SPECIAL BRASS SOLDER FOR STEEL PARTS HARD SOLDERING

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Abstract

Copper based alloys for various purposes are widely used in the whole world as well as in our country. Today, copper based ecological materials are in, particularly ones with different alloying elements as multifunctional materials.

Solder materials are part of this group, so in the frame of IPA project ECOSOLDER special brass solder for steel parts soldering was developed.

Key words: brass, steel parts, hard soldering

Introduction

Brass solders with standard composition are widely used [1-3], but considering the zinc volatility, these are unsuitable in practice. Solder joint became porous after zinc volatilization (above 900°C) and along with that less reliable. On the other hand this problem is ecological too. Because of these facts, these problems can be avoided with addition of some alloying elements, and consequently the optimal characteristics of solder material will be obtained.

The structure and properties of copper-zinc alloys are defined by phase diagram shown at Figure 1.

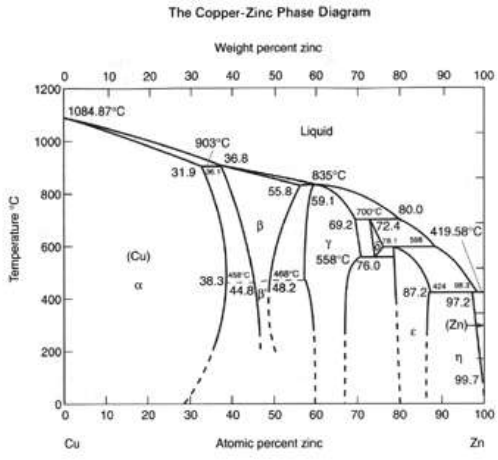

Figure 1. Cu-Zn phase diagram

As alloying elements for copper-zinc alloys aluminum, manganese, nickel, tin, silica and iron are used, and they improved brass design properties, so these brasses are called special brasses. The alloying is performed with 1 to 2%, sometimes 4% of alloying element. With the addition of third element in binary alloys, the structure is modified and the phase transformation boundaries are moved. The amount of β phase is enlarged, as well as the alloying components in α and β phases, until solubility boundary is exceeded. In that case, new phases might be obtained, as intermetallic compounds with greater influence on alloy properties.

Guillet [2] pointed out that addition of each of indicated elements is equal to zinc increment, and the exception is nickel. Coefficients for alloying elements are given in Table 1.

Table 1. Guillet's coefficients for alloying elements in Cu-Zn alloys [2]

Si	Al	Sn	Mg	Cd	Pb	Fe	Mn	Ni
10÷12	4÷6	2	2	1	1	0,9	0,5	-1,4

Apparent zinc content in special brass can be determined knowing these coefficients (Table 1) and phase diagram (Figure 1).

Experimental

In order to obtained suitable solder characteristics, standard Cu-Zn solder was alloyed and the chemical composition Cu-Zn-Sn-Si-Mn solder alloy is given in Table 2.

Table 2. Chemical composition of special brass for hard soldering

Solder	Chemical composition, %							Melting interval	
	Cu	Mn	Sn	Si	Fe	Zn	impurities	solidus	likvidus
CuZnSnSiMn	59÷61	0,5÷1,2	0,2÷0,5	0,15÷0,5	max 0,1	balance	max 0,3	880°C	900°C

CuZnSnSiMn special brass solder is presented at the market in various shapes such as rods, wires or pastes. In the frame of ECOSOLDER project, this special brass solder has been produced in the forms of wires and rods.

Technological procedure for CuZnSnSiMn solder wires production

Technological process of molten wire over the melt crystallization is continuous and consists of several stages: preparation of the batch, pure copper smelting, alloying, casting and reeling. In this way we get a predprofile for further processing up to required diameter.

Batch preparation includes preparation of technically pyre metals, previously cleaned up from dirt and moisture. The OFHC copper is added in furnace in certain portions and for covering the charcoal is used as long as melt alloying is last. The melt is alloyed with Si, Sn and Mn.

Before the Zn addition charcoal is removed and on the surface melt the volcanic ash is placed. This cover is staying until the end of casting.

Casting is done by casting device with melt crystallization above. The refrigerator with a crystallizer in which the initiator of crystallization is installed, dives into the melt, and the melt pushes molten metal in graphite molds where solidified due to heat transfer through the crystallizer primary part which is cooled by water. In order to prevent oxidation of wire, because of high temperatures, the vacuum is used, and this is performed by cooling in secondary crystallizer part.

The withdrawal of molten wire is done by alternately moving and pause.

During casting, the melting temperature is controlled and maintained at about 100°C above the melting point, which is analogly to temperature range 980÷1000°C.

The dimension of the initial wire is Ø8 mm, but can be less in dependence of mold size. Final dimensions for brazing wire are Ø1,5 mm up to Ø 3,0 mm. The order of the draw is determined by the alloy and the alloy deformation degree betwen two passes, as well as deformation degree between annealing.

For this CuZnSnSiMn alloy, recommended deformation degree at one pass is 18÷40%, and 60-80% as total deformation degree between annealing.

Heat treatment consist of intermediate and final annealing. Intermediate annealing aimes to remove stress in material, which are consequence of cold plastic deformation. Final annealing is performed in order to achieve the appropriate material state. For brazing soder materials it is necessary to achieve such mechanical properties that will enable optimal exploatation of material in the form or rods and wires. The residual stresses in the material after cold plastic deformation are removed by final annealing.

The structure of CuZnSnSiMn alloy after plastic deformation and heat treatment is shown at Figure 2.

Figure 2. CuZnSnSiMn alloy after plastic deformation and heat treatment

(magnification 400x)

The intermediate annealing temperature is in range 600÷650°C. Annealing is carried out in inert atmosphere or in air, with obligatory of oxidative surface rinsing with 12% H_2SO_4.

The obtained CuZnSnSiMn solder wire packed according to established standard. It should be noted the necessary quality control of final product which includes the control of shape and size as well as chemical composition control.

Conclusion

In this paper special brass CuZnSnSiMn is presented as ecological material for steel parts soldering. Also, the technological process of CuZnSnSiMn wire is given, considering ecological aspect. This material represents the expansion of multifunctional materials range.

References

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