SNS COLLEGE OF TECHNOLOGY
(An autonomous institution)
Department of Mechanical Engineering

Unit – IV

Topic
Explosive Forming

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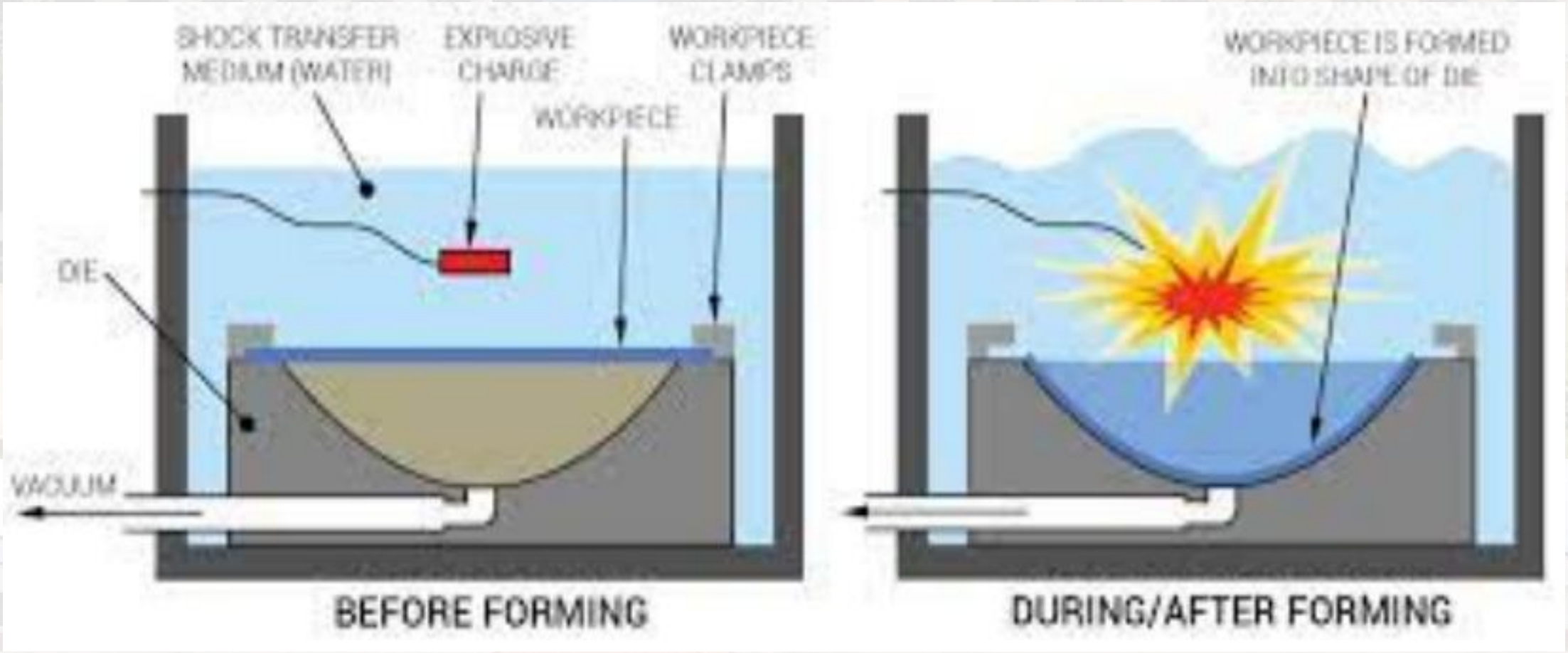
Explosive Forming

Explosive forming is a metalworking technique in which an **explosive charge** is used instead of a punch or press.

It can be used on materials for which a press setup would be **prohibitively large** or require an **unreasonably high pressure**, and is generally much cheaper than building a large enough and sufficiently high-pressure press.

on the other hand, it is unavoidably an individual job production process, **producing one product at a time** and with a long setup time.

Explosive Forming



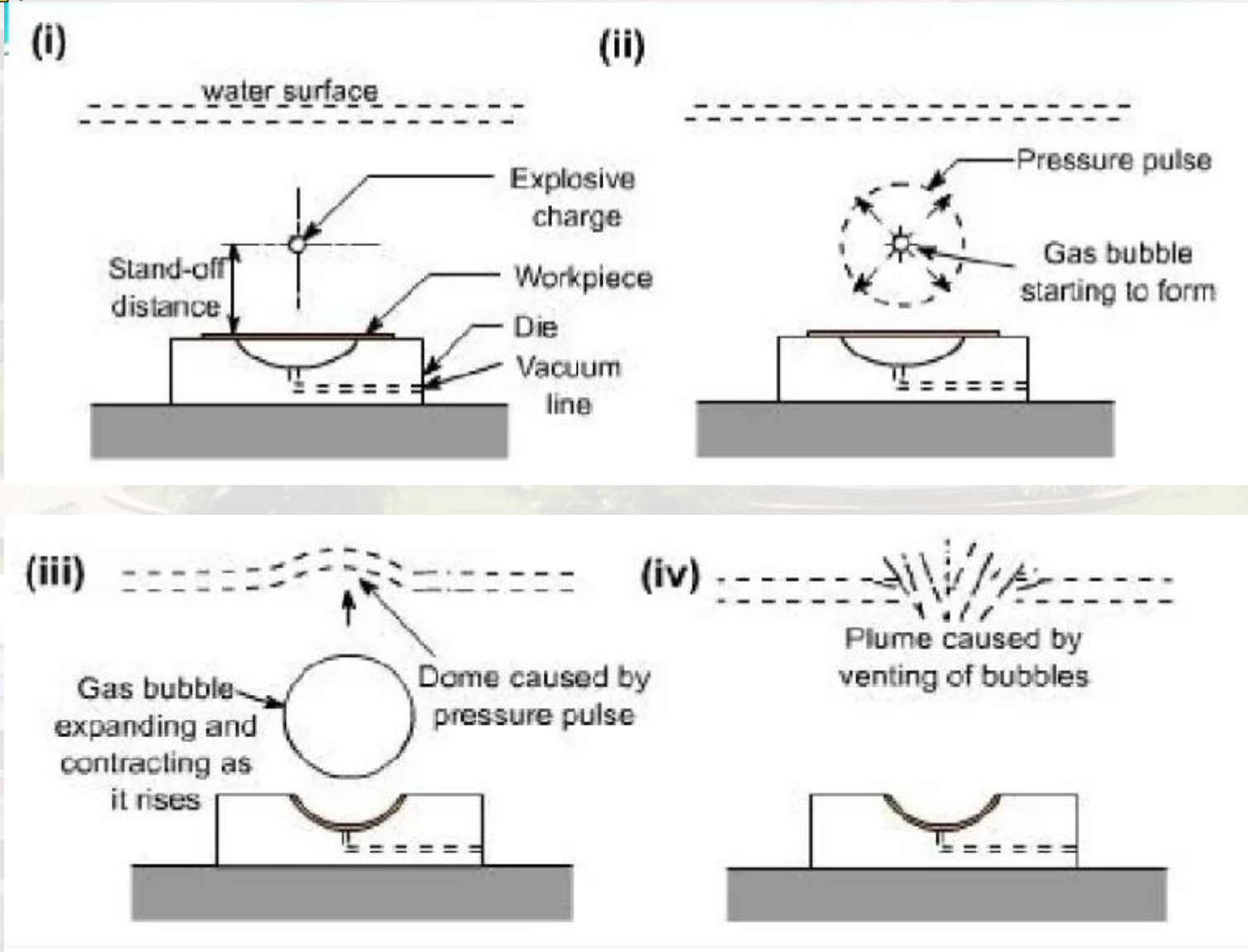
Explosive Forming

There are various approaches; **one is to place metal plate over a die,** with the intervening space evacuated by a vacuum pump, place the whole assembly underwater, and detonate a charge at an appropriate distance from the plate.

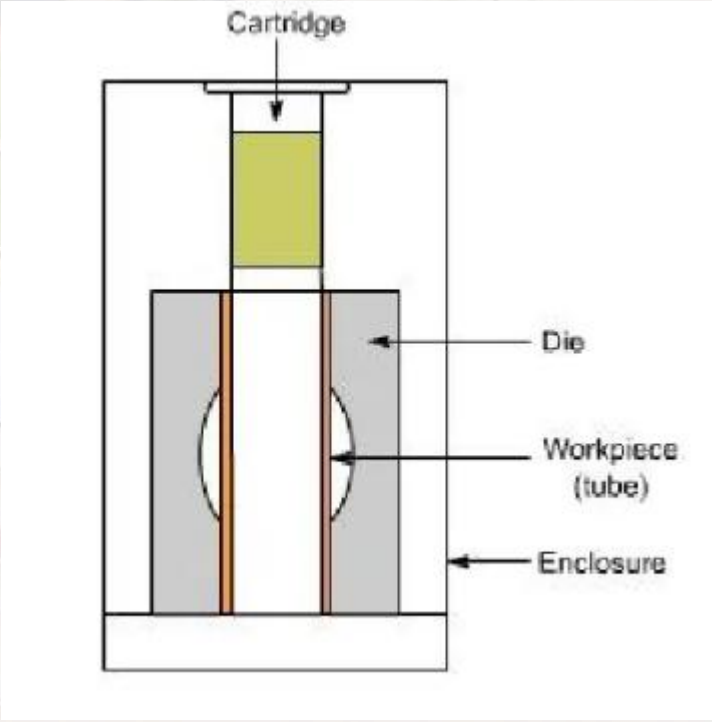
For complicated shapes, a segmented die can be used to produce in a single operation a shape that would require many manufacturing steps, or to be manufactured in parts and welded together with an accompanying loss of strength at the welds.

Explosive Forming

Standoff Method



Cutoff Method



Explosive Forming

Various Techniques Explosive forming operations can be divided into two groups, depending on the **position of the explosive charge** relative to the work piece.

➢ **Standoff Method:**

In this method, metal plate is placed over a die with the intervening space evacuated by a vacuum pump, then whole assembly is placed underwater and **explosive material is placed at an appropriate height above the plate.**

For complicated shapes, a segmented die can be used.

➢ **Contact Method:**

In this method, the explosive charge is **held direct contact with the work piece** while the detonation is initiated.

The detonation produces interface pressures on the surface of the metal up to several million psi.

Explosive Forming

Required Equipments

The equipment requirements depend to a great extent on the volume of production to be carried out in the facility.

The primary equipment consisting of:

- Water tank
- Crane
- Vacuum pump
- Detonator
- Detonating circuit

ROLE OF WATER

- Acts as energy transfer medium
- Ensures uniform transmission of energy
- Muffles the sound of explosion
- Cushioning/ smooth application of energy on the work without direct contact.

PROCESS VARIABLES

- Type and amount of explosive
- Standoff distance – SOD- (Distance between work piece and explosive)
- The medium used to transmit energy
- Work size
- Work material properties
- Vacuum in the die

Explosive Forming

There are many types of explosives available which might be considered for explosive forming operations/ Both commercial and military types have been used.

Military types have been limited to companies which have Government contracts and to companies which have managed to obtain limited amounts on a Government surplus basis.

On the other hand. It is highly desirable to minimize to the greatest possible extent the variety of commercial explosives employed because the cost per pound of commercial explosives is closely related to the volume purchased per order of each type and form.

Most types of explosives do not have unlimited shelf life and the destruction of deteriorated explosives' is expansive.

Explosive Forming

In selecting explosives, it is well to keep in mind handling and storage characteristics:

- Sensitivity to shock and heat
- Tendency to be hygroscopic
- Effect of storage time and conditions on homogeneity
- Behavior upon detonation and suitability of physical form
- Cost of explosive

Explosive Forming

The most common explosives are:

- TNT (Trinitrotoluene)
- Tetryl (Trinitro phenyl methyl nitramine)
- RDX (Cyclotrimethylenetrinitramine)
- PETN (Penta erythrite Tetranitrate)
- Dynamites

Explosive Forming

- Explosives are divide into two classes
- **Low Explosives** in which the ammunition burns rapidly rather than exploding, hence pressure build up is not large.
- **High Explosive** which have a high rate of reaction with a large pressure build up.
- **FEATURES OF LOW AND HIGH EXPLOSIVES**

PROPERTY	HIGH EXPLOSIVE	LOW EXPLOSIVE
METHOD OF INITIATION	Primary HE-ignition, spark, flame or impact	Ignition
	Secondary HE-detonator , or detonator and booster combination	
CONVERSION TIME	Microseconds	Milliseconds
PRESSURE	Upto 4,000,000 psi	Upto 40,000 psi

Explosive Forming

Explosives	Relative power (% TNT)	Form of charge	Detonation Velocity, m/s	Energy, KJ/kg	Maximum pressure, GPa
RDX (Cyclotrimethylene trinitramine, $C_3H_6N_6O_6$)	170	Pressed granules	8380	1270	23.4
TNT (Trinitrotoluene, $C_7H_5N_3O_6$	100	Cast	7010	780	16.5
PETN (Pentaerythritol tetranitrate, $C_5H8N_{12}O_4$)	170	Pressed granules	8290	1300	22.1
Tetryl (Trinitrophenylmethylinitramine, $C_7H_5O_8N_5$)	129	Pressed granules	7832	-----	-----
Blasting gelatin	99	Cartridge plastic	7985	1220	17.9

Explosive Forming

Advantages of Explosive Forming

The advantages of explosive forming are given below:

- ➢ It can simulate a **variety of other conventional metal forming** techniques such as **stamp or press forming and spin forming** in a single operation
- ➢ Explosive hydro-forming can efficiently form **large parts up to 4' square or 10' in diameter**
- ➢ It is particularly suitable for **short production runs** of a large parts such as occurs in aerospace applications
- ➢ It maintains **precise tolerances a**nd eliminated costly welds

Explosive Forming

Disadvantages of Explosive Forming

- Low tooling costs, but high labor cost
- Suitable for low quantity production
- Due to shock waves and spillage of water it is not suitable to carry indoor
- It should be done in open air

Explosive Forming

Applications of Explosive Forming

Explosive forming finds its applications in aerospace such as in the forming of:

- Rocket engine nozzle
- Space shuttle skin
- Sheet Metal Panels
- Housings
- Jet Engine Parts

Thankyou