

Gas Cap Drive @model

Motivation

The most accurate way to simulate [Gas Cap expansion](#) (or shrinkage) is [full-field 3D Dynamic Flow Model](#) where [Gas Cap expansion](#) is treated as one of the fluid phases and accounts of geological heterogeneities, gas fluid properties, [rel perm](#) properties and heat exchange with surrounding rocks.

Unfortunately, in many practical cases the detailed information on the [Gas Cap](#) is not available.

Besides many practical applications require only knowledge of one element of the [Gas Cap expansion](#) process – a pressure support and not the sweep in the invaded zones.

This allows building a [Gas Cap Drive @model](#) using analytical methods.

Inputs & Outputs

Inputs		Outputs	
$p(t)$	field-average formation pressure at time moment t	$Q_{GC}(t)$	Cumulative Gas Cap expansion at surface conditions
p_i	Initial formation pressure	$q_{GC}(t) = \frac{dQ_{GC}}{dt}$	Instantaneous Gas Cap expansion flowrate at surface conditions
V_{GC}	Initial Gas Cap reserves at surface conditions		
$Z(p)$	Gas Cap compressibility factor at pressure p		

Physical Model

Isothermal expansion	Uniform pressure depletion in Gas Cap
$T = \text{const}$	$p_{GC}(t) = p(t)$

Mathematical Model

$$(1) \quad Q_{GC}(t) = V_{GC} \cdot \left(1 - \frac{B_{gi}}{B_g(p)} \right) = V_{GC} \cdot \left(1 - \frac{Z_i}{p_i} \frac{p}{Z(p)} \right)$$

$$(2) \quad q_{GC}(t) = \frac{dQ_{GC}}{dt}$$

where

$B_g(p)$	Gas formation volume factor at pressure p
$B_{gi} = B_g(p_i)$	Gas formation volume factor at Initial formation pressure p_i
$Z_i = Z(p_i)$	Gas Cap compressibility factor at Initial formation pressure p_i

Proxy Models

Ideal Gas ($Z(p) = 1$)	
(3) $Q_{GC}(t) = V_{GC} \left(1 - \frac{p}{p_i} \right)$	(4) $q_{GC}(t) = -\frac{V_{GC} \cdot p_i}{p^2(t)} \cdot \frac{dp}{dt}$
In this case the only parameter of the gas cap model is its initial volume V_{gi}	

See Also

[Petroleum Industry](#) / [Upstream](#) / [Subsurface E&P Disciplines](#) / [Field Study & Modelling](#) / [Gas Cap Drive](#)

[[Depletion](#)] [[Saturated oil reservoir](#)]