49. A New Aluminium Light Alloy "Chlumin."

(Extremely resistible to corrosion by sea water.)

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1. Aluminium light alloys are all very weak for sea water corrosion. Even Duralumin, the best rolling alloy, and Silumin, one of the best casting ones, are not good on this point. Some alloys are really non-corrodible but not used for their inferior mechanical properties and difficulties in casting, rolling or forging. A new alloy was invented in our laboratory 6 years ago, industrial researches were completed and the products are now used in some works. It was named "Chlumin" as it contains chromium, but a few per cent of magnesium and iron are also added. A brief description will be given of it in the following pages.

2. Non-corrodibility. Castings of Chlumin and of an alloy of composition Cu 8%, Al 92%, the most common one, both made by metallic mould, were immersed in 5% NaCl solution. Photo. I shows the result after 4 years. Chlumin gave only little deposit retaining even some luster, while, the other was severely corroded precipitating considerable mass of aluminium hydroxide. The machined surfaces of Chlumin and Silumin plates were exposed to air being sprayed by salt water every day. Many black spots appeared soon on Silumin but Chlumin remained bright for a long time. This difference was observed also on specimens immersed in sea water for a year. Experiments were next carried out somewhat quantitatively. Specimens were immersed in 5% NaCl solution in separate bottles. The quantity of deposit and the weight decrease of specimen were measured after 40 days. The results are summarized in Fig. 1. Chlumin was a little better even than aluminium. Silumin, Y-alloy, Duralumin and all others containing Cu or Zn were attacked severely. The variations of mechanical properties due to corrosion are shown in Fig. 2. Many test pieces of wire were immersed in 5% NaCl solution and the solution was renewed at times to expose them to air for a day to accelerate the corrosion. Chlumin and aluminium wires, annealed or not, lose scarcely their strength by 5 months' immersion. The elongation decreases in some cases. While, Duralumin, variously heat-treated or not, loses both qualities rapidly. After 3 months the strength reduces

to 80 to 20% of the original value and the elongation to 50 to 20%.

3. As a casting alloy. The mechanical properties of a cast alloy depend much on casting conditions. Fig. 3 shows the data on ingots made similarly using same metallic mould. Silumin was in perfectly "modified" condition. Chlumin is a little inferior to Y-alloy in strength and yield point but is superior to it in elongation and impact resistance. It is better than Silumin in every respect and is more easy to cast and safe to use as no special process (modification) is wanted on manufacturing. Any complex form can be cast resisting to severe water pressure test. Pistons of internal combustion engine and parts of electric motor have been used for more than a year with better result than Y-alloy.

4. As a rolling alloy. Wires of Chlumin are compared with those of pure aluminium and Duralumin in Fig. 4 being annealed at various temperatures. Duralumin aged after quenching from 510°C into water is exceedingly good indeed when annealed at temperatures below 200° , but becomes worse than Chlumin at 300° . Besides, it may not be a safe process of manufacturing to quench an alloy of melting point of 620° from above 500° . It may be very difficult to heat a large article uniformly above 500° . A little over heating will set in local melting, and when the temperature is too low some parts must meet the worst heat-treatment of Fig. 4. Heating on welding will spoil the good properties given by quenching and aging and it is often impossible in practice to quench the article again. Quenched Duralumin must be worked in a few hours as it hardens with time. This is a very inconvenient property and unduly treatment unavoidably sometimes applied in practice will spoil the material. Thus, Duralumin in actual use will not always have the best properties. Chlumin, on the other hand, needs no heat-treatment. Taking these circumstances all into account it may be concluded that Chlumin is equal in mechanical properties with Duralumin. Thin plates, wires and articles of complex form are easily manufactured by rolling, drawing and forging.

5. Conclusions. "Chlumin" has a small density of 2.71. In resistance to sea water corrosion it is superior to any known light alloys. In mechanical properties it ranks among the best. It is suitable both for casting and rolling materials. It can be cast easily, machined well and stands to severe water pressure test. As cast it has better mechanical properties than Silumin and Y-alloy and is more anti-corrosive. The product is safe as it needs not any special process (modification) on casting. As a rolling material it can be worked more easily than Duralumin, equals with it in mechanical properties and far

surpasses it in corrosion. It needs no heat-treatment so is safe to use. It is twice as strong as commercial aluminium and resists better to sea water attack.

The further details of this paper will be published in the Journal of the Iron and Steel Institute of Japan, "Tetsu to Hagane."

Photo. 1. Corrosion after 4 years' immersion in NaCl solution.

Cu 8%
Al 92,,

"Chlumin"

Fig. 3. Mechanical properties of aluminium casting alloys.

Fig. 1. Corrosion by sea water and NaCl solution.

Fig. 4. Effect of annealing on mechanical properties of wires.

Fig. 2. Change of mechanical properties due to corrosion by NaCl solution.