

Pressure convolution

For the [pressure diffusion with constant diffusion coefficients](#) and linear homogeneous boundary conditions the pressure response $p(t)$ in one well to a complex flowrate history $q(t)$ in the same well honours the [convolution equation](#):

(1)
$$p(t) = p_0 + \int_0^t p_u(t - \tau) dq(\tau) = p_0 + \int_0^t p_u(t - \tau) \dot{q}(\tau) d\tau$$

where

p_0	initial formation pressure at zero time $t = 0$
$p_u(\tau)$	Drawdown Transient Response
$\dot{q}(\tau) = \frac{dq}{d\tau}$	a pace of sandface flow rate variation per unit time

In case a well is interfering with the offset wells the pressure in a given well n may respond to the offset wells $m \neq n$ and the multi-well form of [convolution](#) is going to be:

(2)
$$p_n(t) = p_{n,0} + \sum_{m=1}^N \int_0^t p_{u,nm}(t - \tau) dq_m(\tau) = p_{n,0} + \sum_{m=1}^N \int_0^t p_{u,nm}(t - \tau) \dot{q}_m(\tau) d\tau = p_{n,0} + \int_0^t p_{u,nm}(t - \tau) \dot{q}_n(\tau) d\tau + p_{n,0} + \sum_{m \neq n}^N \int_0^t p_{u,nm}(t - \tau) \dot{q}_m(\tau) d\tau$$

where

$p_{n,0}$	Initial formation pressure at zero time $t = 0$ for the n -th well
$p_{u,nm}(\tau)$	Drawdown Transient Response in the n -th well to the unit-rate production
$p_{u,nm}(\tau)$	Cross-well Transient Response in the n -th well to the unit-rate production in m -th well
$\dot{q}_m(\tau) = \frac{dq_m}{d\tau}$	A speed of n -th well total sandface flow rate variation

The [pressure convolution](#) principle has some limitations and may not be adequate for some practical cases.

For example, changing reservoir conditions, high compressibility – everything which breaks linearity of diffusion equations.

There are some workarounds on these cases but the best practice is to check the validity of [pressure convolution](#) (and therefore the applicability of [MDCV](#)) on the simple synthetic 2-well [Dynamic Flow Model \(DFM\)](#) with the typical for the given case reservoir-fluid-production conditions.

See Also

[[Well & Reservoir Surveillance](#)] [[Pressure Diffusion](#)] [[Pressure drawdown](#)]

[[Pressure Deconvolution](#)] [[MDCV](#)]

[[Convolution @math](#)]

References

Arthur Aslanyan, Mathematical aspects of Multiwell Deconvolution and its relation to Capacitance Resistance Model,
arxiv.org/abs/2203.01319