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Wu et al.

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(54) **METHOD FOR INHIBITING DEZINCIFICATION OF BRASS**

(71) Applicant: **National Chung-Hsing University**, Taichung City (TW)

(72) Inventors: **Wei-Te Wu**, Tainan City (TW); **Chang-Yu Hung**, Taichung City (TW)

(73) Assignee: **National Chung-Hsing University**

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(57) **ABSTRACT**

A brass alloy with dezincification inhibition capability and good cutting and mechanical properties is provided. The brass alloy includes niobium and brass. Niobium is in an amount ranging from 0.01 to 0.15 part by weight and brass is in an amount ranging from 99.85 to 99.99 parts by weight based on 100 parts by weight of the brass alloy.

METHOD FOR INHIBITING DEZINCIFICATION OF BRASS

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application is a continuation application of and claims priority under 35 USC 120 to co-pending U.S. patent application Ser. No. 14/597,164, filed on Jan. 14, 2015, which claims priority under 35 USC 119 to of Taiwanese Application No. 103101603, filed on January 16, 2014.

FIELD OF THE INVENTION

[0002] The invention relates to a brass alloy with dezincification inhibition capability and good cutting and mechanical properties, more particularly to a brass alloy comprising niobium and brass.

BACKGROUND OF THE INVENTION

[0003] Brass alloy is mainly composed of copper and zinc. Brass alloy also contains a small amount of another metal based on the desired use, such as lead, tin, aluminum and the like. Compared to copper or other copper alloys, brass alloy has a good cutting property, but exhibits poor resistance to corrosion.

[0004] Conventionally, brass alloy contains a small amount of lead in order to improve the cutting property, so as to be suitable for use as a raw material for making components (such as brass pipes) of a potable or drinking water system. The brass pipes are often used in a high temperature environment or used for delivering water containing corrosive materials, such as chlorine.

[0005] However, lead has a relatively low melting point, and selective corrosion of the brass alloy-made component, such as dezincification of the lead-containing brass pipe, tends to occur when the brass alloy-made component is used in a chlorine-containing water environment. Dezincification may seriously damage the structure of the lead-containing brass pipe, and decrease the lifespan thereof. Moreover, lead may be released from the lead-containing brass pipe into water delivered by the potable water system, causing water contamination.

[0006] In order to overcome the aforementioned problems regarding lead contamination and dezincification, it is proposed to use bismuth to replace lead in the brass alloy so as to form a lead-free brass alloy. However, since, similar to lead, bismuth has a low meltingpoint, addition thereof in the brass alloy may render the brass alloy vulnerable to cracking under the high temperature environment.

SUMMARY OF THE INVENTION

[0007] Therefore, an object of the present invention is to provide a brass alloy with dezincification inhibition capability and good cutting and mechanical properties that can overcome at least one of the aforesaid drawbacks associated with the prior art.

[0008] According to the present invention, there is provided a brass alloy with dezincification inhibition capability and good cutting and mechanical properties. The brass alloy includes niobium and brass . The niobium is in an amount ranging from 0.01 to 0.15 part by weight and the brass is in an amount ranging from 99.85 to 99.99 parts by weight based on 100 parts by weight of the brass alloy.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0009] In one embodiment of the present invention, the brass alloy with dezincification inhibition capability and good cutting and mechanical properties includes niobium and brass. Niobium is in an amount ranging from 0.01 to 0.15 part by weight and brass is in an amount ranging from 99.85 to 99.99 parts by weight based on 100 parts by weight of the brass alloy. At least a portion of niobium and a portion of brass are formed into a solid solution.

[0010] With the inclusion of niobium, the dezincification inhibition capability and the cutting property of the brass alloy of the present invention are significantly improved. The reason of the improvement may be attributed to a higher melting point of niobium than that of lead. In addition, niobium is non-toxic. Hence, the brass alloy of the present invention is durable in a high temperature environment, and does not release toxic elements.

[0011] Preferably, niobium is in an amount ranging from 0.029 to 0.077 part by weight and brass is in an amount ranging from 99.923 to 99.971 parts by weight based on 100 parts by weight of the brass alloy. More preferably, the amount of niobium is 0.077 parts by weight and the amount of brass is 99.923 parts by weight based on 100 parts by weight of the brass alloy.

[0012] Brass has an α-phase and a β-phase. Preferably, brass includes 40 to 80 wt % of copper and 20 to 60 wt % of zinc based on a total weight of brass. More preferably, brass includes 50 to 70 wt % of copper and 30 to 50 wt % of zinc based on the total weight of brass. Most preferably, brass includes 55 to 65 wt % of copper and 35 to 45 wt % of zinc based on the total weight of brass. Brass may further include a trace of metal other than copper and zinc, e.g., Ni, Sn or Pb.

[0013] According to the present invention, a method of forming the brass alloy is provided. The method includes preparing a brass alloy composition that contains niobium and brass, melting the brass alloy composition under a temperature ranging from 1100 to 1300° C. for 5 minutes so as to form a brass alloy melt of niobium and brass, and cooling the brass alloy melt in a casting mold to 80 to 85° C. so as to form a solid solution of niobium and brass, followed by removing the casting mold and allowing the solid solution to cool to room temperature.

Examples

[0014] The following examples are provided to illustrate the embodiment of the invention, and should not be construed as limiting the scope of the invention.

Sources of Chemicals

[0015] 1.Copper block: purchased from Shin Chung Industrial

[0016] Co., Ltd.

[0017] 2.Zinc block: purchased from Lai-I Metal Industrial Co., Ltd.

[0018] 3.Niobium powder: purchased from Well-Being Enterprise Co., Ltd.

Comparative Example (CE)

Preparation of a Niobium-Free Brass Alloy

[0019] 171 g copper block and 114.6 g zinc block were placed in a high-frequency induction furnace, followed by melting the copper block and the zinc block under a temperature of from 1100 to 1300° C. for 5 minutes to form a brass alloy melt.

[0020] The brass alloy melt was cooled in a casting mold to 80 to 85° C. so as to form a solid solution, followed by removing the casting mold and allowing the solid solution to cool to room temperature, to form the niobium-free brass alloy.

Examples 1 to 4 (EX1 to EX4)

Preparation of Brass Alloy Including Brass and Niobium

[0021] The brass alloys of Examples 1 to 4 were prepared under conditions similar to those of Comparative Example except that each of the brass alloy compositions of Examples 1 to 4 further includes a niobium powder.

[0022] The brass alloy compositions of Examples 1 to 4 are shown in Table 1.

TABLE 1

	Cu (g)	Zn (g)	Nb (g)
EX1	186	124	0.062
EX2	173.4	115.6	0.116
EX3	154.2	102.8	0.28
EX4	180.56	124.44	0.63

Evaluation Items

1. Component Analysis

[0023] Each brass alloy of Examples 1 to 4 and Comparative Example was cut into a test piece. Each test piece was subjected to component analysis by an inductively coupled plasma mass spectrometer (ICP-MS).

[0024] The results are shown in Table 2.

TABLE 2

	Element Concentration or Amount					
Test Piece	Ni ppm	Cu wt %	Zn wt %	Nb wt %	Sn ppm	Pb ppm
CE	48.54	60.17	39.72	—	14.28	97.96
EX1	47.22	59.22	39.58	0.029	32.22	82.12
EX2	38.55	59.88	39.12	0.051	34.11	77.53
EX3	51.34	59.53	39.66	0.062	43.28	73.87
EX4	49.19	59.32	39.73	0.077	35.46	80.86
Detection Limit (ppm)	0.090	0.083	0.562	0.003	0.047	0.047

Note:
"—" means not added or does not exist

[0025] As shown in Table 2, the amounts of niobium in EX1 to EX4 are respectively 0.029, 0.051, 0.062 and 0.077 part by weight based on 100 parts by weight of the brass alloy. The composition of Comparative Example is free of the niobium powder.

2. Amount of Dezincification

[0026] Each brass alloy of Examples 1to4and Comparative Example was cut into a test piece. The test pieces of Examples 1 to 4 and Comparative Example were subjected to dezincification test according to AS2345 Australia standard method.

[0027] The results are shown in Table 3.

3. Cutting Property Test

[0028] Each brass alloy of Examples 1 to 4 and Comparative Example was cut into a test piece for the cutting property test. Each test piece was placed on a drilling machine for drilling. The drilling was conducted using a titanium-plated high speed steel drill bit (size: ⅛ inch) at a drilling speed of 1450 rpm and a drill feeding speed of 0.2 mm/sec.

[0029] The results are shown in Table 3.

TABLE 3

	Amount of Nb (%)	depth of dezincification (μm)	length of cutting (cm)
CE	0	839	6.875
EX1	0.029	121.4	5.712
EX2	0.051	113.2	4.192
EX3	0.062	110.9	2.875
EX4	0.077	43.6	1.007

[0030] The larger the depth of dezincification, the less the ability of the brass alloy to prevent dezincification. As shown in Table 3, Examples 1 to exhibit smaller depths of dezincification as compared to that of Comparative Example. The result indicates that the brass alloys which include niobium have better dezincification inhibition capability.

[0031] In particular, the comparison shows that the depth of dezincification decreases from 839 μm (CE) to 43.6 μm (EX3), i.e., an increase of 95% in the dezincification inhibition capability.

[0032] The shorter the length of the cutting, the better the cutting property of the brass alloy. As shown in Table 3, each of the brass alloy of Example 1 to 4 exhibits a shorter length of cutting as compared to that of Comparative Example. The comparison result indicates that the brass alloys which include niobium have a better cutting property.

[0033] In summary, with the inclusion of niobium in the brass alloy of the present invention, the dezincification inhibition capability and the cutting and mechanical properties can be improved.

[0034] While the present invention has been described in connection with what is considered the most practical embodiment, it is understood that this invention is not limited to the disclosed embodiment but is intended to cover various arrangements included within the spirit and scope of the broadest interpretation and equivalent arrangements.

What is claimed is:

1. A method for inhibiting dezincification of brass, comprising adding niobium into brass to form a brass alloy composition, melting the brass alloy composition to form a brass alloy melt, and cooling the brass alloy melt to room temperature so as to form a brass alloy with dezincification inhibition capability, wherein, based on 100 parts by weight of said brass alloy, said niobium is in an amount ranging from 0.01 to 0.15 parts by weight, and said brass is in an amount ranging from 99.85 to 99.99 parts by weight.

2. The method according to claim **1**, wherein before cooling to room temperature, the brass alloy melt is cooled to 80 to 85° C.

3. The method according to claim **1**, wherein the step of melting the brass alloy composition is conducted under a temperature ranging from 1100 to 1300° C.

4. The method according to claim **1**, wherein, based on 100 parts by weight of said brass alloy, said niobium is in an amount ranging from 0.029 to 0.077 parts by weight and said brass is in an amount ranging from 99.923 to 99.971 parts by weight.

5. The method according to claim **1**, wherein, based on 100 parts by weight of said brass alloy, said niobium is 0.077 parts by weight and said brass is 99.923 parts by weight.

6. The method according to claim **1**, wherein said brass includes 40 to 80 wt % of copper and 20 to 60 wt % of zinc.

7. The method according to claim **6**, wherein said brass includes 50 to 70 wt % of copper and 30 to 50 wt % of zinc.

8. The method according to claim **7**, wherein said brass includes 55 to 65 wt % of copper and 35 to 45 wt % of zinc.

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