Total sandface flowrate = qt

Total produced or injected flowrate of all fluids across the well-reservoir contact with the volumes measured at the sandface temperature and pressure conditions.

Usually abbreviated as q_t or qB (with the latter does not imply a product) or specifically $q_t^{\uparrow}$ for production and $q_t^{\downarrow}$ for injection.

The concept applies both to producing and injecting wells.

The main purpose of describing the intakes and offtakes in terms of the Total sandface flowrate q_t is that it measures the actual flowing volumes in porous formations and as such directly relate to reservoir pressure.

For volatile oil fluid model the total sandface flowrate is related to surface flowrates of fluid components as:

(1) $q_t^{\uparrow} = q_w^{\uparrow} + q_o^{\uparrow} + q_g^{\uparrow} = B_w\, q_W^{\uparrow} + (B_o - R_s\, B_g)\, q_O^{\uparrow} + (B_g - R_v\, B_o)\, q_G^{\uparrow}$	(2) $q_t^{\downarrow} = q_w^{\downarrow} + q_g^{\downarrow} = B_w\, q_W^{\downarrow} + B_g\, q_G^{\downarrow}$

where

$q_w^{\uparrow},\ q_o^{\uparrow},\ q_g^{\uparrow}$	water sandface flowrate, oil sandface flowrate, gas sandface flowrate
$q_W^{\uparrow},\ q_O^{\uparrow},\ q_G^{\uparrow}$	produced water surface flowrate, oil surface flowrate, gas surface flowrate
$q_W^{\downarrow},\ q_G^{\downarrow}$	injected water surface flowrate, gas surface flowrate
$B_w,\ B_o,\ B_g$	formation volume factors for water, oil, gas
$R_s,\ R_v$	Solution GOR and Vaporized oil ratio at sandface pressure/temperature conditions

The total sandface flowrate $q_t^{\uparrow}$ of production is related to Liquid production rate $q_L^{\uparrow}$ as:

(3) $q_t^{\uparrow} = \left[B_w Y_W + \left((B_o - R_s B_g) + Y_G \cdot (B_g - R_v B_o)\right) \cdot (1 - Y_W)\right] \cdot q_L^{\uparrow}$

where

$Y_W = \frac{q_W^{\uparrow}}{q_L^{\uparrow}}$	Production Water Cut
$Y_G = \frac{q_G^{\uparrow}}{q_O^{\uparrow}}$	Production Gas-Oil-Ratio = GOR

Starting with definition of Total sandface flowrate (1) and substituting the expression of Oil surface flowrate, Gas surface flowrate, Water surface flowrate through Liquid production rate one arrives to (3).

It simplifies for the Black Oil model ($R_v = 0$) to:

(4) $q_t^{\uparrow} = B_w\, q_W^{\uparrow} + (B_o - R_s\, B_g)\, q_O^{\uparrow} + B_g\, q_G^{\uparrow}$

or

(5) $$q_t^{\uparrow} = \left[B_w Y_W + \Big((B_o - R_s B_g) + Y_G \cdot B_g \Big) \cdot (1 - Y_W) \right] \cdot q_L^{\uparrow}$$

It simplifies further down to production from undersaturated reservoir as:

(6) $$q_t^{\uparrow} = B_w \, q_W^{\uparrow} + B_o \, q_O^{\uparrow} = \left[B_w Y_W + B_o \cdot (1 - Y_W) \right] \cdot q_L^{\uparrow}$$

and even simpler for single-phase fluid (water, dead oil or dry gas) with surface flow rate $q^{\uparrow}$ and formation volume factor B as below:

(7) $$q_t^{\uparrow} = q^{\uparrow} B, \quad \text{meaning :} \quad q_t = q_W^{\uparrow} \cdot B_w \quad \text{or} \quad q_t = q_O^{\uparrow} \cdot B_o \quad \text{or} \quad q_t = q_G^{\uparrow} \cdot B_G$$

See Also

Petroleum Industry / Upstream / Subsurface E&P Disciplines / Well Testing (WT) / Flowrate Testing / Flowrate

[Well & Reservoir Surveillance]

[Sandface flowrates] [Oil sandface flowrate] [Gas sandface flowrate] [Water sandface flowrate]

[Surface flowrates] [Oil surface flowrate] [Gas surface flowrate] [Water surface flowrate] [Liquid production rate]

[Non-linear multi-phase diffusion derivation @model]