

MODERN MACHINING & FORMING METHODS

(ELECTIVE - III) Instruction

4 Periods per week Duration of University Examination

3 Hours University Examination

75 Marks Sessional

25 Marks

Unit-V

Stretch Forming: Introduction, types of stretch forming: stretch draw forming, rotary stretch forming or stretch wrapping, compression forming, radial draw forming. Stretch forming equipment & accessories, accuracy & surface finish, process variables & limitations.

Tube spinning: Introduction, methods of tube spinning, Backward spinning, Forward spinning, machines & tools used. Machine variables, speeds & feeds, effect of tube spinning on work metal properties & applications.

Hydrostatic Forming: Process principle, description & applications.

Water Hammer Forming (WHF): Schematic diagram of the process, principle of operation, process variables, work materials, process limitations & applications.

Suggested Reading:

1. P.C. Pandey & H.S. Shah, Modern Machining Process, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1980.
2. A. Bhattacharya, New Technology, The Institution of Engineers (India), 1984.
3. Davies & Austin, Developments in High Speed Metal Forming, The Machinery Publishing Co. Ltd., 1985.
4. Production Technology, HMT.

Syllabus

Hydrostatic Forming: Process principle, description & applications.

Water Hammer Forming (WHF): Schematic diagram of the process, principle of operation, process variables, work materials, process limitations & applications.

Water hammer forming (WHF)

Basic introduction

Water / Fluid Hammer or Hydraulic Shock: It is a [pressure](#) surge or wave caused when a [fluid](#) in motion is forced to stop or change direction suddenly (momentum change).

- Medium used: mostly liquid, sometimes gas.
- A valve closed suddenly at an end of a [pipeline](#) system creates a pressure wave in it.
- The force applied is a measure of the rate of change in momentum (Newton's 2nd law).
- The kinetic energy supplied may be calculated from notation $K.E = mv^2/2$.

WHF is similar to Explosive forming process in that enormous amount of energy is applied to the workpiece, which deforms into required shape within fraction of a second.

- Used in producing the shapes like conical, convex & cup shaped.
- Somewhat slower than the explosive forming process
- Kinetic energy of a falling weight is converted into pressure energy with the help of water hammer forming equipment.
- The pressure energy is directed to the blank, to deform it into the die shape.

Process parameters

- amount of pressure developed in the cylinder,
 - depends on the height of fall & weight of falling object.
- thickness & size of the blank.

The water hammer effect in the case of sudden closure of cylinder, in which fluid in motion can be taken as the basis for analyzing the pressures developed in the cylinder of the water hammer forming equipment.

- There is a sudden repeated knocking in the pipeline when the pressure is released suddenly from the tap in a toilet.
- This mini version is known as “water hammer”.
- Its magnified level is dangerous for irrigation & hydroelectric projects, but it has great application in sheet forming process.
- The pressure waves that are created in the column of water by impact of plunger; these created pressure waves are transmitted & exert the force on work piece, which is plastically deformed by straining in an arrangement of die.
- The efficiency of the Water Hammer Forming is if highest order compared to other High Velocity Forming processes,
 - It is defined as the ratio of the energy absorbed in plastic deformation of the work piece to the kinetic energy of the drop weight at impact with the plunger.

- Efficiency is typically between 40 & 50 percent.
- A plunger is used to produce shock waves in a fluid (water) medium & the shock energy is used to deform the workpiece into required shape.

Types if any

Working principle

Equipment

- Metal blank of suitable shape.
- Die with required cavity.
- Pressure cylinder filled with suitable fluid.
 - designed to withstand about 200 atmospheres
 - located on top of the blank
 - rubber O-ring between sheet & cylinder to make it leak proof.
- Fluids preferred: Water, Vegetable oil or Grease.
- The cylinder top flange is bolted to the die holder.
- A plunger is positioned in the pressure cylinder in contact with water.

Process description

- A drop weight is raised to the suitable height.
- It is allowed to fall under gravity on the plunger.
- Kinetic energy of falling weight is converted into pressure energy of shock wave.
- The sheet / blank is deformed into the shape of die by this energy.

Process variations

Process parameters

Performance characteristics

Advantages

Disadvantages

Applications

Extra

- rubber 'O' rings of different sizes & thickness are used to make cylinder leak proof.
- One 'O' ring of 4 mm thick & 36 mm diameter for the plunger & two 'O' rings of dia 100 mm & 120 mm of thickness 5 mm were used at the bottom of the cylinder.
- These 'O' rings were applied with grease to act as leak proof & pressure tight.
- Water hammer forming of annealed aluminum & copper blanks of diameter 120 mm & thickness of 0.8 mm, has been taken for experimental work & the influence of the process parameters like, pressure transmitting medium, potential energy, distribution of hoop strains, radial strains, & central deflection of the deformed metal has been observed.
- Pure aluminum & copper sheets of 0.8mm thickness & suitable circular blanks of 120mm size are cut with shears & the edges of the blanks are filed to the correct shape.
- For all the blanks center is located then the blanks are marked with concentric circles with a radial interval of 10 mm & two radial lines with an included angle of 45 degrees.
- The marked aluminum & copper blanks are annealed & used for deformation in water hammer forming process.
- The pressure cylinder is filled with water or any chosen hydraulic fluid & the plunger is pushed through the guide bush to position on the water column.
- The weight or ram is lifted to the required height & suddenly relieved.
- The shock waves produced in fluid column develop high pressures with this impact load on the plunger.
- The high pressure fluid column deforms the blank into the die & produces the required shape.
- The above procedure is repeated.