Metal Forming Processes (ME5807)

Dr. Yogesh Kumar
Assistant Professor
Mechanical Engineering Department
National Instiute of Technology Patna
Bihar - 800 005, India
yogesh.me@nitp.ac.in

High-Energy-Rate Forming (HERF)

- Processes to form metals using large amounts of energy over a very short time
  - Explosive forming
  - Electrohydraulic forming
  - Electromagnetic forming

Explosive Forming

First used to form metals in the 1900's. A sheet metal blank is clamped over a die, and the entire assembly is lowered into a tank filled with water. The air in the cavity is evacuated, and an explosive is detonated at a certain height above.

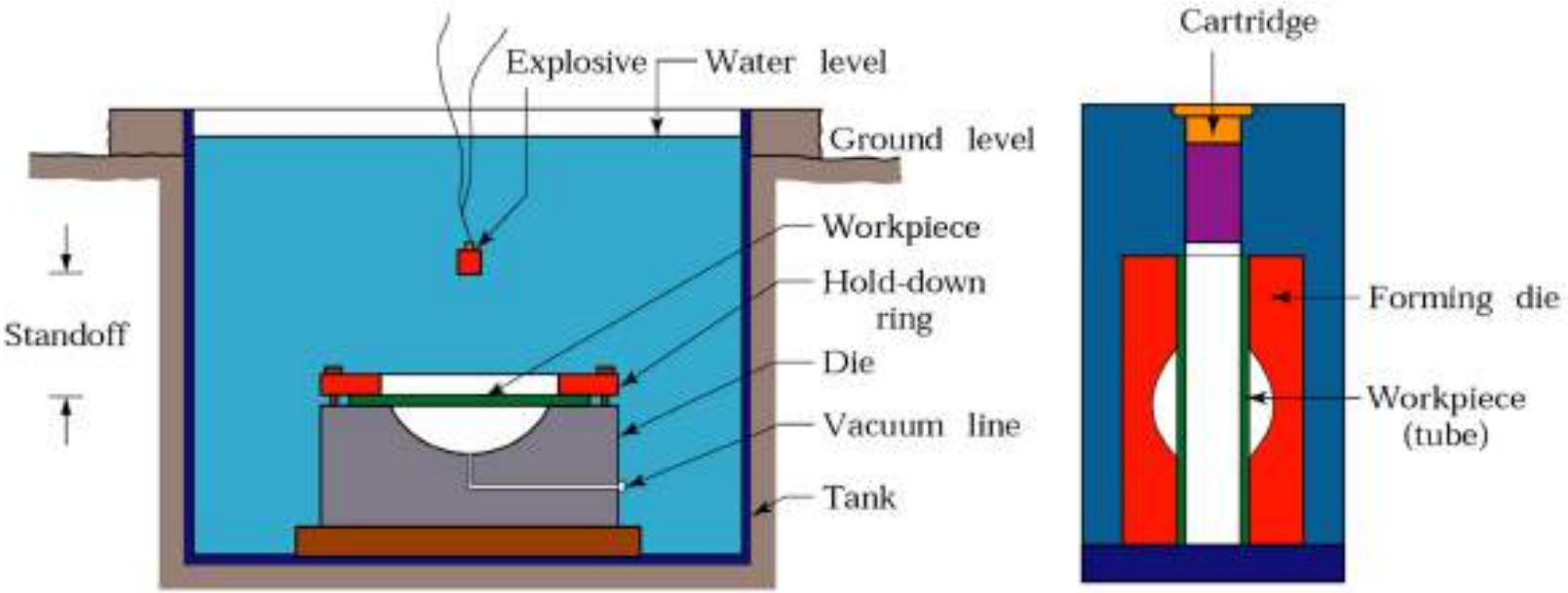

Figure: Explosive Forming

Explosive Forming

Use of explosive charge to form sheet (or plate) metal into a die cavity

- Explosive charge causes a shock wave whose energy is transmitted to force part into cavity
- Applications: large parts, typical of aerospace industry

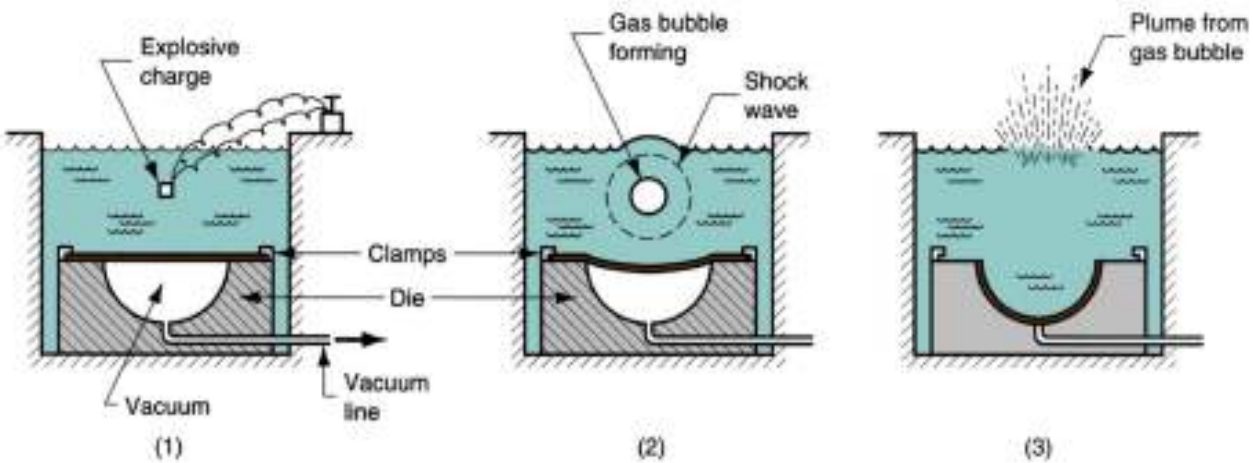

Figure: Explosive forming: (1) setup, (2) explosive is detonated, and (3) shock wave forms part and plume escapes water surface

Magnetic-Pulse Forming or Electromagnetic Forming

Energy stored in a capacitor bank is discharged rapidly through a magnetic coil. Magnetic field crosses metal tube (conductor) creating eddy currents which have an opposing magnetic field.

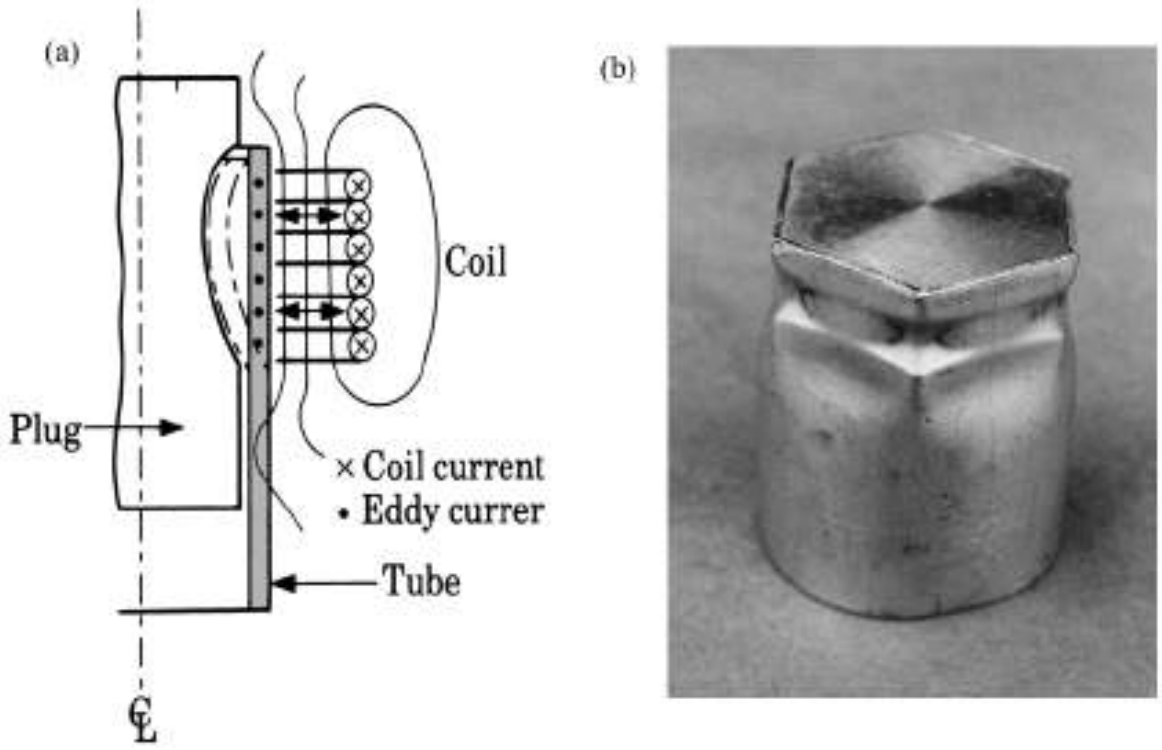

Figure: (a) Schematic illustration of the magnetic-pulse forming process used to form a tube over a plug. (b) Aluminum tube collapsed over a hexagonal plug by the magnetic-pulse forming process.

Magnetic-Pulse Forming or Electromagnetic Forming

Sheet metal is deformed by mechanical force of an electromagnetic field induced in workpart by an energized coil

- Presently the most widely used HERF process
- Applications: tubular parts

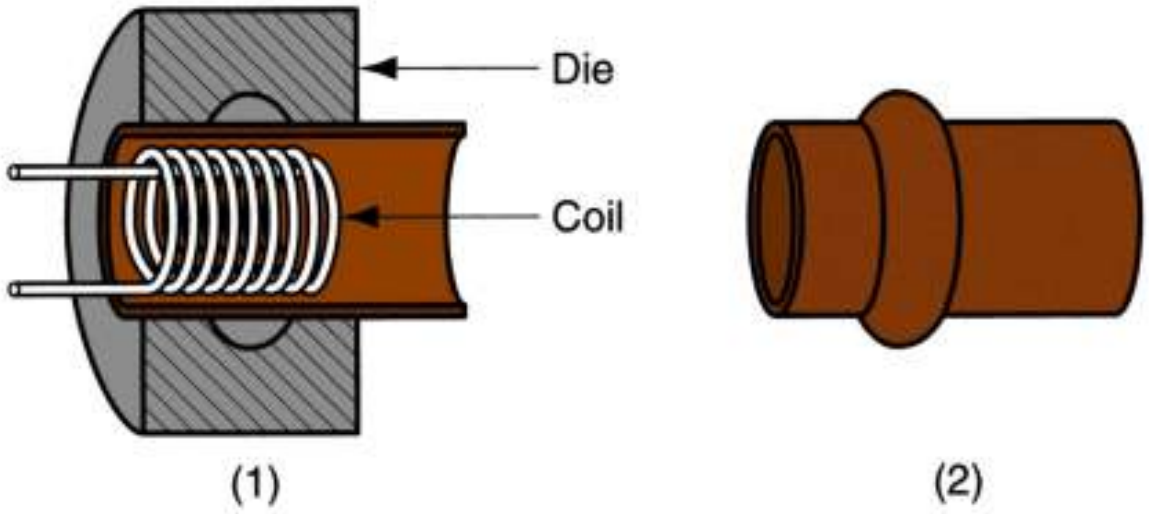

Figure: Electromagnetic forming: (1) setup in which coil is inserted into tubular workpart surrounded by die; (2) formed part

End of Module