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METHOD OF PURIFYING ALUMINUM

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This invention relates to the purification of aluminum containing excessive amounts of iron. Aluminum and aluminum base alloys containing large amounts of iron are usually undesirable. Except in certain instances, an iron content of over one per cent is generally deleterious. Quite often aluminum of excessive iron content is produced and more often aluminum scrap, or secondary metal, has an iron content which is unduly high. The reduction of the iron content of aluminum has presented a serious problem. The result can only be obtained by expensive means, most of which, from a commercial viewpoint, are not justifiable. Consequently much aluminum containing iron over about 1 percent can only be used where, as, for instance, in the deoxidation of steel, the iron content is not deleterious.

The object of this invention is the provision of a method of purifying aluminum or aluminum base alloys containing more than about 1 per cent of iron. For convenience, the word "aluminum" as used herein and in the appended claims, is defined to include not only aluminum but also aluminum base alloys.

I have discovered that excessive amounts of iron may be removed from aluminum by forming, in accordance with my invention, a melt containing said aluminum and a predetermined amount of magnesium and thereafter dividing the melt into at least two separate portions, one of which is lower in iron content and higher in magnesium than the original aluminum. I have discovered that by this method the iron content of aluminum containing excessive amounts thereof may be substantially reduced.

The practice of my invention may be accomplished in the following manner. Aluminum containing an excessive amount of iron is placed in a crucible or similar holding device and melted. To the molten aluminum is then added an amount of magnesium which is predetermined by experiment and which is in such quantity as to insure the hereinafter described result. The magnesium is stirred into the melt and the resultant melt allowed to stand for a short time. Preferably the melt should have placed on its surface a molten salt flux, such as is well known to the art, to prevent unnecessary oxidation. Since the process is essentially one of settling out the iron, the melt thus formed should be allowed to settle for at least about 5 minutes although, apparently, the elimination of the iron begins simultaneously with the inception of solution of magnesium in the melt. After this settling period the melt is separated into at least two portions by removing from the melt the upper portion which is low in iron. The process may be made a continuous one and additional aluminum and magnesium introduced into the melt. If desired, the magnesium and aluminum may be melted together or the magnesium first melted and the aluminum added thereto—the precise method of forming the melt being one of operative expediency.

The amount of iron eliminated depends upon the amount of magnesium added, the temperature of the melt, the length of the settling period, and the care with which a separation is made between the upper (iron-impoverished) and the lower (iron-enriched) portion of the melt. The amount of magnesium added may be readily predetermined by considering the composition of the desired final melt and the amount of iron to be eliminated and by performing a simple experiment to determine operating conditions. The predetermined amount will usually lie, in practice, between about 5 to about 60 per cent since alloys having these concentrations are useful. However, in any case, I prefer to add not less than about 5 per cent of magnesium. The melt should be maintained, for best results, at a temperature immediately above the temperature at which the constituents of the melt, exclusive of the iron constituent, first begin to solidify.

The effect of the methods of my invention in removing iron from aluminum is best shown by way of example. For instance, under similar conditions of temperature and time, a melt consisting of aluminum containing about 4.5 per cent of iron and a melt consisting of aluminum of similar iron content and about 5 per cent of magnesium were al-

lowed to stand in molten form and thereafter the upper portion of each melt was decanted off and analyzed. The decanted portion of the melt consisting only of aluimnum contained about 2 per cent of iron while the decanted portion of the melt consisting of aluminum and magnesium contained only 1.3 per cent of iron.

In another instance, about 247 pounds of aluminum containing about 5 per cent iron was melted in an iron pot capable of holding more than 400 pounds of molten aluminum alloy. To this melt was added about 156 pounds of magnesium scrap borings; the mix was stirred until the whole was molten. From the top about 332 pounds of molten metal was removed, the analysis of which showed an iron content of 0.18 per cent and a magnesium content of about 28.3 per cent. The balance of the melt in the bottom of the pot contained about 15.3 per cent iron and about 27.48 per cent magnesium. There was a certain amount of metal loss, chiefly magnesium, on account of dross and oxide formation at the surface which was occasionally skimmed off. The 332 pounds of pig containing 28.3 per cent magnesium and only 0.18 per cent iron could be diluted with ordinary aluminum ingot to give an aluminum-magnesium alloy containing such desired amounts of magnesium as, say, 5 per cent or ten per cent. The residue containing 15.3 per cent iron and 27.48 per cent magnesium is disposable to the steel trade for refining purposes.

The last example of the benefits of my invention is particularly striking in that it illustrates the formation of two waste products—an aluminum containing 5 per cent of iron and magnesium scrap borings—into a useful aluminum base alloy containing magnesium and having a low iron content.

Although I have described my invention with reference to certain operative details, my invention is not limited thereto except as it is defined in the appended claims.

I claim:

1. The process of removing iron from aluminum containing excessive amounts thereof which comprises forming a melt containing said aluminum and magnesium, and thereafter dividing the melt into at least two separate portions, one of which is lower in iron content and higher in magnesium content than the aluminum from which the melt was originally formed.

2. The process of removing iron from aluminum containing excessive amounts thereof which comprises forming a melt containing said aluminum and magnesium, allowing the melt to stand for at least five minutes and thereafter separating the melt into at least two portions, one of which is lower in iron content and higher in magnesium content than the aluminum from which the melt was originally formed.

3. The process of removing iron from aluminum containing excessive amounts thereof which comprises forming a melt containing said aluminum and magnesium, allowing the melt to stand for at least five minutes at a temperature immediately above the temperature at which the least fusible constituent of the melt, exclusive of the iron constituent, will solidify and thereafter separating the melt into at least two portions, one of which is lower in iron content and higher in magnesium content than the aluminum from which the melt was originally formed.

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