

**"A method for manufacturing a lead-free or low lead
content brass billet and billet thus obtained"**

DESCRIPTION

The present invention relates to a process for
5 obtaining a brass billet and to a brass billet thus
obtained. In particular, the present invention relates to
a lead-free or low lead content brass billet.

In particular, brass is conventionally defined "lead-
free" if the lead content is lower than 0.1% by weight;
10 it is defined "low lead content" if the lead content is
comprised between 0.1% and 0.2% by weight.

As known, brass, alloy of copper (Cu) and zinc (Zn),
is a material widely used in the manufacturing industry,
above all by virtue of its excellent castability, which
15 allows to obtain semi-finished castings by means of
casing processes, and the excellent machinability, which
allows to finish the semi-finished product appropriately
by means of chipping machining.

The machinability of brass strongly depends on the
20 amount of lead (Pb) it contains.

However, the need to make some artifacts, e.g. faucets
or other components in contact with water, particularly
drinking water, with lead-free alloys has arisen in
recent years. Mainly, such requirement springs from the
25 need to prevent the lead from dissolving in water, with

consequences deemed negative for health.

The research and development efforts of very many manufacturers thus address the definition of lead-free brass, which has mechanical and machinability features
5 similar to those of traditional brass.

In this direction, one of the most promising addresses is the replacement of lead with graphite. With this regard, the Applicant is the owner of Italian patent application for invention No. 10 2013 9021 8136 5.

10 The present invention is part of this context, and in particular relates to an innovative process for manufacturing lead-free or low lead content brass billets and to the billet thus obtained.

The features and the advantages of the process
15 according to the present invention will be apparent from the description shown below.

Figures 1 and 2 show microstructures, at two different enlargements, of lead-free brass bars according to the present invention, characterized in head and center, in
20 cross section.

Figure 3 is a table taken from international standard ISO3685, which illustrates different chip forms.

According to a process, the billet is obtained by extrusion, either direct or inverted, of a powder
25 comprising brass powder and graphite powder.

The extrusion is performed in temperature conditions such to achieve a sintering of the powders and at a predetermined advancement speed of the punch, e.g. 120 millimeters/second.

5 For example, before performing the extrusion, the mixed powder is preheated to a preheating temperature, preferably lower than the melting temperature, for a predetermined interval of time. For example, the mixed powder is preheated to 720°C for 1 hour.

10 The brass powder is substantially a lead-free or has low lead content; furthermore, the graphite powder is preferably joined in measure between 0.5% - 2% by weight with respect to the brass powder, preferably about 1%.

According to a variant embodiment, the brass powder is
15 obtained by means of splat cooling, melt-spinning, atomization process, by means of chemical reactions, such as precipitation, or by means of mechanical processes, such as grinding.

In particular, the atomization process can be
20 performed as gas atomization, vacuum or inert atmosphere gas atomization, water atomization, centrifuge atomization, revolving disc atomization, by ultra-rapid solidification, ultrasonic atomization.

Preferably, the brass powder has a wide grain size
25 range, e.g. between 500µm and 50µm; such a wide range,

and possibly the irregular shape of the grain size, promotes the compacting of the powders.

Furthermore, according to a variant embodiment, the graphite powder is obtained by grinding.

5 The brass powder and the graphite powder are mixed, e.g. in a mixer/batcher, for a predetermined interval of time.

According to a variant embodiment, the mixed powder is collected in cylindrical containers, named cans, e.g.
10 made of copper, which after having been filled and inert gas having been blown inside them, are hermetically closed, e.g. by welding.

For example, the inert gas used is Argon (Ar).

The containers are loaded into the extrusion machine
15 and after preheating or during a heating, the extrusion, either direct or inverted, is performed, thus obtaining a composite billet, which contains the material of the container, e.g. on the surface.

Successively, a peeling operation for eliminating the
20 material of the container of the composite billet is performed, thus obtaining the desired billet.

According to a further variant embodiment, the extrusion press is directly loaded with the mixed powder, directly obtaining the desired billet; this avoids the
25 peeling process.

According to a yet further variant embodiment, the mixed powder, before sintering, is pressed, e.g. either in the container or directly in the extrusion press.

Experimental tests

5 For example, in an experimental test:

- a first can C1, of diameter of about 70 millimeters, was prepared containing mixed lead-free brass and graphite powder, precompacted to 120 tonnes; and

- a second can C2, of diameter of about 70
10 millimeters, containing mixed lead-free brass and graphite powder, not compacted.

Preheating to 720°C for 1 hour was performed on both cans C1, C2; the two cans C1, C2 were then subjected to direct extrusion, with extrusion ratio 8:1, punch speed
15 12 millimeters/second and final diameter of the billet of 30 millimeters.

Two bars were obtained: bar B1 from can C1 and bar B2 from can C2.

For both bars, the final density was about 8 grams/cm³
20 and a hardness HV_{5Kg} of about 85.

Figures 1 and 2 show micro-structures, at two different enlargements, of bars B1 and B2, characterized in head and center, in cross section.

Traction tests have indicated for both bars a Rp0.2%
25 of about 170MPa, a Rm of about 370 MPa and an A% of 23%.

Such tests indicate that the bars thus obtained have mechanical and micro-structural features which are mutually similar and practically identical to those of bars obtained by means of traditional cycle.

5 Embodiment of the invention

According to the invention, the billet is obtained by extrusion, either direct or inverted, of a mixture of lead-free or low lead content brass chips and graphite powder.

10 The mixture is preheated or, in a variant embodiment, is heated during the extrusion.

The word "chip" identifies a more or less thin strip of material, generally snarled. For example, the chip has the forms shown in table G.1 of International Standard
15 ISO3685 (figure 3).

The brass chips derive from the mechanical machining by chip removal performed on the semi-finished products made of lead-free or low lead content brass.

According to a variant embodiment, the brass chips are
20 fragmented by grinding, so that the billet is obtained by means of extrusion, either direct or inverted, of a mixture of fragmented, lead-free or low lead content brass chips and graphite powder.

The chips are fragmented by grinding, e.g. in mills,
25 with separation of the fraction having grain size smaller

than a predetermined grain size, e.g. <0.5 mm (brass fragments), and recirculation of the remaining fraction.

Successively, the brass fragments are mixed with graphite powder (e.g. average grain size of $20\text{ }\mu\text{m}$), e.g.
5 1% w/w, e.g. in revolving mixers, to obtain a uniform mixture.

Innovatively, the process according to the present invention is extremely advantageous from the industrial point of view because it envisages the relatively simple
10 management of powders and chips and the use of the existing extrusion presses.

In particular, the use of chips advantageously allows to perform the mechanical manufacturing by chipping in a remote plant and the separation of the fragments and the
15 extrusion in a main plant. The chip is transported from the remote plant to the main plant without incurring in the problems of powders transporting.

CLAIMS

1. A method for obtaining a lead-free or low lead content brass billet, comprising the steps of

- performing mechanical machining by chip removal on a semi-finished product made of lead-free or low lead content brass, obtaining a predetermined amount of chips, wherein said chips are thin strips of material, either distended or snarled;
- preparing a predetermined amount of graphite powder, having a predetermined average grain size;
- separating brass fragments having grain size smaller than a predetermined grain size in said amount of chips;
- mixing the brass fragments with graphite powder, obtaining a brass-graphite mixture;
- heating the brass-graphite mixture, obtaining a heated mixture;
- subjecting the heated mixture to an extrusion, obtaining said lead-free or low lead content brass billet;

wherein

- the step of mechanical machining by chip removal is performed in a remote plant;
- the predetermined amount of chips is transported to a main plant;

– the steps of separating the brass fragments and of subjecting the heated mixture to an extrusion are performed in said main plant.

2. A method according to claim 1, wherein the predetermined amount of chips is ground, e.g. in mills, and brass fragments having a grain size smaller than a predetermined grain size, e.g. 0.5 millimeters, are separated.

3. A method according to claim 1 or 2, wherein the mixture comprises graphite powder in an interval 0.5% - 1% by weight.

4. A method according to claim 2 or 3, wherein the mixture is heated to a temperature comprised between 600 – 780°C.
5. A method according to any one of the preceding claims, wherein a sintering process occurs during the extrusion.
6. A method according to any one of the preceding claims, wherein the extrusion is direct.
7. A method according to any one of the claims from 1 to 5, wherein the extrusion is inverted.