Periodic Pressure Pulsations

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

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

(2) $$p = \sum_k p_k \cdot \cos\left(\frac{2\pi\, k\, t}{T} + \delta_k\right)$$

where

L	distance between the pint of flow variation and point of pressure response, being: • well radius $L = r_w$ for Self-Pulse Test • distance between generating and receiving well $L = \sqrt{(\mathbf{r}_{\text{Generator}} - \mathbf{r}_{\text{Receiver}})^2}$ for Pressure Pulse Interference Test
q_k	k-th harmonic amplitude of flowrate variation
(3) $p_k = \frac{q_k}{\sigma} \ldots$	k-th harmonic amplitude of pressure response to the flowrate variation
(4) $\delta_k = \frac{\pi}{8} + \frac{L}{\sqrt{\chi T}}$	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