

## riag Cu 375

**Acid bright copper bath for high brilliance, low-stressed and ductile deposits**

### Properties:

- excellent bright deposits for functional and decorative applications
- low – stressed, ductile coatings, suited for plating on plastics
- high levelling and extraordinary brightness even at low coating thickness

### Bath make up

	Range	Optimum
Copper sulphate ( $\text{CuSO}_4 \times 5 \text{H}_2\text{O}$ )	190 – 240 g/L	220 g/L
Sulphuric acid, 96 %, chem. pure ( $\text{H}_2\text{SO}_4$ )	50 – 70 g/L	60 g/L
Sodium chloride chem. pure (NaCl)	70 – 140 mg/L	120 mg/L
<b>riag Cu 375 Make up</b>	8 – 12 mL/L	10 mL/L
<b>riag Cu 375 Brightener</b>	0.6 – 0.8 mL/L	0.7 mL/L
<b>riag Cu 375 Leveller</b>	0.4 – 0.6 mL/L	0.5 mL/L

### Make up of 100 litres bath volume:

Dissolve copper sulphate in a separate tank in approximately 50 L of demin. water. Add approx. 0.2 kg of activated carbon and stir for about 1 hour.

Filter carefully into the working tank and fill up almost to the end volume with demin. water.

Add sulphuric acid slowly and carefully and sodium chloride, which has been dissolved in a small quantity of water, to the clear solution under stirring. After cooling down to room temperature add organic additives. Stir well again.

If basic chemicals of bad quality are used, it is recommended to dummy-plate for 2 – 3 Ah/L at 1 A/dm<sup>2</sup> before adding organic additives.

**Attention:** After make up, analysis of chloride content should take place more frequently until a stable anode- film has been formed.

## Process and equipment:

Tanks	Polypropylene, PVC, rubber-lined steel		
Bath agitation	an air agitation of 10 – 20 m <sup>3</sup> /h air per meter cathode-rod is required. The used air should be oil – and dust free. In addition a mechanical agitation is recommended.		
Filtration	continuous filtration, 2 – 4 bath volumes per hour. Porosity of filter as low as possible.		
Exhaust	recommended		
Temperature	20 – 30 °C		
pH-value	< 1.0 supervision not necessary		
Anodes	all types of anodes can be used if their purity is 99.9 % copper and if they contain 0.02 – 0.06 % phosphorus		
Current density	Cathodic:	1.0 – 6.0	A/dm <sup>2</sup> (rack)
		1.0	A/dm <sup>2</sup> (barrel)
	Anodic	0.5 – 2.5	A/dm <sup>2</sup>

## Supervision and correction:

For maintenance of the bath supervision of the following parameters is required

## Operating values

	Range	Optimum
Copper (Cu <sup>2+</sup> )	50 – 60 g/L	56 g/L
Sulphuric acid (H <sub>2</sub> SO <sub>4</sub> )	60 – 70 g/L	65 g/L
Chloride (Cl)	70 – 140 mg/L	75 mg/L

To **increase the copper content** by 1 g/L add 393 g of copper sulphate x 5 H<sub>2</sub>O per 100 L bath volume. Copper sulphate should be dissolved in demin. water and treated with activated carbon. At the same time **riag Cu 375 Make up** must be replenished (50 mL/kg Copper sulphate x 5 H<sub>2</sub>O).

To **increase the sulphuric acid content** by 1 g/L add 100 g of sulphuric acid, density 1.84 g/cm<sup>3</sup> chem. pure, per 100 L bath volume. Sulphuric acid must be as clear as water.

To **increase the chloride content** by 1 mg/L add 165 mg of sodium chloride per 100 L bath volume.

**riag Cu 375 Brightener** and **riag Cu 375 Leveller** have to be replenished at regular intervals.

## Replenishing for 10'000 Ah:

<b>riag Cu 375 Brightener</b>	1.0 L	(0.5 – 1.5 L)
<b>riag Cu 375 Leveller</b>	0.9 L	(0.6 – 1.2 L)

The consumption depends on requested degree of brightness and drag out.

**riag Cu 375 Make up** will be consumed in general by drag out. With every addition of copper sulphate add 50 ml of **riag Cu 375 Make up** per kg Copper sulphate – 5H<sub>2</sub>O.

**Important:** Supervision of the organic additives is done by Hull-cell testing.

## Safety arrangements

We recommend wearing safety glasses, gloves and protective clothing during working with sulphuric acid.

For further information please consult the safety data sheets.

## Waste water treatment / Environmental protection

The concentrates as well as their rinsing waters contain copper sulphate and sulphuric acid. They are extremely dangerous for the environment. The waste water needs to be prepared according legal regulations before getting in the canalisation.

## Liability

This instruction manual was compiled with reference to the state of the art and all current standards, and is based on the long-term knowledge and experience of riag. However, riag cannot monitor compliance with this instruction manual and the methods described herein at the customer/end-user's premises. Work carried out with riag products must be adapted accordingly to meet local conditions. In particular, riag cannot accept liability for damage, loss or cost incurred due to a failure to adhere to this instruction manual, improper application of the methods, unauthorised technical modifications, insufficient maintenance or the absence of maintenance in respect of the requisite technical hardware or equipment, or in the event of use by unqualified personnel. riag is not liable for damage or loss caused by riag or its employees except where intention or gross negligence can be proved. riag furthermore reserves the right to make changes in relation to products, methods and the instruction manual without prior notice.

Our goods and services are subject to the General Terms and Conditions for Delivery of the Association of Surface Technology Suppliers (VLO), which can be viewed at [www.riag.ch](http://www.riag.ch) (link "terms and conditions", document "General Terms and Conditions for Delivery", version 3/2018), which we gladly send you on request.

This transaction is governed by material Swiss law (Law of Obligations), excluding private international law (conflict of laws) and intergovernmental treaties, specifically the CISG.

riag Oberflächentechnik AG  
Murgstrasse 19a  
CH-9545 Wängi  
T +41 (0)52 369 70 70  
F +41 (0)52 369 70 79  
riag.ch  
info@riag.ch

**Analytical instructions:****Determination of copper content:**

Reagents:	EDTA-standard solution, 0.05 mol/L Ammonia solution (300 g Ammonia, 25 %/L) Indicator: Murexid, 1:100 grinded with sodium chloride
Procedure:	10 mL of copper bath into a 250 mL volumetric flask fill up with demin. water to the mark and stir well 25 mL of this solution (1.0 mL bath solution) into a 500 mL Erlenmeyer flask, add 250 mL of demin. water carefully add diluted ammonia until solution turns deep-blue. Add a pinch of indicator Titrate with 0.05 mol/L EDTA-standard solution until the colour changes from reddish-yellow to deep-violet
Calculation:	Copper (g/L) = consumed EDTA solution in mL x 3.177

**Determination of sulphuric acid content:**

Reagents:	0.1 mol/L NaOH-standard solution Methylorange 0.1 %
Procedure:	10 mL of copper bath into a 250 mL volumetric flask. Fill up with demin. water to the mark and mix well. Put 25 mL of this solution into a 250 mL Erlenmeyer flask and add 100 mL of demin. water. Continue with adding 5 drops of Methylorange titrate with 0.1 mol/L NaOH-standard solution until the colour changes from red to yellow.
Calculation:	Sulphuric acid (g/L) = consumed NaOH solution in mL x 4.9

**Determination of chloride content:**

Reagents:	0.005 mol/L Mercuric(II)-nitrate-standard solution 0.1 mol/L Silver nitrate-solution diluted Nitric acid (1:1)
Instruction:	25 mL of copper bath into a 250mL Erlenmeyer flask, add 30 mL of demin. water and 30 mL of diluted nitric acid, add 3 – 5 drops of 0.1 mol/L Silver nitrate-solution to form a staying turbidity, titrate immediately under strong stirring with 0.005 Mol Mercuric(II)-nitrate-standard solution until turbidity clarifies
Calculation:	Chloride (mg/L) = consumed Mercuric(II)-nitrate solution in mL x 14.2

## Hull-Cell instruction

Before testing in the hull-cell make sure that the contents of copper, sulphuric acid and chloride are adjusted within the prescribed limits.

**Equipment:** Hull-cell 250 mL with air agitation  
rectifier 0 – 6 V/ 0 – 5 A  
test sheets of brass or copper  
scotch brite and abrasive powder

**Instruction:** put 250 mL of bath solution into the cell  
clean test sheet with abrasive powder and scotch brite  
rinse well under flowing water  
dip into 10 % sulphuric acid  
rinse again  
insert test sheet in Hull-cell  
turn on air agitation  
adjust 2.0 A  
after 10 min switch off current and remove test panel from the cell  
rinse the test panel well and dry carefully

## Interpretation:

With normal concentration of the constituents the test panel shows bright deposits from 0 – 100 mm. Backside totally covered.

## Problems and their causes

1. **riag Cu 375 Brightener and riag Cu 375 Leveller, shortage of both Brighteners:**  
poor levelling at all current densities, hazyness at low current density from 85 – 100 mm
2. **Excess of both Brighteners:**  
strong excess (> 2-fold conc.) shows a sharp demarcated not levelled area at low current density  
  
**riag Cu 375 Brightener** Shortage: poor levelling at all current densities  
Excess: sharp demarcated not levelled area at low current density
4. **riag Cu 375 Leveller**  
Shortage: burning at high current density  
Excess: strong hazyness or dull deposits at low current densities
5. **Influence of riag Cu 375 Make up**  
Shortage: relief deposits at high and medium current density improper reaction on dosage of brightener and leveller  
Excess: low current density hazy

Error	Cause	Remedy
<b>Burning at HCD</b>	Bath temperature too low Copper content too low Excess of <b>riag Cu 375 Brightener</b>  Shortage of <b>riag Cu 375 Leveller</b>	Increase temperature  Add copper sulphate  Control additions Work out excess of <b>riag Cu 375 Brightener</b> or destroy with $H_2O_2$  Addition of 0.2 mL/L <b>riag Cu 375 Leveller</b>
<b>Relief-like deposits in HCD</b>	Shortage of <b>riag Cu 375 Make up</b>  Shortage of chloride ions	Add 5 mL/L <b>riag Cu 375 Make up</b>  Adjust chloride content
<b>Dull deposits at LCD</b>	Bath temperature too high  Excess of <b>riag Cu 375 Leveller</b>  Shortage of <b>riag Cu 375 Make up</b>  Bath is organically contaminated	Cool electrolyte  Work out excess of <b>riag Cu 375 Leveller</b>  Add 1 – 3 mL/L <b>riag Cu 375 Make up</b>  Add 50 – 100 mg/L potassium persulphate
<b>Levelling sharply reduced in LCD</b>	Excess of <b>riag Cu 375 Brightener</b>	Work out excess of <b>riag Cu 375 Brightener</b> or destroy with $H_2O_2$
<b>Generally, levelling too low</b>	Shortage of <b>riag Cu 375 Brightener</b> and <b>riag Cu 375 Leveller</b>  Excess of chloride ions	Add <b>riag Cu 375 Brightener</b> and <b>riag Cu 375 Leveller</b>  Treat electrolyte with 1 % Silver sulphate solution. 440 mL silver sulphate solution must be added per 100 L to precipitate 10 mg/L chloride.
<b>Electrolyte reacts badly to additions of brightener</b>	Organic contamination	Add 50 – 100 mg/L potassium persulphate  Clean bath with 5 – 10 g/L activated carbon, then add 50 % of new make up additives

Error	Cause	Remedy
<b>Consumption of additives too high</b>	<p>Bath temperature too high.</p> <p>Ratio of <b>riag Cu 375 Brightener</b> and <b>riag Cu 375 Leveller</b> not correct</p> <p>Excessive sludge on anodes</p>	<p>Cool bath</p> <p>Adjust to correct ratio.</p> <p>Wrong anodes or anodic current density too high</p>
<b>Worse adhesion to nickel</b>	Excess of brightener <b>riag Cu 375 Brightener</b>	Work out excess of <b>riag Cu 375 Brightener</b> or destroy with $H_2O_2$ or do after copper plating electro-cleaning
<b>Worse adhesion to nickel strike</b>	Nickel solution contains sulphurous compounds	Use sulphur-free semi-bright nickelbath
<b>Deposit covered with fine pores</b>	<p>Pump is sucking air</p> <p>Air agitation incorrect</p> <p>Shortage of <b>riag Cu 375 Make up</b></p>	<p>Remove pump suction pipes from zone of agitated air</p> <p>Jets of air agitation pipes too small. Diameter must be at least 3 mm.</p> <p>Add 5 mL/L <b>riag Cu 375 Make up</b></p>
<b>Deposit covered with particles</b>	<p>Particles in the bath</p> <p>Air is contaminated</p> <p>Burning of deposits</p> <p>Impurities of copper sulphate</p> <p>Unsuitable anodes</p>	<p>Filter thoroughly</p> <p>Check air-filter</p> <p>See item 1</p> <p>Filter copper sulphate solution</p> <p>Use suitable anodes</p>
<b>Anodes passive</b>	<p>Sulphuric acid too high</p> <p>Copper content too high</p> <p>Chloride content too high</p> <p>Anode bags clogged or too fine</p> <p>Bath is contaminated with large amount of iron</p>	<p>Dilute electrolyte</p> <p>Dilute electrolyte</p> <p>See item 5</p> <p>Clean anode bags</p> <p>Dilute solution</p>