and filled with water up to 100 cm^3. After 24 hours volume of created gel were measured. Minimal volume of created gel for high quality bentonite is 90 cm^3.[3]

The results of the moisture, swelling and colloid volume investigation are shown in the table 1 and picture 1.

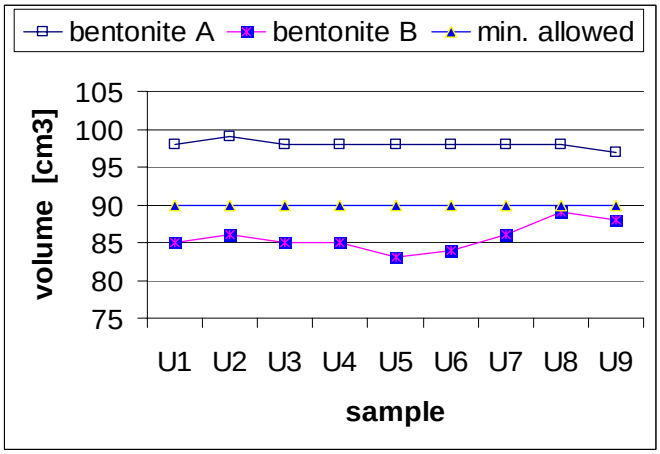
Table 1.Results of the moisture, swelling and colloid investigation

Results of moisture investigation											
Type of bentonite	U1 [%]	U2 [%]	U3 [%]	U4 [%]	U5 [%]	U6 [%]	U7 [%]	U8 [%]	U9 [%]	avera ge.	St. Dev.
A	8,35	8,25	8,34	8,55	8,85	8,70	9,45	8,67	9,12	8,70	0,39
B	7,60	7,85	7,65	6,40	6,30	5,95	8,00	6,95	7,80	7,16	0,78
max. allowed	12	12	12	12	12	12	12	12	12		
Results of swalling investigation											
	U1 [cm^3]	U2 [cm^3]	U3 [cm^3]	U4 [cm^3]	U5 [cm^3]	U6 [cm^3]	U7 [cm^3]	U8 [cm^3]	U9 [cm^3]	Sr. V.	St. Dev.
A	27	29	26	27	29	27	24	27	25	26,8	1,64
B	22	23	22	21	25	24	22	24	25	23,1	1,45
min. allowed	20	20	20	20	20	20	20	20	20		

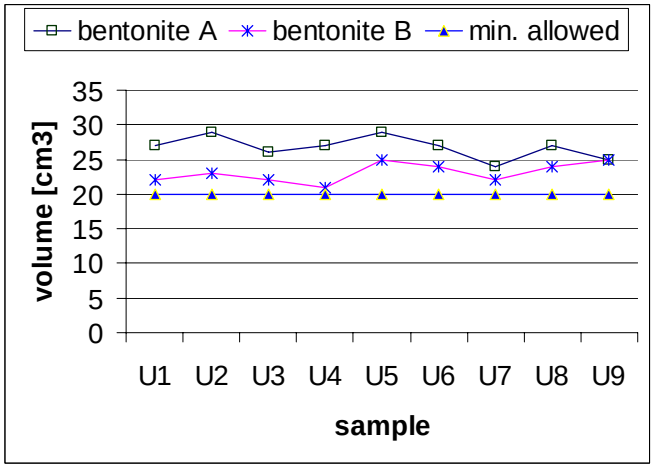
Results of colloid behaveour investigation											
	U1 [cm^3]	U2 [cm^3]	U3 [cm^3]	U4 [cm^3]	U5 [cm^3]	U6 [cm^3]	U7 [cm^3]	U8 [cm^3]	U9 [cm^3]	Sr. V.	St. Dev.
A	98	99	98	98	98	98	98	98	97	98	0,5
B	85	86	85	85	83	84	86	89	88	85,67	1,87
min. allowed	90	90	90	90	90	90	90	90	90		



a) moisture results



b) colloid volume results



c) swelling volume results

Picture 1. Results of the moisture, swelling and colloid volume investigation

2.4. Mechanical properties of the bentonite/sand mixture

After finishing investigation above mentioned properties of the both type of bentonites bentonite/sand mixture were prepared and mechanical properties were tested. Standard bentonite/sand mixture with 7% of bentonite and 4% of moisture were used for investigation and following properties tested:[1,4]

- Green compression strength
- Green shear strength
- Gas permeability

Mixture prepared with high quality bentonite should have following values for above mentioned properties:

- Green compression strength – min. allowed 65kPa
- Green shear strength – min. allowed 20 kPa
- Gas permeability- 80-120

Investigated mixtures with benotnite A i B had following values (average values after three measuring)

- Green compression strength – 125 kPa
- Green shear strength – min. allowed 40 kPa
- Gas permeability- 115

3. CONCLUSIONS

After finishing experimental investigations of bentonites A and B in laboratory for casting at Faculty for Metallurgy and Materials Science following can be concluded:

- Values for moister of bentonite A is lower than max. allowed for foundry bentonites
- Values for swelling and colloid volume are higher than min. allowed for foundry bentonites
- Values for mechanical properties of the mixture prepared with the bentonite A are higher than min allowed for foundry bentonites
- Gas permeability of the bentonite A mixture is lower than max allowed values.

4. REFERENCES

[1] M. Branković, Materijali za izradu livničkih kalupa i jezgri, Tehnološko-metalurški fakultet, Beograd, 1974. godina

[2] P. Brzaković, Priručnik za proizvodnju i primjenu građevinskih materijala nemetaličnog porijekla, Orion Art, Beograd, 2000. godina

[3] M. Branković, Tehnologija livačkih kalupa, Univerzitet u Beogradu, 1982. godina

[4] B. M. Zoran i autori, Ljevački priručnik, Savez ljevača Hrvatske, Zagreb, 1984. godina

[5] N. Pajević, livenje Gvožđa i čelika, Univerzitet u Beogradu, 1974. godina

[6] World Casting Census, Modern Casting, American Foundry Soviety, December, 2007. god