cunova

AMC®-

ML Coating for Mould Tubes

MELTING & CASTING
TECHNOLOGIES

AMT® ADVANCED MOULD TECHNOLOGY

AMC® - ML Coating for Mould Tubes

Challenge

In casting operations, mould tubes are exposed to an extreme varity of operational loads. In addition to a high thermal and high abrasive load, the steel melt often also introduces tramp elements into the process which cause a chemically induced damage. Such tramp elements like zinc or sulphur often originate from the steel scrap. The formation of cracks and as a result a spalling of the coating in the meniscus level are typical damage patterns which necessitates a replacement of the mould tube.

Solution

cunova has developed the AMC®-ML coating to provide effective protection of the mould tube against the combined chemical, thermal and mechanical loads.

Characteristics:

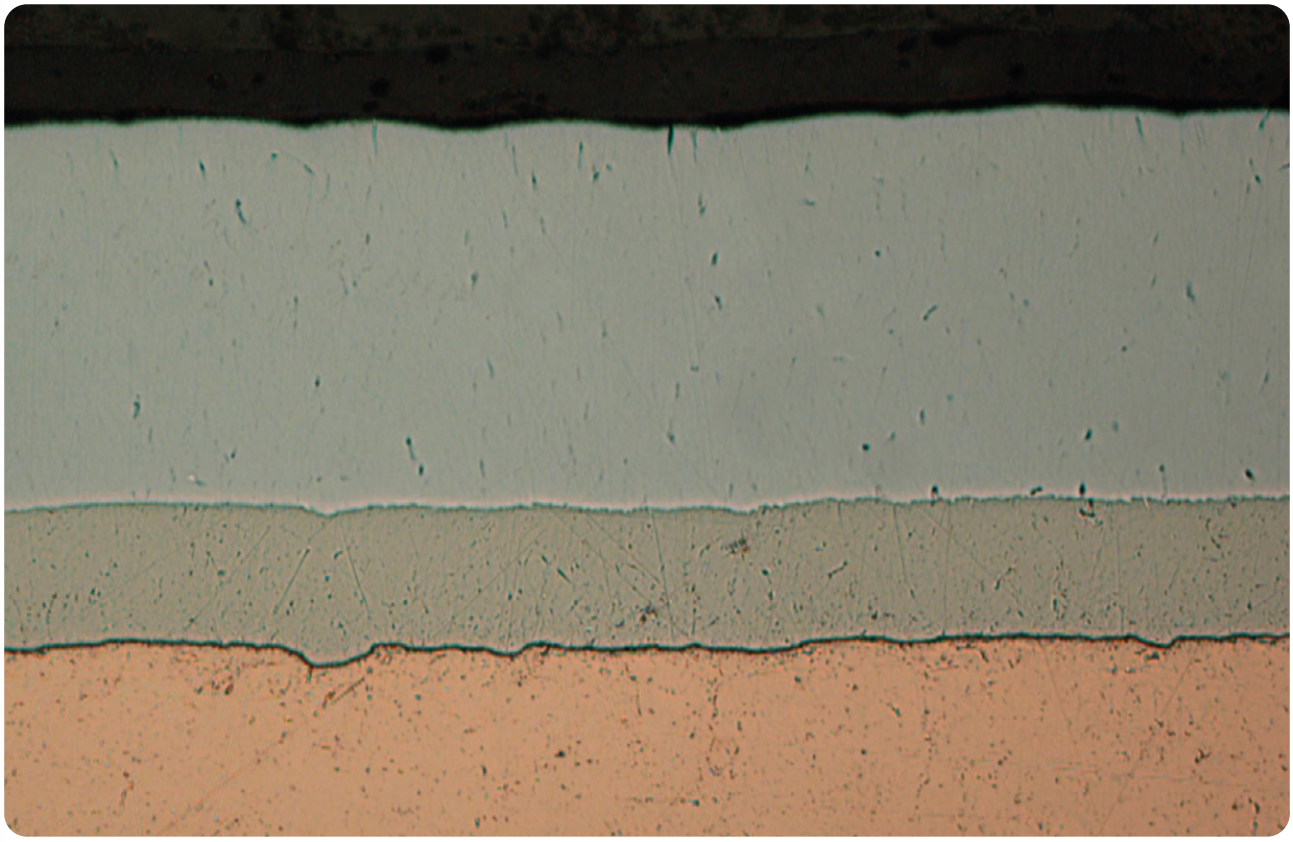
- Thin, multi layered coating with high heat transfer rate
- Very good resistance to combined chemical, thermal and abrasive loads

Application

- Available with all types of mould alloys Cu/CuAg/ CuCrZr
- Application with all types of Standard and Bloom mould tubes
- Application with Textured Moulds and WAVE Moulds

Advantages:

- Reduced diffusion of harmful elements:
  - less brass formation with chrome chipping due to zinc
  - less copper cracking due to sulphur
- Longer lifetime even in the presence of tramp elements in the liquid steel
- Improved resistance against diffusion as well as mechanical abrasion
- Reduced maintenance costs
- Lower mould cost per ton of casted steel



Sectional view of the AMC®- ML coating in the ingot mould tube

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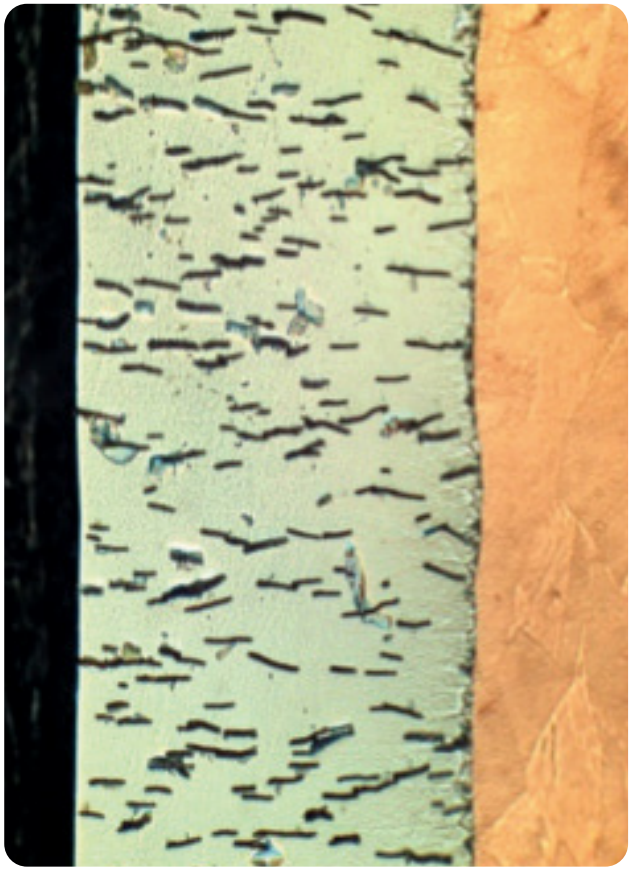
Reasons for improved AMC®-ML (Multi-Layer) Coating

The most dangerous und lifetime reducing factors in the area of the meniscus of a mould tube are overheating and harmful elements. To protect the mould tube against the attack of harmful elements we need to understand which elements are injuring the meniscus and the way it works.

During the last years the lifetime of mould tubes could be raised significantly. This increased lifetime is bringing new problems in the picture. Diffusion problems had not been so dramatically in the past because mould had been scrapped due to other reasons before there was enough time for those harmful elements to penetrate the chrome and copper.

The major harmful chemical elements – like sulphur [S] and zinc [Zn]-which are harmful to both copper and/or coatings are well known. A Cr-coating cannot avoid diffusion because every type of Cr coating has micro cracks running through which the harmful elements will diffuse.



Section view of a typical Cr-Layer

Black spots are sulphur corrosion

Sulphur

The source of the sulphur is mainly oil lubrication during casting. Most notably are here the mineral and synthetic casting oils. A possible other source can be the S content of the liquid steel, if for example “free cutting steel grades” are casted. These “free cutting steel grades” are high in S. The reason for the high S amount is that during CNC machining the chips are staying small and do not create long turnings and problems.

Sulphur coming to the copper will lead to chrome chipping at elevate temperatures (e.g. >= 270 °C) by forming voluminous, brittle coppersulfides and development of cracks due to sulphur corrosion.

Sulphur corrosion

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Zinc

The source of zinc is the cooling scrap in the converter or the prematerial scrap in the EAF.

Zn as a "tramp" element from the steel diffuses into the copper when exposed to high temperatures for a prolonged time period and thus diffusion process increases.

Higher zinc levels in the steel and high local surface temperatures - especially at the meniscus - lead to the development of hard and brittle (bulky) brass phases on the copper surface, which accelerate the development and propagation of cracks into the ductile copper.

Then the bulky brass phases separate the chrome from the copper which results in an early chrome chipping and further on in cracks in the copper. Mechanical stresses from the steel strand enhance the process.

Protection against harmful elements Zn and S

AMC®-ML (Multi-Layer) Coating

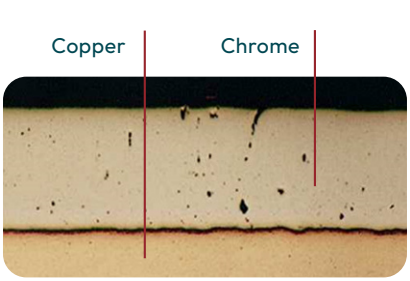
The tight flash of the intermediate layer is building a diffusion barrier between the micro cracking chrome layer and the Copper material we want to protect. It can be applicated on all copper alloys and all types of mould tubes like billet, bloom and Beam Blank.

Due to this protection shield the penetration time for the diffusion takes much longer.

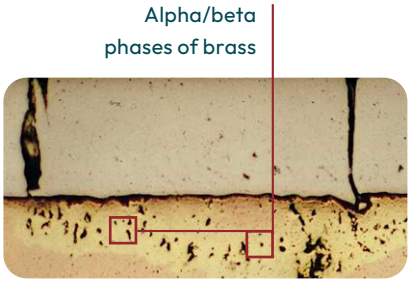
Benefits:

- Less chrome chipping and brass formation due to zinc
- Less copper cracking due to sulphur
- Longer lifetime and reduced maintenance costs

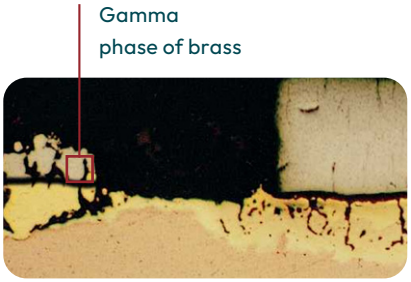
Coating Damage from Zinc



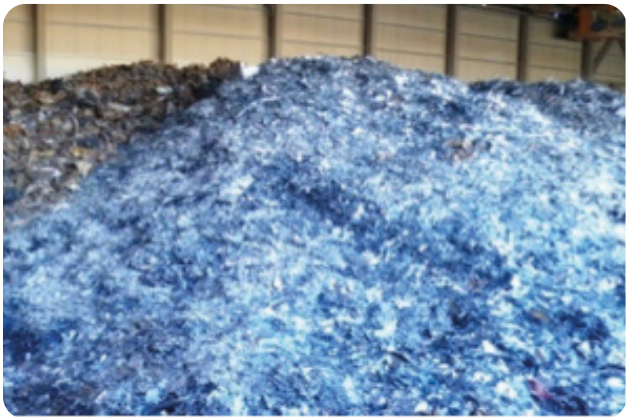
Original chrome coating (cross section)



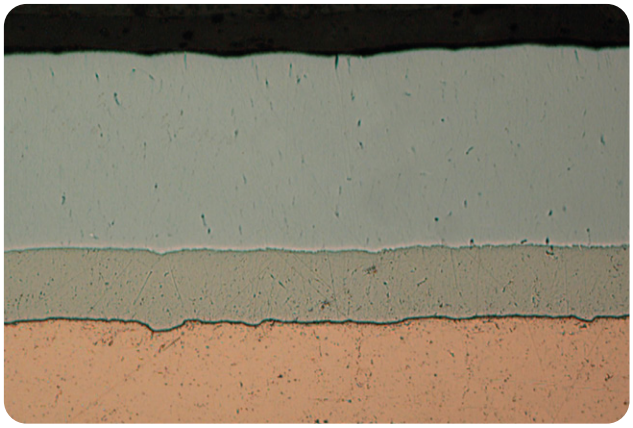
First damage stage



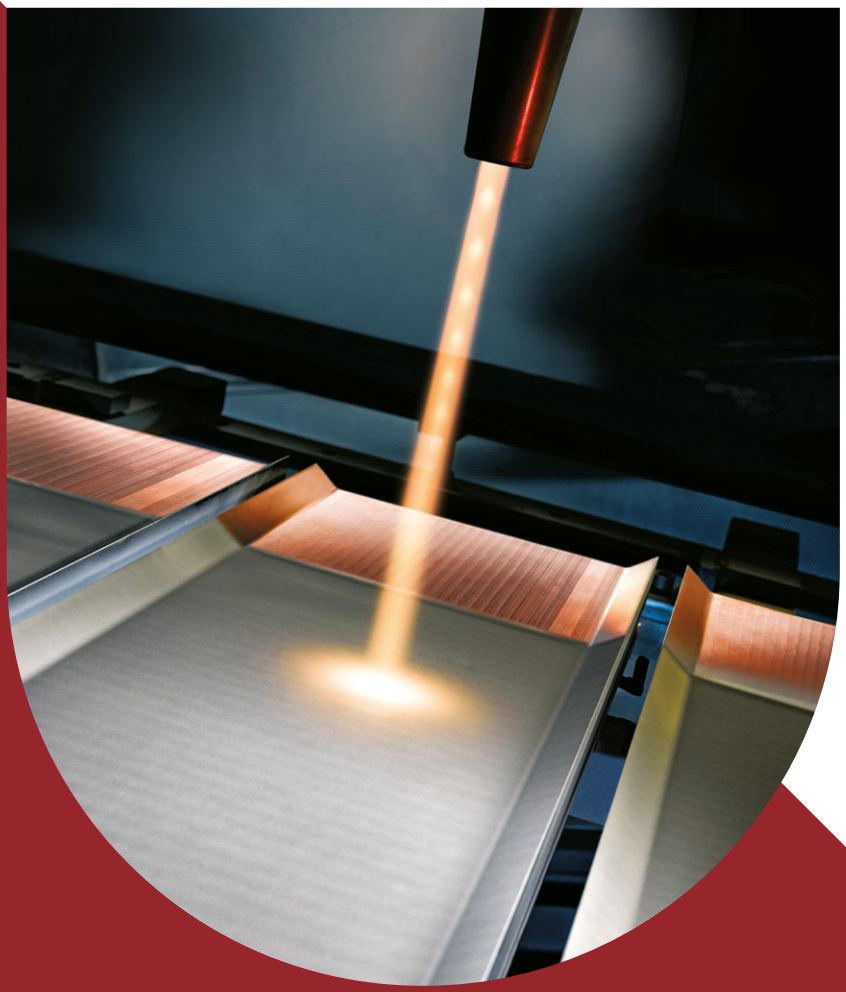
Final failure stage: chrome layer flakes off



Coated sheets and stamping scrap are protected against corrosion with Zn.



Section view of the new AMC®-ML Coating



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