EASECAST®

THE INNOVATIVE GENERATION
OF LEAD-FREE COPPER MATERIALS

PASSION FOR **TECHNOLOGY.**

RHEINMETALL

Conventional alloys containing lead used previously in solid form are classified as harmful in the EU from a lead concentration of 0.3 %. The permissible occupational exposure limit, measured as a biological value, has also been reduced considerably. Further classifications and restrictions are to be expected in the future. Alloys will therefore have to meet much more stringent requirements.

THE SOLUTION: EASECAST®

KS Gleitlager GmbH, one of the largest European manufacturers of bronzes and gunmetals and part of the Rheinmetall Group, has developed an innovative lead-free alloy on the basis of sulphur as a chip breaker in the form of EASECAST®. Crucial elements in the development were protection of people and the environment, as well as maintaining the competitiveness of copper-based standard materials such as Rg7 (CC493K) and Gbz12 (CC483K).

In contrast to many other developments in this area, the chosen solution is advantageous because the fundamental structure of the previous materials is preserved. The lead is simply replaced with the phases Cu_2S and ZnS. Like lead, these are present in the interdendritic structure (see Fig. 1-4). This means the properties of these alloys are directly comparable to the current standard. True to the name of the product range EASECAST®, this means that changing over to lead-free materials on a copper basis is as easy as possible.

AVAILABILITY

As one of the largest European manufacturers of bronzes and gunmetals, KS Gleitlager GmbH met its commitments in line with Rheinmetall AG's self-image. Instead of asserting a claim for being the sole representative, as quickly as possible, the company initiated incorporation into Standard EN 1982, which is linked to non-discriminatory licensing to others in the market. This means there is no monopoly; processors and users can happily participate in the market just like before and compare offers from different manufacturers. Having a single European standard is cheaper than dealing with numerous alloys only with low tonnages.

AN INTEGRATED APPROACH

Sustainability and compatibility are already highly significant when selecting and using materials. When developing the EASECAST® product range, special attention was therefore placed on creating an integrated cycle, based on current practice. This means, to a certain extent, the materials can be combined with lead-free alloys containing sulphur for use in the field of drinking water. Instead of offering expensive individual solutions, depending on the application, recycled material and scrap from different industrial sectors can be used. This saves the environment, facilitates scrap sales and reduces CO_2 because of the high percentage of recycling.

ENVIRONMENTAL FRIENDLINESS

Copper glance (Cu_2S) and zinc blende (ZnS) are naturally occurring minerals. With EASECAST® products, it is now also technically possible to use these minerals in solid copper-based alloys.

Re-alloying of the lead substitute elements when using recycled material or scrap is not necessary with the EASECAST® product range. The lead substitute elements have a low to very low melting loss, meaning corrections are mostly unnecessary. If there is sulphur, this can be removed using known desulphurisation techniques, such as adding cerium or magnesium. This means the material is also available to other alloy groups without complex refining.

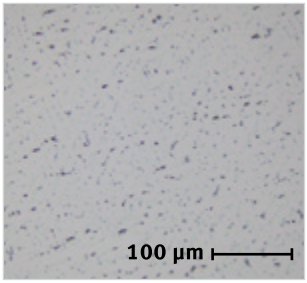

Fig. 1: Microsection material Rg7 (CC493K)

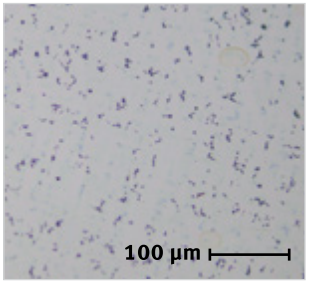

Fig. 2: Microsection material EC7

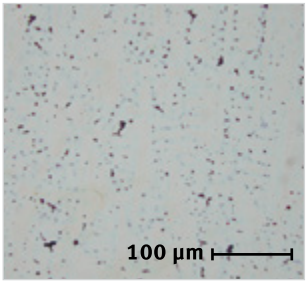

Fig. 3: Microsection material Gbz12 (CC483K)

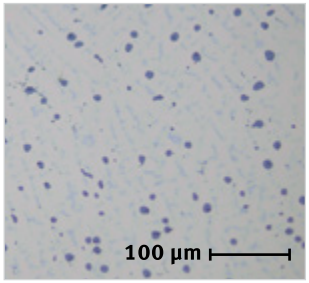

Fig. 1: Microsection material EC12

DURABILITY

The corrosion behaviour of the alloys EC7 and EC12 match those of the standard material containing lead, both in fresh water and in salt water and oil, and in the majority of tests even exceeds the alloys Rg7 (CC493K) and Gbz12 (CC483K).

CHEMICAL COMPOSITION

EC7 as an alternative material to Rg7 (CC493K) is lead-free in accordance with the current specifications of the European Chemicals Agency, with a maximum lead content of 0.09 %. The same applies for EC12, which was developed as a substitute for the alloy Gbz12 (CC483K). Alongside the alloys mentioned, there is of course also the possibility of meeting customer-specific requirements under the umbrella of the EASECAST® series. Other standard alloys, such as Gbz12Ni (CC484K), can of course be covered by the lead-free EASECAST® standard.

	Rg7 CC493K	EC7	Gbz12 CC483K	EC12
Cu	81.0 - 85.0	85.0 - 92.3	85.0 - 89.0	85.0 - 89.0
Sn	5.4 - 8.0	5.4 - 8.0	10.5 - 13.0	10.5 - 13.0
Zn	2.0 - 5.0	1.0 - 3.5	≤ 0.5	≤ 0.5
Ni	≤ 2.0	1.1 - 2.5	≤ 2.0	0.1 - 2.0
P	≤ 0.10	0.03 - 0.06	≤ 0.60	≤ 0.60
S	≤ 0.10	0.2 - 0.6	≤ 0.05	0.1 - 0.55
Pb	5.0 - 8.0	≤ 0.09	≤ 0.7	≤ 0.09
Fe	≤ 0.2	≤ 0.2	≤ 0.2	≤ 0.2
Sb	≤ 0.3	≤ 0.3	≤ 0.15	≤ 0.15
Al	≤ 0.01	≤ 0.01	≤ 0.01	≤ 0.01
Si	≤ 0.01	≤ 0.01	≤ 0.01	≤ 0.01
Cd	–	≤ 0.01	–	≤ 0.01
Mn	–	–	≤ 0.2	≤ 0.2

Tab. 1: Chemical composition [% by mass]

MECHANICAL PROPERTIES

The validation of the mechanical properties was performed in accordance with DIN EN 1982, thereby meeting the technical standard. In the case of alloy EC7, the dependency between the wall thickness and the mechanical properties was successfully reduced by slightly increasing the nickel content.

Both the mechanical and the tribological properties thereby correspond to those of the standard materials containing lead.

	Rg7 CC493K	EC7	Gbz12 CC483K	EC12
Hardness [HB10/1000]	≥ 70	≥ 70	≥ 90	≥ 90
Tensile strength Rm [MPa]	≥ 260	≥ 260	≥ 300	≥ 300
Yield strength Rp0.2 [MPa]	≥ 120	≥ 120	≥ 150	≥ 150
Fracture elongation A5 [%]	≥ 12	≥ 12	≥ 6	≥ 6

Tab. 2: Mechanical properties

MACHINING

Feed rate, cutting speeds and cutting depths, along with the arising chip shapes, are just a few of the important factors when it comes to machining.

Thanks to the machining expertise of KS Gleitlager GmbH, the machining properties were investigated thoroughly as early as in the development stage of the alloys.

This meant it was possible to develop materials which are comparable to the materials Rg7 (CC493K) and Gbz12 (CC483K) in their machining parameters (see Fig. 5 and 6).

Fig. 5: Rg7 (CC493K) chip with industrial machining

Fig. 6: EC7 chip with industrial machining

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