# WOIL plot

The plot of WOR (along y-axis) against the inverse oil production rate $q_O$ (along x-axis) (see **Fig. 1**).

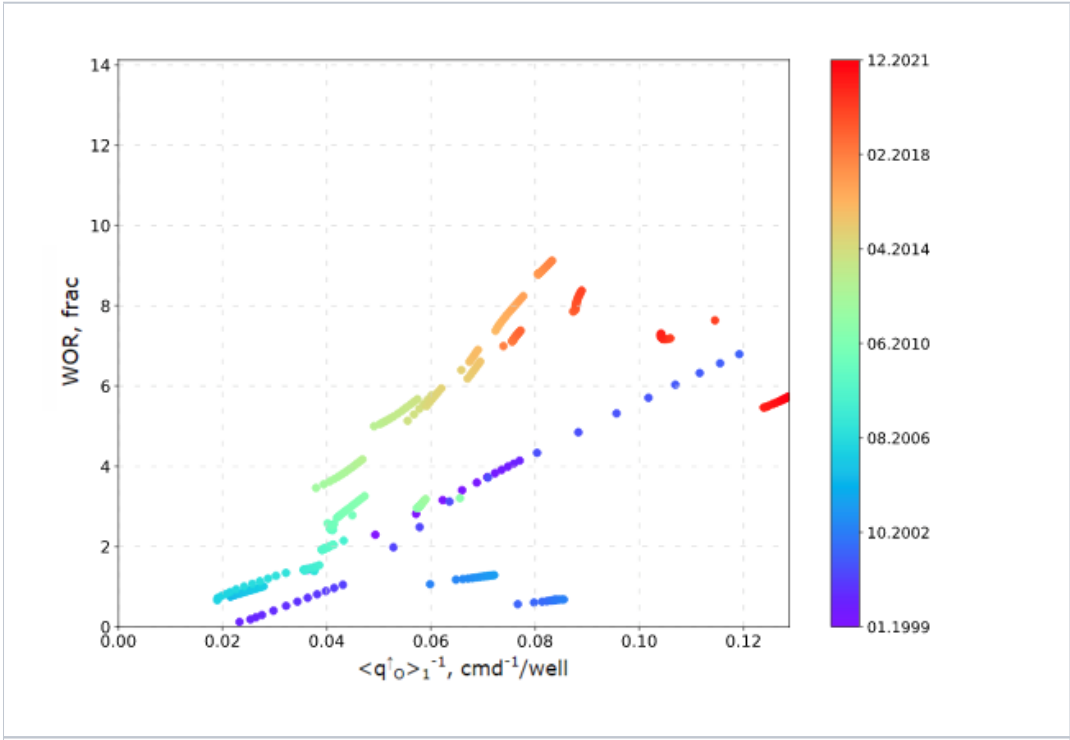


**Fig. 1.** WOR (logarithmic vertical axis) vs inverse oil production rate (linear horizontal axis)

It can be used for express Watercut Diagnostics of thief water production.

The mathematical model of the thief water production from aquifer is based on the following equation:

| (1) $WOR = \frac{q_W}{q_O} = a + b \cdot q_O^{-1}$ | (2) $a = J_{1O}^{-1} \cdot (J_{1W} + J_{2W})$ | (3) $b = J_{2W} \cdot (p_2^* - p_1^*)$ |
|---|---|---|

where

| | | | | | |
|---|---|---|---|---|---|
| | | $q_W$ | water production rate | $q_O$ | oil production rate |
| $p_1^*$ | formation pressure in petroleum reservoir | $J_{1W}$ | water productivity index of petroleum reservoir | $J_{1O}$ | oil productivity index of petroleum reservoir |
| $p_2^*$ | formation pressure in aquifer | $J_{2W}$ | water productivity index of aquifer | | |

For the case of aquifer pressure is higher than that of petroleum reservoir: $b > 0 \Leftrightarrow p_2^* > p_1^*$

For the case of aquifer pressure is lower than that of petroleum reservoir: $b < 0 \Leftrightarrow p_2^* < p_1^*$

In practical applications, the equation (1) is often considered through the weighted average values:

(4) $$\langle WOR \rangle = \frac{\langle q_W \rangle}{\langle q_O \rangle} = a + b \cdot \langle q_O^{-1} \rangle$$

where

| | |
|---|---|
| $\langle q_W \rangle$, $\langle q_O \rangle$ | are weighted average of $q_W$ and $q_O$ |

There are different ways to calculate weighted average of the dynamic variable, for example:

| t-weighted average | q-weighted |
|---|---|
| $\langle A \rangle_t = \frac{1}{t} \int_o^t A(t)\, dt$ | $\langle A \rangle_q = \frac{1}{Q(t)} \int_o^t A(t)\, q(t)\, dt$ |

## See Also

Petroleum Industry / Upstream / Production / Subsurface Production / Field Study & Modelling / Production Analysis / Watercut Diagnostics

## References

Chan, K. S. (1995, January 1). Water Control Diagnostic Plots. Society of Petroleum Engineers. doi:10.2118/30775-MS