07/03/2016

- Multiphase flow transportation
  ↓
  Flow assurance

- HYSYS usage
- Production enhacement techniques
  - ESP
  - Gas Lift
  - Multiphase boosting (wet gas compression)
  - increase number of wells
  - stimulation

before easter ↑

- Optimization of production systems
  - gas lift
  - ESP, routing

- Dynamics of marine structures
- Problem class with Prosper and GAP

<u>Multiphase flow transport</u>: if I have enough energy to produce the desired field rate

- longer transportation distances

- Low temperatures

- Accurate prediction of pressure and temperature drop in transportation pipelines

Flow Assurance

Ensure a successful transportation of hydrocarbons from the reservoir to the processing facilities

Main problem of transportation

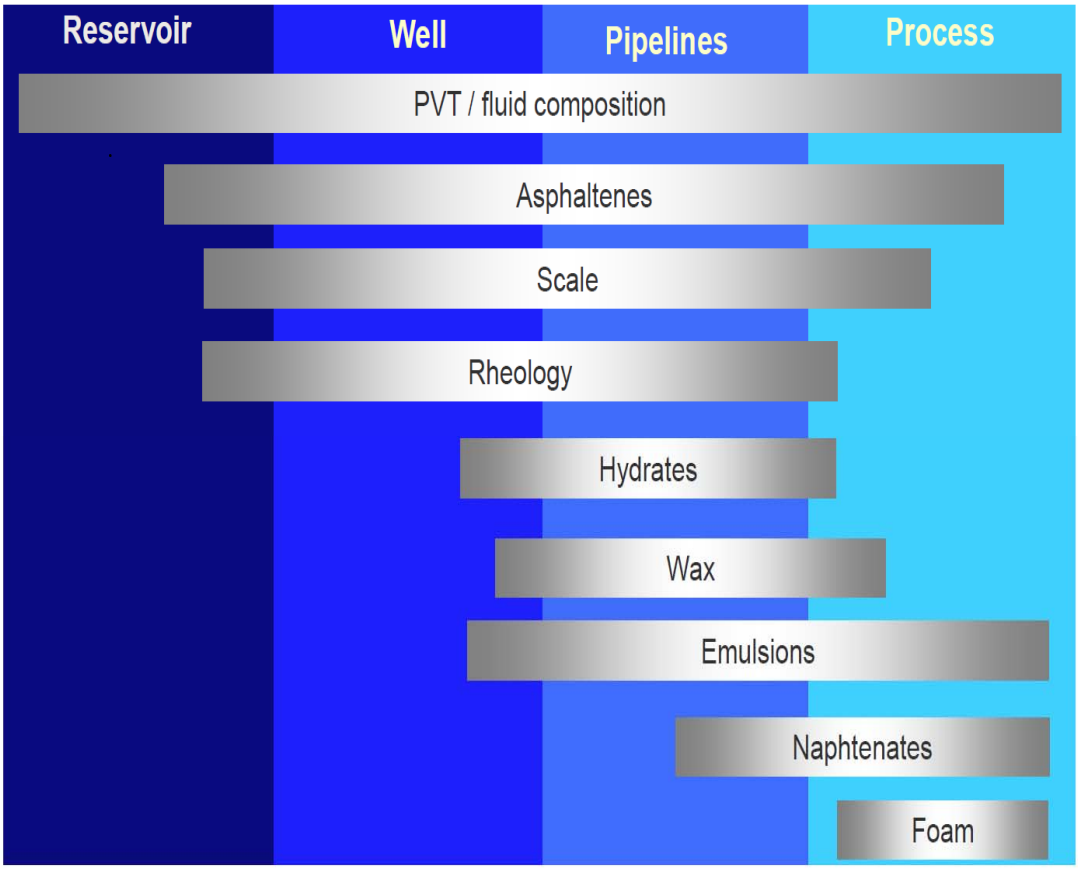
- pressure drop → gas liberation
  liquid condensation

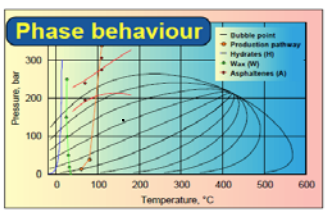
  liq accumulation → extra press drop
  difficult to transport

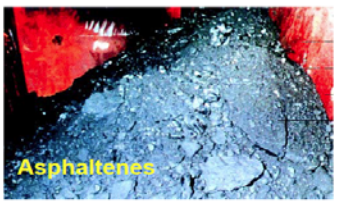
- Temperature drop → ↑ liq viscosity
  liq dropout of gas

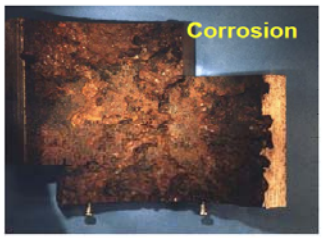
- intermitent flow
  - processing facilities
  - structural damage: jumper, pipe conections, risers (flow induce vibration
  - Causes extra pressure drop

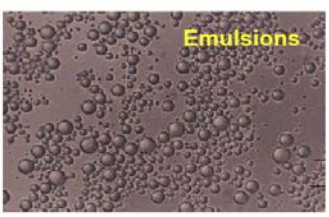
Usually for long transportation distances, multiphase flow we use transient multiphase simulators → OLGA, LEDA

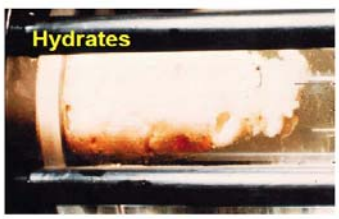










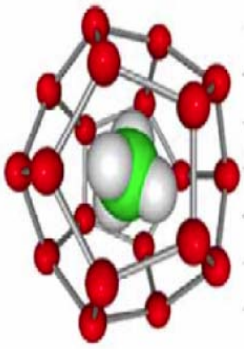


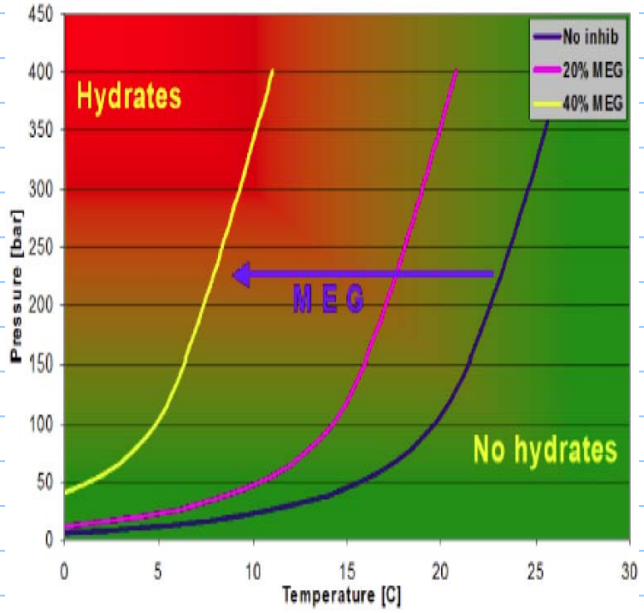
Wax 'slug' in pig trap at Statfjord B

Inhibitors:Methanol, mono ethylene glycol

Hydrates

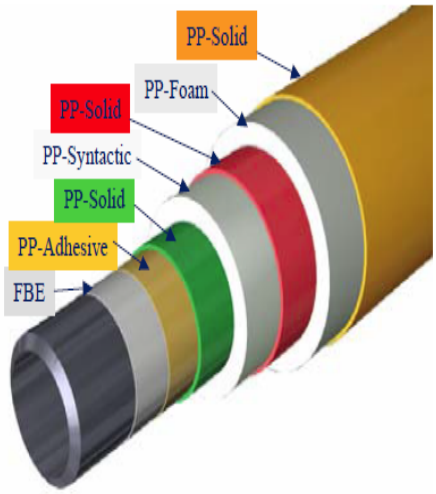
- Hydrate is water in a solid structure with small gas molecules in cavities
  - –Much like snow/ice
    - Water freeze at 0ºC, what about hydrates?
- Requirements for hydrate formation
  - –Free water
  - –Small gas molecules (N_2, CO_2, CH_4, C_2,C_3,...)
  - –Low temperature
  - –High pressure

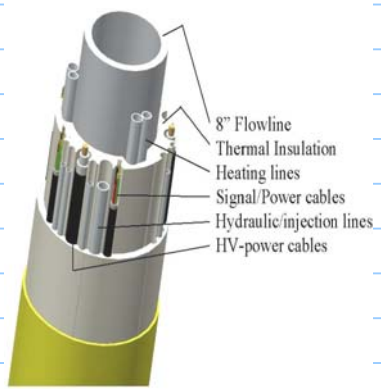




Hydrate equilibrium line: correlations, measurement, EOS equilibrium calculations

Injection of chemicals: costly!
Conserve heat, avoid high temperature drop





Wax: regular pigging

Anti slugging measures:
- gas lift in riser base
- choking at platform

How did I calculate molar flow to input in hysys?

$\dot{m}_g = q_g \rho_g$

$\dot{m}_o = q_o \rho_o$

$\dot{m}_T = \dot{m}_g + \dot{m}_o$

$\frac{\dot{m}}{MW} = \dot{n}$

$MW = \sum x_i M_i$