EXPLOSIVE FORMING

Introduction:

A punch in conventional forming is replaced by an explosive charge.

Explosives used can be:

- High energy chemicals like TNT, RDX, and Dynamite.
- Gaseous mixtures
- Propellants.

Factors to be considered while selecting an HERF process:

- Size of work piece
- Geometry of deformation
- Behavior of work material under high strain rates
- Energy requirements/ source
- Cost of tooling / die
- Cycle time
- Overall capital investment
- Safety considerations.

Types of explosive forming:

1) Unconfined type or Stand off technique
2) Confined type or Contact technique

1) Unconfined type (or Stand off technique)

Principle:

The work is firmly supported on the die and the die cavity is evacuated. A definite quantity of explosive is placed suitably in water medium at a definite stand off distance from the

work. On detonation of the explosive charge, a pressure pulse (or a shock wave) of very high intensity is produced.

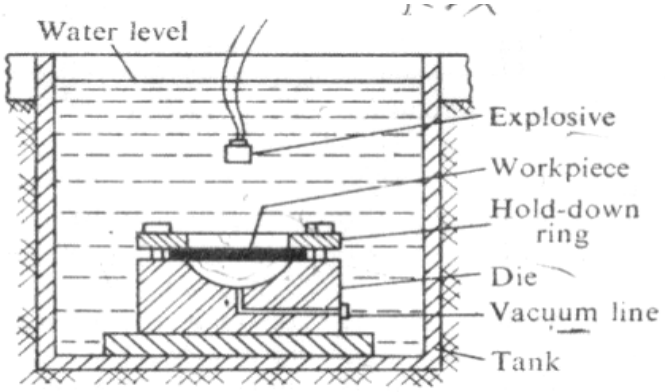

Fig. Unconfined Type Explosive Forming

A gas bubble is also produced which expands spherically and then collapses. When the pressure pulse impinges against the work (plate or sheet0, the metal is deformed into the die with a high velocity of around 120 m/s (430km/h).

The vacuum is necessary in the die to prevent adiabatic heating of the work which may lead to oxidation or melting.

Role of water:

i) Acts as energy transfer medium
ii) Ensures uniform transmission of energy
iii) Muffles the sound of explosion
iv) Cushioning/ smooth application of energy on the work without direct contact.

Process Variables

i) Type and amount of explosive: wide range of explosive sis available.
ii) Stand off distance – SOD- (Distance between work piece and explosive): Optimum SOD must be maintained.
iii) The medium used to transmit energy: water is most widely used.
iv) Work size:

v) Work material properties
vi) Vacuum in the die

Advantages;

i) Shock wave is efficiently transmitted through water and energy is transmitted effectively on the work
ii) Less noise
iii) Less probability of damage to work.
iv) Large and thick parts can be easily formed
v) Economical, when compared to a hydraulic press

Limitations:

i) Optimum SOD is essential for proper forming operation.
ii) Vacuum is essential and hence it adds to the cost.
iii) Dies must be larger and thicker to withstand shocks.
iv) Not suitable for small and thin works.
v) Explosives must be carefully handled according to the regulations of the government.

Applications:

- Ship building,
- Radar dish,
- Elliptical domes in space applications

2) Confined System (or Contact Technique)

Principle:

The pressure pulse or shock wave produced is in direct contact with the work piece (usually tubular) and hence the energy is directly applied on the work without any water medium.

The tube collapses into the die cavity and is formed. It is used for bulging and flaring operations.

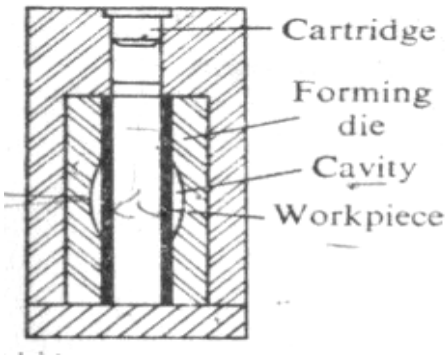

Fig. Confined (Contact) type Explosive Forming

Advantages:

i) Entire shock wave front is utilized as there is no loss in water.
ii) More efficient as compared to unconfined type.
iii)

Disadvantages:

i) More hazard of die failure
ii) Vacuum is required in the die
iii) Air present in the work piece (tube) is compressed leading to heating.
iv) Not suitable for large and thick plates.

Applications;

Bulging and flaring of tubes.

Source : http://elearningatria.files.wordpress.com/2013/10/mp3_unit8_herf_final.pdf