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

- Equipment used in forging consists of forging machines, classified as hammers or presses, and forging dies.
- In addition, auxiliary equipment is needed, such as furnaces to heat the work, mechanical devices to load and unload the work, and trimming stations to cut away the flash in impression-die forging.

(1) **Forging Hammers:** operate by applying an impact loading against the work. They deliver impact energy to the workpiece.

- Used for impression-die forging.
- The upper portion of the forging die is attached to the ram, and the lower portion is attached to the anvil.
- The work is placed on the lower die, and the ram is lifted and then dropped.
- When the upper die strikes the work, the impact energy causes the part to assume the form of the die cavity.
- Several blows of the hammer are often required to achieve the desired change in shape.

- Forging hammers are classified into:
 - **1 Gravity drop hammers:** achieve their energy by the falling weight of a heavy ram, and the force of the blow is determined by the height of the drop and the weight of the ram.
 - 2 Power drop hammers: accelerate the ram by pressurized air or steam.
 - **Disadvantage:** a large amount of the impact energy is transmitted through the anvil and into the floor of the building.



Figure: Diagram showing details of a drop hammer for impression-die forging.

(2) **Forging Presses:** apply gradual pressure, rather than sudden impact, to accomplish the forging operation.

- Include mechanical presses, hydraulic presses, and screw presses.
- Mechanical presses convert the rotating motion of a drive motor into the translation motion of the ram.
- Hydraulic presses use a hydraulically driven piston to drive the ram.
- Screw presses apply force by a screw mechanism that drives the vertical ram.

- **Upsetting** and **Heading**: a deformation operation in which a cylindrical workpart is increased in diameter and reduced in length.
 - Used in the fastener industry to form heads on nails, bolts, etc (in these applications, it is referred to as heading).
 - More parts produced by upsetting than any other forging operation.
 - Performed cold, hot or warm on special upset forging machines, called headers or formers.
 - Long wire is fed into the machines, the end of the stock is upset forged, and then the piece is cut to length to make the desired hardware item.

 Upsetting and Heading: a deformation operation in which a cylindrical workpart is increased in diameter and reduced in length.



Figure: An upset forging operation to form a head on a bolt. (1) wire stock is fed to the stop; (2) gripping dies close on the stock and the stop is retracted; (3) punch moves forward; and (4) bottoms to form the head

• **Upsetting** and **Heading**: a deformation operation in which a cylindrical workpart is increased in diameter and reduced in length.



Figure: Examples of heading (upset forging) operations: (a) heading a nail using open dies, (b) round head formed by punch, (c) and (d) heads formed by die, and (e) carriage bolt head formed by punch and die.

- Swaging and Radial Forging: forging processes used to reduce the diameter of a tube or solid rod.
 - The Swaging process is accomplished by means of rotating dies that hammer a workpiece radially inward to taper it as the piece is fed into the dies.
 - Radial Forging is similar to swaging in its action against the work and is used to create similar part shapes. The difference is that in radial forging the dies do not rotate around the workpiece; instead, the work is rotated as it feeds into the hammering dies.



Figure: Swaging process to reduce solid rod stock; the dies rotate as they hammer the work. In radial forging, the workpiece rotates while the dies remain in a fixed orientation as they hammer the work.



Figure: Examples of parts made by swaging: (a) reduction of solid stock, (b) tapering a tube, (c) swaging to form a groove on a tube, (d) pointing of a tube, and (e) swaging of neck on a gas cylinder.

- **Trimming**: an operation used to remove flash on the workpart in impression-die forging.
 - In most cases, Trimming is accomplished by shearing.
 - Trimming is usually done while the work is still hot.
 - In cases where the work might be damaged by the cutting process, Trimming may be done by alternative methods, such as grinding or sawing.



Figure: Trimming operation (shearing process) to remove the flash after impression-die forging.

Thank You