Numerically Investigating the Effects of Artificial Fractures and Gel-Treatment on Hydrocarbon Recovery for Experimentally Waterflooded Core Samples by Using Embedded Discrete Fracture Model of MRST

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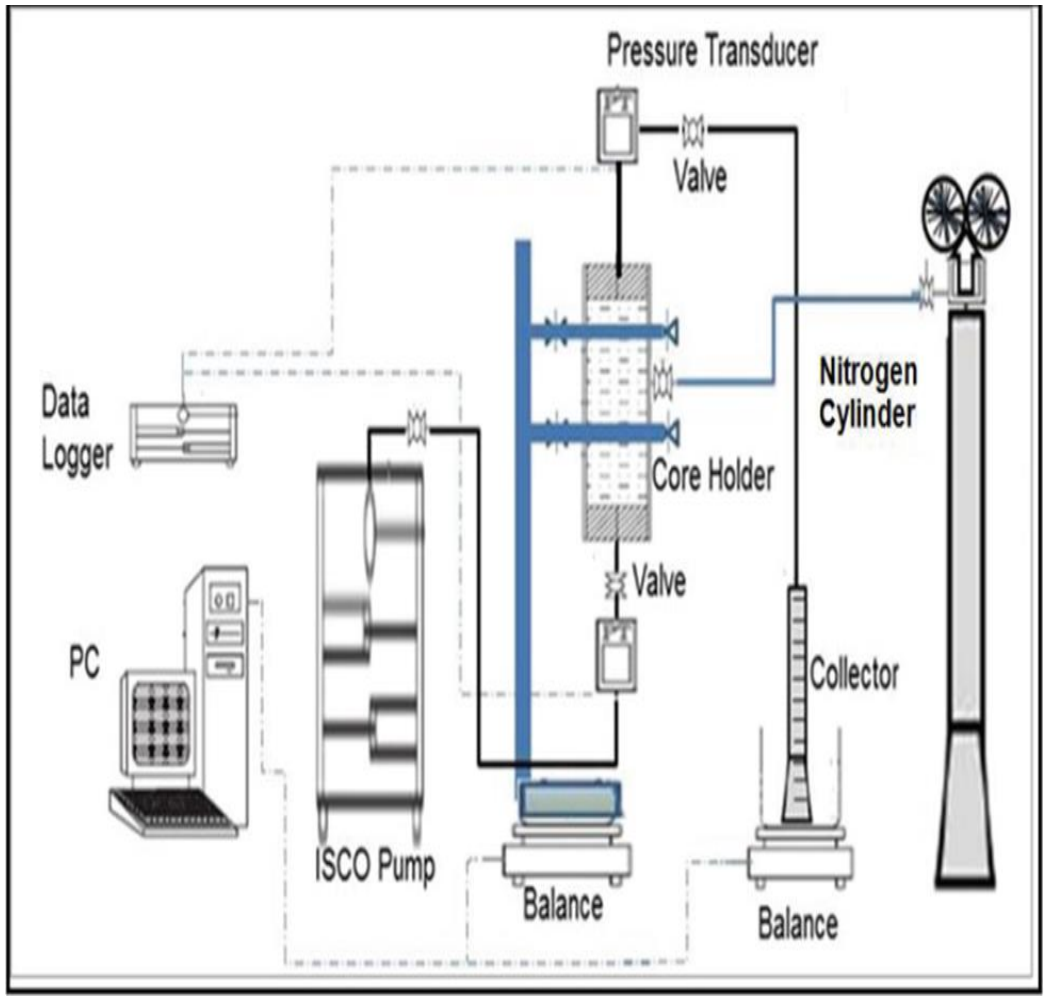
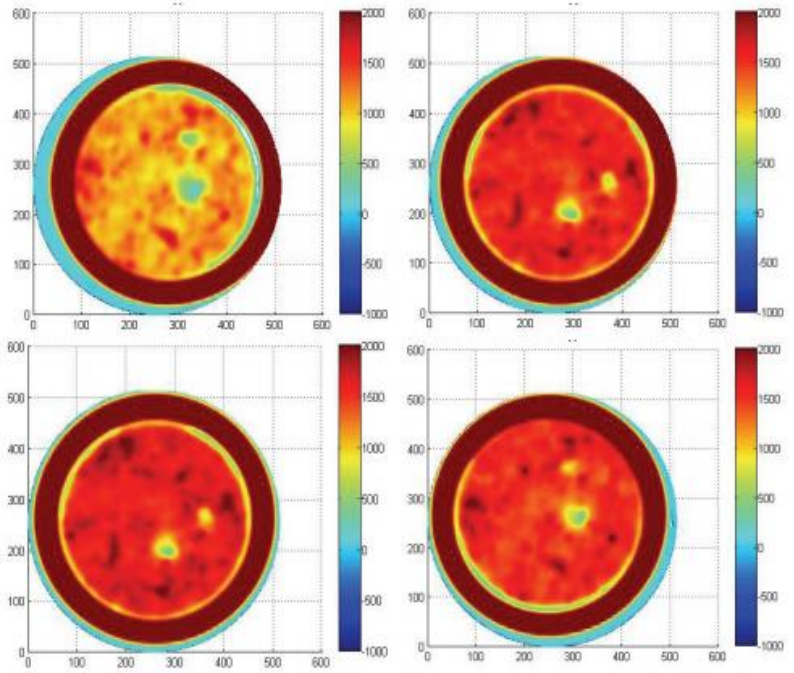
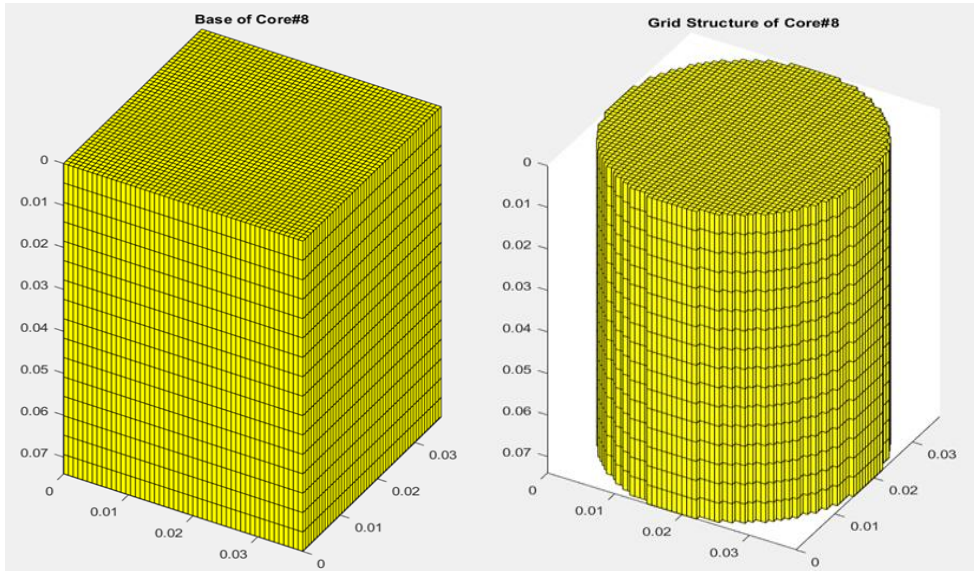
Experimental Set-Up

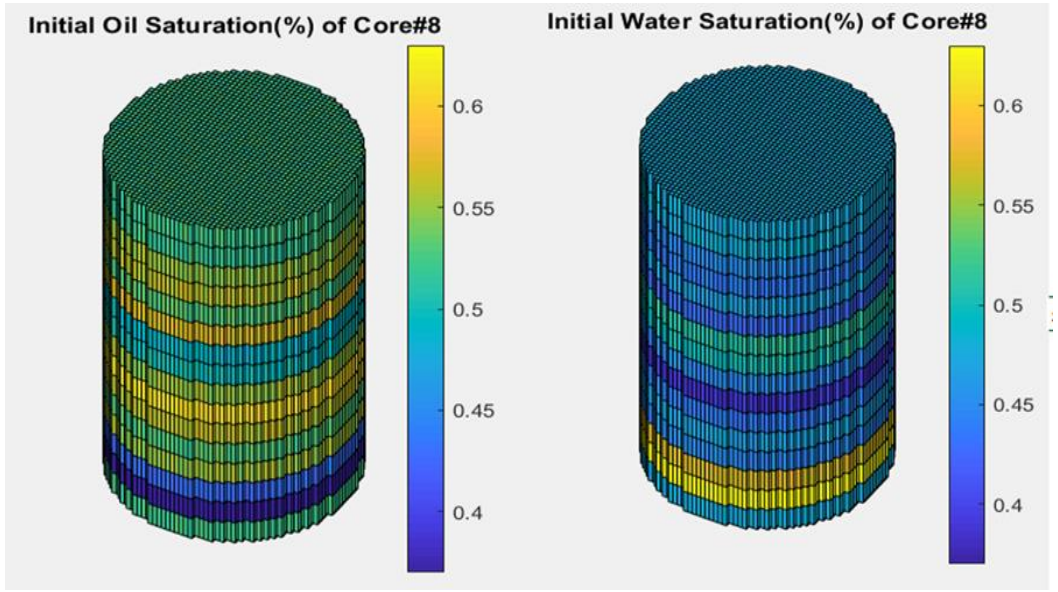


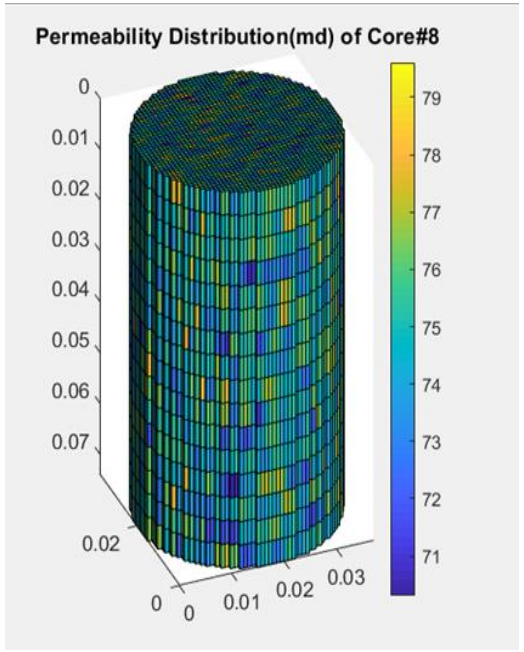


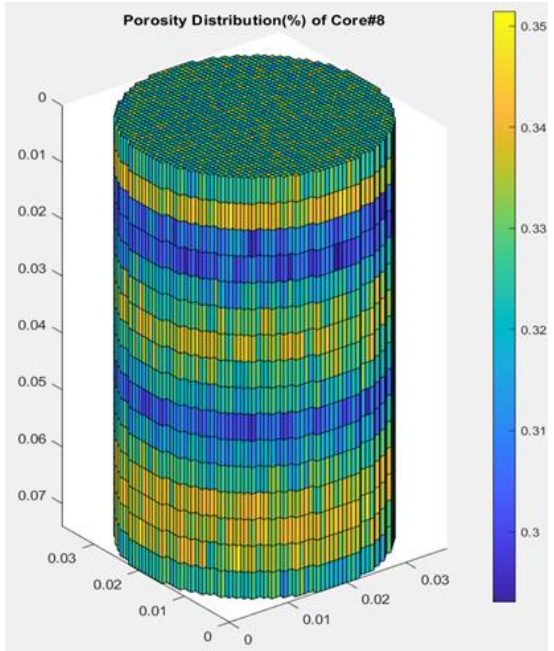
Core Plug	Fracture	Polymer Gel Treatment
Core Plug#2	Naturally fractured	Not applied
Core Plug#3	Artificially fractured	Applied to fracture
Core Plug#5	Non-fractured	Applied to matrix
Core Plug#7	Artificially fractured	Applied to fracture
Core Plug#8	Non-fractured	Not applied

Modelling of Core Plugs/Non-fractured

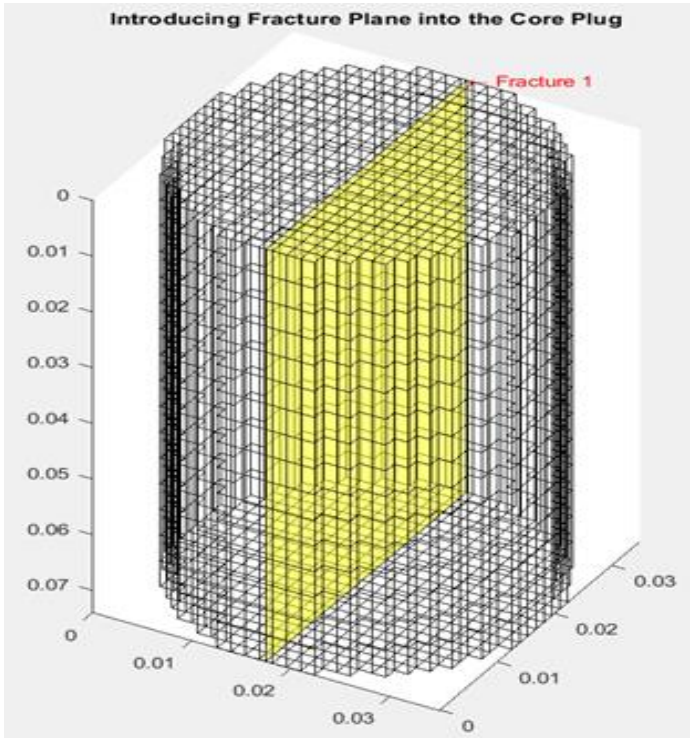


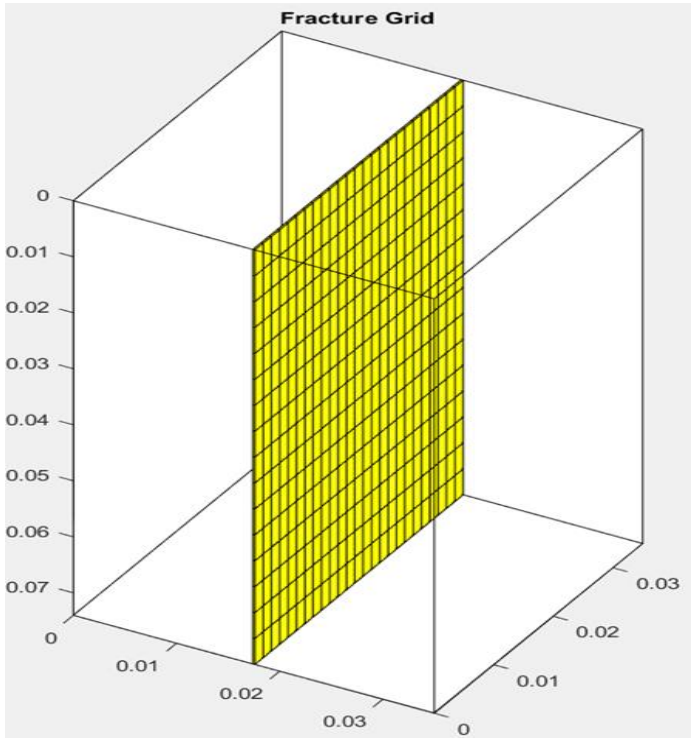


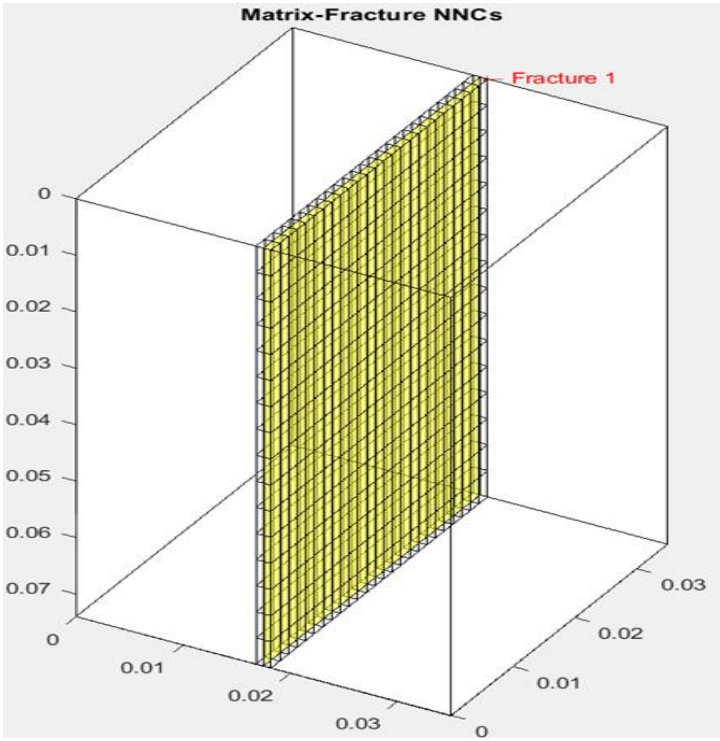




Modelling of Core Plugs/Fractured and Gel-Treated

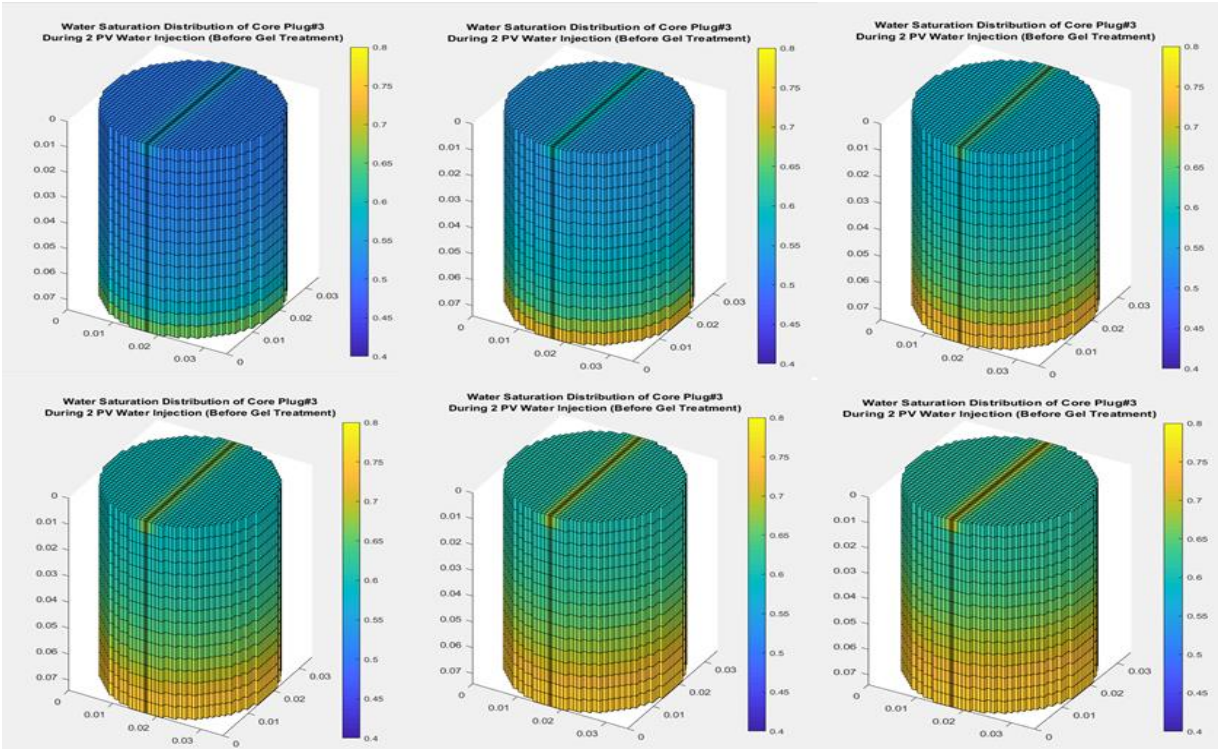




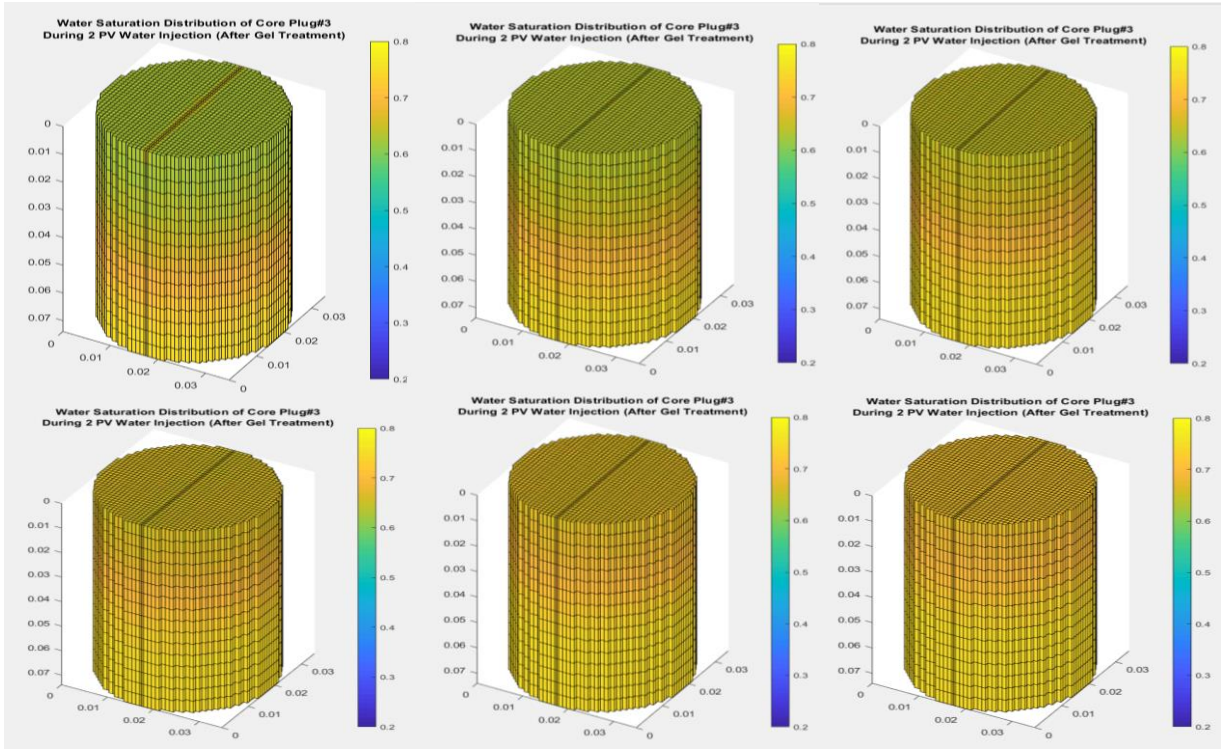


Polymer-gel treatment is modelled by changing fracture permeability and aperture.

3D Water Saturation Profile of Core Plug#3 During Water Injection



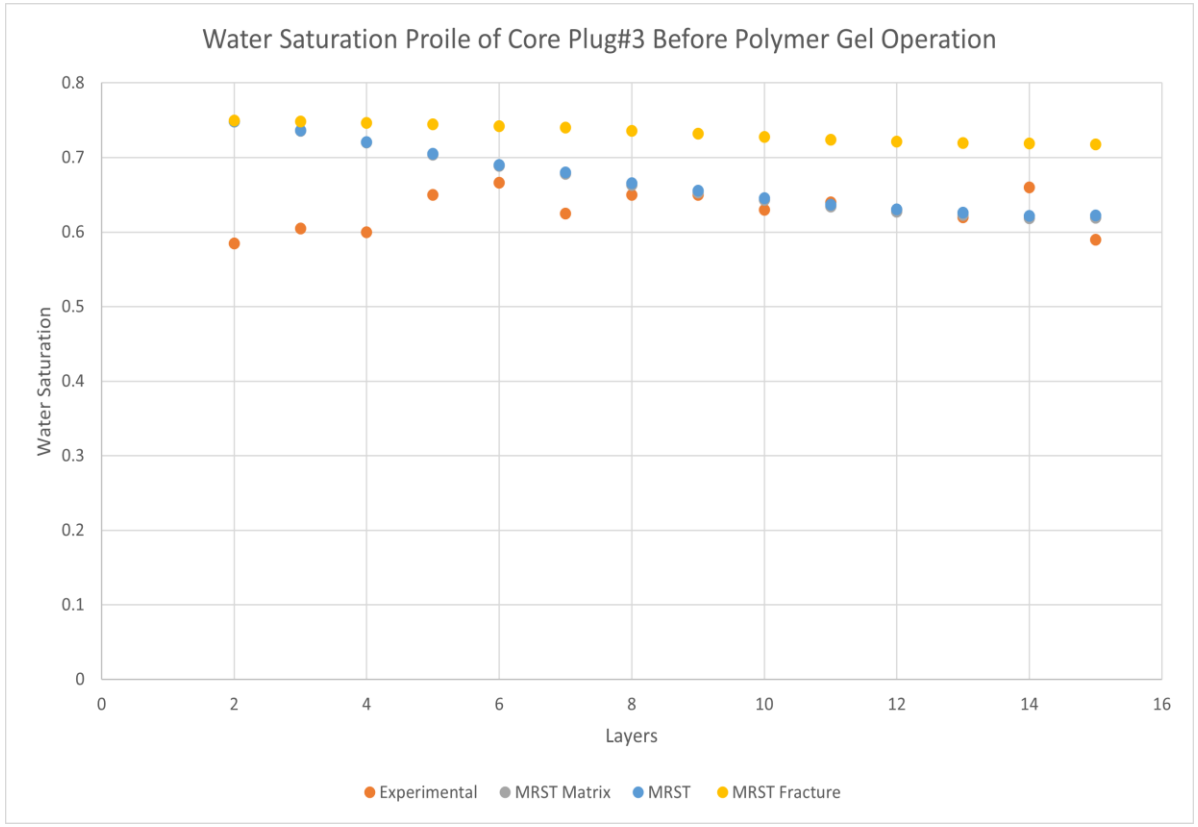
Before Polymer Gel Treatment

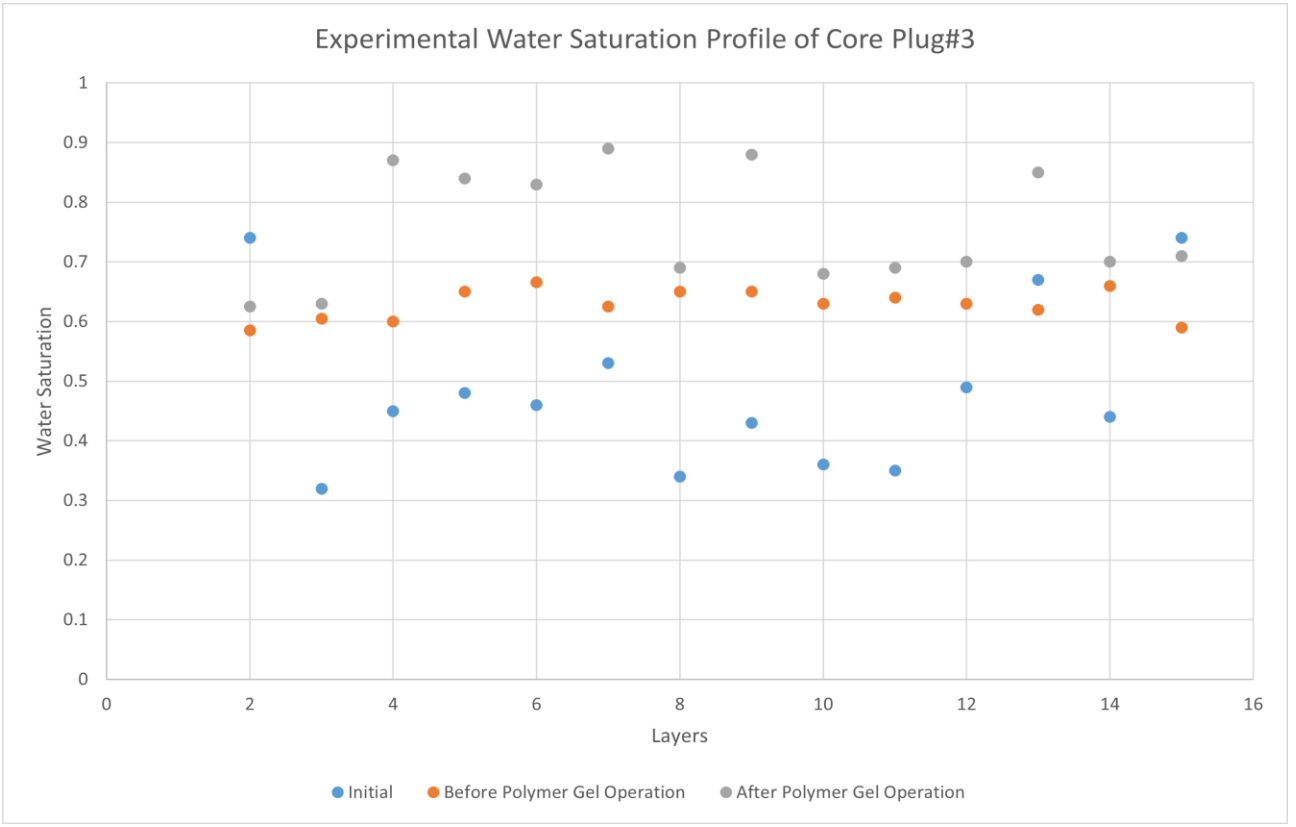


After Polymer Gel Treatment

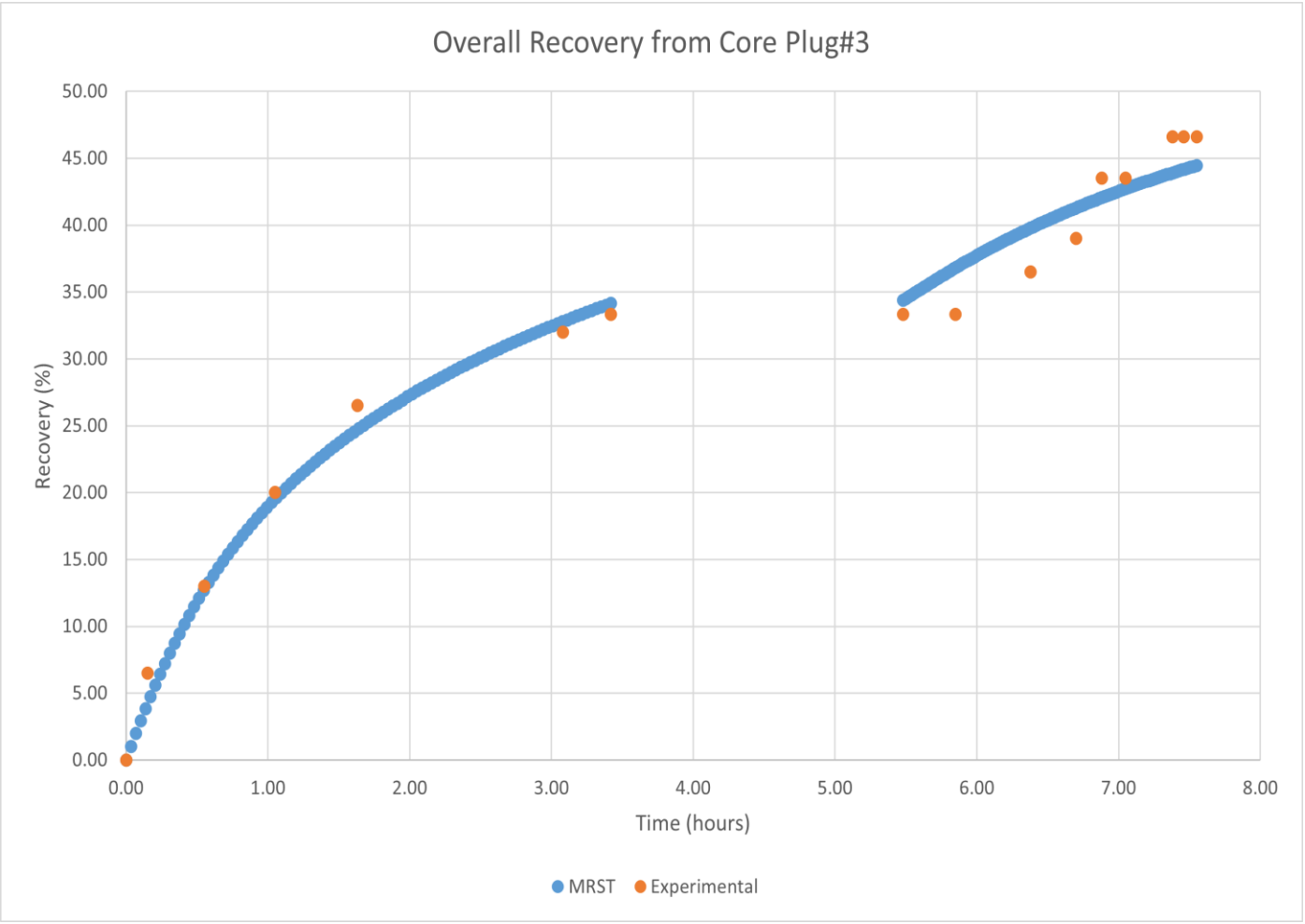
Total injection volumes are
0.2 PV----0.5 PV-----1 PV
1.4 PV----1.7 PV-----2 PV

Water Saturation Profiles of Core Plug#3





Recovery Match and Summary of Core Plug#3



Parameter	Experimental	MRST Model
Initial Oil Volume(cc)	15	15.78
Initial Sw %	49.47	50.5
Porosity %	34	33.57
Permeability	81	80.53
Pore Volume (cc)	24	24.14
Remaining Oil Volume After 2 PV Water Injection (cc)	10	10.3
Oil Recovery (%) After 2 PV Water Injection	33.33	34.15
Mean Sw(%) After 2 PV Water Injection	63.87	65.33
Polymer Gel Treatment		
Remaining Oil Volume After Polymer Gel Treatment and 2 PV more Water Injection (cc)	7	8.78
Oil Recovery (%) After Polymer Gel Treatment and 2 PV more Water Injection	46.66	44.47
Mean Sw (%) After Polymer Gel Treatment and 2 PV more Water Injection	71.1	72.53

Core Plug#8
Non-fractured, Non-Polymer Gel Treated

Parameters	Experimental	MRST Model
Initial Oil Volume(cc)	13	13.52
Initial Sw %	46.9	47.85
Porosity %	32	32.46
Permeability	74	73.98
Pore Volume (cc)	25.8	25.99
Remaining Oil Volume After 2 PV Water Injection (cc)	7.5	7.73
Oil Recovery After 2 PV Water Injection	42.5	42.79
Mean Water Saturation After 2 PV Water Injection	69.4	70.2

Core Plug#2
Naturally Fractured, Non-Polymer Gel Treated

Parameter	Experimental	MRST Model
Initial Oil Volume(cc)	12	12.78
Initial Sw %	52.63	52.5
Porosity %	34	33.97
Permeability	207	210
Pore Volume (cc)	27.05	27
Remaining Oil Volume After 2 PV Water Injection (cc)	7.5	8.05
Oil Recovery After 2 PV Water Injection	36.66	37.04
Mean Water Saturation After 2 PV Water Injection	69.63	70.09

Core Plug#7
Artificially Fractured, Polymer Gel Treated

Parameter	Experimental	MRST Model
Initial Oil Volume(cc)	14	13.91
Initial Sw %	41.7	41.54
Porosity %	32	32
Permeability	116	114.9678
Pore Volume (cc)	25.45	23.54
Remaining Oil Volume After 2 PV Water Injection (cc)	10	9.89
Oil Recovery(%) After 2 PV Water Injection	28.57	28.87
Mean Sw(%) After 2 PV Water Injection	58.34	58.38
Polymer Gel Treatment		
Remaining Oil Volume After Polymer Gel Treatment and 2 PV more Water Injection (cc)	8	8.23
Oil Recovery (%) Polymer Gel Treatment and 2 PV more Water Injection	42.85	40.83
Mean Sw(%) Polymer Gel Treatment and 2 PV more Water Injection	66.5	65.45

Core Plug#5
Non-Fractured, Polymer Gel Treated

Parameter	Experimental	MRST Model
Initial Oil Volume(cc)	14	14.15
Initial Sw %	43.04	41.54
Porosity %	31	31
Permeability	41	40.5
Pore Volume (cc)	24.66	24.83
Remaining Oil Volume After 2 PV Water Injection (cc)	7	6.92
Oil Recovery(%) After 2 PV Water Injection	50	52.14
Mean Sw(%) After 2 PV Water Injection	72	72.72
Polymer Gel Treatment		
Remaining Oil Volume After Polymer Gel Treatment and 2 PV more Water Injection (cc)	5	5.44
Oil Recovery(%) Polymer Gel Treatment and 2 PV more Water Injection	64.28	61.56
Mean Sw(%) Polymer Gel Treatment and 2 PV more Water Injection	76	78.09

Effects of Fracture Permeability/Aperture on Oil Recovery