Multiphase fluid compressibility @model

Compressibility of multiphase fluid in thermodynamic equilibrium at a given pressure p and temperature T is a linear sum of its single-phase components:

(1) $$c_f(p,T) = \sum_\alpha s_\alpha \cdot c_\alpha(p,T)$$

where

s_α	α-phase volume share, subjected to $\sum_\alpha s_\alpha = 1$
$c_\alpha(p,T)$	α-phase compressibility as function of pressure p and temperature T

The total multiphase volume:

(2) $$V = \sum V_\alpha$$

where V_α are volumes, occupied by individual phases.

The volume fraction of individual phase is defined as:

(3) $$s_\alpha = \frac{V_\alpha}{V}$$

This leads to:

(4) $$c_f = \frac{1}{V}\frac{\partial V}{\partial p} = \frac{1}{V}\sum_\alpha \frac{\partial V_\alpha}{\partial p} = \sum_\alpha \frac{V_\alpha}{V}\frac{1}{V_\alpha}\frac{\partial V_\alpha}{\partial p} = \sum_\alpha s_\alpha \, c_\alpha$$

In most popular practical case of a 3-phase fluid model this will be:

(5) $$c_f = s_w \, c_w + s_o \, c_o + s_g \, c_g$$

where $\{w, o, g\}$ mean water phase, oil phase and gas phase.

See also

Physics / Mechanics / Continuum mechanics / Fluid Mechanics / Fluid Statics / Fluid Compressibility / Fluid Compressibility @model