

WHY LIGHT INGOTS ARE SO HEAVY?

8 Technology



Stacked Properzi bundles by courtesy of Dubai



Properzi ingot bundles by courtesy of Alba

It is quite interesting to observe that, over the years, the vast majority of objects and tools invented to make our daily lives easier and more comfortable have been improved and somehow changed both in design and configuration.

For example, if we look at the automotive industry, it does not make any sense to compare a car designed during the 1970s with a modern car of the same category and brand designed two years ago. In short, many and many efforts have been expended by car manufacturers to improve safety and comfort.

Surely, such developments have occurred due to the law of competition “to be number one you must perform better than your competitor”; certainly the laws of marketing have played an important role, i.e. “more accessories more money” but, indisputably, the attention to safety has been the main focus of research and innovation.

After this preamble, coming back to the nonferrous commodities industry, it is worthwhile noting that aluminium ingots are a very important commodity since more than one-third of the global aluminium consumption is presently supplied in ingot form.

It would be very interesting to understand if and which kinds of changes and/or improvements have been done to this important commodity during the past 45 years. How to verify this?

Well, I could keep in my hands one aluminium ingot made today with a conventional open top ingot casting machine and try to travel back in time 45 years with the help of a modern “time machine”; hopefully one that is more reliable than the DeLorean DMC-12 used in the movie “Back to the Future”.

The time machine starts and works perfectly and I’m back in 1968, a little bit tired but excited. Personal computers and mobile phones do not exist, clothes are different and cars are absolutely primitive compared with those of today. Since I’m back in 1968 I try also to collect some data. The global population is approximately 3.4 billion (more than 7 billion today); the aggregated demand for electricity worldwide is in the range of 4,000 TWh (one fifth that of today).

To fulfill my task, I visit a smelter and obtain a newly fabricated ingot and finally compare the two ingots. At first glance the shape of the two ingots is very similar and the weight is the same!

I hope this story of fantasy has not bothered our readers too much as my intention was simply to illustrate that aluminium ingots are more or less the same as they were four or five decades ago. What is even more surprising is that the heavy weight of 50 lb. (22.7 kg) has remained unchanged although several users of aluminium ingots still have the need to handle each ingot manually, one by one, in order to feed small crucibles in die casting operations.



View of modern Track & Belt ingot caster

I have a question for our readers. Since the ingots have been designed for re-melting purposes, either bundle by bundle or ingot by ingot, why are the ingots so heavy? I say "heavy" because I am taking into consideration those users who have the need of handling manually each ingot, one by one.

To understand the background of the present shape of ingots and the reasons why the standard weight is 50 lb. (22.7 kg), we should consider that the hourly output of a mould chain (open top ingot caster) depends on the weight of the ingots and the length of the mould chain according to the equation:

$$P = \frac{W \times L}{l_s \times t_s} \times K$$

Where

- >> **P** is the hourly output of the line
- >> **W** is the ingot mass
- >> **L** is the line length
- >> **l_s** is the spacing between moulds
- >> **t_s** is the solidification time
- >> **K** is a corrective coefficient

The above equation is the background of the techno/economic compromise among the weight of each ingot to reach an acceptable production output and the cost of the plant. In fact, if we increase the length of the conveyor (L), the capital expenditure (CapEx) increases due to an increased space requirement and a higher number of moulds. The space between two consecutive moulds (l_s) can be reduced but

only up to a certain extent; the solidification time is more or less a fixed number unless the CapEx is further increased (mould of different material with better conductivity than traditional).

In conclusion, the designer of the open top mould conveyors had to evaluate the best possible compromises among the various limitations. At the end of the day, 50 lb. is a round number and it was in compliance with the workplace regulations at that time. However, times have changed!

Since the ingots are delivered packaged in bundles of approximately 1 ton with dimensions meant to maximize the loading of containers and trucks, is it really necessary that the weight of each ingot be 50 lb. (22.7 kg)? Or, is it also possible that the 1 ton bundle be composed of lighter ingots, for instance 13.6 kg (30 lb.)?

The Properzi Ingot Casting System is already used in several factories in Europe and in the G.C.C. countries. In 2005, we commissioned two large Properzi Ingot Casting Machines for the production of foundry alloys at Alba (Bahrain) and Dubal (U.A.E.). The picture enclosed (courtesy of Dubal) shows such ingots having a nominal weight of 10 kg.

Properzi's vision is to offer the market the same shape ingots presently produced by Alba and Dubal but with a weight of 13.6 kg instead of 10 kg.

At the production rate of 2,000 ingots per hour and with the same recorded OEE (Overall Equipment Efficiency) consolidated in several plants in operation, the ingot producer can produce more than 180,000 tpy with only one machine.

Properzi ingots are characterized by: constant weight, repeatable shape and dimensions, no rejection due to off-size ingots, and de-moulding problems do not exist.

Innovation is an effort that is meant to give industry not only higher profits and lower transformation costs, not only better and repeatable quality, but, above all, better working conditions for the human beings. *By Carmelo Maria Brocato*