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Metal powder manufacturing process using the oxy-acetylene plasma atomization method

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ABSTRACT

The powder metallurgy process is one of the metalworking technologies by compacting a quantity of powder from pure materials or alloys in a mold, then sintering or heating in a furnace at a certain temperature until bonding occurs between the powder particles. Several advantages of powder metallurgy technology, namely: eliminating or minimizing the machining process, no wasted material, high surface accuracy and smoothness, increased strength and wear resistance, and complex product shapes. Atomization method is a method that is often used to make powders in bulk. Several known atomization methods are the water atomization method, the gas atomization method, and the centrifugal atomization method. Several new methods in the atomization method are the plasma atomization method, liquid explosion atomization method, ultrasonic atomization method, and so on. In this study, molten aluminum metal was used as the starting material, the process used was the oxy-acetylene plasma welding process. The data obtained by testing the distribution of powder, testing the distribution of powder weight, and testing the macro structure of the powder. The powder produced from the oxy-acetylene plasma burst has the characteristics of a non-spherical powder, but is in the shape of a teardrop. This grayish black color is caused by the powder undergoing an oxidation process and a carburizing process. powder weight distribution test, and powder macro structure testing. The powder produced from the oxy-acetylene plasma burst has the characteristics of a non-spherical powder, but is in the shape of a teardrop. This grayish black color is caused by the powder undergoing an oxidation process and a carburizing process. powder weight distribution test, and powder macro structure testing. The powder produced from the oxy-acetylene plasma burst has the characteristics of a non-spherical powder, but is in the shape of a teardrop. This grayish black color is caused by the powder undergoing an oxidation process and a carburizing process.

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1. INTRODUCTION

The powder metallurgy process is one of the metalworking technologies by compacting a quantity of powder from pure materials or alloys in a mold, then sintering or heating in a furnace at a certain temperature until bonding occurs between the powder particles. Several advantages of powder metallurgy technology, namely: eliminating or minimizing the machining process, no wasted material, high surface accuracy and smoothness, increased strength and wear resistance, and complex product shapes. One of the factors that influence the quality of powder metallurgical products is the characteristics of the raw material, namely powder. Powder characteristics include particle size, particle shape, particle surface area, friction between particles, particle internal structure, composition, homogeneity, and contamination. The properties and characteristics of the powder is largely determined by the method of making the powder. Atomization method is a method that is often used to make powders in bulk. Several known atomization methods are the water atomization method, the gas atomization method, and the centrifugal atomization method. Several new methods in the atomization method are the plasma atomization method, the liquid explosion atomization method, the ultrasonic atomization method, and so on. The atomization method is still being developed to improve the quality and productivity of the resulting powder. The technique of using other energy sources allows the discovery of new atomization methods. Atomization method is a method that is often used to make powders in bulk. Several known atomization methods are the water atomization method, the gas atomization method, and the centrifugal atomization method. Several new methods in the atomization method are the plasma atomization method, the liquid explosion atomization method, the ultrasonic atomization method, and so on. The atomization method is still being developed to improve the quality and productivity of the resulting powder. The technique of using other energy sources allows the discovery of new atomization methods. Atomization method is a method that is often used to make powders in bulk. Several known atomization methods are the water atomization method, the gas atomization method, and the centrifugal atomization method. Several new methods in the atomization method are the plasma atomization method, the liquid explosion atomization method, the ultrasonic atomization method, and so on. The atomization method is still being developed to improve the quality and productivity of the resulting powder. The technique of using other energy sources allows the discovery of new atomization methods. Several new methods in the atomization method are the plasma atomization method, the liquid explosion atomization method, the ultrasonic atomization method, and so on. The atomization method is still being developed to improve the quality and productivity of the resulting powder. The technique of using other energy sources allows the discovery of new atomization methods. Several new methods in the atomization method are the plasma atomization method, the liquid explosion atomization method, the ultrasonic atomization method, and so on. The atomization method is still being developed to improve the quality and productivity of the resulting powder. The technique of using other energy sources allows the discovery of new atomization methods.

2. RESEARCH METHOD

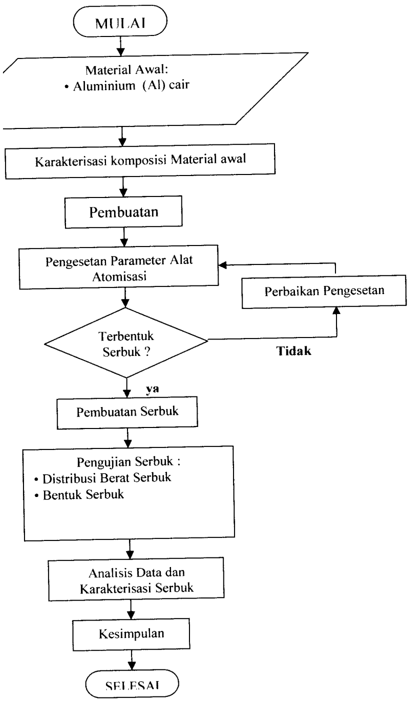

Image 1. Test process flowchart

2.1 Testing the size of the powder

The powder produced from the oxy-acetylene welding atomization process was tested by sieve analysis mesh. This sieve test aims to separate the powder based on the mesh size level. There are six grades of mesh sizes used, namely mesh sizes of 0.04 mm, 0.06 mm, 0.025 mm, 0.030 mm, 0.060 mm, <0.060 mm. The picture of the sifter is like the picture below.

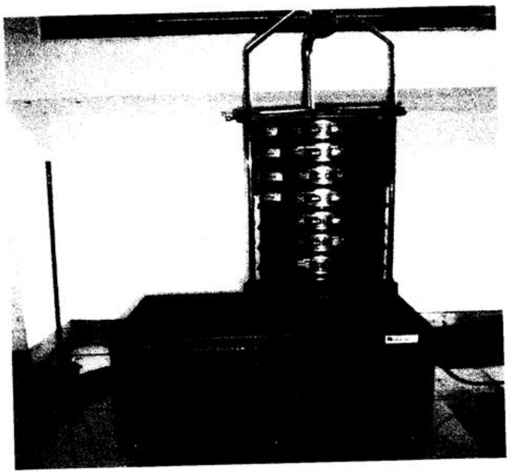

Figure 2. SieveAnalysisMesh

2.2 Powder Weight Distribution Testing

After the powders are separated according to mesh size, then weighing is carried out. This weighing aims to determine the weight distribution of the powder size resulting from this oxyethylene welding atomization process. The cumulative size of the powder can be determined from the percent cumulative weight of the powder. Finished powder. d.weigh with Digital scales.

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3. RESULTS AND DISCUSSIONS

This chapter will discuss the testing processes and discussion of the oxy-acetylene plasma atomization process, and the process parameters, as well as the results of the powder form obtained from the oxy-acetylene plasma atomization process.

3.1. Sieve Testing

Based on the results of the sieving test, a comparison can be seen between each mesh, as in the following table:

Table 1. The results of the sieving test from the oxy-acetylene plasma atomization process

No	Sieve size	Hole Diameter (Microns)	Weight / Grams		
1	<60	<20	0.1	4.85436893	4.85436893
2	60	250	0.78	37.8640777	42.7184466
3	30	600	0.22	10.6796117	53,3980583
4	25	710	0.34	16.5048544	69,9029126
5	6	3260	0.34	16.5048544	86.407767
6	4	4750	0.28	13.592233	100
Total			2.06		

From the results of the sieving test above, it can be seen that the ratio of the weight of the powder obtained is shown in the graph. From the data shown on the 60 mesh graph, it can be seen that the weight of the powder is the highest, while the size of the weight that is the least is found in the mesh <60.

3.2. Particle Shape Testing

The powder produced by the oxy-acetylene plasma atomization process was viewed using a digital optical microscope, with magnifications of four, ten, and forty magnifications. On an optical microscope, the powder form is in the form of a teardrop (tear drop), has a smooth surface, and the powder size is quite small

3.3 Master Per Layer Cutting

To determine the scale parameters used to determine how large the scale value of each micron is in the particle, as a reference we can use a piece of brass wire, which measures 0.09 mm in diameter, using a micrometer with an accuracy of 0.01 mm. After that, the wire fibers were photographed with an optical microscope with a magnification of four lenses. magnification ten, magnification forty, at magnification four using a manual measurement using an ordinary ruler reads a diameter of 0.8 mm, at ten magnification the wire diameter is read using a manual measurement with an ordinary ruler reading a diameter of 2 mm, and at magnification the lens diameter is forty the wire is read using manual measurement with a ruler that reads 7 mm in diameter. view image

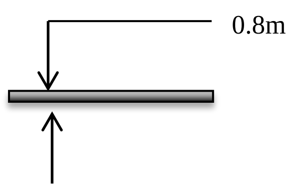

Image 3. Wire Fibers On Lens Magnification 4 with a Diameter of 0.8 mm

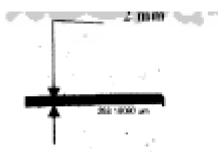

Figure 4. Wire Fibers On Lens Magnification 10 with a Diameter of 2 mm

Figure 5. Wire fibers on a magnification lens 14 with a diameter of 7 mm

The results of the measurements above are to find the equivalent diameter of the particle, the equivalent diameter is the diameter line with a dotted line, which is centered in the middle of the particle surface, while the measurement is done by; the measurement results on the actual diameter of the object from the micrometer are multiplied by the measurement results from manual measurements, these results and measurements are multiplied again by the result of the cross-sectional area of the particle (A), the result of this multiplication is the resulting value of the Equivalent Diameter of the particle, with units of micron meters. To find the micron value on the particle, it can be used in the following way; 1 cm = 10 mm, then 10 mm is multiplied by the result value from digital measurement divided by manual measurement, from these results the micron particle value can be known.

3.4 Particle Area Calculation

In this study to calculate the Particle Area (A), it can be used in a simple way, namely by using millimeter block paper. The resulting powder from the atomization process is then sieved, this is to compare the weight of the powder from each mesh. This sieving process uses six levels of mesh, with sizes; mesh four (topmost), mesh six, mesh two five, mesh thirty, mesh sixty, mesh less than sixty (bottom / result). After obtaining the results of the sieving process, the powder was photographed with an optical microscope, with a lens magnification of four, ten magnifications, and forty magnifications. In this photo test the data used only uses three mesh levels, namely mesh thirty, mesh sixty, and mesh smaller than sixty. Results, from all the particles, which are obtained, from each-. each mesb is photographed, n, to tell how the shape of the powder is, then the powder is photographed once again to all the powder. but only one. selected is close, form b,a XLo. after the powder is obtained. kemud.au difo, using an empa lens magnifier, sepu.ub magnification. and magnification of forty, .th was printed. It is necessary to pay attention when printing stale, fine powder or to reduce the size of the bas.l print, this is very influential on h3Si'^aTget how much the Area of the Particles is, we can use a simple way, namely by using mnimeter block paper, bas photo a elan ka put it under the mlmeter paper b.ok, then has, the powder k„ iTskan it on the millimeter block paper after, then we calculate how many umlab is in the particles on the millimeter paper b,ok then the powder is photographed and wipes all the powder. but only one. selected is close, form b,a XLo. after the powder is obtained. kemud.au difo, using an empa lens magnifier, sepu.ub magnification. and magnification of forty, .th was printed. It is necessary to pay attention when printing stale, fine powder or to reduce the size of the bas.l print, this is very influential on h3Si'^aTget how much the Area of the Particles is, we can use a simple way, namely by using mnimeter block paper, bas photo a elan ka put it under the mlmeter paper b.ok, then has, the powder k„ iTskan it on the millimeter block paper after, then we calculate how many umlab is in the particles on the millimeter paper b,ok then the powder is photographed and wipes all the powder. but only one. selected is close, form b,a XLo. after the powder is obtained. kemud.au difo, using an empa lens magnifier, sepu.ub magnification. and magnification of forty, .th was printed. It is necessary to pay attention when printing stale, fine powder or to reduce the size of the bas.l print, this is very influential on h3Si'^aTget how much the Area of the Particles is, we can use a simple way, namely by using mnimeter block paper, bas photo a elan ka put it under the mlmeter paper b.ok, then has, the powder k„ iTskan it on the millimeter block paper after, then we calculate how many umlab is in the particles on the millimeter paper b,ok kemud.au difo, using an empa lens magnifier, sepu.ub magnification. and magnification of forty, .th was printed. It is necessary to pay attention when printing stale, fine powder or to reduce the size of the bas.l print, this is very influential on h3Si'^aTget how much the Area of the Particles is, we can use a simple way, namely by using mnimeter block paper, bas photo a elan ka put it under the mlmeter paper b.ok, then has, the powder k„ iTskan it on the millimeter block paper after, then we calculate how many umlab is in the particles on the millimeter paper b,ok kemud.au difo, using an empa lens magnifier, sepu.ub magnification. and magnification of forty, .th was printed. It is necessary to pay attention when printing stale, fine powder or to reduce the size of the bas.l print, this is very influential on h3Si'^aTget how much the Area of the Particles is, we can use a simple way, namely by using mnimeter block paper, bas photo a elan ka put it under the mlmeter paper b.ok, then has, the powder k„ iTskan it on the millimeter block paper after, then we calculate how many umlab is in the particles on the millimeter paper b,ok

3.5 Analysis of Test Results

From the results of the data above, it can be concluded that in the sieving test, the most abundant powder distribution is in the sixty mesh, while the least mesh is found in the mesh smaller than sixty. From the oxy-acetylene plasma atomization process which uses a single nozzle and the initial material is liquid aluminum, the powder form tends to be more in the direction of tear drops, this is due to the lack of multiple nozzles, the gas pressure that comes out is small, and the reservoir powder (chamber) does not meet the requirements, namely the chamber must be airtight, this aims so that the powder is not contaminated with outside air. The physical form of the resulting powder is not spherical, but teardrop-shaped, the powder undergoes an oxidation process and a carburizing process. this is because the material which is already in the form of liquid metal, is sprayed again with pressurized gas so that the powder undergoes an oxidation and carburizing process, this results in a less spherical shape of the powder and the color of the powder is opaque black in color. In the process of making metal powders using the oxy-acetylene plasma atomization method which uses molten aluminum as the starting material, the powder size tends to be larger, this is due to the pouring of liquid metal done manually, the distance from the smelting furnace to the powder making tool is far enough so that a decrease in temperature occurs at the liquid metal to be poured, and the flame used is not quite right, this greatly affects the yield of powder. This results in the shape of the powder being less spherical and the color of the powder being opaque black. In the process of making metal powders using the oxy-acetylene plasma atomization method which uses molten aluminum as the starting material, the powder size tends to be larger, this is due to the pouring of liquid metal done manually, the distance from the smelting furnace to the powder making tool is far enough so that a decrease in temperature occurs at the liquid metal to be poured, and the flame used is not quite right, this greatly affects the yield of powder. This results in the shape of the powder being less spherical and the color of the powder being opaque black. In the process of making metal powders using the oxy-acetylene plasma atomization method which uses molten aluminum as the starting material, the powder size tends to be larger, this is due to the pouring of liquid metal done manually, the distance from the smelting furnace to the powder making tool is far enough so that a decrease in temperature occurs at the liquid metal to be poured, and the flame used is not quite right, this greatly affects the yield of powder.

4. CONCLUSION

Atomization Process Oxy-acetylene plasma can be used to make metal powders. The metal powder produced from the oxy acetylene plasma atomization process has the characteristics of a relatively smaller size, the powder tends to be more towards a tear drop shape, this is due to the lack of a large number of nozzles, the pressure of the gas coming out is small, and the powder reservoir (chamber) does not meet the requirements, namely the chamber must be airtight, this aims so that the powder is not contaminated with outside air. The physical form of the resulting powder is not spherical, but teardrop-shaped, the powder undergoes an oxidation process and a carburizing process, the color of the powder is opaque black.

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