# GRACE COLLEGE OF ENGINEEERING

## ME8073 UNCONVENTIONAL MACHINING PROCESSES

### UNIT I INTRODUCTION AND MECHANICAL ENERGY BASED PROCESSES

1. **What is the need for unconventional machining processes?**

   High production rate Low cost of production Better surface integrity, High surface finish

2. **What are the characteristics of UCM processes?**

   - Performance is independent of strength barrier
   - Use different kinds of energy in direct form
   - In general, low MRR but better quality products
   - Comparatively high initial investment cost

3. **Differentiate the conventional and unconventional machining processes in terms of principles.**

   In conventional processes, the material is removed in the form of chips by the advancing cutting tool that plastically deforms (shearing) the material ahead. In the case of the UCM processes, energy (Electrical, Chemical, Thermo-Electric, Mechanical) in its direct form is utilized for the material removal and so there is no physical contact between the workpiece and tool.

4. **What are the various types of energy sources used in non-traditional machining techniques? Give examples for each.**

   - Pneumatic pressure- AJM
   - Hydraulic pressure- WJM, USM, AWJM
   - Corrosion- CHM, CHB, PCM
   - High current density in electrolytes- ECM
   - High voltage- EDM (for sparking); IBM, EBM (ionizing); LBM (creating avalanche in lazing medium); PAM (for ionizing the plasma gases)

5. **Classify the different types of unconventional machining processes based on the mechanical energy**.

   Abrasive Jet Machining (AJM)

Water Jet Machining (WJM)

Ultrasonic Machining (USM)

Abrasive Water Jet Machining (AWJM)

6. **Identify the mechanism of material removal, transfer media and energy source for EDM.**

Mechanism of material removal- Fusion of materials by arcs Transfer media - Electron stream Energy source - High voltage

7. **Identify the mechanism of material removal, transfer media and energy source for ECM.**

Mechanism of material removal- Ion displacement

Transfer media - Electrolyte

Energy source - High current

8. **Identify the mechanism of material removal, transfer media and energy source for EBM.**

Mechanism of material removal- Vaporization

Transfer media - Electron stream

Energy source - High voltage

9. **Identify the mechanism of material removal, transfer media and energy source for LBM.**

Mechanism of material removal- Vaporization

Transfer media - Amplified coherent light radiation

Energy source - High voltage

10. **Identify the mechanism of material removal, transfer media and energy source for PAM.**

Mechanism of material removal- Vaporization

Transfer media - Ionised gas stream

Energy source - High voltage

11. **Identify the mechanism of material removal, transfer media and energy source for USM.**

Mechanism of material removal- Erosion

Transfer media - High velocity particles

Energy source - Hydraulic pressure

12. **Identify the mechanism of material removal, transfer media and energy source for AJM.**

Mechanism of material removal- Erosion

Transfer media - High velocity particles

Energy source - Pneumatic pressure

**13. What is the principle behind abrasive jet machining?**

A jet of inert gas consisting of very fine abrasive particles strikes the work piece at high velocity (usually between 200-400 m/sec) resulting in material removal through chipping / erosive action.

**14. What is the mechanism of material removal in AJM?**

***Erosion.*** Abrasive jet machining removes material through the action of a focused stream of abrasive-laden gas

**15. What are the major subsystems of AJM?**

AJM system consists of four major subsystems:

- Gas propulsion system
- Metering system
- Delivery system
- Abrasive collection system

**16. Why the abrasive particles not reused in the AJM?**

During the process, abrasive particles get contaminated with different gases used in the process, affecting their cutting efficiency; Also the cutting capacity decreases after the first application. Further, cost of the abrasive is also low.

**17. Why is AJM not suitable for soft materials?**

Abrasive particles used in AJM can penetrate and embed with soft material

**18. Name the abrasive materials that are used for the AJM.**

The common abrasives used for the AJM process are:

- Dolomite
- Sodium Bicarbonate
- Glass beads
- Silicon carbide

- Silicon Nitride
- Alumina

**19. Name different gases used in AJM. Which of this is most widely used?**

- Dry air
- Carbon-di-oxide
- Nitrogen
- Helium

Air is most widely used owing to easy availability and little cost.

20. **What is the effect of the grain size on the material removal rate (MRR) in the AJM?**

**Finer** grain sizes are less irregular in shape, and hence, posses lesser cutting ability. Moreover, finer grains tend to stick together and choke the nozzle. The most favourable grain sizes range from 10 to 50 m. Larger particle sizes remove the material faster.

**21. What is the effect of jet velocity on the MRR in AJM?**

The kinetic energy of the abrasive jet is utilised for metal removal by erosion. The jet velocity is a function of the nozzle pressure, nozzle design, abrasive grain size and the mean number of abrasives per unit volume of the carrier gas. In general with increase in the jet velocity, the MRR increases. .

**22. Define mixing ratio. What is the effect of mixing ratio on the MRR?**

Mixing ratio is the ratio of the volume flow rate of the abrasive per unit time to the volume flow rate of the carrier gas per unit time. A large value of mixing ratio should result in higher rates of MRR but a large abrasive flow rate has been found to adversely influence jet velocity and may sometimes even clog the nozzle.