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THE EFFECT OF ADDITIONAL VARIATIONS OF FLY ASH & BENTONITE ON THE PROPERTY AND DEFECTS OF GASHOLES ON THE RESULTS OF ALUMINUM METAL CASTING

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KEYWORDS

sand casting
fly ash
bentonite
permeability
moisture levels
gasholes

The objectives of this study to describe: (1) The effect of adding fly ash and bentonite to the permeability of molding sand. (2) The effect of adding fly ash and bentonite to the moisture of molding sand. (3) The effect of adding fly ash and bentonite to gas holes defect on aluminum metal casting. This study is conducted at Polytechnic of Manufacture Ceper, Klaten. The method used is the pre-experimental design which one-shot case study design. The compositions of the molding sand are varied is fly ash and bentonite. The Sample variations are divided into 4 types based on fly ash and bentonite concentration. The comparison of fly ash and bentonite concentration are: variation A are 0%:9%, variation B are 1%:8%, variation C are 2%:7%, and variation D are 3%:6%. The tests which are done in this study such as permeability test by using permeability tester, moisture test by using moisture tester, and holes defect test by using visual observation and calculation of gas holes defect. The results showed that: (1) adding fly ash and bentonite can decrease the permeability values of molding sand. The lowest permeability values occur at variation D that is 85.34 cm3 /min. (2) Adding fly ash and bentonite can decrease the moisture of molding sand. The lowest moisture values occur at variation D that is 5,26 %. (3) Adding fly ash and bentonite can improve the quality of castings. The results of castings at variation B which adds fly ash and bentonite have fewer gas hole defects compared with a variation which no adding fly ash that is 3,15 cm^3.

INTRODUCTION

The quality of a cast product one of which is determined by the method used for casting. Sand mold (sand casting) is one method many used. The sand mold consists of green sand mold and dry (dry sand). Wet sand mold (greensand) is a type of frequent sand mold used. Wet sand mold has the advantages are easy to get and the cost tends to be cheap compared to other prints Use of wet sand molds for the manufacture of castings products is still encountered flaws that occur such as rudeness the surface of the castings, liquid metal penetration into in the mold, gas bubbles, cavities shrinkage, mold loss, and inclusions slag.

Problems that arise in wet sand mold casting are one of them is the surface quality of the castings, that is the onset of defects caused by gas holes by its permeability and moisture content appropriate (Purbowo and Tjitro, 2003: 43). Flaw Gasholes are one type of defect in castings in the form of holes on the surface castings. The cause is due to a mixture binder on the wet printing sand which is insufficient or excessive levels. Water content is the amount of water contained in its sand print and expressed as a percentage. Permeability is the ability of a mold to let the gas out during processing metal during into the mold. Permeability being too low will cause air trapped in

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the mold cavity and deformed gasholes. Defects of gas holes can be overcome by way regulate permeability and content sand moisture.

Tjitro and Hendri (2009) researched the effect of fly ash on compressive strength and hardness of sand molds. The results show the addition of 2% fly ash on capable sand mold composition increased 11.4% compressive strength and 82.6% sand mold hardness compared to the composition of the sand mold without fly ash. This research is intended to determine the addition of variations of fly ash and bentonite against permeability and print sand moisture content, as well as defects of gasholes on the results of aluminum casting.

RESEARCH METHODS

Testing using 4 variations of fly ash and bentonite, variations can be seen in table 1.

Table 1. Variations of Fly ash and Bentonite

Variations	*Fly ash* (%)	Bentonit (%)
Variations A	0	9
Variations B	1	8
Variations C	2	7
Variations D	3	6

Fly ash and bentonite will be mixed into printed sand as a binder and added with water. The composition can be seen in Table 2.

Table 2. Composition of Printed Sand

Variations	Silica Sand (gram)	Weight (gram)		Volume Water (ml)
		Bentonite	**Fly ash**	
A	1720	180	0	50
B	1720	160	20	50
C	1720	140	40	50
D	1720	120	60	50

Permeability Test

Printed sand permeability test specimens were cylinders with a diameter of 50 mm and a height of 50 mm. Testing is done by compacting the sand with a sand rammer and then testing it using a permeability tester.

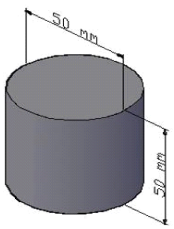


Figure 1. Permeability Test Specimen

Water Content Test

Tests were carried out using a moisture tester with a sample weighing 50 grams and carried out three times until a constant value was obtained.

Casting

Casting uses block-shaped molds with dimensions of 200 mm long, 50 mm wide, and 20 mm high. Each variation is cast three times. The aluminum used is Aluminum Silica (AlSi) with a silica composition of 16% (AlSi 16%).

Gasholes Defect Test

After the casting process, the cast specimen is machined until it has the same dimensions then visual observation is made and the volume of the gasholes defect

RESULTS AND DISCUSSION

Figure 2. The permeability test results

Figure 4 Permeability test results The highest permeability is obtained at specimen at 150.66 cm3 / minute. The lowest permeability was obtained in specimen D with 85.34 cm3 / minute. The addition of fly ash will reduce the permeability of printed sand. The high silica content in fly ash will help bentonite in binding sand. The gaps between the grains of sand will be filled by the two binders, namely fly ash and bentonite. The porous bentonite particles with different sizes are occupied by fly ash particles with different sizes. This causes the gaps between the grains of sand that are occupied by bentonite and the gaps in the bentonite are occupied by fly ash particles or vice versa. So that the gap becomes narrow and the permeability drops.

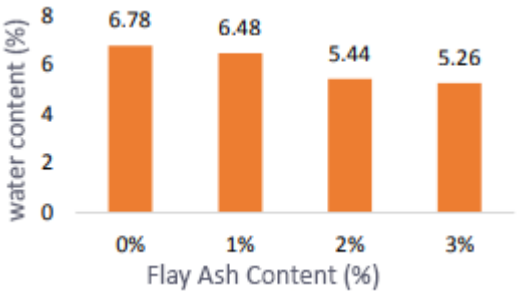
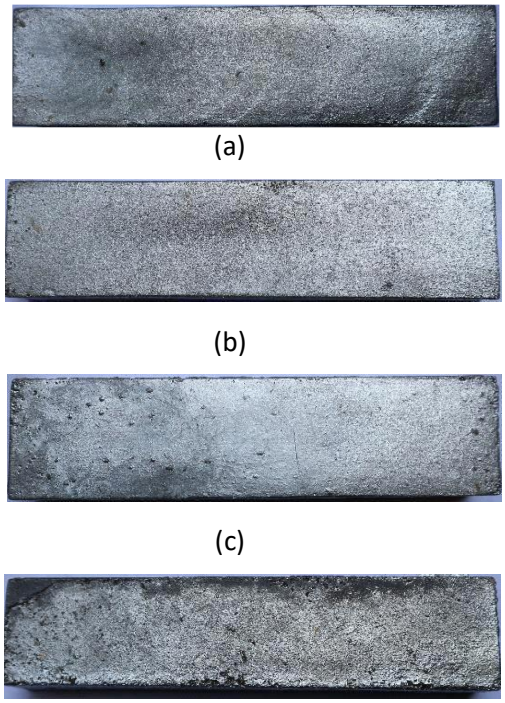


Figure 5. Water Content Result

Figure 5. Water Content Test Results. Water content test results from each variation resulted in a low moisture content for the wet sand mold size. According to Surdia and Chijiwa in Masnur and Warman (2016: 4), it is explained that the water content in printed sand ranges from 6% to 12%. This is due to the use of an insufficient amount of water in the mold composition. The highest water content was obtained in specimen A with a water content of 6.78%. The lowest water content was obtained in specimen D with a moisture content of 5.26%. The results of the water content test explained that the increasing of fly ash, the more water needed so that because it uses the same percentage of water, namely 5% into the mold, the increase in fly ash, the water content decreases due to lack of water. Insufficient water content will reduce permeability because there is inactivated fly ash which will fill the voids between grains of sand.

Result of Casting



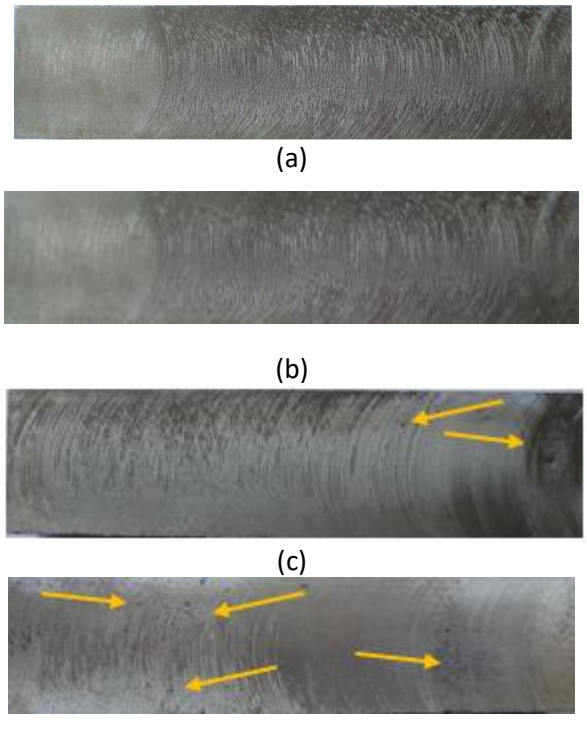
(a)

(b)

(c)

(d)

Figure 6. Casting Results before processing machining (a). Variation A, (b). Variation B, (c). Variation C, (d). Variation D.



(a)

(b)

(c)

(d)

Figure 7. Results of casting before after machining (a). Variation A, (b). Variation B, (c). Variation C, (d). Variation D.

Gasholes Defect Test Results Based on visual observation it can be seen that specimens C and D have defects gasholes at most. This matter due to low permeability causing air to get trapped inside the mold so that gasholes defects arise. In specimen A the gasholes defects occur minimal but surface castings tend to be rude. This is because permeability is too high causes the surface of the castings to become Rough. Specimen B has the results best

because its permeability lower than specimen A, so has a smoother surface than specimen A. Based on volume calculations gasholes defects can be described in figure 8.

Figure 8. Gasholes Defect Test Results Specimen B has a defect value the lowest gasholes is 3.2 cm3, meanwhile highest defect of gasholes in specimen D namely 8.74 cm3. Cast aluminum specimens A and B have high defect values at least. It is because of value permeability is high enough causes the binding reaction to occur good progress is characterized by its height permeability. With high permeability hence the ability of the mold to release gas also the better, resulting in deformed gasholes that happen less. Water content on specimens A and B also fit into the ideal criteria moisture content, namely 6% to 12%. But on specimen B based on defect calculation gasholes have fewer defects. So that the permeability in specimen B more fit, neither too tall nor low.

In specimen, D has a defect most of which are caused by permeability is too low. So that gas will be trapped in the mold and cause disability. Tjitro and Hendri (2009: 198) says the composition of bentonite in specimen D 6% still enters the tolerance limit for the use of bentonite but use the amount of water in the mixture to little print sand. So that is suspected to affect the performance of bentonite and fly ashin binding.

CONCLUTION

Based on research results and the discussion then concluded as follows:

1. You can add fly ash and bentonite to reduce permeability to sand print.
2. The addition of fly ash and bentonite can reduce the moisture content in the printed sand.
3. You can add fly ash and bentonite to improve the quality of the castings.

Evidenced by the results of castings with the addition of 1% fly ash has defects gasholes 3.2 cm3 compared without using fly ash. This study uses fly ash and bentonite with maximum percentage 3%. Research can be developed by do a test with a percentage above 3%. It is expected to produce composition of sand molding and its binder have better quality.

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