

AMM® – Advanced Mould Materials
High-performance alloy ELBRODUR® B 95 / NIB



Copper alloy for high productivity
aluminium strip casting

KME Germany GmbH & Co. KG
Aluminium strip casting
[EN]





Against this background KME started the development of copper alloys suitable for sleeves for aluminium strip casting.

Intensive research work of KME led to the development of special alloy systems and manufacturing technologies which make it possible for Al strip casting sleeves to be made of copper alloys.

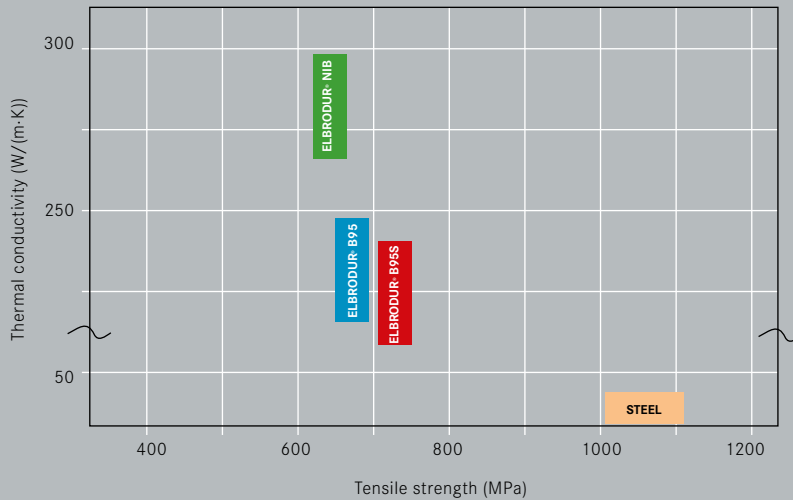
As a result of this development KME can now offer casting sleeves made out of the KME copper alloy ELBRODUR® B 95. A material designed to cope with high stresses and temperatures occurring in twin-roll strip casting of aluminium.

The following properties, and the specific combination thereof in the alloy and finished product, are of utmost importance for satisfactory performance of the casting sleeves:

- High hardness and strength
- High thermal conductivity
- High hardness and strength at elevated temperatures
- High fatigue strength

Another advantage of the new technology consists in the fact that the re-equipment with copper casting sleeves does not require any modification of the machine itself, making it possible for the user to change from steel to copper sleeves, and vice versa, whenever it is necessary, depending on the capacity needs and the demands which the cast product is expected to meet.

Thermal conductivity and strength of copper alloys



Cu alloys for copper shells

The stress load which casting sleeves have to cope with in Al strip casting is making extremely tough demands on the sleeve material. KME has managed to develop a special alloy system for this particular application.

ELBRODUR® B 95

Elbrodur® B 95 is a highly developed, state-of-the-art, CuCoBe alloy which obtains its particular properties by way of precipitation hardening and a special thermomechanical processing. The material possesses a medium thermal conductivity, and excellent thermal and mechanical properties which it retains even at high temperatures.

ELBRODUR® NIB

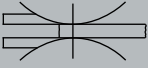
This is a newly developed material based on CuNiBe. It has been developed specifically for use in moulds for near-net-shape casting and other moulds that need to withstand particularly high stresses.

Its outstanding characteristics are high strength along with medium conductivity, and it has a special resistance to cracking when exposed to thermal stresses caused by large temperature fluctuations in the mould wall.

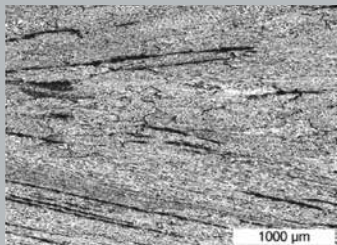
Productivity range

The high thermal conductivity of copper based alloys, as compared with the steel alloys that are normally used today, makes for much better heat removal from the aluminium strip. This particular advantage of copper casting sleeves can be put to use for the purposes of increasing the casting speed and thus the productivity of the system. Doubling the casting speed becomes possible thereby. Depending on the customers demands and the available casting equipment the copper casting sleeves could be used for both rolls, but also in the combination with a conventional steel sleeve.

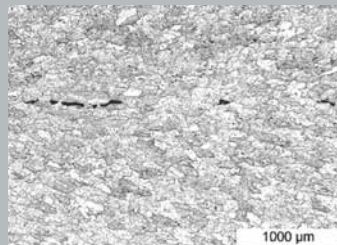
Potential increase in casting speed

Roll casting	Strip thickness	Productivity	Casting speed
	mm	t/(m-h)	m/min*
St/St Shell	5-10	0.5-1.5	0.9-1.25
St/Cu Shell		1.6-2.2	-1.8
Cu/Cu Shell		1.8-2.8	1.6-2.6

* Strip thickness 8 mm



Cast with St-sleeves



Cast with Cu-sleeves

Product quality

In addition to the increase in productivity the use of copper sleeves offers also the possibility to produce an as cast strip with improved material properties due to the enhanced cooling/solidification conditions.

Depending on the aluminium alloy a much finer grain size with an almost round shape can be achieved. This tends to result also in improved mechanical properties of the strip in the as cast state. Furthermore the negative effect of the centreline segregation can almost be prevented.

The copper side strip surface doesn't have grain growth during high temperature homogenization heat treatment. This is good news when considering Manganese bearing alloys like 3003, which has always the tendency to grain growth during heat treatment. The effect of the copper shells on others alloys has to be observed in future process steps.

Maintenance and remachining

The reworking of copper casting sleeves can be done using the same methods of machining that are used in the case of steel sleeves. There is no need for any special action in connection with the turning and grinding operations so that users can stick to their established maintenance routines.

Summary

The current performance results of KME copper casting sleeves used in Al strip casting have shown that

- copper casting sleeves make it possible to achieve significant increases in casting speed/productivity;
- copper sleeves offer new ways and means of optimising the product quality of cast Al strip;
- the use of copper casting sleeves does not necessitate any modification of the strip casting machines and lines;
- users can stick to their established maintenance procedures.

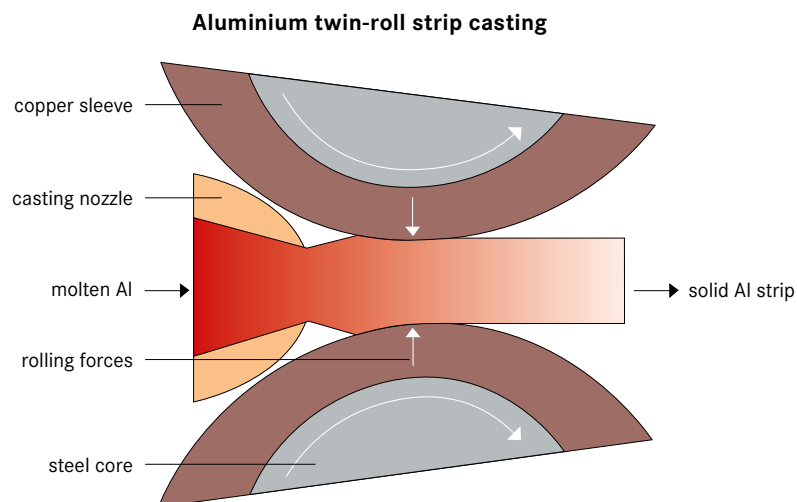
The drawback of the twin-roll method of aluminium strip casting as compared to other casting processes has been low productivity. The cause of the productivity limits has been mainly in the difficulty of removing heat from the melt/strip-roll contact zone. Substitution of the steel alloy shells used today by high conductivity engineering materials opens up very interesting potentials of improving the production capacity of such casting systems.

Due to the limited hardness, ductility and especially strength at higher temperatures of available copper alloys the attempts made to apply copper sleeves in strip casting have not been successful in the past.

In view of the performance requirements of twin-roll casting machines the materials of choice for the casting sleeves, have mostly been special stainless steel alloys up until the present day.

The disadvantage of these alloys is their limited thermal conductivity, i.e. about $35 \text{ W/(m}\cdot\text{K)}$, which is just about 10 % of the conductivity of copper.

The use of copper sleeves for aluminium strip casting makes it possible for the user to achieve a significant increase in casting speed and thus in productivity of the machine. It moreover offers possibilities of optimizing cast product quality and can allow the substitution of heat treatment/annealing steps in the processing of the Al alloy.



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