United States Patent Office

2,870,485

Patented Jan. 27, 1959

2,870,485

MANUFACTURE OF POWDERS OF COPPER AND COPPER ALLOYS

William David Jones, London, England, assignor to F. W. Berk & Company Limited, London, England, a British company

No Drawing. Application June 26, 1956
Serial No. 593,835

Claims priority, application Great Britain
October 28, 1955

6 Claims. (Cl. 18—47.3)

This invention relates to the manufacture of copper powders having a low apparent density.

Copper powders of low apparent density are at present made either by electrolysis or by reduction of agglomerates of copper oxide, which yield a sponge-like mass having the requisite properties. The shape of the particles made by electrolysis is dendritic. A copper of low apparent density is essential for the production of sintered articles, having a considerable and controlled porosity, such as self-lubricating bearings, as the low apparent density of the powder as it is filled into the mould permits considerable pressing and this is accompanied by the development of sufficient green strength in the compact to enable it to be handled between the press and the sintering furnace. It should be noted that a fine tin powder is often mixed with the copper prior to its being pressed and a lubricant, such as zinc stearate, is also employed to facilitate pressing and add green strength to the compact.

It is an object of the present invention to provide an improved process for producing copper powders having a low apparent density using a process involving atomisation of the molten metal.

However, if copper is atomised in an air jet under the usual conditions a somewhat spherical powder is obtained which has a high apparent density, i. e. the percentage of voids in the powder as poured into a mould is relatively low and even copper atomised by a jet of water had an apparent density of about 3.83 gm./cc.

It has now been found that these difficulties can be overcome if to the copper there is added a small proportion of one or more of the metals hereinafter specified and if the atomisation is effected by water.

Accordingly, the present invention provides a process for the manufacture of a copper powder having a low apparent density wherein molten copper containing a small proportion of one or more of the metals magnesium, calcium, lithium, zirconium and titanium is atomised by means of an aqueous liquid, such as water.

Of the metals specified magnesium is preferred, and preferably it is used in a proportion of at least 0.2% by weight of the copper. Calcium is preferably used in a proportion of at least 0.5%, lithium at least 0.2% and zirconium at least 0.5%, by weight of the copper.

The following examples illustrate how the process of the invention may be carried into effect.

(1) Copper was thoroughly deoxidised by poling with a green stick, various proportions of magnesium were added and the melt covered with a layer of charcoal and atomised in the apparatus described in United Kingdom specification No. 553,672 using a water pressure of 1200 lbs./sq. in., the water flowing at 32 gallons per minute. The pouring temperature was 1200° C. and the atomising rate approximately 15 lbs. per minute.

The results obtained are shown in Table I.

In Table I and the tables in the other examples the oxygen content was measured by heating the powder obtained in hydrogen for 15 minutes at 840° C. and measuring the percentage loss of weight. This does not give a total oxygen content but approximately assesses that which is obtained by hydrogen reduction. The flow rate is the time taken for 50 gms. of the powder to flow through a 60° funnel having an orifice of 0.176" diameter at its lower end, and in the screen analysis measurements "percent on 100" means the percentage retained on a 100 mesh B. S. S. sieve, "percent 100/200" means the percentage passing a 100 mesh B. S. S. sieve but not passing a 200 mesh B. S. S. sieve, "percent 200/300" means the percentage passing a 200 mesh B. S. S. sieve but not passing a 300 mesh B. S. S. sieve, and "percent through 300" means the percentage passing a 300 mesh B. S. S. sieve.

Table I

Percent Mg in copper	0.7	0.5	0.35	0.25	0.2	0
Percent Cu in powder	98.48	99.25	99.42	99.48	99.24	99.83
Percent Mg in powder	0.68	0.43	0.32	0.21	0.19	nil
Percent Oxygen content		0.06	0.06	0.03	0.16	0.11
Flow rate in secs	20	18	16	14	15.8	14.2
Apparent density, gms./cc	1.5	1.52	1.7	2.07	3.0	3.84
Screen analysis:						
Percent on 100	trace	trace	trace	trace	nil	nil
Percent 100/200	21.6	27.5	18.2	21.3	14.2	33.8
Percent 200/300	18.6	22.0	17.4	18.9	16.4	20.4
Percent through 300	59.7	50.5	64.4	59.8	69.4	45.8

(2) Example 1 was repeated but using various proportions of calcium instead of magnesium.

The results are shown in Table II.

Table II

Percent Ca in copper	0.7	0.5	0.35	0.25
Percent Cu in powder	99.1	98.88	99.3	99.52
Percent Ca in powder	0.61	0.34	0.31	0.22
Percent Oxygen content	0.32	0.09	0.14	0.15
Flow rate in secs	9.6	8.8	7.0	7.3
Apparent density, gms./cc	1.69	2.04	3.1	3.41
Screen analysis:				
Percent on 100	Trace	Trace	Trace	Trace
Percent 100/200	29.2	17.7	16.5	14.9
Percent 200/300	23.6	18.6	20.3	28.2
Percent through 300	47.2	63.7	63.2	56.9

(3) Example 1 was repeated but using various proportions of lithium instead of magnesium. The results are shown in Table III.

Table III

Percent Li in copper	0.5	0.35	0.2
Percent Cu in powder	98.96	99.35	99.16
Percent Li in powder	0.42	0.30	0.16
Percent Oxygen content	0.31	0.01	0.22
Flow rate in secs	14.0	13.9	10.3
Apparent density, gms./cc	1.90	2.0	2.36
Screen analysis:			
Percent on 100	0.3	0.2	trace
Percent 100/200	29.2	25.6	28.8
Percent 200/300	21.5	19.0	20.7
Percent through 300	49.0	55.2	50.5

(4) Example 1 was repeated using various proportions of zirconium instead of magnesium.

The results are shown in Table IV.

Table IV

Percent Zr in copper	1.2	0.7	0.2
Percent Cu in powder	98.1	99.14	99.6
Percent Zr in powder	0.9	0.51	0.1
Percent Oxygen content	0.16	0.08	0.24
Flow rate in secs	13.7	14.3	6.1
Apparent density, gms./cc	1.85	2.14	3.73
Screen analysis:			
Percent on 100	trace	trace	trace
Percent 100/200	23.1	30.1	23.4
Percent 200/300	18.7	21.0	23.6
Percent through 300	58.2	48.9	53.0

(5) Example 1 was repeated using various proportions of titanium instead of magnesium.

The results are shown in Table V.

Table V

Percent Ti in copper	1.2	0.7	0.5
Percent Cu in powder	98.67	98.77	99.33
Percent Ti in powder	0.96	0.60	0.43
Percent Oxygen content	0.09	0.04	0.08
Flow rate in secs	27.0	16.4	19.2
Apparent density, gms./cc	1.99	2.77	3.0
Screen analysis:			
Percent on 100	0.1	trace	0.1
Percent 100/200	34.8	12.2	23.2
Percent 200/300	23.4	14.7	19.0
Percent through 300	41.7	73.1	57.7

What I claim is:

1. A process for the manufacture of a copper powder of low apparent density which comprises incorporating with substantially pure copper such a small proportion of a metal selected from the group consisting of magnesium, calcium, lithium, zirconium and titanium that the copper remains substantially pure and in such amount as to effectively cause the conversion of a molten mass of the resultant copper composition subjected to atomization by an aqueous liquid to a copper powder of low apparent density suitable for the production of sintered articles, and then atomizing a molten mass of such resultant copper composition by means of such aqueous liquid to convert the same into a copper powder of low apparent density containing at least approximately 98% of copper and less than approximately 1% of said incorporated metal.

2. A process for the manufacture of a copper powder of low apparent density which comprises incorporating with substantially pure copper such a small proportion of a metal selected from the group consisting of magnesium, calcium, lithium, zirconium and titanium that the copper remains substantially pure and in such amount as to effectively cause the conversion of a molten mass of the resultant copper composition subjected to atomization by water to a copper powder of low apparent density suitable for the production of sintered articles, and then atomizing a molten mass of such resultant copper composition by means of water to convert the same into a copper powder of low apparent density containing at least approximitely 98% of copper and less than approximately 1% of said incorporated metal.

3. A process for the manufacture of a copper powder of low apparent density which comprises incorporating with substantially pure copper at least approximately 0.2% by weight of magnesium calculated on the weight of the copper but not in such quantity as to provide more than approximately 1% of magnesium in the copper powder of low apparent density whereby the magnesium is in sufficient amount to effectively cause the conversion

of a molten mass of the resultant copper composition subjected to atomization by means of an aqueous liquid to a copper powder of low apparent density but not in such amount as to substantially affect the purity of the copper in such powder, and then atomizing a molten mass of such resultant composition by means of such aqueous liquid to convert the same into said copper powder of low apparent density.

4. A process for the manufacture of a copper powder of low apparent density which comprises incorporating with substantially pure copper at least approximately 0.5% by weight of calcium calculated on the weight of the copper but not in such quantity as to provide more than approximately 1% of calcium in the copper powder of low apparent density whereby the calcium is in sufficient amount to effectively cause the conversion of a molten mass of the resultant copper composition subjected to atomization by means of an aqueous liquid to a copper powder of low apparent density but not in such amount as to substantially affect the purity of the copper in such powder, and then atomizing a molten mass of such resultant composition by means of such aqueous liquid to convert the same into said copper powder of low apparent density.

5. A process for the manufacture of a copper powder of low apparent density which comprises incorporating with substantially pure copper at least approximately 0.2% by weight of lithium calculated on the weight of the copper but not in such quantity as to provide more than approximately 1% of lithium in the copper powder of low apparent density whereby the lithium is in sufficient amount to effectively cause the conversion of a molten mass of the resultant copper composition subjected to atomization by means of an aqueous liquid to a copper powder of low apparent density but not in such amount as to substantially affect the purity of the copper in such powder, and then atomizing a molten mass of such resultant composition by means of such aqueous liquid to convert the same into said copper powder of low apparent density.

6. A process for the manufacture of a copper powder of low apparent density which comprises incorporating with substantially pure copper at least approximately 0.5% by weight of zirconium calculated on the weight of the copper but not in such quantity as to provide more than approximately 1% of zirconium in the copper powder of low apparent density whereby the zirconium is in sufficient amount to effectively cause the conversion of a molten mass of the resultant copper composition subjected to atomization by means of an aqueous liquid to a copper powder of low apparent density but not in such amount as to substantially affect the purity of the copper in such powder, and then atomizing a molten mass of such resultant composition by means of such aqueous liquid to convert the same into said copper powder of low apparent density.

References Cited in the file of this patent

UNITED STATES PATENTS

905,232	Rossi	Dec. 1, 1908
2,157,979	Cooper et al.	May 9, 1939
2,255,204	Best	Sept. 9, 1941
2,482,423	Malcolm	Sept. 30, 1949
2,667,431	Burnside	Jan. 26, 1954

FOREIGN PATENTS

7,657	Great Britain	Mar. 29, 1911
512,142	Great Britain	Aug. 30, 1939
553,672	Great Britain	June 1, 1943
719,047	Great Britain	Nov. 24, 1954