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Difference in Filling Property between Two Types of Binder Treated Powders Made of Atomized or Reduced Iron Powder

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Abstract

The filling property of the binder treated iron based powder made of atomized iron powder was compared with that of the one made of reduced iron powder. The latter one showed a better filling property than the former one, although the original reduced powder showed a worse flow rate. Changing the particle size distribution of the original atomized powder from wide to narrow like the original reduced iron powder, improved the filling property of the binder treated powder. As a result, the particle size distribution of the original iron powder was found to strongly affect the filling property of the binder treated powder.

Keywords : filling property, binder treated powder, atomized powder, reduced powder, particle size distribution

1. Introduction

Increasing yield by decreasing the weight scatter of sintered parts and cutting the second operations, such as sizing and machining, are effective for lowering their costs.

An iron powder with poor fluidity has been believed to worsen the weight scatter of green compacts; therefore the flow rate has been used as an indicator of the fluidity for a long time. Kondoh observed the filling property directly by his original apparatus. The air in the die cavity removed through the powder bed in the feed shoe during the die filling. The exchange of the entrapped air with the powder was essential for the die filling [1]. Larsson measured the filling property of the binder treated iron mixed powder [2]. The filling property deteriorated when the moving speed of the feed shoe increased and the thickness of the cavity decreased.

Little has been reported about the comparison of filling properties of binder treated iron powders made of atomized or reduced powders. Therefore the authors measured and compared the filling properties of both powders in this report. The result showed that the binder treated powder made of the reduced powder with a poor flow rate gave a better filling property. There are a lot of differences between both original powders, such as in the particle size distribution, the surface shape and the quantity of inner porosity. In this report we have focused on the difference in particle size distributions of both original powders, and its influence on the filling property is discussed.

2. Experimental and Results

General properties of iron powders The particle size distributions and the powder shapes of the original iron powders used in this study are shown in Table 1. The original reduced powder shows a higher flow rate, therefore, it has poorer fluidity than the original atomized one. As the original reduced one contains less amounts of portions smaller than 325# or larger than 100#, its particle size distribution is narrower than the original atomized one. The original reduced one has a much more irregular surface and contains a lot of internal pores.

Table 1. Particle size distributions, flow rates, and features of the shapes of the original iron powders

Particle size distribution (mass%)	Atomized powder	Reduced powder
+80#	0.4	0.0
-80#/+100#	9.1	1.0
-100#/+150#	19.6	30.7
-150#/+200#	23.3	33.3
-200#/+250#	7.4	9.0
-250#/+325#	17.2	14.7
-325#	22.9	11.4
Flow rate(S/50g)	23.4	26.9
Surface irregularity	low	much
Intenal porosity	few	much

Preparation method of binder treated powders. The original iron powders were added to 2 mass % of copper powder, 0.6 mass % of graphite powder and 0.8 mass % of zinc stearate as a lubricant, and mixed on heating.

The basic atomized powder with the same particle size distribution of the original reduced powder was made by the sieving and mixing method described as follows. The

original atomized powder was classified into seven portions by the difference in particle size as shown in Table 1 by sieving classification. Each particle was weighed out as the same weight ratio of the portions of the original reduced powder and was mixed by a V-type blender for 15 minutes.

Evaluation method of filling property An illustrated apparatus for measuring the filling property is shown in Fig. 1. It mainly consists of a cavity and a feed shoe. Three types of cavities, whose sizes were 20mm in width, 60mm in height and 1.2 or 5mm in thickness, are used. The feed shoe was moved forward to the position just above the cavity, stopped for 1.0s and moved backward to the original position at a speed of 200mm/s.

The weights of the powders filled into the cavities were measured. They were divided by the cavity volumes for calculating the filling densities. The ratio of the filling density to the apparent density of the powder was defined as the filling ratio, which was used as an index of the filling property.

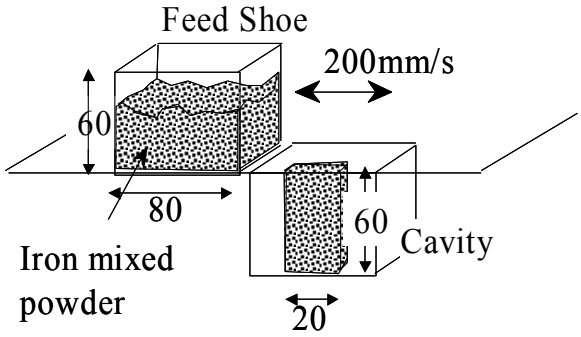

Fig. 1. Schematic illustration of the apparatus for evaluating filling property.

Comparison in the filling property between the binder treated atomized and the reduced powders. The filling ratios of the binder treated powders made of the reduced powder are better than those of the atomized powders at the cavity thicknesses of 1 and 2 mm as shown in Fig. 2, although the original reduced powder shows poorer fluidity than the original atomized powder.

In addition, the binder treated powder made of the basic atomized powder, powder A, whose particle size distribution is adjusted to the same as that of the original reduced powder, gives almost the same level as the original reduced powder.

These results suggest that the particle size distribution of the original iron powder strongly affects the filling property.

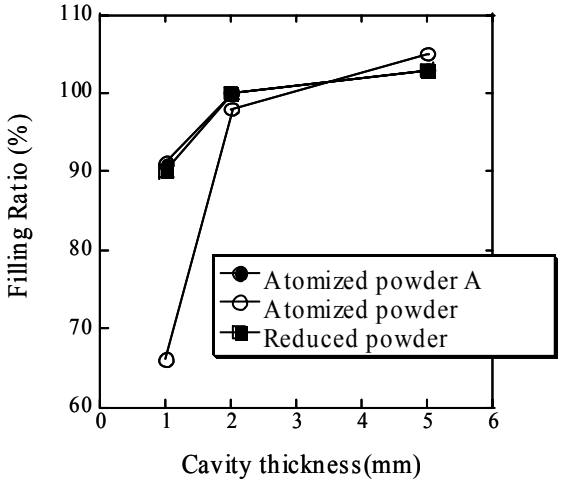

Fig. 2. Filling ratio of the binder treated powder using the atomized powder with the same particle distribution of the reduced powder compared with those made of the atomized and the reduced powders.

3. Summary

1. Binder treated powder made of the reduced iron powder shows better filling property than that made of the atomized one.
2. The particle size distribution of the original iron powder strongly affects the filling property of the binder treated powder.

4. References

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