

# SLUGGING

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## DEFINITION

Slug flow occurs in multiphase flow systems, i.e. oil and gas flow. It is characterized by alternating flow of liquid and gas resulting in an unsteady behaviour of the fluid leading to intermittent sequence of liquid slugs followed by longer gas bubbles flowing through a pipe. The lighter, faster moving continuous fluid which contains gas bubbles pushes ahead of the liquid.

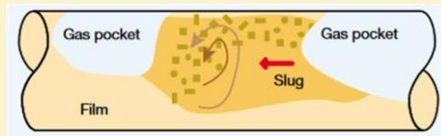
In slug flow, velocity of gas or vapour portion is approximately 2 to 2.25 times that of liquid portion. **SLUG** often refers to the heavier, slower moving fluid but sometimes refers to the bubbles of lighter fluid. Slug flow occurs mostly in piping networks transporting wet gas. 10% of oil fields experience the slugging phenomena. Slugging occurs mainly in risers and flowlines of production systems.



## TYPES OF SLUGGING

### Hydrodynamic slugging

Starts from the stratified flow regime where gas and liquid flow rates are moderate. It is initiated by the instability of waves on the gas/liquid interface in near horizontal flow. Slugs are formed by waves growing on the liquid surface to a height sufficient to completely fill the pipe leading to slugs of liquid and bubbles of gas flowing through the pipe.



### Operationally-induced Slugs

These slugs are formed during operational transfer between steady state and transient state during operations like pigging, start up, blowdown, shutdown and changes in flowrate.

### Terrain-Induced Slugs

They occur when a low point in the line becomes filled with liquid and the liquid is unable to move until gas pressure behind the blockage builds high enough to push the liquid out of the low spot as a slug. It can produce very long slugs in pipeline-riser systems (up to 3-4 times the riser height).

## IMPLICATIONS

- × Severe slugging may cause platform trips and plant shutdown.
- × Causes flooding and damage of receiving facilities when slugs are larger than slug catcher capacity.
- × High pressure in the separator.
- × Poor phase separation.
- × Fatigue due to repeated impact.
- × Overload on gas compressors.
- × Platform trips and possible early platform abandonment.

## SLUG MANAGEMENT



- ✓ Pigging of flow lines.
- ✓ Use of slug catchers.
- ✓ Gas Injection at riser base.
- ✓ Choking at the riser top or upstream the separator.
- ✓ Line sizing optimization.