Harmonic Pressure Pulsations

In case of harmonic pulsations and sufficiently long pressure-rate delay time and a simple diffusion model (single-bed homogeneous reservoir without boundary) the pressure pulse response can be approximated by analytical model:

(1) $$q = q_1 \cdot \cos\left(\frac{2\pi\, t}{T}\right)$$

(2) $$p = p_1 \cdot \cos\left(\frac{2\pi\, t}{T} + \delta_1\right)$$

where

L	distance between the point of flow variation (pressure pulse generating well) and point of pressure response (pressure pulse receiving well), being: • well radius $L = r_w$ for Self-Pulse Test • distance between generating and receiving well $L = \sqrt{(\mathbf{r}_{\rm Generator} - \mathbf{r}_{\rm Receiver})^2}$ for Pressure Pulse Interference Test
q_1	1^{st} harmonic amplitude of flowrate variation
(3) $p_1 = \frac{q_1}{\sigma} ...$	1^{st} harmonic amplitude of pressure response to the flowrate variation
(4) $\delta_1 = \frac{\pi}{8} + \frac{L}{\sqrt{\chi T}}$	phase shift caused by pressure response delay to the flowrate variation
(5) $\sigma = \left\langle \frac{k}{\mu} \right\rangle h$	formation transmissbility
(6) $\chi = \left\langle \frac{k}{\mu} \right\rangle \frac{1}{c_t\, \phi}$	formation pressure diffusivity

References