

Homework #1 Solution

Calculate the water fractional flow (f_w) as a function of water saturation (S_w) and plot f_w versus S_w for the following fluid system:

$$\begin{aligned}k_{rw}^* &= 0.1 \\k_{row}^* &= 0.7 \\n_w &= 1.5 \\n_o &= 0.25 \\S_{orw} &= 0.30 \\S_{wr} &= 0.25 \\\mu_w &= 0.6 \text{ cp} \\\mu_o &= 2.4 \text{ cp}\end{aligned}$$

The water fractional flow (f_w) is calculated using the following expression,

$$f_w = \frac{\lambda_w(S_w)}{\lambda_w(S_w) + \lambda_o(S_w)}$$

Where,

$$\text{mobility of water is, } \lambda_w(S_w) = \frac{k_{rw}(S_w)}{\mu_w}$$

$$\text{and mobility of oil is, } \lambda_o(S_w) = \frac{k_{ro}(S_w)}{\mu_w}$$

The relative permeability is calculated as a function of saturation using the Corey correlation,

$$k_{rw} = k_{rw}^* \left(\frac{S_w - S_{wr}}{1 - S_{orw} - S_{wr}} \right)^{n_w}$$

$$k_{ro} = k_{ro}^* \left(\frac{S_o - S_{orw}}{1 - S_{orw} - S_{wr}} \right)^{n_o}$$

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Table 1 shows the values of water fractional flow as a function of saturation.

Table 1. Values of Water fractional flow as a function of water saturation

Water Saturation (fraction)	Water Fractional Flow (fraction)
0.25	0
0.26	0.0019984
0.27	0.0059628
0.28	0.011553
0.29	0.018754
0.3	0.027626
0.31	0.038264
0.32	0.050784
0.33	0.065309
0.34	0.081967
0.35	0.10088
0.36	0.12217
0.37	0.14593
0.38	0.17224
0.39	0.20112
0.4	0.23257
0.41	0.26653
0.42	0.30287
0.43	0.34142
0.44	0.38189
0.45	0.42396
0.46	0.46722
0.47	0.51122
0.48	0.55544
0.49	0.59937
0.5	0.64245
0.51	0.68419
0.52	0.7241
0.53	0.76175
0.54	0.79682
0.55	0.82902
0.56	0.8582
0.57	0.88425
0.58	0.90717
0.59	0.92702
0.6	0.94394
0.61	0.95808
0.62	0.96967
0.63	0.97893
0.64	0.98612
0.65	0.99148
0.66	0.99528
0.67	0.99778
0.68	0.99922
0.69	0.99987
0.7	1

A plot of water fractional flow as a function of water saturation is show in Figure 1.

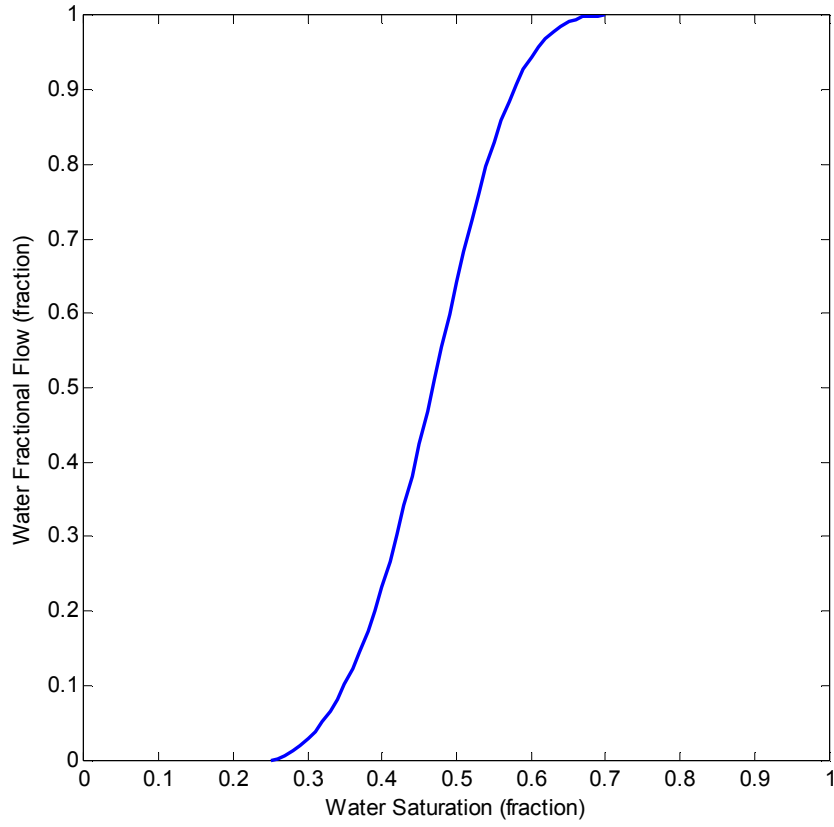


Figure 1. Plot of water fractional flow as a function of water saturation