

## CUPROCOND 67 L - WIRE COPPERING

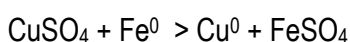
Single component liquid product for chemical coppering of wires for tires and welding.

In the Automotive industry the classic carbon steel wire was replaced around the 80s with copperized wire, exponentially improving the resistance and performance of the tire itself; the copper layer binds to the special rubber of the tire consolidating the overall structure of the finished product.

In the welding market the copper wire must have, besides the conductivity characteristics, a shiny aesthetic appearance.

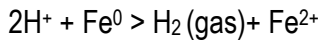
Currently for the preparation of the coppering solution, copper sulfate water and concentrated sulfuric acid (66Be) are solubilized in water.

The copper in solution ( $\text{CuSO}_4$ ) thus obtained reacts with the base metal ( $\text{Fe}^0$ ) by oxidation-reduction, creating on the material the copper deposit according to the following reaction



As shown, the reaction brings iron in solution which accumulates until the solution is spent, and therefore the need for its replacement, once reached about 40 g / l

Simultaneously, as a parasitic reaction, the sulphuric acid attack on metal (Fe) occurs. Also this reaction brings the iron in solution, creating, at the same time, gaseous hydrogen (H<sub>2</sub>).



The hydrogen (H<sub>2</sub>) developed on the metal surface by the oxidation-reduction reaction contrasts the adhesion of the copper, increases the surface roughness, creates micro-crystalline embrittlement phenomena (causing physical properties variation) and increases the iron in solution limiting the duration of the coppering solution.

For this purpose Condoroil has developed CUPROCOND 67 L, product with addition of corrosion inhibitors which slow down the parasitic acid dissolution process, consequently reducing the formation of hydrogen. In order to optimize the process, and therefore the final result, in the formulation of CUPROCOND 67 L, inert surfactants have also been included, which allow to have an uniform adhesion reaction of copper, and antioxidant agents which limit the oxidation, due to atmospheric agents, towards the obtained copper layer.

The dissolution of copper sulfate in water and sulfuric acid necessary for the preparation of the currently used copper mixture also involves the problem of handling, during mixing, with consequent dangerousness and therefore mandatory precautions for safety in the working environment ( fumes reaction, handling and possible acid splashes)



The dissolution of the sulphate copper salt in addition to being dangerous, does not give complete guarantees of the correct working parameters that are dependent on the dosages made and the manual skills of the operators.

The concentration of the copper in solution is in fact a fundamental parameter for the thickness and uniformity of the final layer to be obtained, so it is fundamental to dissolve the sulphate copper salt in an optimal manner



to obtain the desired concentration; Cuprocond 67 L limits this possible inconvenience because all the copper in the formulation is in solution and immediately available; the solution obtained by mixing 12% of CUPROCOND 67 L in water must only be heated to working temperature (40 ° C) and corrected with sulfuric acid, up to the free acidity required by the specific line.

The obtained copper layer is relative and proportional to the surface to which the chemical adhesion will occur: smoother and cleaner is the surface to be coppered and better will be the resulting layer in terms of uniformity.

The surfaces to be coppered must therefore be free from organic residues and oxides that would limit adhesion; for this need, the operations to be performed before the treatments with Cuprocond 67 L are the degreasing for the elimination of oil, grease and dirt in general and a subsequent pickling in sulfuric acid for the elimination of unwanted oxides

Recommended correct working parameters are :

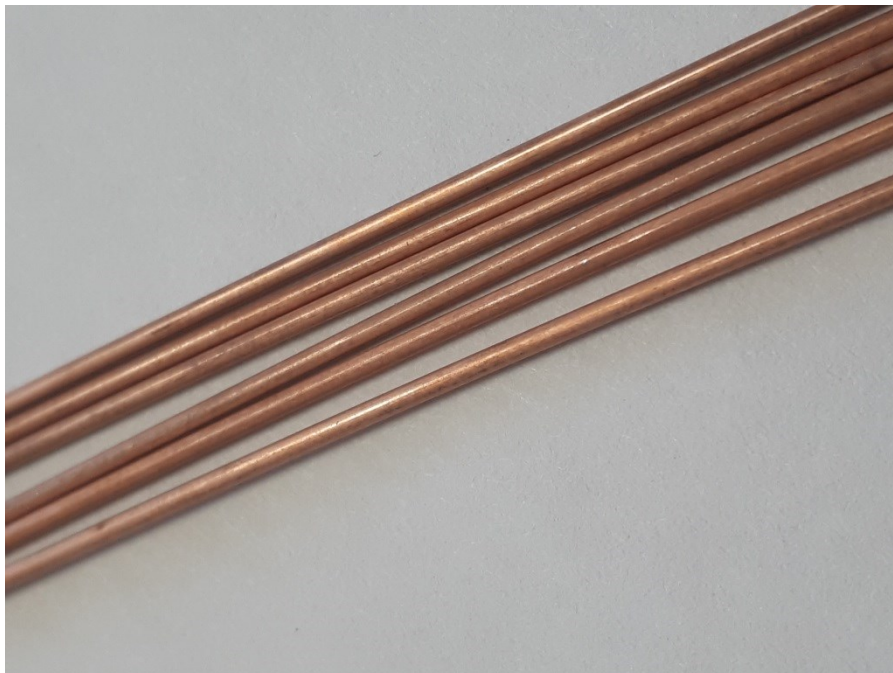
Free acidity : between 8 and 10 ( ccNaOH on 10 cc sampled)

Copper concentration : 4,5-5,5 grams per liter

Iron concentration : 5-40 grams per liter

The copper content must be maintained in the operating parameters indicated as, if it were lower, the desired layer would not be reached and if it were higher, there could be phenomena of unwanted copper sulphate crystals which would be subtracted from the coppering solution

The iron content determines the duration of the coppering solution; Cuprocond 67 L guarantees a correct copper layer (0.02 micron) up to an iron concentration equal to 40 grams per liter; once this threshold has been exceeded, the appearance of the piece will tend to a mat brown-dark color compared to the classic shiny copper color that the market asks for.



By maintaining these parameters it is possible to guarantee the production of a copper coating having a constant thickness of 0.02 µm.

To meet the market requirements inherent to bronzed wire, it was specially formulated a Cuprocond additive able to meet these needs.

To obtain a working bath with correct operating parameters it is necessary to prepare it with 15% of Cuprocond 67 L and 0.1% of Cuprocond Additive.

From the tests carried out, the optimal working parameters necessary to obtain the correct degree of bronzing are as follow

copper	Iron	tin
4.5 – 5.5 g/l	5 g/l < Fe < 40 g/l	1 – 1,5 g/l

Finally, we highlight the possibility, with the use of the technologies to minimize waste proposed by Condoroil Stainless, to recover from the spent solution, by-products having a certain commercial value such as metal copper, sulfuric acid and ferrous sulfate.

The recovery of these components not only allows to obtain secondary raw materials with a certain commercial value, but also to reduce the costs of waste water treatment and disposal of the sludge generated during the purification itself.

