SNS COLLEGE OF TECHNOLOGY
COIMBATORE
(An Autonomous institution)
Department of mechanical engineering

UNIT - III

ECM

Prepared by
P.Divyakumar
AP/Mech
SNSCT

- In chemical energy methods, the metal is removed from the w/p through controlled etching of the w/p material in contact with chemical solution.
- In electrochemical energy methods, material is removed by ion displacement of the w/p material in contact with chemical solution.
- Example
  - Electro chemical machining
  - Electro chemical grinding
  - Electro chemical honing
  - Electro chemical deburring

3. Electro Chemical Machining

- ECM is one of the recent and most useful machining process. In this process, electrolysis method is used to remove the metal from the workpiece.
- It is best suited for the metals and alloys which are difficult to be machined by mechanical machining processes.

Principle

- The process is based on the principle of faraday's law of electrolysis which may be stated as follows

1. The first law states that the amount of any material dissolved or deposited, is proportional to the quantity of electricity passed.
2. The second law proposes that the amount of change produced in the material is proportional to its electrochemical equivalent of the material.

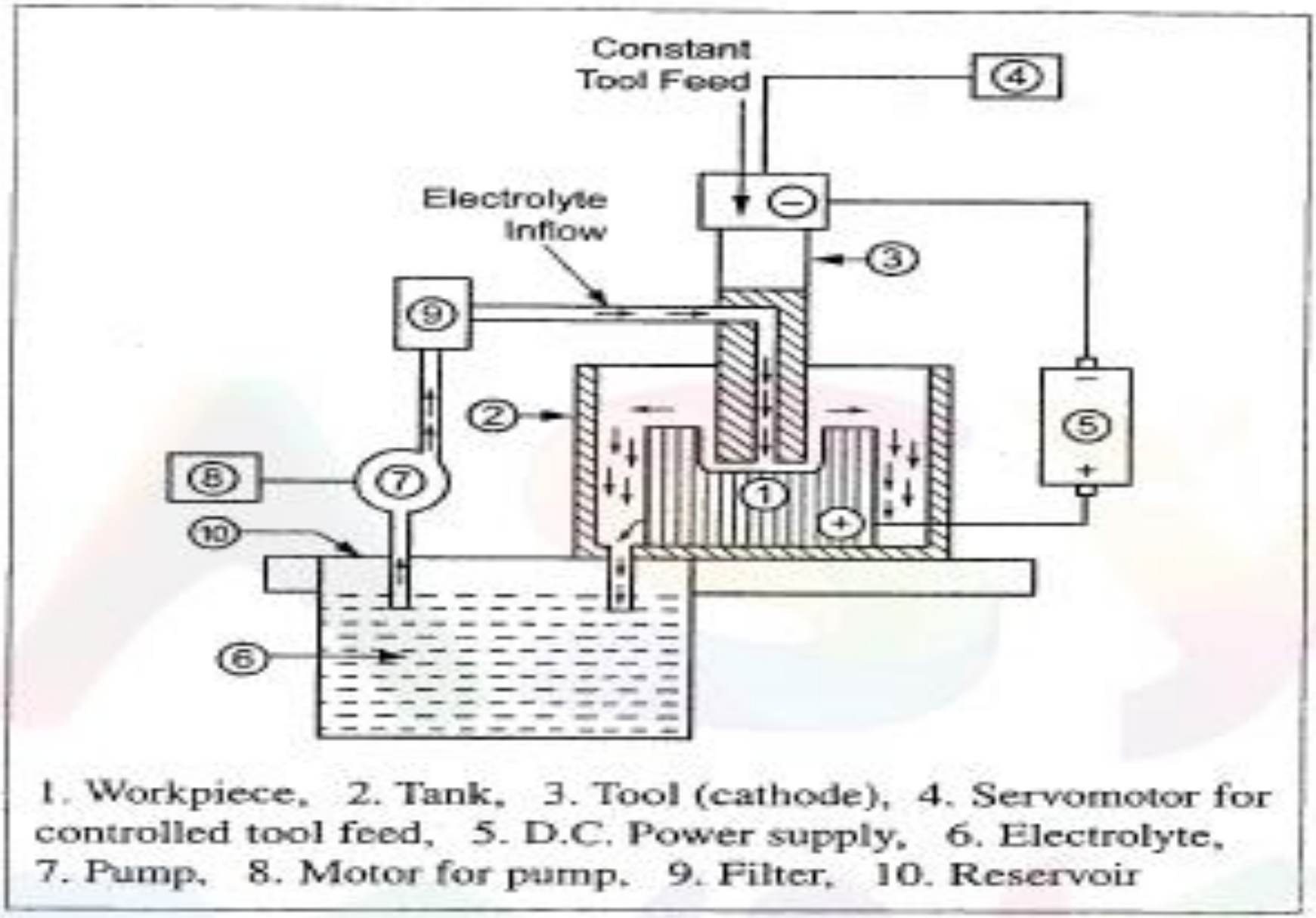
Basically in the electroplating, the metal is deposited on the work piece, while in ECM, the objective is to remove the metal from the workpiece.

Contd..,

- So, the reverse of electro plating is applied in ECM process.
- Therefore, the work piece is connected to positive terminal (anode) and the tool is connected to negative terminal (cathode).
- When the current is passed, the workpiece loses metal and the dissolved metal is carried out by circulating and electrolyte between the work and tool.

Construction and working

- It consists of
  - Work piece
  - Tool
  - Servomotor for controlled tool feed
  - DC power supply
  - Electrolyte
  - Pump
  - Motor for pump
  - Filter and reservoir for electrolyte



1. Workpiece, 2. Tank, 3. Tool (cathode), 4. Servomotor for controlled tool feed, 5. D.C. Power supply, 6. Electrolyte, 7. Pump, 8. Motor for pump, 9. Filter, 10. Reservoir

- A sharpened tool is used in this process
- Tool- Negative terminal (Cathode)
- W/p- Positive terminal (Anode)
- **Tool**
  - should have enough
  - thermal and electrical conductivity ,
  - high chemical resistance to electrolyte,
  - adequate stiffness and machinability.
  - Tool material- Stainless steel, Titanium, Brass, Copper.
  - Tool- Hollow tubular tube though which electrolyte is circulated b/w tool and w/p.

- **Electrolyte**
  - Sodium nitrate solution.
  - Sodium chloride (Good alternative) – but little corrosive.
  - Sodium hydroxide, Sodium fluoride, Potassium nitrate and potassium chloride.
- Servomotor- controlling the tool feed
- Filter- used to remove the dust particles from electrolytic fluid.

Working Principle

- The tool and workpiece are held close to each other with a very small gap (0.05 to 0.5 mm) between them by using servo motor.
- The electrolyte from the reservoir is pumped at high pressure and flows through the gap between the w/p and tool at velocity of 30 to 60 m/s.
- A mild D.C voltage about 5 to 30 volts is applied between the tool and w/p.
- Due to the applied voltage, the current flows through the electrolyte with positively charged ions and negatively charged ions. The positive ions move towards the tool (cathode) while negative ions move towards workpiece (anode)

- The electro chemical reaction takes place due to the flow of ions and it causes the removal of metal from the w/p in the form of sludge.

Advantages

- MRR is High
- Wear and tear of tool is negligible.
- Machining is done at low voltage.
- Complex shapes can be machined.
- High surface finish can be obtained (0.2 to 0.8 microns)
- Very thin sections can be easily machined
- Toughness and brittleness of a material has no effect on the machining process.

Disadvantages

- Non conducting materials cannot be machined.
- Consumption of power is nearly 100 times more than in turning or milling the steel.
- Machining process is comparatively slow.
- Initial investment is quite high.
- More space is required.

Application

- Machining complicated profiles, such as jet engine blades, turbine blades, turbine wheels.
- Drilling small deep holes, such as in nozzles.
- Machining of cavities and holes of irregular shapes.
- Machining of blind holes and pockets such as in forging dies.
- Machining of hard materials and heat resistant materials.