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TREATMENT OF ALUMINUM

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The invention relates to a method of improving the internal structure and mechanical properties of aluminum and its alloys and the elimination from these metals of gases, dross, oxide films, and other or similar inclusions. "Aluminum" as used herein and in the appended claims includes not only pure aluminum and aluminum in all grades of commercial purity but also aluminum base alloys containing more than about 50 per cent of aluminum.

It is known in the art that a number of causes contribute towards the development in aluminum base alloys of lower mechanical properties than those of which such alloys are inherently capable. Chief among these causes are gases, dross, and oxide films, or mechanical inclusions held in solution or mechanical suspension beneath the surface of the molten metal. Likewise the presence of gas, dross, oxide film, and these mechanical inclusions causes defects in products fabricated from either aluminum or aluminum base alloys. These defects usually take the form of laminations, surface blisters, etc. and, in some cases at least, uneven grain size of the fabricated products has been attributed and traced to the presence of gas, dross, oxide film, and other inclusions in the metal. Various "fluxes" and methods of treatment of the metal have been heretofore devised in attempts to eliminate these defects. Of these fluxes, some have been ineffective, others have been attended by the generation of noxious gases and odors, others have been inflammable and explosive, while still others react with the molten metal to an injurious extent. Some of these fluxes have had a measure of success.

I have discovered that titanium chloride in gaseous form may be advantageously used to treat molten aluminum and remove therefrom the gases, oxide films, dross, and other inclusions which cause the defects hereinabove mentioned. Titanium chloride is effective, according to my discoveries, both as a scavenger and as a grain refiner. While there are three forms of titanium chloride, namely, titanium dichloride, titanium trichloride, and titanium tetrachloride, I prefer to use the tetrachloride because it is comparatively inexpensive. Any of these three compounds may, however, be used and, under ordinary foundry conditions, none of them are injurious to the operator nor are they explosive or inflammable. Moreover, they do not injuriously react with the molten metal.

I have also discovered that the treatment of the metal with titanium chloride has a beneficial effect even when the metal is cast under the most favorable commercial conditions and that if the metal treated with titanium chloride gas be allowed to solidify and be again remelted, the beneficial effect caused by the treatment is not lost but is in some cases even accentuated.

Titanium tetrachloride, the preferred compound, is obtainable commercially as a liquid and is stable in this form up to about 136° centigrade as long as it is kept from free contact with the atmosphere. In treating molten aluminum with titanium tetrachloride, the compound may be heated to about 136° centigrade in the immediate vicinity of the molten metal and the gaseous product allowed to bubble through the molten metal, the gas being carried beneath the surface of the metal by means of a tube formed from some heat-resistant material. The amount of gas supplied, or the time of treatment, is by no means critical since there is a gradual improvement which begins when the gas is first introduced into the molten metal and which ends when the metal is substantially free from gas and undesirable inclusions. We have obtained satisfactory results with a gas treatment of about 3 or 4 minutes' duration when a heat of molten metal of 150 pounds is used. The factor for determining the time of treatment is the amount of suspended or dissolved gases, oxides, dross or other inclusions present in the metal. Because of the varying contents of such foreign matters in different lots of metal, it is sometimes necessary to make preliminary tests to determine the proper time of treatment. However, I have found that under ordinary conditions a treatment with the gas for a few minutes—say 3 to 8 minutes—is entirely satisfactory.

Test specimens cast from a heat of an

aluminum alloy containing 4 per cent of copper and lesser amounts of silicon and iron had, before treatment with titanium tetrachloride, a tensile strength of 29,800 pounds per square inch and an elongation of 9 per cent in 2 inches. After the heat had been treated for about 4 minutes with titanium tetrachloride gas, test specimens cast therefrom had a tensile strength of 31,800 pounds per square inch and an elongation of 10.5 per cent in 2 inches. Some of the treated metal was allowed to solidify and was then remelted, after which specimens cast therefrom had a tensile strength of 34,200 pounds per square inch and an elongation of 12 per cent in 2 inches. The improvement in this case, while substantial, does not truly reflect the beneficial effect produced since test specimens may not, and usually do not, contain large gas cavities or dross inclusions which may be present in larger castings. Such inclusions, however, cause service failures in such castings and the removal of these inclusions is one of the major benefits of my invention. The beneficial effect of treating aluminum with titanium chloride as noted by an improvement in the physical properties of the aluminum is important, but other beneficial effects, such as the production of aluminum products free from laminations, surface blisters, or segregated inclusions sufficient in size to cause localized mechanical failure are other benefits of equal or greater importance which are obtained by the practice of my invention.

I claim:

1. The method of removing gas, dross, oxide films, and other detrimental inclusions from aluminum consisting in contacting the molten metal with titanium tetrachloride in gaseous form.

2. The method of removing gas, dross, oxide films, and other detrimental inclusions from aluminum consisting in contacting the molten metal with titanium chloride in gaseous form.

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