Proceedings of the 72nd World Foundry Congress
21-25th May 2016, Nagoya, Japan

Achieving a clean foundry plant with adopting artificial sand in an old plant

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In this report, we report about improving our plant's environment with adopting artificial sand.
By changing all the silica sand to alumina artificial sand, free silica in the powder dust dropped from 9.7% to 3.0%. As the result, the lung disease risk caused by dust (pneumonia) decreased and the working environment of level 3 was improved to level 2.
But, there were several problems to use the artificial sand. We have solved the artificial sand's problems and brought out the artificial sand's merits.

Keywords: *artificial sand, working environment, thermal expansion, lung disease caused by dust (pneumonia), external shrinkage, foundry plant*

1. Introduction

As our head-quarter foundry plant was built about 60 years ago, many equipments were old and its environment was very bad. In addition to, the government revised strictly the environmental law, so we must improve our plants environment. Therefore, in order to achieve a clean foundry plant, we considered adopting artificial sand.

2. Technical problems to be solved.

In order to check the problems caused by changing the silica sand to the artificial sand, we cast test pieces, 300*200*H300mm. We varied the artificial ratio to silica sand and molded all the 8 test pieces with the ratio varied sand around 100mm from test pieces in the same flask. We cast the test pieces with the composition of ISO 185/JL/300 gray iron.

After shake-out, we investigated all the 8 test pieces. External shrinkages were formed on the cope surface. Fig.1 shows the effect of the artificial sand ratio on external shrinkage volume in gray iron. The external shrinkage volume increases with increasing the artificial sand ratio. As the countermeasure against the external shrinkage, we determine to use risers.

3. Effect of changing sand

Table 1 shows the environmental level improvement with introducing artificial sand. Level 1 means good and level 3 means bad. In the case of level 3, the environmental law orders us to improve the place. The environmental level of shake-out had been 3. Following the law, we improved the shake-out with introducing artificial sand. As the result, the working environmental level was improved from 3 to 2. Table 2 shows the detail of the environment measurement data at shake-out room. Free silica in the powder dust dropped from 9.7% to 3.0%. The lung disease risk caused by dust (pneumonia) decrease. We could improve the working environment with introducing the artificial sand.

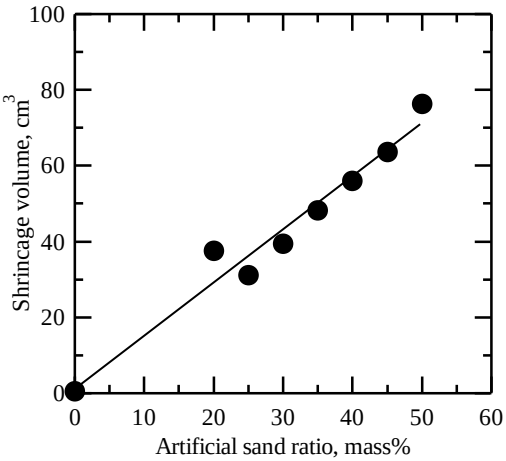


Fig.1 Effect of the artificial sand ratio on external shrinkage volume in gray cast iron.

Table 3 shows the other effects of changing sand. Compared to the silica sand, the artificial sand is said not to be broken and can be used semi-permanently. To confirm it, we did friability test. As shown in table 3, the friability of artificial sand is 1.1, lower than that

Table 1 Environmental level with introducing artificial sand

	Before introducing	After introducing				
	2008 Mar	2008 Aug	2009 Sep	2010 Sep	2011 Sep	2012 Sep
Shake-out room	Level3	Level2	Level2	Level2	Level2	Level1
Moldig area1	Level2	Level1	Level2	Level2	Level2	Level2
Moldig area2	Level2	Level1	Level1	Level	Level1	Level1

Table 2 Detail of the environment measurement data at shake-out room

	Before introducing artificial sand	After introducing artificial sand		
	2008 Mar	2008 Aug	2011 Sep	2012 Sep
Free silica ratio (%)	9.7	3.6	3.0	3.0
Requirement for level 1	E_{A1}<0.45 and C_B<0.45	E_{A1}<0.96 and C_B<0.96	E_{A1}<0.66 and C_B<0.66	E_{A1}<0.66 and C_B<0.66
Requirement for level 2	E_{A2}<0.45 and C_B<0.675	E_{A2}<0.96 and C_B<1.44	E_{A2}<0.66 and C_B<0.99	E_{A2}<0.66 and C_B<0.99
Requirement for level 3	0.45<E_{A2} or 0.675<C_B	0.96<EA2 or 1.44<CB	0.66<EA2 or 0.99<CB	0.66<EA2 or 0.99<CB
1st Enviromental Assessment E_{A1}(mg/m^3)	1.95	1.78	1.50	0.62
2nd Enviromental Assessment E_{A2}(mg/m^3)	0.81	0.63	0.61	0.23
Measurement data at B point C_B(mg/m^3)	0.77	0.47	0.56	0.25
Enviromental Level	3	2	2	1

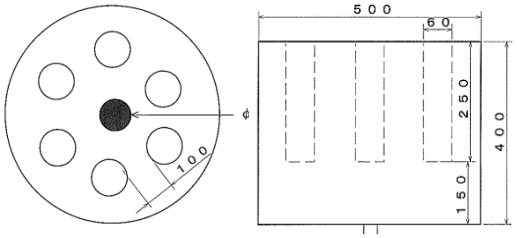
of silica sand (1.25). As the artificial sand does not break easily, the additive amount reduced from 1.2% to 0.25% and the waste amount reduced from 1.72% to 1.13%. However, in fact, the artificial sand breaks, to a certain extent.

Table 3 Other effects of changing sand

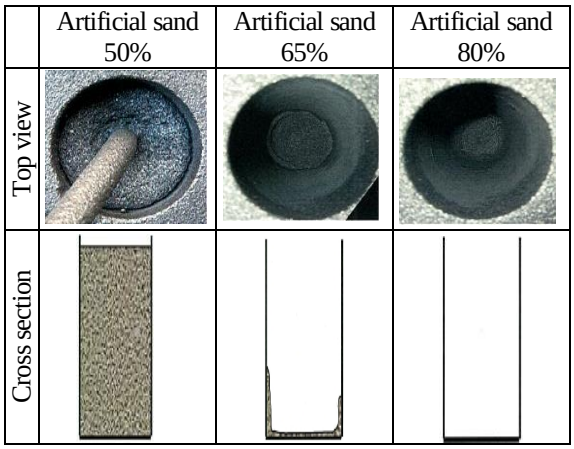
	Before introducing artificial sand	After introducing artificial sand
Friability	1.25	1.1
Additive new sand(%)	1.27	0.25
Waste rate (%)	1.72	1.13
Penetration	Existed	Nothing
Riser in gray iron	Nothing	Necessary
Bulk specific gravity(g/cm^3)	1.3-1.6	1.9-2.1

We checked where the artificial sand breaks and found it breaks during sand's reconditioned process. At that time, we used the sand reconditioning equipment, where the sand was collided to the wings with high-speed rotation. During this process, the sand broke. As the countermeasure against it, we introduced new method that the sand is reconditioned with mutual friction. With this method we could prevent the sand-broke.

Secondly, the artificial sand is said to have high penetration resistibility because of its high refractoriness. Fig.2 shows the penetration test result. We varied the artificial sand ratio to the silica sand and cast test pieces. When the artificial sand is less than 50%, the penetration is shown. When its ratio is more than 65%, the penetration reduced greatly. When its ratio is more than 80%, the penetration is not shown.



(a)Shape of Test piece, mm



(b)Test resuluts

Fig.2 Penetration test result

By the way, there were several problems to use the artificial sand. Firstly, there was a problem of external shrinkage. In the past, we did not use risers in gray iron. But in the case of using artificial sand, we must use risers even in gray iron, in order to prevent the external shrinkage.

Secondly, there was a problem of reducing maximum product weight. Compared to the silica sand, the artificial sand shows higher apparent density. Because of it, the maximum casting weight which we could produce became smaller.

4. Conclusion

As described above, we have solved the artificial sand's problems and brought out the artificial sand's merits. Therefore, even though the plant is still old, we have achieved a clean foundry plant friendly to human.