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MacDermid INCORPORATED

METEX® S-1 ADD AGENT

Semi-Bright Cyanide Copper Process

Product Code No. 16501

DESCRIPTION:

Metex S-1 Semi-Bright Cyanide Copper Process provides a method of plating fine grain semi-bright copper from cyanide solutions at a high rate of deposition, freedom from pitting and roughness, and with ease of control. The properties of the deposit make it a highly desirable coating for buffing.

The deposit is excellent as a stop-off before case hardening.

The process can also be used when a substantial deposit of nickel is to be plated directly over the copper deposit. Other advantages will become apparent as the bath is more fully described below.

EQUIPMENT:

Tank	Koroseal or approved rubber lining preferred. Plain steel may be used. Test rubber linings especially if operation is to be at high temperature over 66°C (150°F). Do not use Koroseal at temperature above 66°C (150°F).
Heating Coil	Welded steel. Soldering or brazing must not be used.
Agitation	Cathode bar at 4 to 10 feet per minute (1.2 to 31 m/ minute), rapid solution agitation from recirculating pumps, or air agitation.
Anodes	Type in order of preference: OFHC, forged balls, rolled, electrolytic, cast.

OPERATING CONDITIONS:

Temperature	60° to 71°C (140° to 160°F), 60°C (140°F) recommended
Voltage	2 to 6 volts, depending upon temperature and cathode area

MAKE-UP PROCEDURE:

Bath Composition

Copper cyanide	45 gm/L (6.0 oz/gal)
Sodium cyanide	58 gm/L (7.75 oz/gal)
Potassium hydroxide	19 gm/L (2.5 oz/gal)
Metex Cyanide Copper Addition Agent No. S-1	1% by volume
Rocheltex (Data Sheet No. 6561) or Cupramex PL (Data Sheet No. 6591)	6% by volume
For rack	4% by volume

For barrel	8% by volume

Approximate Analysis

Copper (as metal)	31 gm/L (4.2 oz/gal)
Free sodium cyanide	7.5 gm/L (1.0 oz/gal)
Potassium hydroxide	19 gm/L (2.5 oz/gal)
Rocheltex or Cupramex PL	6% by volume
For rack For barrel	4% by volume 8% by volume
pH	13.2 to 13.5

SOLUTION CONTROL & MAINTENANCE:

Preparing the Bath

Prepare the solution in an auxiliary tank, if available, and filter through carbon into the plating tank. The plating tank and the make-up tank should be thoroughly clean. Add water (approximate temperature 49°C [120°F]) to one-third of the final volume of the plating bath to the make-up tank.

Add the chemicals in the following order:

Rocheltex or Cupramex PL

Potassium hydroxide

Sodium cyanide

Copper cyanide

Make a slurry of copper cyanide with water. Add this slurry to the make-up tank with good stirring. Make sure that all chemicals are in solution, then add water to almost the required volume. Filter the plating solution through activated carbon (equivalent 1 lb of carbon per 100 gallons [1.2 gm/L] of plating solution) into the plating tank. Heat the plating solution to the operating temperature and add Metex Cyanide Copper Addition Agent No. S-1. Check the control factors, adjust if necessary. The bath is now ready for plating.

If an auxiliary tank is not available, the chemicals may be put into solution in the clean plating tank in the order and manner described above. Add water to the operating level, adjust temperature, add Metex Cyanide Copper Addition Agent S-1 and start plating.

Filtration and carbon treatment of the prepared solution is necessary for efficient operation of the Metex Semi-Bright Cyanide Copper Plating Process No. S-1.

Range of Bath Composition

Although the bath will operate over a wide range, it is well to keep the solution in balance somewhat near that of the make-up composition:

Copper metal	30 to 37.5 gm/L (4.0 to 5.0 oz/gal)
Free cyanide	7.5 to 15 gm/L (1.0 to 2.0 oz/gal)
Potassium hydroxide	15 to 34 gm/L (2.0 to 4.5 oz/gal)
Rocheltex	
or	
Cupramex PL	
For rack	4 to 6% by volume
For barrel	6 to 8% by volume

Additions

Use potassium hydroxide and not sodium hydroxide. Potassium hydroxide promotes good bath conductivity and good anode corrosion. When the bath is being used exclusively for plating zinc base die castings, the potassium hydroxide should be carried at the lower limit of the recommended range.

Maintain the recommended free sodium cyanide concentration of the bath by the addition of high quality sodium cyanide specified by “suitable for use in electro-plating solutions”. Carry the free sodium cyanide within the recommended range to assure good anode corrosion and plating characteristics.

If it is necessary to increase the copper metal content of the bath, use a high quality grade of copper cyanide. To increase the copper metal concentration of the bath 1 oz/gal (7.5 gm/L), add 1.4 oz/gal (10.5 gm/L) copper cyanide. To put this quantity of copper cyanide into solution, it will require approximately 1.6 oz/gal (12 gm/L) sodium cyanide. Thus, when making additions of copper cyanide to the bath, adjust the free sodium cyanide concentration of the solution accordingly.

Metex Wetting Agent can be used when required. Metex Non Pitter N-17 (Data Sheet No. 6517) for non-air agitated baths and Metex Non Pitter N-18 (Data Sheet No. 6518) for air agitated baths.

Current Density

Operate the bath at current densities of about 20 to 40 amperes per sq ft (27 to 44 amps/sq dm). The allowable current density will vary somewhat depending upon the bath chemistry, the configuration and racking of parts being plated, the temperature of the solution, and method of agitation. In all cases, the current density should be sufficient to give a cathode efficiency of about 90 to 95%. By operating at this slightly reduced cathode efficiency, pitting is not encountered although no surface-active agents are used in the bath.

The absence of surface-active agents in the bath permits plating of nickel directly on the copper deposit after only thorough rinsing and acid dipping. If the rinsing is

ideal, the acid dip may be eliminated. Thus, this copper process can be used where no post-cleaning cycles are available or economically feasible.

By employing a brightener system that allows operation at reduced cathode efficiency, these advantages are possible over baths which usually are operated at 100% cathode efficiency:

- The possible elimination of a copper strike before copper plate.
- Elimination of the danger of immersion copper plate with resulting poor adhesion, particularly on steel.
- Higher current densities (faster plating) can be obtained and better plate distribution experienced.
- Bath not as susceptible to trouble caused by organic or metallic contamination.

Speed

The Metex Semi-Bright Cyanide Copper Plating Process No. S-1 should deposit copper to a thickness of about 7 to 10 microns (0.0003 to 0.0004") in 10 minutes. The plate distribution is good with very little build-up on corners or edges.

Roughness

If the usual precautions (good housekeeping, filtration, cleaning and plating technique) are observed, roughness, particularly on zinc based die castings and steel having a high quality buffed finish, should not be a problem. Tanks should be deep in relation to rack length and the work to be plated should be a reasonable distance (5 to 10" [13 to 25 cm]) from the anodes. Where the use of anode bags or diaphragms is indicated, a 7 ounce desized cotton canvas 48 to 80 twill is a very suitable material for fabrication. Other materials such as nylon or polyethylene are satisfactory.

Bath Contamination

Organic impurities may be removed from the bath by filtration through activated carbon, such as Darco Activated Carbon. Zinc contamination is removed by the process of electrolytic purification of the bath at low current densities using steel dummy cathodes.

Chromium Contamination

As in all bright copper cyanide solutions, chromium contamination, in small amounts, causes etching and staining of plated work. Higher contamination produces blisters and skip plate.

All precautions possible to eliminate chromium contamination should be observed. Use good racks, adequate rinses, dump cleaners and acids periodically, use special cleaners which tolerate high chromium contamination. The addition of 5 lbs (2.3 kilograms) Metex Chrome Reducer M-623 (Data Sheet No. 6508) to every 100 lbs (45 kilograms) of cleaner in your cleaner tank is excellent for reducing chrome contamination in your copper solution. Use a separate copper strike.

Sodium hydrosulfite must not be used to remove chromic acid contamination nor can sodium polysulfide be used to remove zinc contamination.

Brighter Maintenance

The need for, and the amount of additions, should be determined with the use of plating tests either on panels plated in a beaker or in a Hull cell. Excessive additions of brightener should be avoided. Additions should be made in increments

of one-fifth, or less, the amount of the original addition. Metex Cyanide Copper Addition Agents are stable and do not deteriorate when the copper bath is idle. Brightener consumption, when the bath is in operation, is relatively low, but will vary somewhat depending upon dragout losses and conditions of operation. After some experience is acquired, a tank operator can very easily make additions to the plating tank on the basis of the appearance of the plated work.

Hull Cell Checks

For laboratory evaluation, a standard 267 mL Hull cell should be used with either steel or buffed brass cathodes. The cathode panels should be copper plated for 5 minutes, at 2 amperes, 60°C (140°F), no agitation.

Stripping of the Deposit

Copper stripping may be done by immersion or electrolytic method. For removing copper from steel by immersion, use Metex Strip Aid (Product Code No. 13501), or Metex Copper Stripper F (Product Code No. 13860). Contact your MacDermid representative for further details.

Rate of Deposition

The following chart is a guide for the time required to plate various average thicknesses at varying current densities on the work.

Time Required in Minutes for Deposits at Various Current Densities, 100% Current Efficiency

Deposit				Time in Minutes A/SF			
Thickness Inch	Microns	Weight Oz. Per Sq. Ft.	Gm. Per Sq. Dm.	10	20	30	40
0.0001	2.5	0.074	0.226	5.3	2.6	1.8	1.3
0.0002	5.0	0.148	0.450	10.6	5.3	3.5	2.6
0.0003	7.5	0.222	0.672	15.8	7.8	5.3	3.9
0.0004	10.0	0.296	0.900	21.1	10.6	7.0	5.3
0.0005	12.7	0.370	1.121	26.4	13.2	8.8	6.6
0.0006	15.0	0.444	1.345	31.7	15.8	10.6	7.9
0.0007	18.0	0.518	1.570	36.9	18.5	12.3	9.2
0.0008	20.0	0.592	1.794	42.2	21.1	14.1	10.6
.00009	23.0	0.660	2.018	47.5	23.8	15.8	11.9
0.0010	25.4	0.740	2.242	52.0	26.4	17.6	13.2
0.0015	38.0	1.110	3.363	79.2	39.6	26.4	19.8
0.0020	51.0	1.480	4.484	105.0	52.8	35.2	26.4

This table is calculated on the required 528 ampere minutes to deposit 0.001" (25.4 microns) copper on 1 sq ft (9.3 sq dm) of area (0.084 oz/amp hr [0.237 gm/amp hr]).

SAFETY & WARNING: MacDermid, Inc. recommends that the company/operator read and review the MacDermid Material Safety Data Sheets for the appropriate health and safety warnings before use.

Metex Semi-Bright Cyanide Copper Plating Process No. S-1 when prepared for use, is an alkaline cyanide solution and is hazardous.

Material Safety Data Sheets are available from MacDermid Incorporated.

WASTE TREATMENT:

Prior to using any recommendations or suggestions by MacDermid, Inc. for waste treatment, the user is required to know the appropriate local/state/federal regulations for on-site or off-site treatment which may require permits. If there is any conflict regarding our recommendations, local/state/federal regulations take precedent.

Metex Semi-Bright Cyanide Copper Plating Process No. S-1 contains cyanide, copper and alkalies and must be treated for removal of these before disposal.

ORDER INFORMATION:

Product	Product Code	Container
Metex S-1 Add Agent	16501	5 & 55 gallons