Properties of Reservoir Fluids (PGE 362)

Phase Behavior of Liquids

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Single Component System
Single Component System
Two Components System

![Diagram](https://via.placeholder.com/150)

- **Pressure**
- **Liquid**
  - First Bubble of Gas
- **Gas**
  - Last Drop of Liquid
- **Dew Point**

**Legend**:
- Liquid
- Gas
- Pressure
- Volume
Two Components System

![Diagram showing pressure-volume relationship for a two-component system with critical point and bubble point at various temperatures.]
Multicomponent System
Multicomponent System
Multicomponent System
Multicomponent System

Black Oil
Multicomponent System

Volatile Oil
Multicomponent System

Near-Critical Crude Oil
Multicomponent System

Near-Critical Gas
Multicomponent System

Retrograde Gas
Multicomponent System

Wet Gas
Multicomponent System

Dry Gas

![Diagram of a multicomponent system with a phase diagram showing gas, liquid, and pressure depletion at reservoir temperature.](Image)
The Gibbs’ phase rule:

- The number of phases that can coexist in equilibrium for a system under conditions of (T & P).
- \( F = C - P + 2 \)
- \( F \): the variance or the number of degree of freedom.
- \( C \): the minimum number of components or chemical compounds required to make up the system.
- \( P \): the number of phases that are present when the system is at equilibrium.

**Note:** The number of degrees of freedom is the number of independent intensive variable, i.e., the largest number of properties such as temperature or pressure that can be varied simultaneously and arbitrarily without affecting one another.
Multicomponent System

The Gibbs’ phase rule:
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**One component**

\[ F = C - P + 2 \]

\[ C = 1 \]

\[ F = 1 - P + 2 \]

\[ F = 3 - P \]
The Gibbs’ phase rule:

**One component**

\[ F = 3 - P \]