18/11 METHODS OF CLEANING THE METAL SURFACE:

- Physical / Solvent Cleaning: To dissolve oils and greases Eg: CCl_4, CH_2Cl_2, $CHCl=CCl_2$
- Chemical / Alkali Cleaning: To remove minute organic residues, removal of tarnish and oxide films. eg $NaOH$, Na_2CO_3, Na_3PO_4.
- Mechanical Cleaning: Removal of oxide layer or rust and other inorganic deposits. Eg impact tools like sandpaper, knife scrapers, wire brushes etc.
- Pickling: Removal of oxide films by means of an acid: eg 10-30% H_2SO_4
- Electropolishing: The metal to be cleaned is made as anode in a suitable acid soln

ELECTROPLATING OF CHROMIUM

Decorative Chromium: A thin deposit of Cr applied over either Cu-Ni or Ni undercoat. 0.25 - 0.75 μm.

Hard Chromium: Involves deposition of a thick coating of chromium directly over the substrate. 2.5 - 300 μm.

	Decorative	Hard
Bath composition	Chromic acid (250)g + H_2SO_4 (2.5g) + Trivalent Cr (1g)	Chromic acid (250g) + H_2SO_4 (2.5g) + Trivalent Cr (1g)
Operating temp.	313-328 K	313-328 K
Anode	Insoluble Pb-Sn alloy	Insoluble Pb-Sn alloy.
Cathode	Article to be coated	Article to be coated.
Current density	20-40 mA/cm^2	30-40 mA/cm^2
Cathode efficiency	10-15	17-21
Applications	Decorative applns with corrosion resistance finish	Coating of industrial components like gauges, dies etc

Pure Cr is not used as anode because it affects the chromic acid conc in the bath and it affects the coating. And due to increased acidity the coating will be black.
Also anode efficiency is way higher (almost 5 times) than cathode efficiency which will cause more Cr ions to be present in the bath and hence affect the chromic acid conc.

Cu-Ni undercoating is present as Cr is microporous and it does not have good rust resistance.

ELECTROLESS PLATING.

Method of depositing a metal or alloy over a substrate (conductor or non conductor) by controlled chemical reduction of the metal ions by a suitable reducing agent without using electrical energy.

Metal ions + Reducing agent
Metal + oxidized product.

Process of electroless plating:

i) Preparation of active surface.
treatment with $SnCl_2$ and $PdCl_2$ on the plastic surface.

$$SnCl_2 + PdCl_2 \rightarrow Pd + SnCl_4$$

Pd is coated on plastic

ii) Preparation of plating bath (composition of the bath)

a) Metal to be coated in the form of respective salt soln
b) Reducing agents like formaldehyde and sodium hypophosphate
c) Complexing agents like EDTA, tartarates, citrates to form metal complexes to prevent excess deposition
d) Stabilizers like thiourea, Ca ions to prevent decomp of the bath
e) Accelerators like succinates, glycinates to increase plating rate.

f) Brighteners like thiosulphate to give a lustrous appearance.
g) Buffers like boric acid to maintain pH.

Reduction step: Active surface is dipped in the bath and deposition is carried out.
The rate of deposition is controlled by the amount of reducing agent

ELECTROLESS PLATING OF Cu

Composition of bath:
- Coating soln : $CuSO_4$ soln (12 g/l)
- Redn agent : HCHO 8 (8 g/l)
- Buffer : NaOH (15 g/l) and Rochelle salt (14 g/l)
- Complexing agent : EDTA disodium salt (20 g/l)
- Optimum pH : 11
- Optimum temp : 25°C

$$Cu^{2+} + 2e \longrightarrow Cu \text{ (reduction)}$$
$$2HCHO + 4OH^- \longrightarrow 2HCOO^- + 2H_2O + H_2 + 2e^- \text{ (oxdn)}$$

$$Cu^{2+} + 2HCHO + OH^- \longrightarrow 2HCOO^- + 2H_2O + H_2 + Cu$$

ADVANTAGES

More uniform coating with better TP than electroplating
No electrical energy required.
Superior quality deposits.
additives, levelers or complex filtration not required
Simple equipment.

- Plating on articles made of insulators and semiconductors.
- Coating is harder & better wear resistance.
- Coating possesses unique mechanical and chemical properties.

DISADVANTAGES.

- Cost of waste treatment high
- Frequency of dumping electroless bath is high
- Cost per unit weight of the deposited metal are more.
- Needs pure chemicals
- Chemical reductants expensive.
- Metal salts and reductants are thermodynamically not stable
- Impurities, dust or colloidal particles promote decomp of bath components.

APPLICATIONS

- Used for metalizing PCBs
- For producing through-hole connection necessary when double sided PCBs are fabricated
- For plating on non conductors.

COMPARISON OF ELECTROPLATING AND ELECTROLESS PLATING

	Electroplating	Electroless plating
Driving Force	Electrical energy	Decreasing in free energy of the redox rxn
Cathodic Rxn	$M^{n+} + ne^- \rightarrow M$	$M^{n+} + ne^- \rightarrow M$
Anode	Seperate anode	Reducing agent in soln
Name of deposit	Pure metal or alloy.	Metal with reducing agent & oxidized products as impurities
Thickness (μm)	1-100	1-100.
Applicability	To conductors only.	To conductors and non conductors.
Throwing Power (TP)	Less TP: cannot be used for irregular shapes & intricate objects	More TP: can be used for irregular & uneven shaped objects.