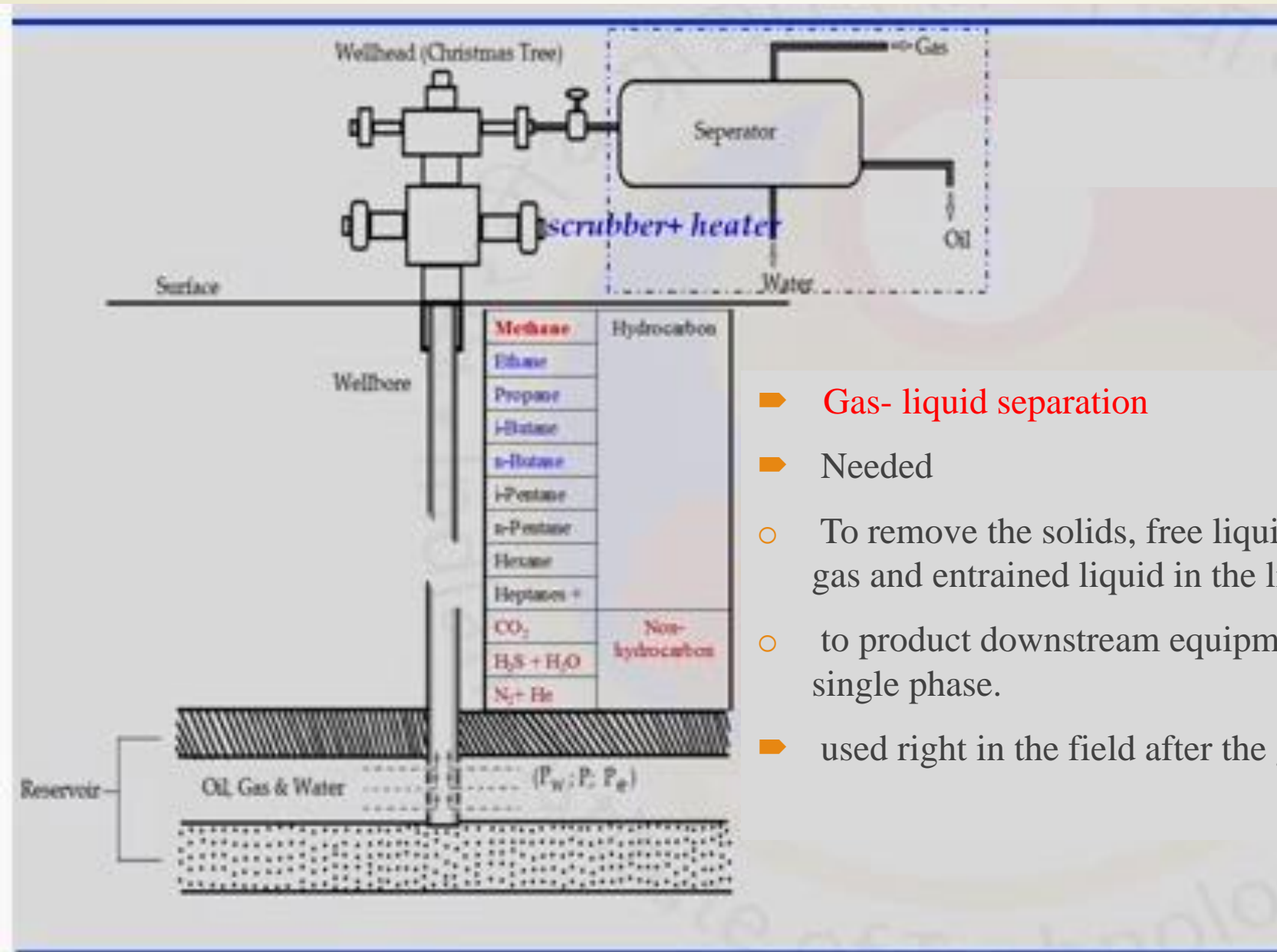


# Lecture 9

## Petrochemicals Engineering

### Phase Separation

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➤ Gas- liquid separation

➤ Needed

○ To remove the solids, free liquid, entrained liquid in the gas and entrained liquid in the liquid.

○ to product downstream equipment designed to handle a single phase.

➤ used right in the field after the gas is produced.

## Various separation principles

Momentum	<ul style="list-style-type: none"><li>○ separation of two fluids with different densities if there is change in flow direction.</li><li>○ lighter phase will turn faster than the heavier phase thereby causing separation.</li></ul>
Gravity	Setting of liquid droplets and solid particles out of gas if gravitation force is more than the drag force.
Filtration	Separation is obtained by passing the mixture through a porous barrier.
Centrifugal force	Separation is achieved due to difference in density and the components separate radially in centrifugal field.



## Gas-liquid separators ( based on gas to liquid ratio)

```
graph TD; A[Gas-liquid separators ( based on gas to liquid ratio)] --> B[High gas to liquid ratio]; A --> C[Low gas-liquid ratio]; B --> D["1- Flare knock out drums<br/>2- Scrubbers etc."]; C --> E["1- Oil/ gas separation<br/>2- Flash tank etc."];
```

High gas to liquid ratio

- 1- Flare knock out drums
- 2- Scrubbers etc.

Low gas-liquid ratio

- 1- Oil/ gas separation
- 2- Flash tank etc.

## Gas-liquid separators ( based on gas to liquid ratio)

Gravity

Centrifugal

Gas filter


Twister  
supersonic

Slug  
catchers

High-efficiency  
liquid-gas coalesce

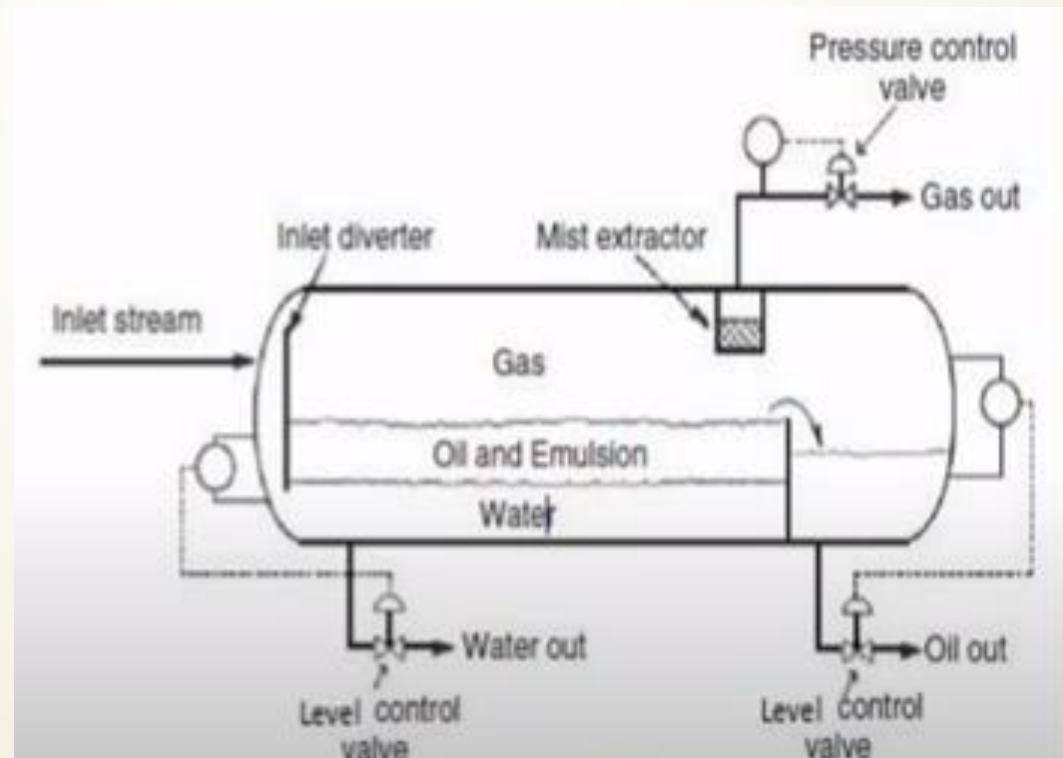


## ➤ Gravity separators

- ❖ Used to separate a mixed phase stream into gas and liquid phases that are relatively free of each other.
  - ❖ Gravitational forces control separation
  - ❖ Lowering the gas velocity increases efficiency of the gas/liquid separation.
  - ❖ Large vessel size required to achieve setting.
  - ❖ Not designed to remove droplets smaller than 250  $\mu\text{m}$ .
- 

## ➤ Components of gravity separators

- ❖ A primary gas/liquid separation section with an inlet diverter → remove the bulk of the liquid from the gas.
- ❖ A gravity settling section → provide adequate retention time so that proper settling may take place.
- ❖ A mist extractor at the gas outlet → capture entrained droplets or those too small to settle by gravity.
- ❖ Pressure and level control valves → proper pressure and liquid-level controls.







**Types of gravity separators**  
( based on geometric configuration)



```
graph TD; A([Types of gravity separators  
( based on geometric configuration)]) --- B([Vertical]); A --- C([Horizontal]); A --- D([Spherical]);
```

**Vertical**

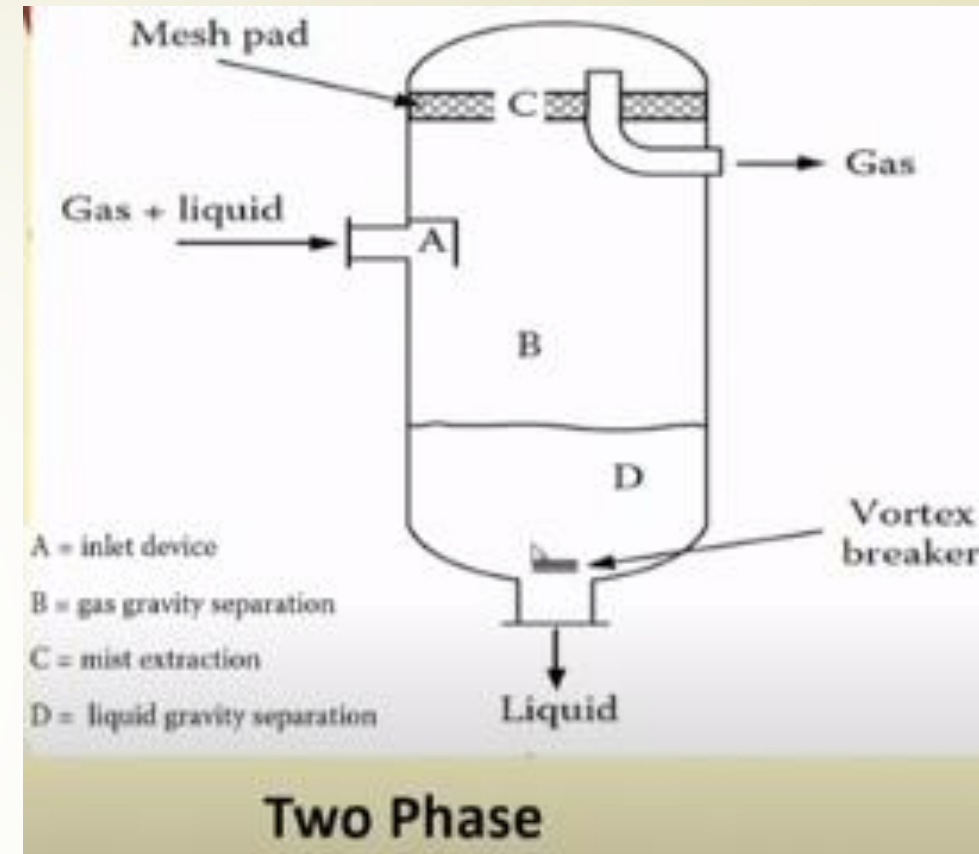
**Horizontal**

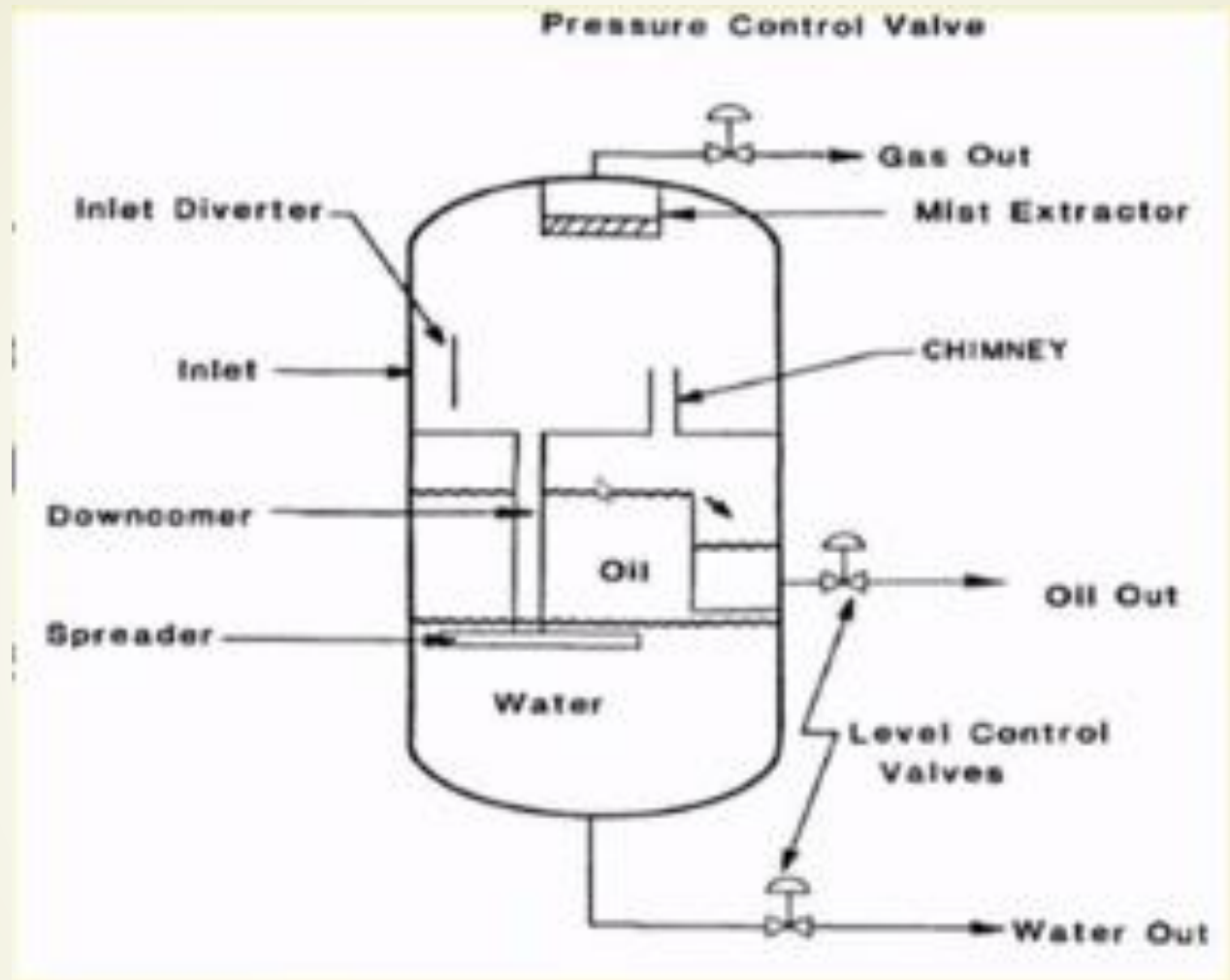
**Spherical**



## Vertical separator

- ❖ Is commonly used for low liquid to gas ratio
- ❖ Occupies less platform area → preferred offshore
- ❖ Has large vertical height → prevents revalorization of the liquid in to vapor.
- ❖ Has gas flowing upwards → oppose flow of liquid droplets by gravity
- ❖ size is bigger and thus costlier than horizontal separators.





**Three Phase**



Thank you