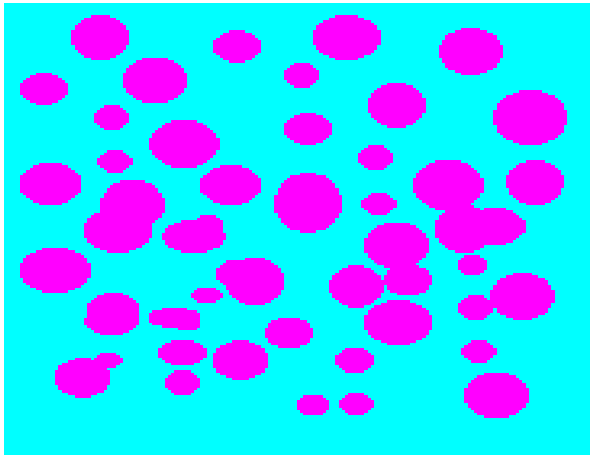
Two-Phase

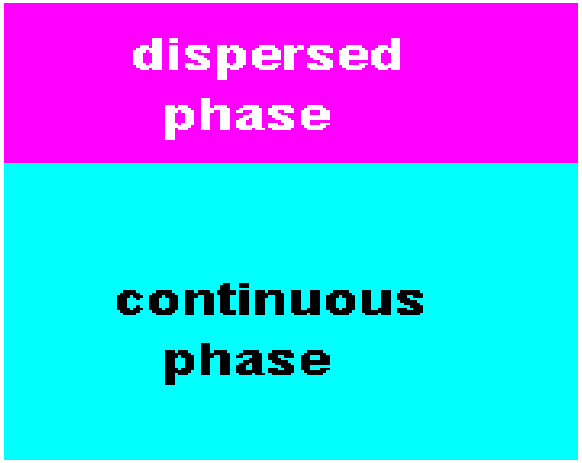
What is two-phase flow?

- Single-phase flow → fluid flow in a single state
- Multiphase flow → simultaneous flow of several fluid phases
- Common multiphase flow are (i) gas-liquid, (ii) liquid-liquid or (iii) liquid-solid.
- Why is it so important? Severity of pressure drop problems that may result to operational problems in a process

liquid two-phase system vigorously mixed

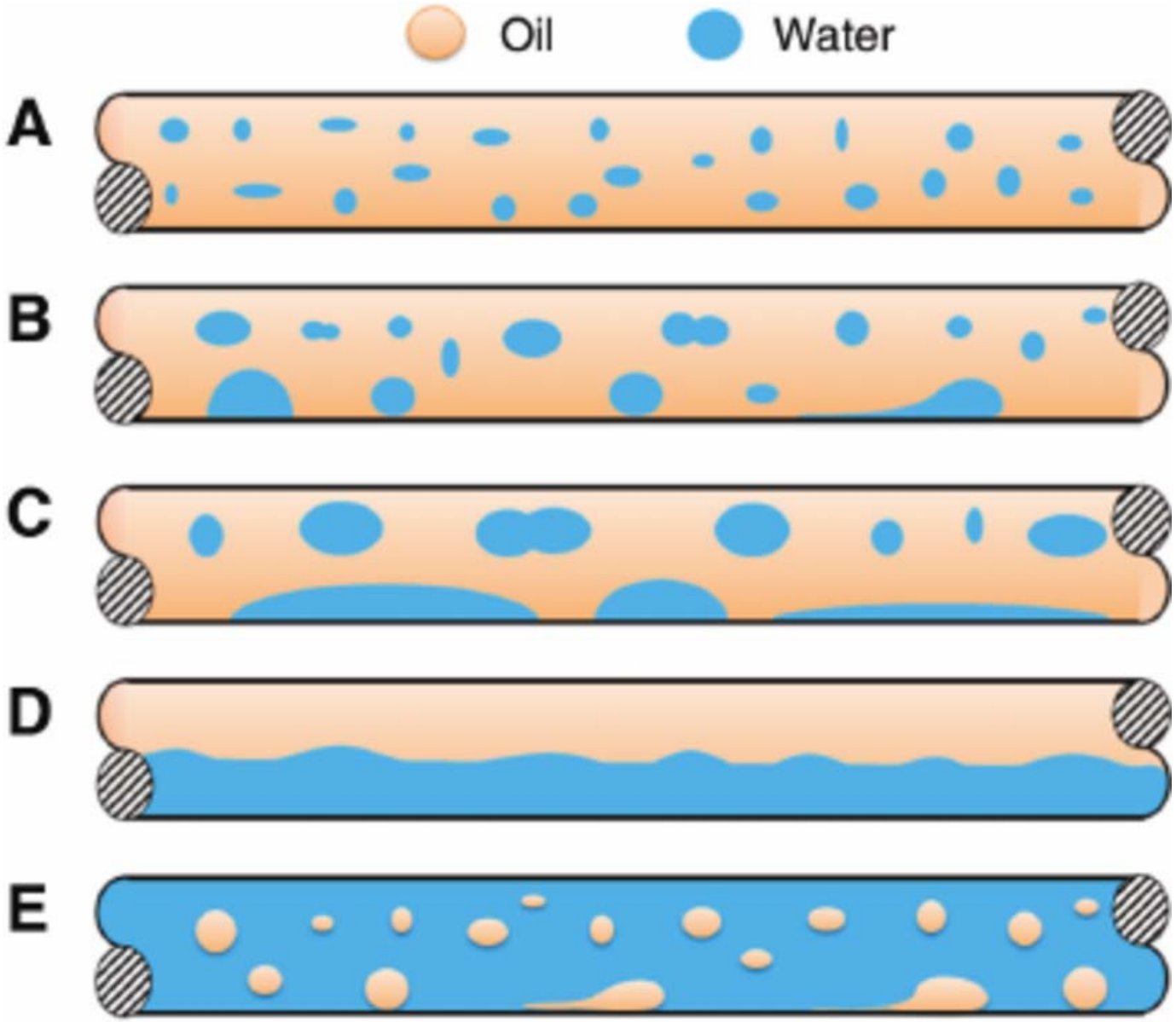


during mixing

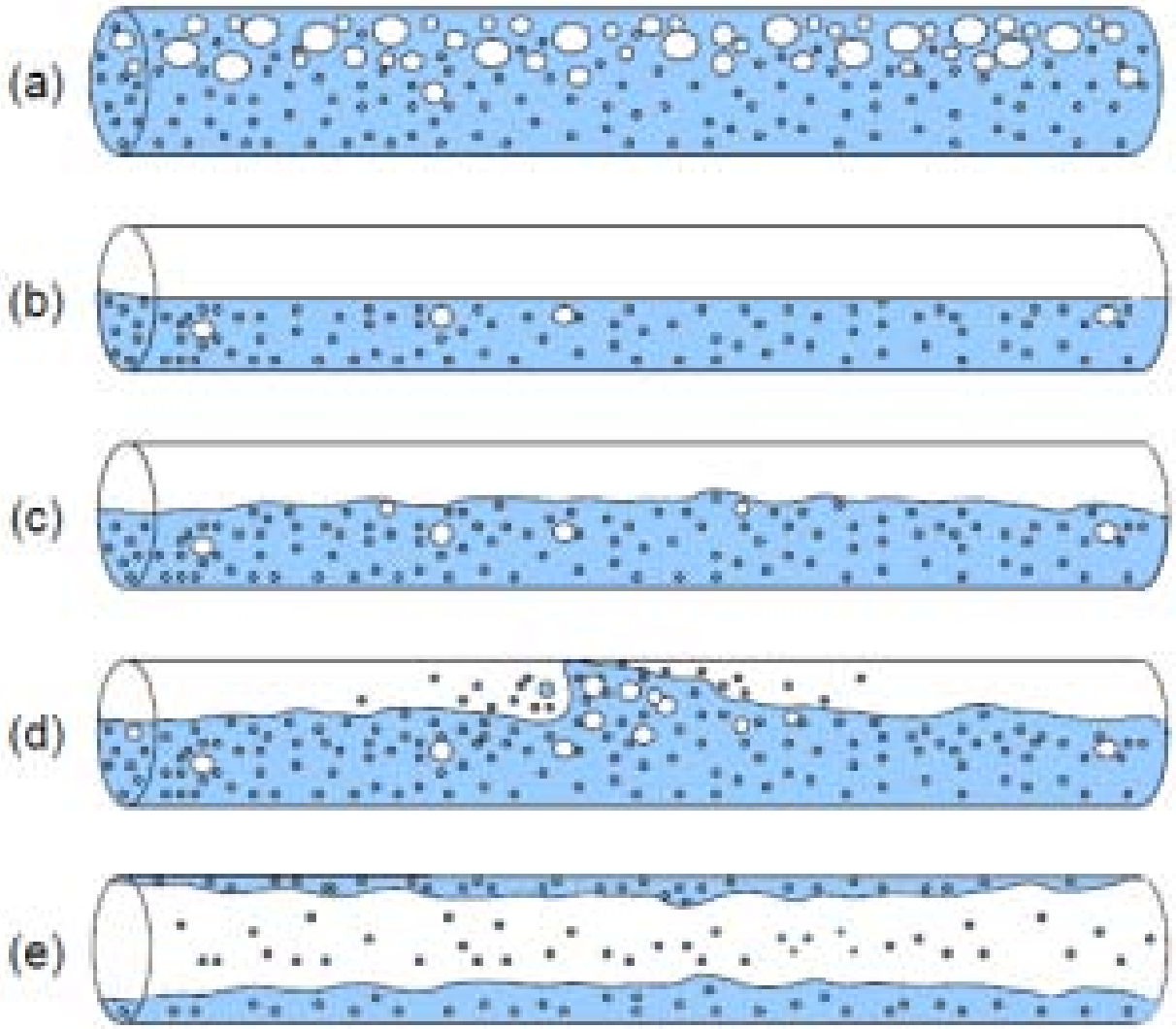


after settling

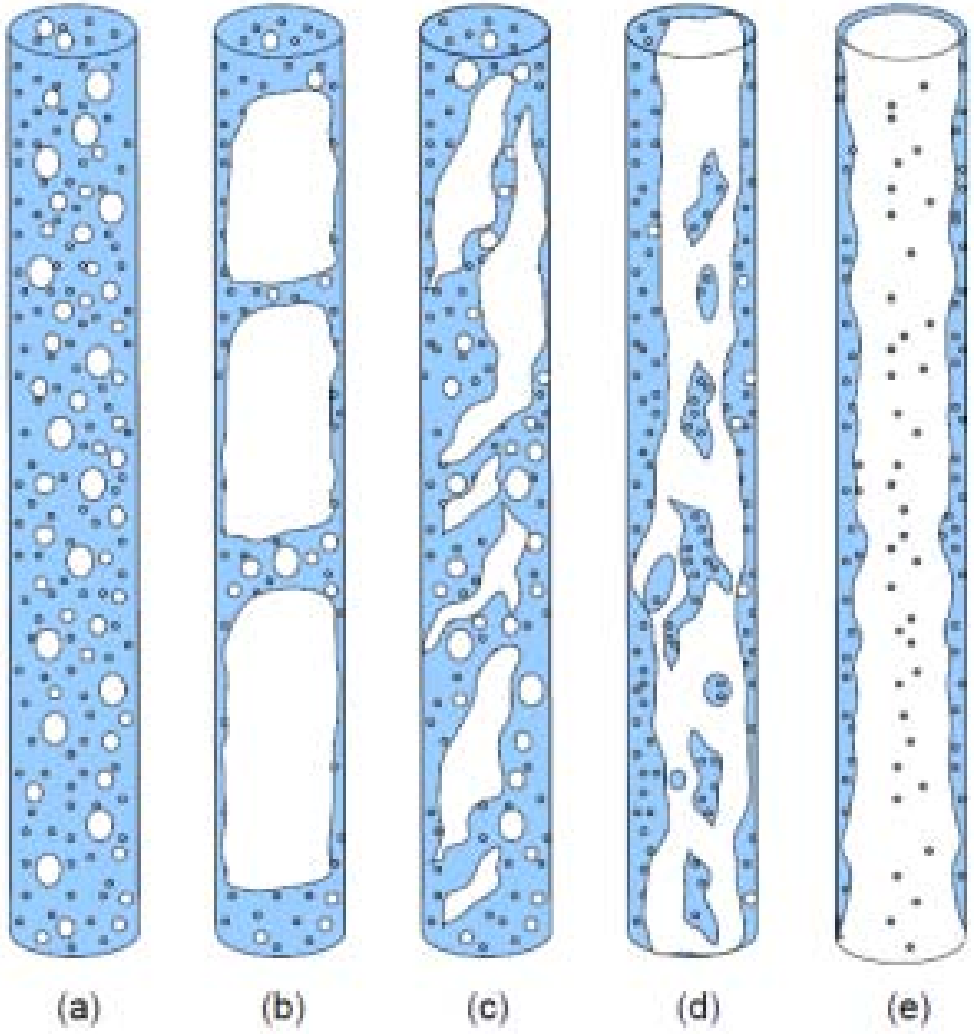
Two-Phase Horizontal pipes



Horizontal fluid flow [(a) bubble flow, (b) stratified flow, (c) wavy flow, (d) slug flow, (e) annular flow]:

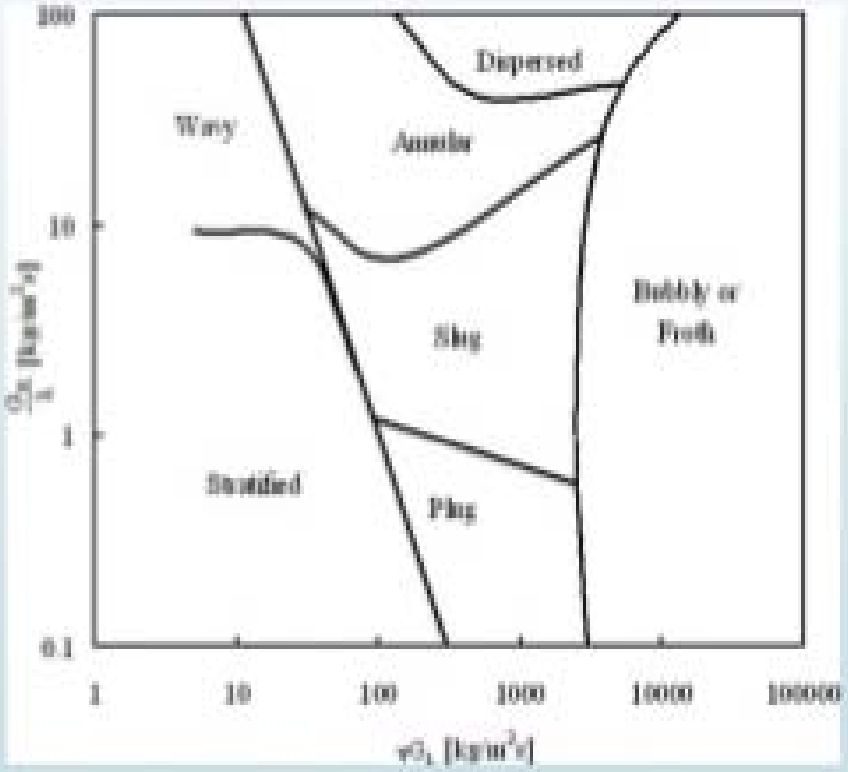


Vertical fluid flow [(a) bubble flow, (b) plug slug flow, (c) foam flow, (d) annular streak flow, (e) annular flow]:

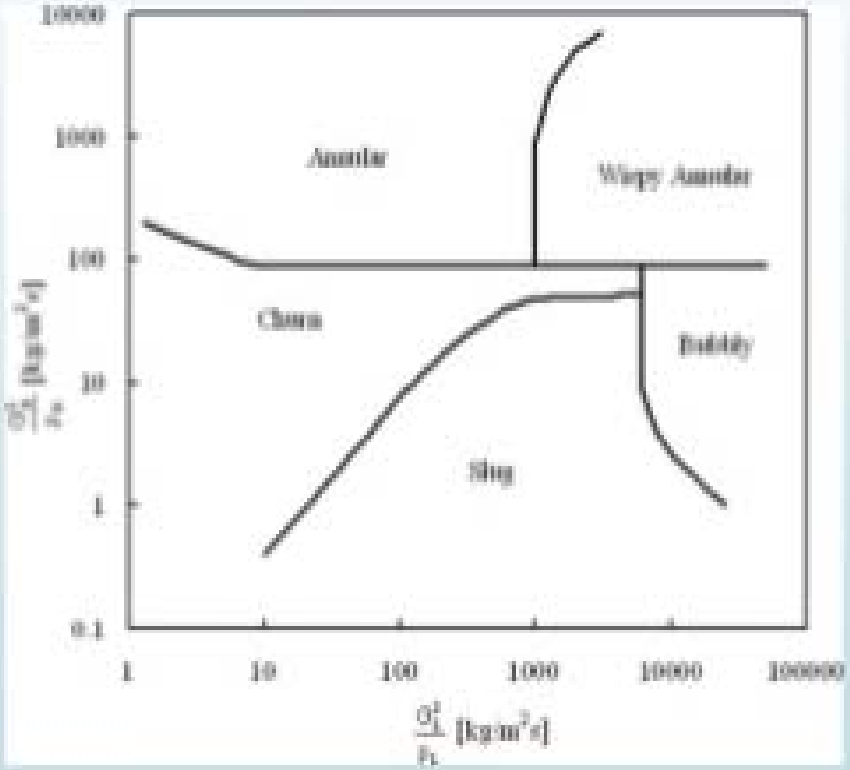


Flow Pattern Maps

The **Baker** flow-pattern map for **horizontal gas-liquid cocurrent** flow.



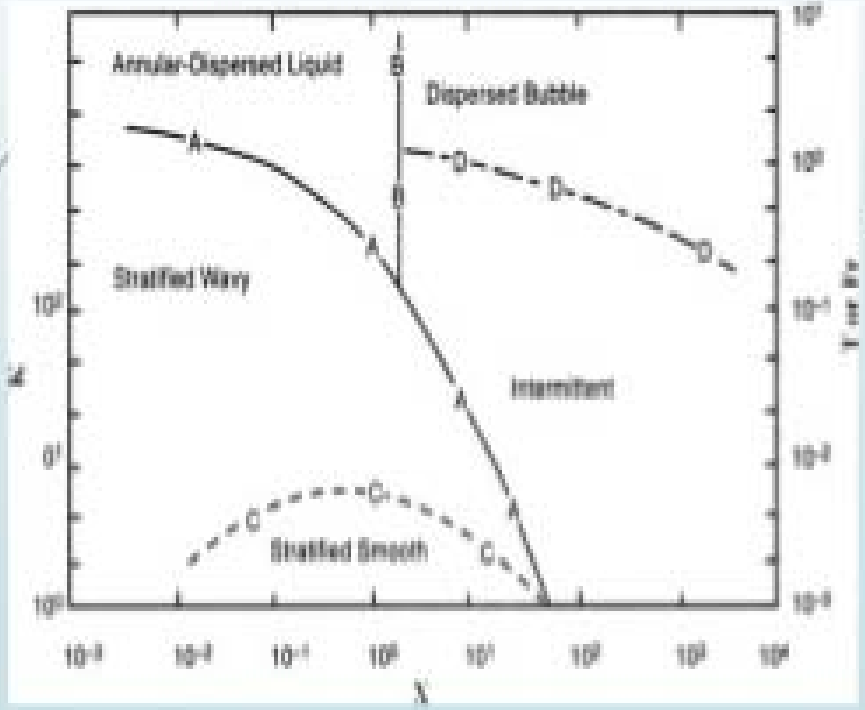
The **Hewitt and Roberts** flow-pattern map for **vertical upward gas-liquid cocurrent** flow



Based on **observations** of cocurrent flow of **gaseous** and **condensate petroleum products** in **horizontal pipes**.

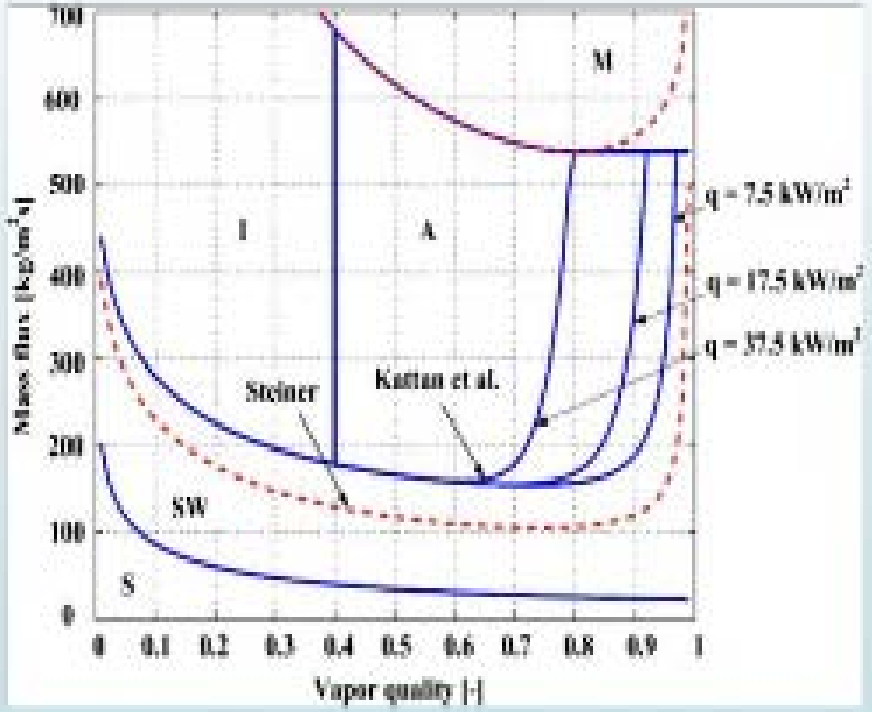
Flow Pattern Maps

The Theoretical **Taitel and Dukler** flow-pattern map for **horizontal gas-liquid cocurrent** flow :



X : Martinelli parameter
$X = [(dP/dZ)_L / (dP/dZ)_G]^{0.5}$

The **Kattan–Thome–Favrat** flow-pattern map compared to the **Steiner** map :



Evaluated for **R410A** at T_{sat}=5°C in a **13.84 mm internal diameter** tube at different heat fluxes