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PROCESS FOR PURIFYING METALS

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This invention relates to the purification of metals, more particularly to the purification of lead, tin, and alloys thereof.

One of the objects of the present invention is to devise a simple, economical and efficient means for the removal of gold from lead, tin and alloys thereof, and, where silver is present, to effect the removal of gold selectively with respect to the silver. Other objects of the present invention will be apparent from the detailed description thereof later to follow.

The prior art has taught means for removing gold and silver from primary lead bullion. It has been the almost universal custom to remove gold and silver by the well known Parkes Process and usually these elements are removed together, necessitating a subsequent separation or parting of the gold from the silver. In some instances, however, in order to obviate the necessity for subsequent parting of the gold and silver in the silver crusts, the gold is removed in an initial zincing operation, in which case an appreciable amount of silver is also removed. By the exercise of the present invention it is possible to effect a more selective removal of the gold while at the same time employing a much less amount of reagent metal than is required in the Parkes Process.

In carrying out the present invention, the metal to be purified, i. e., lead, tin or alloys thereof, containing gold, is melted in a suitable kettle or container and aluminum is placed on top of the metal. After the molten metal to be purified is brought to a temperature at which the aluminum will liquefy or dissolve therein, it is actively stirred in order to dissolve and thoroughly incorporate the aluminum into the melt. When the proper temperature is thus reached, the aluminum will react within a few minutes with the gold to form a mush of compounds, probably intermetallic, which tends to float on top of the molten alloy being treated. The molten metal is then allowed to cool to a temperature somewhat above its solidification point, for example, 50° C. to 100° C. above its freezing point. This causes the insoluble mush to thicken and float on top of the melt where it may readily be skimmed off or be removed in any other convenient manner.

The amount of aluminum or aluminum-alloy to be employed will, of course, depend upon the amounts of gold to be removed from the metal. Generally speaking, to effect a complete removal of the gold, the amount of aluminum to be employed should be from about one-half to

about ten times the amount of such impurities by weight. It is, of course, obvious that if but a portion of the gold is to be removed, the amount of aluminum employed will be accordingly reduced.

The temperature at which the above process is carried out may be any temperature above that necessary to cause the aluminum to liquefy or dissolve and depends somewhat on the composition of the metal to be purified. Generally speaking, it may be any temperature from about 500° C. to about 670° C.

The following examples will serve to illustrate the present invention and are given merely for illustrative purposes, and no undue limitations as to temperature, quantity of reagents, efficiency, etc., are to be deduced therefrom.

EXAMPLE 1

Gold removal from pure lead

3,174 grams of commercially pure lead containing 1.008 ounces per ton of added gold were melted in a small ladle and treated with 4.8 grams of aluminum amounting to 0.15 per cent (or 3 lbs. per ton); the metal was then hand-stirred at a temperature of about 660° C. and a mush formed on top of the melt. The molten metal was then allowed to cool and the insoluble mush skimmed off. It was found that 99.2 per cent of the gold was removed by the aluminum.

EXAMPLE 2

Removal of gold from silver-containing lead

3,385 grams of a commercially pure lead with 0.98 ounce per ton of added gold and 97.7 ounces per ton of added silver were melted in a ladle and treated at a temperature of about 660° C. with 5.08 grams of aluminum amounting to 0.15 per cent (or 3 lbs. per ton). An insoluble mush was formed and skimmed off from the purified metal. It was found that 100 per cent of the gold and 9 per cent of the silver were removed by the aluminum.

It will be noted that the aluminum employed in the above Examples 1 and 2 was greatly in excess of the necessary requirements. This excess was used in view of hand stirring, the insolubility of aluminum in lead, the difficulty of incorporating such small amounts in experimental small lots of metal and the great value of the gold to be recovered. However, it is not necessary to use this excess of aluminum. Furthermore, as the following example will show, it is possible to incorporate the aluminum at a

lower temperature if an aluminum alloy such as an aluminum-zinc alloy be used.

EXAMPLE 3

Removal of gold from silver-containing lead by the use of an alloy of aluminum

293,730 grams of lead containing 0.499 ounce of gold and 103.6 ounces of silver per ton were melted in a suitable pot. When the temperature reached approximately 555° C., 71 grams (or about 1/4 of a pound per ton) of an aluminum-zinc alloy in the form of small pieces containing 50 per cent aluminum and 50 per cent zinc were added with constant stirring. Owing to the lower melting point of the aluminum-zinc alloy, it was possible to add the same to the lead at a temperature approximately 100° C. below that of adding pure aluminum. After about 3 minutes, the temperature having dropped to about 545° C., the stirring was stopped and the insoluble mush formed was skimmed off. It was found on analysis that the lead was entirely freed of gold. The removal of gold was 100 per cent and about 6.47 per cent of the silver was also removed.

Since copper is usually present in lead bullion, the following example is given to show the removal of gold from bullion containing copper.

EXAMPLE 4

Removal of gold from silver-containing lead by the use of an alloy of aluminum

279,302 grams of lead containing 0.31 ounce of gold and 117.9 ounces of silver, per ton, and analyzing 0.0046 per cent copper, were melted in a suitable kettle and at the temperature of approximately 550° C., 84.5 grams of a 50-50 aluminum-zinc alloy were added with constant stirring. After three minutes, the stirring was stopped and the insoluble mush formed was skimmed off.

Upon analysis, it was found that all the gold had been removed and that 6.7 per cent of silver had also been removed. The copper content had dropped from 0.0046 per cent to 0.0015 per cent, showing that while 100 per cent of the gold was removed, small amounts of silver and copper were also removed.

It is to be understood that suitable fluxes or covering slags such as the well known approximate eutectic mixture of 2/3 calcium chloride (CaCl₂) and 1/3 sodium chloride (NaCl), may be used if desired during any of these treatments in order to insure against the possibility of any loss by drossing.

It will be observed that the temperature of operation of 660° C. was reduced to about 550° C. by the use of an alloy of aluminum instead of pure aluminum. However, the preferential nature of the gold removal with respect to both silver and copper was unimpaired.

While the use of an aluminum-zinc alloy has been described above, it is to be noted that other alloys of aluminum may be used in order to lower the temperature of the reaction and thus effect savings in fuel consumption and kettle life. Generally speaking, an aluminum alloy, re-

gardless of its proportional composition, may be employed which will have a melting point below that of pure aluminum and which will not be detrimental to the reaction hereindescribed.

The foregoing description and examples of the present invention have been given merely for illustrative and not limitative purposes and it is to be understood that there is no intention of excluding any modification capable of accomplishment by the exercise of mere skill of the art.

We claim:

1. The process of removing gold from lead, tin and alloys thereof which comprises melting the metal to be purified, adding thereto aluminum together with a slag of molten salts, agitating the molten mass at a temperature of about 660° C. until the desired removal of the gold is effected by the formation of a mush, then allowing the mixture to cool to a temperature of about 50° C. to about 100° C. above the solidifying point thereof, and separating the mush from the purified metal.

2. The process of selectively removing gold, in the presence of silver, from lead, tin and alloys thereof, which comprises melting the metal to be purified, admixing therewith a degolding agent from the group comprising aluminum and aluminum alloys which have a lower melting point than aluminum, agitating the molten mass at a temperature at which the degolding agent will liquefy therein until the desired removal of gold is effected by the formation of a mush, allowing the molten mass to cool and separating the mush containing the gold from the degolded metal.

3. The process of selectively removing gold, in the presence of silver, from lead, tin and alloys thereof, which comprises melting the metal to be purified, admixing therewith aluminum, agitating the molten mass at a temperature at which the aluminum will liquefy therein until the desired removal of gold is effected by the formation of a mush, allowing the molten mass to cool and separating the mush containing the gold from the degolded metal.

4. The process of selectively removing gold, in the presence of silver, from lead, tin and alloys thereof, which comprises melting the metal to be purified, admixing therewith an aluminum alloy having a lower melting point than aluminum, agitating the molten mass at a temperature at which said aluminum alloy will liquefy therein until the desired removal of gold is effected by the formation of a mush, allowing the molten mass to cool and separating the mush containing the gold from the degolded metal.

5. The process of selectively removing gold, in the presence of silver, from lead, tin and alloys thereof, which comprises melting the metal to be purified, admixing therewith an aluminum-zinc alloy, agitating the molten mass at a temperature at which said aluminum-zinc alloy will liquefy therein until the desired removal of gold is effected by the formation of a mush, allowing the molten mass to cool and separating the mush containing the gold from the degolded metal.

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