Fluid Compressibility

@wikipedia

Compressibility of the fluid with density ρ and molar volume V_m as a function of temperature T and pressure p:

(1) $$c(T,p) = \frac{1}{\rho}\left(\frac{\partial \rho}{\partial p}\right)_T = -\frac{1}{V_m}\left(\frac{\partial V_m}{\partial p}\right)_T$$

There is no universal full-range analytical model for Fluid Compressibility but there is a good number of approximations which can be effectively used in engineering practice.

Approximations

Incompressible fluid	**Compressible fluid**		
	Slightly compressible fluid	**Strongly Compressible Fluid**	
	Real Gas		**Ideal Gas**
(2) $c(T,p) = 0$	(3) $c(T,p) = c_0 = \text{const}$	...	(4) $c(T,p) = \frac{1}{p}$
(5) $\rho(T,p) = \rho_0(T)$	(6) $\rho(T,p) = \rho_0 \cdot \exp[c_0(T) \cdot (p - p_0)]$	...	(7) $\rho(T,p) = \frac{\rho_0(T)}{p_0} \cdot p$
(8) $Z(T,p) = \frac{p}{p_0}$	(9) $Z(T,p) = \frac{p}{p_0} \cdot \exp[-c_0(T) \cdot (p - p_0)]$	...	(10) $Z(T,p) = 1$

where

c	fluid compressibility
ρ	fluid density
Z	Z-factor

A number of full-range mathematical models of Fluid Compressibility can be found in Fluid Compressibility @model.

The multi-phase fluid compressibility is a linear sum of compressibilities of its phases (see multi-phase fluid compressibility @ model).

Fluid Compressibility of popular petroleum fluids at SPE Standard Conditions (STP):

Fluid	Typical Range, GPa^{-1}
Natural Gas	10,000
Gas Condensate	100
Oil	1 – 10
Water	0.44 – 0.51 GPa^{-1}

See also

Physics / Mechanics / Continuum mechanics / Fluid Mechanics / Fluid Statics

[Compressibility] [Z-factor]

[Multi-phase compressibility @model] [Fluid Compressibility @model]

[Incompressible fluid] [Slightly Compressible Fluid] [Strongly Compressible Fluid] [Ideal Gas]

[Water compressibility (c_w)] [Oil compressibility (c_o)] [Gas compressibility (c_g)]