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Properties of Reservoir Fluids (PGE 362)

Phase Behavior of Liquids

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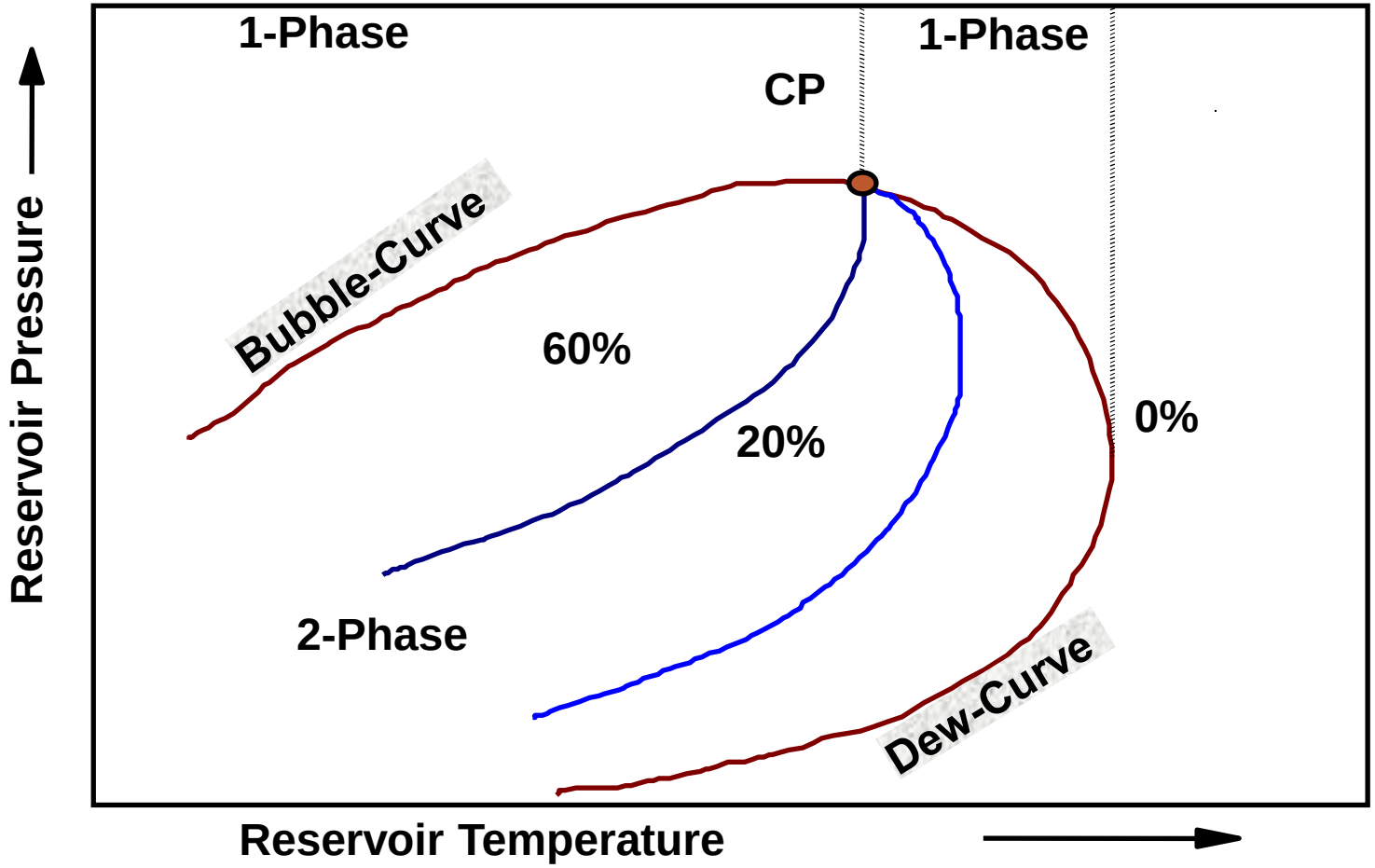
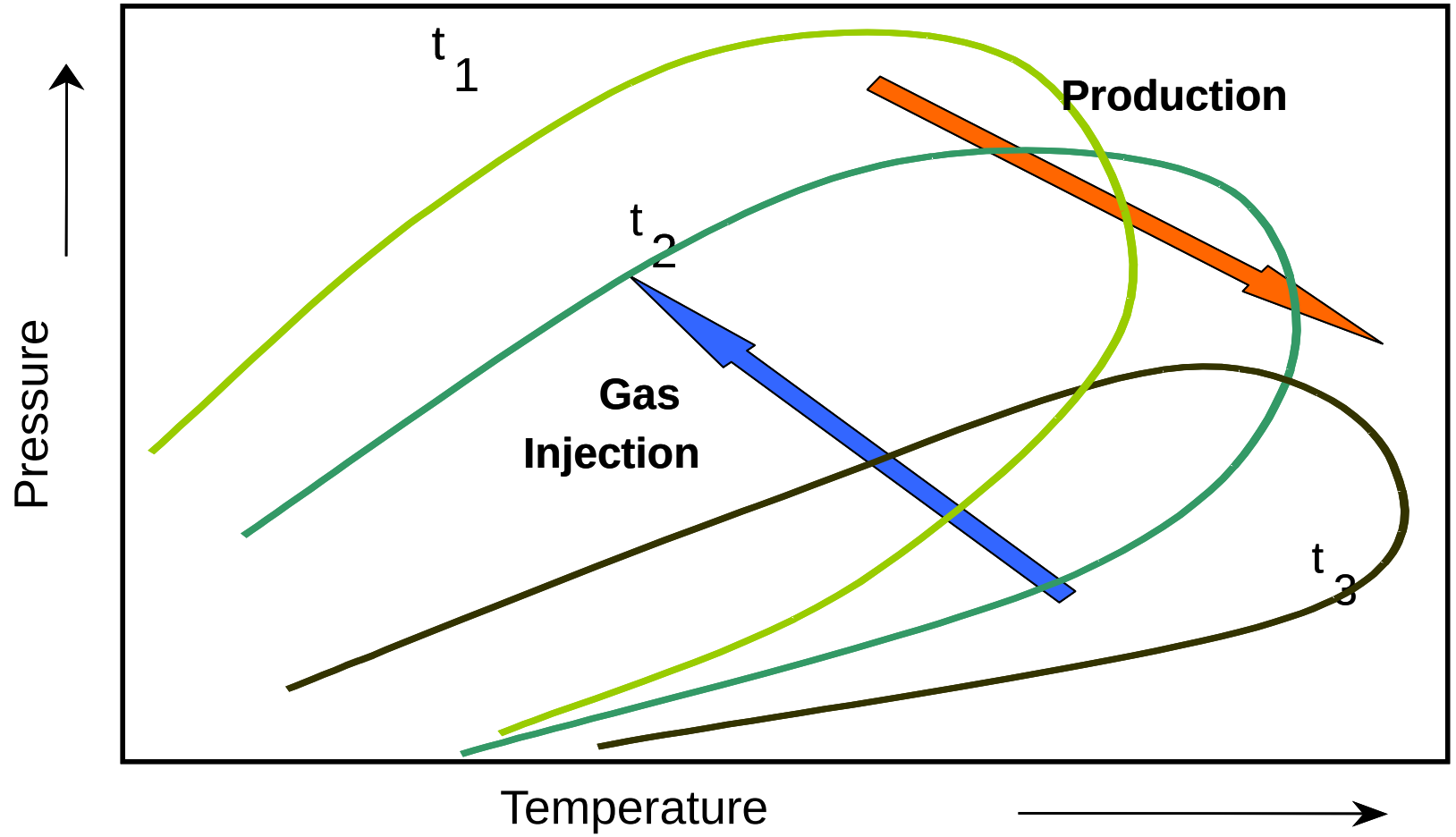
Pressure-Temperature Diagram for Multicomponent Systems



Importance of Pressure-Temperature Diagram



Terminologies

- **Phase**
  - A portion of the system which has homogeneous intensive properties and it is bounded by a physical surface.
- **Interface**
  - Separates two or more phases. These phases are solid, liquid(s), and gas
- **Intensive Properties**
  - Independent of system mass (i.e density)
- **Extensive Properties**
  - Dependent of system mass (i.e volume)

Terminologies

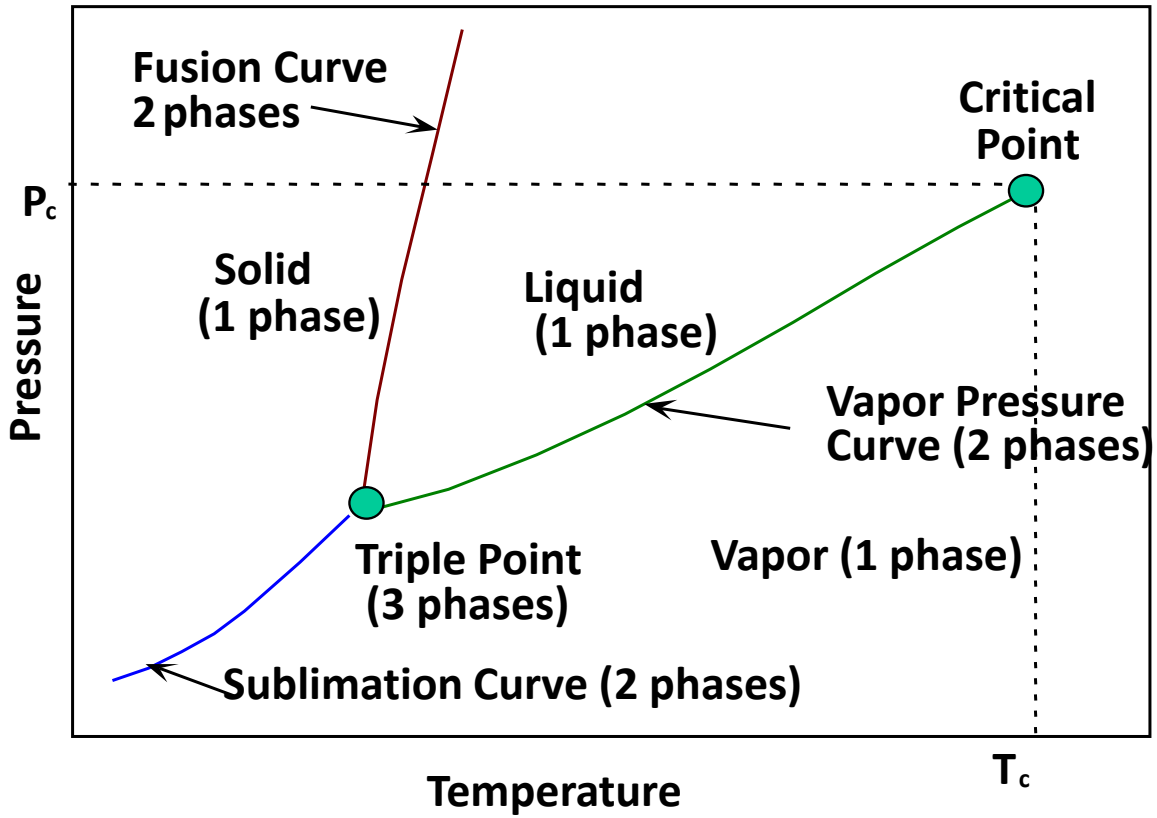
- **System**
  - A body of matter with finite boundaries (physical or virtual)
- **Closed system**
  - Does not exchange matter with surroundings but may exchange energy (heat).
- **Open system**
  - Does exchange matter and energy with surroundings.
- **Homogenous system**
  - Intensive properties change continuously and uniformly (smoothly)
- **Heterogeneous system**
  - System made up of two or more phases in which the intensive properties change abruptly at phase-contact surfaces

Terminologies

- **Properties**
  - Characteristics of a system (phase) that may be evaluated quantitatively. These are,
    - Phase density (liquid, gas, solid)
    - Compressibility
    - Surface tension
    - Viscosity
    - Heat capacity
    - Thermal conductivity

Phase Diagram

- **Types of phase diagrams for a single component (pure substance)**
  - Pressure-Temperature (PT)
  - Pressure-Volume (PV) or (Pρ)
  - Temperature-Volume (TV) or (T ρ)



Phase Diagram

- **Interesting videos**
  - Phase Diagrams and the States of Matter
    - http://www.youtube.com/watch?v=gbUTffUsXOM
  - Triple Point
    - http://www.youtube.com/watch?v=BLRqpJN9zeA
  - What is Supercritical fluid
    - http://www.youtube.com/watch?v=QHcqyFm0i9M#aid=P8sRLIeLU1Q

Pressure-Volume-Temperature

- **Temperature-Volume (TV)**
  - At constant pressure the volume of a liquid at any temperature can be estimated using the formula:
    - $V = V_o\left(1 + \alpha(T - T_o)\right)$
    - V_o : initial volume at T_o
    - α : average coefficient of thermal expansion (different for different liquids)
  - At constant temperature the volume of a liquid at any pressure can be estimated using the formula:
    - $V = V_o\left(1 - C(P - P_o)\right)$
    - C: average coefficient of compression (different for different liquids)