

DESCRIPTION

Cu-Sn MIXTURE POWDER AND PROCESS FOR PRODUCING THE SAME

5

TECHNICAL FIELD

The present invention relates to bronze sintered powder; that is, Cu-Sn mixed powder to be used as powder metallurgical raw material powder for an oil-impregnated sintered bearing or the like, and the manufacturing method of such Cu-Sn mixed powder.

BACKGROUND ART

Conventionally, copper powder such as electrolytic copper powder, and tin powder were used as the powder metallurgical raw material powder for an oil-impregnated sintered bearing or the like, and a method of mixing these powders to a target ratio and then compacting and sintering such powders was used. Nevertheless, since the specific gravity, grain size and grain diameter of copper powder and tin powder are different, it is difficult to mix these powders evenly. Further, the foregoing case will be subject to so-called liquid-phase sintering where copper and tin are alloyed via a liquid phase during the sintering process. However, since the shrinkage factor during sintering will become great, there is a problem in that the dimensional accuracy will be inferior.

In light of the above, bronze powder is being used as the raw material for performing sintering in order to overcome many of the foregoing problems. Nevertheless, since fine powder is solely obtained via the atomization method upon manufacturing bronze powder, since the particle configuration is spherical, there is a new problem in that the compactibility will be inferior.

Thus, a proposal has been made for mixing and alloying irregular-shaped copper powder and tin powder, without using atomized powder.

Meanwhile, a proposal has been made for using pulverized bronze powder in response to the foregoing demand. When the bronze powder becomes too fine, however, there is a problem in that the flowability of the sintered raw material powder becomes inferior,

and the compactibility also deteriorates. Thus, the present inventors proposed a method of manufacturing sintered bronze powder using two different types of electrolytic copper powder of different sizes (refer to Patent Document 1). This method increased the flowability, improved the compactibility, and showed favorable characteristics as a bronze sintered compact.

Nevertheless, this kind of sintered bronze powder is demanded to be near-complete bronze powder, and this results in higher manufacturing costs. Thus, given the present circumstances, the existing sintered bronze powder is not necessarily satisfactory.

[Patent Document 1] Japanese Patent Laid-Open Publication No. S62-67102

DISCLOSURE OF THE INVENTION

Thus, an object of the present invention is to obtain Cu-Sn powder capable of increasing compactibility such as the green density and rattler value of powder, improving sintering characteristics such as the radial crushing strength, and reducing costs upon manufacturing powder metallurgical raw material powder for an oil-impregnated sintered bearing or the like.

In order to achieve the foregoing object, the present inventors discovered that it is possible to obtain Cu-Sn powder, which is powder metallurgical raw material powder, capable of increasing compactibility such as the green density and rattler value of powder, improving sintering characteristics such as the radial crushing strength, and reducing costs upon manufacturing powder metallurgical raw material powder for an oil-impregnated sintered bearing or the like by using the mixed powder of pulverized powder of a partially alloyed Cu-Sn sintered compact, and electrolytic copper powder.

Based on the foregoing discovery, the present invention provides:

- 1) Cu-Sn mixed powder to be used as powder metallurgical raw material powder composed of mixed powder of pulverized powder of a partially alloyed Cu-Sn sintered compact and electrolytic copper powder;
- 2) The Cu-Sn mixed powder according to paragraph 1) above,

wherein the Sn content of the pulverized powder of the partially alloyed Cu-Sn sintered compact is 10 to 12wt%;

3) The Cu-Sn mixed powder according to paragraph 1) or paragraph 2) above, wherein the total Sn content in the mixed powder is 8 to 10wt%;

4) The Cu-Sn mixed powder according to any one of paragraphs 1) to 3) above, wherein the partially alloyed Cu-Sn sintered compact is a sintered compact of electrolytic copper powder and atomized tin powder; and

5) The Cu-Sn mixed powder according to any one of paragraphs 1) to 4) above, wherein the Cu-Sn mixed powder is mixed powder for an oil-impregnated sintered bearing.

The present invention further provides:

6) A manufacturing method of Cu-Sn mixed powder to be used as powder metallurgical raw material powder, comprising the steps of manufacturing a partially alloyed Cu-Sn sintered compact by sintering Cu powder and Sn powder, obtaining Cu-Sn pulverized powder by pulverizing the sintered compact, and subsequently mixing the Cu-Sn pulverized powder and electrolytic copper powder.

7. The manufacturing method of Cu-Sn mixed powder according to paragraph 6) above, wherein the Sn content of the pulverized powder of the partially alloyed Cu-Sn sintered compact is 10 to 12wt%;

8) The manufacturing method of Cu-Sn mixed powder according to paragraph 6) or paragraph 7) above, wherein the total Sn content in the mixed powder is 8 to 10wt%;

9) The manufacturing method of Cu-Sn mixed powder according to any one of paragraphs 6) to 8) above, wherein the partially alloyed Cu-Sn sintered compact is a sintered compact of electrolytic copper powder and atomized tin powder;

10) The manufacturing method of Cu-Sn mixed powder according to any one of paragraphs 6) to 9) above, wherein the partially alloyed Cu-Sn sintered compact is manufactured by sintering Cu powder and Sn powder at a sintering temperature of 500 to 700°C;

11) The manufacturing method of Cu-Sn mixed powder according to any one of paragraphs 6) to 10) above, wherein Cu-Sn pulverized powder of -100 mesh and electrolytic copper powder of -100 mesh are mixed; and

12) The manufacturing method of Cu-Sn mixed powder according to

any one of paragraphs 6) to 10) above, wherein Cu-Sn pulverized powder of -100 mesh and in which fine powder of -350 mesh is 45% or less, and electrolytic copper powder of -100 mesh and in which fine powder of -350 mesh is 25% or less are mixed.

5 The Cu-Sn powder of the present invention to be used as the powder metallurgical raw material powder yields superior effects in that it is capable of increasing compactibility such as the green density and rattler value of powder, improving sintering characteristics such as the radial crushing strength, and reducing costs upon manufacturing
10 powder metallurgical raw material powder for an oil-impregnated sintered bearing or the like by using the mixed powder of pulverized powder of a partially alloyed Cu-Sn sintered compact, and electrolytic copper powder.

15 BEST MODE FOR CARRYING OUT THE INVENTION

 The Cu-Sn mixed powder of the present invention to be used as the powder metallurgical raw material powder uses the mixed powder of pulverized powder of a partially alloyed Cu-Sn sintered compact,
20 and electrolytic copper powder. Electrolytic copper powder is generally manufactured according to a process known as the electrolysis method, and standard electrolytic copper powder manufactured according to such method may be used (Material: New Edition of Powder Metallurgy, Written by Teruhisa Watanabe,
25 Published by Gijutsu Shoin, 5th Edition Published on October 15, 1987, Pages 15 to 17).

 In particular, for use in powder metallurgy, it is desirable to use electrolytic copper powder of roughly -100 mesh. Incidentally, since the flowability will deteriorate if it is excessively pulverized as fine
30 powder, it is particularly desirable to keep electrolytic copper powder of -350 mesh at 25% or less.

 Standard atomized tin powder may be used as the tin powder to be mixed. By mixing electrolytic copper powder and tin powder as described above, the partially alloyed Cu-Sn sintered compact is able
35 to easily obtain a relatively even mixed status without much segregation since it is not aiming to obtain complete bronze alloy powder.

 When manufacturing a partially alloyed Cu-Sn sintered compact,

it is desirable that the Sn content to be mixed is 10 to 12wt%. The reason for making the Sn content of this pulverized powder 10 to 12wt% is because the sintered compact will become too hard and difficult to pulverize if the Sn content exceeds 12wt%, and the Sn content of the Cu-Sn mixed powder as the ultimate target will be low if the Sn content is less than 10wt%. This Sn amount is made to be slightly greater than the Sn amount of the Cu-Sn mixed powder as the ultimate target. This is because Sn will be diluted by the electrolytic copper powder to be added subsequently.

The mixed powder of the foregoing Cu powder and Sn powder is sintered at a sintering temperature of 500 to 700°C to manufacture a partially alloyed Cu-Sn sintered compact.

After manufacturing the partially alloyed Cu-Sn sintered compact by sintering the foregoing Cu powder and Sn powder, this sintered compact is pulverized to obtain Cu-Sn pulverized powder. Desirably, the grain size of this pulverized powder is made to be -100 mesh in order to improve the compactibility and sinterability. Since the flowability will deteriorate if the powder is pulverized excessively into fine powder, it is particularly desirable to keep the Cu-Sn powder of -350 mesh at 45% or less.

Subsequently, the foregoing Cu-Sn pulverized powder and electrolytic copper powder are mixed, and the components are adjusted so that the total Sn content in the mixed powder will be 8 to 10wt%; that is, so that the total Sn content will become an optimal composition ratio or an ultimate composition ratio to be used as the sintered compact of a bearing or the like (for example, the composition ratio as a bronze component).

Although the Sn content may be outside of the foregoing range as a matter of course, the reason why the total Sn content is made to be 8 to 10wt% is because the optimal composition as a bronze oil-impregnated sintered bearing is within the foregoing range.

The Cu-Sn mixed powder obtained according to the above may be used as the mixed powder for an oil-impregnated sintered bearing. [Examples]

Examples of the present invention are now explained. Incidentally, these examples are merely illustrative, and the present invention shall in no way be limited thereby. In other words, the present invention shall include the various modes and modifications covered by

the technical spirit of this invention.

(Example 1)

Electrolytic copper powder (-100 mesh) and atomized tin powder were mixed at a ratio (weight ratio) of 89:11, and sintered in H₂ + N₂ mixed gas atmosphere at 630°C (Cu-11% Sn product). The highest temperature residence time was 30 min.

A partially alloyed (70% alloyed) sintered compact was thereby obtained. Subsequently, this sintered block was ground coarsely, thereafter pulverized with a hammer mill type pulverizer, and sieved at 100 mesh to obtain Cu-11% Sn pulverized powder of -100 mesh.

Subsequently, -100 mesh electrolytic copper powder was added to the foregoing -100 mesh Cu-11% Sn pulverized powder at a ratio (weight ratio) of 81.8:18.2, and placed in a mixer to obtain Cu-9% Sn mixed powder. Incidentally, 0.5% of lubricant meta flow A (not included in the total) was added and mixed to this mixed powder.

The characteristics of the obtained sintered mixed powder were examined. The apparent density (g/cm³) and flow rate (s/50g) were examined as the powder characteristics, the green density (g/cm³) and rattler value (%) were examined as the compacting characteristics, and the radial crushing strength (kgf/mm²) was examined as the sintering characteristic. The results are shown in Table 1 to Table 3.

[Table 1]

	Apparent Density (g/cm ³)	Flow Rate (s/50g)
Example 1	2.54	29
Example 2	2.53	29
Example 3	2.46	28
Example 4	2.50	28
Example 5	2.51	28
Comparative Example 1	2.45	25
Comparative Example 2	2.70	21
Comparative Example 3	2.70	27

[Table 2]

	Radial Crushing Strength (kgf/mm ²)
Example 1	27.6
Example 2	27.5
Example 3	27.3
Example 4	27.0
Example 5	27.5
Comparative Example 1	25.8
Comparative Example 2	23.8
Comparative Example 3	23.9

[Table 3]

5

	1.25t/cm ²		1.5t/cm ²	
	Green Density (g/cm ³)	Rattler Value (%)	Green Density (g/cm ³)	Rattler Value (%)
Example 1	5.60	7.6	5.82	3.9
Example 2	5.59	8.0	5.81	4.6
Example 3	5.61	8.4	5.83	4.5
Example 4	5.60	8.1	5.82	4.5
Example 5	5.61	8.0	5.82	4.5
Comparative Example 1	5.65	11.2	5.87	4.6
Comparative Example 2	5.63	100.0	5.85	41.2
Comparative Example 3	5.65	30.8	5.88	5.0

(Example 2)

-250 mesh electrolytic copper powder was added to the -100 mesh Cu-11% Sn pulverized powder obtained in Example 1 at a ratio (weight ratio) of 81.8:18.2, and placed in a mixer to obtain Cu-9% Sn

10

mixed powder. Incidentally, 0.5% of lubricant meta flow A (not included in the total) was added and mixed to this mixed powder.

The characteristics of the obtained sintered mixed powder were examined. The apparent density (g/cm^3) and flow rate (s/50g) were examined as the powder characteristics, the green density (g/cm^3) and rattler value (%) were examined as the compacting characteristics, and the radial crushing strength (kgf/mm^2) was examined as the sintering characteristic. The results are shown in Table 1 to Table 3.

(Example 3)

Electrolytic copper powder (-100 mesh) and atomized tin powder were mixed at a ratio (weight ratio) of 89:11, and sintered in $\text{H}_2 + \text{N}_2$ mixed gas atmosphere at 550°C (Cu-11% Sn product). The highest temperature residence time was 30 min.

A partially alloyed (60% alloyed) sintered compact was thereby obtained. Subsequently, this sintered block was ground coarsely, thereafter pulverized with a hammer mill type pulverizer, and sieved at 100 mesh to obtain Cu-11% Sn pulverized powder of -100 mesh.

Subsequently, -100 mesh electrolytic copper powder was added to the foregoing -100 mesh Cu-11% Sn pulverized powder at a ratio (weight ratio) of 81.8:18.2, and placed in a mixer to obtain Cu-9% Sn mixed powder. Incidentally, 0.5% of lubricant meta flow A (not included in the total) was added and mixed to this mixed powder.

The characteristics of the obtained sintered mixed powder were examined. The apparent density (g/cm^3) and flow rate (s/50g) were examined as the powder characteristics, the green density (g/cm^3) and rattler value (%) were examined as the compacting characteristics, and the radial crushing strength (kgf/mm^2) was examined as the sintering characteristic. The results are shown in Table 1 to Table 3.

(Example 4)

Electrolytic copper powder (-100 mesh) and atomized tin powder were mixed at a ratio (weight ratio) of 90:10, and sintered in $\text{H}_2 + \text{N}_2$ mixed gas atmosphere at 690°C (Cu-10% Sn product). The highest temperature residence time was 30 min.

A partially alloyed (80% alloyed) sintered compact was thereby obtained. Subsequently, this sintered block was ground coarsely, thereafter pulverized with a hammer mill type pulverizer, and sieved at 100 mesh to obtain Cu-10% Sn pulverized powder of -100 mesh.

Subsequently, -100 mesh electrolytic copper powder was added

to the foregoing -100 mesh Cu-10% Sn pulverized powder at a ratio (weight ratio) of 80.0:20.0, and placed in a mixer to obtain Cu-8% Sn mixed powder. Incidentally, 0.5% of lubricant meta flow A (not included in the total) was added and mixed to this mixed powder.

5 The characteristics of the obtained sintered mixed powder were examined. The apparent density (g/cm^3) and flow rate (s/50g) were examined as the powder characteristics, the green density (g/cm^3) and rattler value (%) were examined as the compacting characteristics, and the radial crushing strength (kgf/mm^2) was examined as the sintering characteristic. The results are similarly shown in Table 1 to Table 3. (Example 5)

Electrolytic copper powder (-100 mesh) and atomized tin powder were mixed at a ratio (weight ratio) of 88:12, and sintered in $\text{H}_2 + \text{N}_2$ mixed gas atmosphere at 690°C (Cu-12% Sn product). The highest temperature residence time was 30 min.

A partially alloyed (75% alloyed) sintered compact was thereby obtained. Subsequently, this sintered block was ground coarsely, thereafter pulverized with a hammer mill type pulverizer, and sieved at 100 mesh to obtain Cu-12% Sn pulverized powder of -100 mesh.

20 Subsequently, -100 mesh electrolytic copper powder was added to the foregoing -100 mesh Cu-12% Sn pulverized powder at a ratio (weight ratio) of 83.3:16.7, and placed in a mixer to obtain Cu-10% Sn mixed powder. Incidentally, 0.5% of lubricant meta flow A (not included in the total) was added and mixed to this mixed powder.

25 The characteristics of the obtained sintered mixed powder were examined. The apparent density (g/cm^3) and flow rate (s/50g) were examined as the powder characteristics, the green density (g/cm^3) and rattler value (%) were examined as the compacting characteristics, and the radial crushing strength (kgf/mm^2) was examined as the sintered characteristic. The results are similarly shown in Table 1 to Table 3. (Comparative Example 1)

Electrolytic copper powder (-100 mesh) and atomized tin powder were mixed at a ratio (weight ratio) of 91:9, and sintered in $\text{H}_2 + \text{N}_2$ mixed gas atmosphere at 630°C (Cu-9% Sn product). The highest temperature residence time was 30 min.

A partially alloyed (70% alloyed) sintered compact was thereby obtained. Subsequently, this sintered block was ground coarsely, thereafter pulverized with a hammer mill type pulverizer, and sieved at

100 mesh to obtain Cu-9% Sn pulverized powder of -100 mesh. The obtained powder was used as the sintered powder

As with the foregoing Examples, the apparent density (g/cm^3) and flow rate (s/50g) were examined as the powder characteristics, the green density (g/cm^3) and rattler value (%) were examined as the compacting characteristics, and the radial crushing strength (kgf/mm^2) was examined as the sintering characteristic. The results are compared with the Examples and shown in Table 1 to Table 3.

(Comparative Example 2)

As with Comparative Example 1 above, electrolytic copper powder (-100 mesh) and atomized tin powder were mixed at a ratio (weight ratio) of 91:9, and sintered in $\text{H}_2 + \text{N}_2$ mixed gas atmosphere at 750°C (Cu-9% Sn product). The highest temperature residence time was 30 min. This results in further alloying in comparison to Comparative Example 1.

A partially alloyed (90% alloyed) sintered compact was thereby obtained. Subsequently, this sintered block was ground coarsely, thereafter pulverized with a hammer mill type pulverizer, and sieved at 100 mesh to obtain Cu-9% Sn pulverized powder of -100 mesh. The obtained powder was used as the sintered powder

As with the foregoing Examples, the apparent density (g/cm^3) and flow rate (s/50g) were examined as the powder characteristics, the green density (g/cm^3) and rattler value (%) were examined as the compacting characteristics, and the radial crushing strength (kgf/mm^2) was examined as the sintering characteristic. The results are compared with the Examples and shown in Table 1 to Table 3.

(Comparative Example 3)

Electrolytic copper powder (-100 mesh) and atomized tin powder were mixed at a ratio (weight ratio) of 89:11, and sintered in $\text{H}_2 + \text{N}_2$ mixed gas atmosphere at 630°C (Cu-11% Sn product). The highest temperature residence time was 30 min.

A partially alloyed (70% alloyed) sintered compact was thereby obtained. Subsequently, this sintered block was ground coarsely, thereafter pulverized with a hammer mill type pulverizer, and sieved at 100 mesh to obtain Cu-11% Sn pulverized powder of -100 mesh. -100 mesh atomized copper powder was further added thereto at a ratio (weight ratio) of 81.8:18.2, and placed in a mixer to obtain Cu-9% Sn mixed powder. Incidentally, 0.5% of lubricant meta flow A (not

included in the total) was added and mixed to this mixed powder. The obtained powder was used as the sintered powder

As with the foregoing Examples, the apparent density (g/cm^3) and flow rate (s/50g) were examined as the powder characteristics, the green density (g/cm^3) and rattler value (%) were examined as the compacting characteristics, and the radial crushing strength (kgf/mm^2) was examined as the sintering characteristic. The results are compared with the Examples and shown in Table 1 to Table 3.

As described above, with the Comparative Examples, the apparent density as the powder characteristic was of an average level at 2.45 to 2.70 g/cm^3 , and the flow rate was inferior at 21 to 27s/50g, resulting in the deterioration of compactibility. The green density as the compacting characteristic was of a relatively favorable level at 5.63 to 5.65 g/cm^3 . Nevertheless, the rattler value at 1.25t/ cm^2 was considerably inferior at 11.2 to 100.0%. The same result was obtained at 1.5t/ cm^2 . The radial crushing strength as the sintering characteristic was relatively favorable at 23.8 to 25.8 kgf/mm^2 .

Contrarily, with the Examples, the apparent density as the powder characteristic was of a standard level at 2.46 to 2.54 g/cm^3 , and the flow rate improved to 28 to 29s/50g. The green density as the compacting characteristic was of a favorable standard level at 5.59 to 5.61 g/cm^3 , and the rattler value improved significantly to 7.6 to 8.4% at 1.25t/ cm^2 . This also improved significantly to 3.9 to 4.6% at 1.5t/ cm^2 . The radial crushing strength as the sintering characteristic showed favorable high strength at 27.3 to 27.6 kgf/mm^2 .

INDUSTRIAL APPLICABILITY

As described above, since the Cu-Sn powder of the present invention as the powder metallurgical raw material powder yields superior effects in that it is capable of increasing compactibility such as the green density and rattler value of powder, improving sintering characteristics such as the radial crushing strength, and reducing costs upon manufacturing powder metallurgical raw material powder for an oil-impregnated sintered bearing or the like by using the mixed powder of pulverized powder of a partially alloyed Cu-Sn sintered compact, and electrolytic copper powder, the Cu-Sn powder of the present invention is useful as a bronze oil-impregnated sintered

bearing or the like.

CLAIMS

1. Cu-Sn mixed powder to be used as powder metallurgical raw material powder composed of mixed powder of pulverized powder of a partially alloyed Cu-Sn sintered compact and electrolytic copper powder.
2. The Cu-Sn mixed powder according to claim 1, wherein the Sn content of the pulverized powder of the partially alloyed Cu-Sn sintered compact is 10 to 12wt%.
3. The Cu-Sn mixed powder according to claim 1 or claim 2, wherein the total Sn content in the mixed powder is 8 to 10wt%.
4. The Cu-Sn mixed powder according to any one of claims 1 to 3, wherein the partially alloyed Cu-Sn sintered compact is a sintered compact of electrolytic copper powder and atomized tin powder.
5. The Cu-Sn mixed powder according to any one of claims 1 to 4, wherein the Cu-Sn mixed powder is mixed powder for an oil-impregnated sintered bearing.
6. The manufacturing method of Cu-Sn mixed powder to be used as powder metallurgical raw material powder, comprising the steps of manufacturing a partially alloyed Cu-Sn sintered compact by sintering Cu powder and Sn powder, obtaining Cu-Sn pulverized powder by pulverizing the sintered compact, and subsequently mixing the Cu-Sn pulverized powder and electrolytic copper powder.
7. The manufacturing method of Cu-Sn mixed powder according to claim 6, wherein the Sn content of the pulverized powder of the partially alloyed Cu-Sn sintered compact is 10 to 12wt%.
8. The manufacturing method of Cu-Sn mixed powder according to claim 6 or claim 7, wherein the total Sn content in the mixed powder is 8 to 10wt%.
9. The manufacturing method of Cu-Sn mixed powder according to any one of claims 6 to 8, wherein the partially alloyed Cu-Sn sintered compact is a sintered compact of electrolytic copper powder and atomized tin powder.
10. The manufacturing method of Cu-Sn mixed powder according to any one of claims 6 to 9, wherein the partially alloyed Cu-Sn sintered compact is manufactured by sintering Cu powder and Sn powder at a sintering temperature of 500 to 700°C.
11. The manufacturing method of Cu-Sn mixed powder according to

any one of claims 6 to 10, wherein Cu-Sn pulverized powder of -100 mesh and electrolytic copper powder of -100 mesh are mixed.

12. The manufacturing method of Cu-Sn mixed powder according to any one of claims 6 to 10, wherein Cu-Sn pulverized powder of -100 mesh and in which fine powder of -350 mesh is 45% or less, and electrolytic copper powder of -100 mesh and in which fine powder of -350 mesh is 25% or less are mixed.