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DESIGN A NEW SYSTEM IDENTIFICATION FOR A GASOLINE FLOW RATE THROUGH LAND LAYERS OF RESERVOIR SYSTEM

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ABSTRACT

In this work try to use different factors that effect on adsorption of gasoline from reservoirs. Study the effects of four inputs factors angles, diameter, bed's volume and height of reservoirs on adsorption of gasoline. Design a new mathematical model to evaluate all important parameters that effect on the system. Compare between experimental and theoretical results to reach to the high accuracy 98.96% that represents a new mathematical model. Then, make system identification to specify the most active parameters that effect on the adsorption of gasoline. Diameter of reservoir has a big effect on the output and interactions of the system reaches to 75.5%. Also, the height of a reservoir has active effect about 30.98%. Angle of slope of reservoir has less effects compare to diameter and height of reservoir.

KEYWORDS: Gasoline, Mathematical model, Adsorption, System identification, Optimization.

1. INTRODUCTION

Oil and gas accumulations occur in underground traps formed by structural and/or stratigraphic features. The hydrocarbon accumulations usually occur in the more porous and permeable portion of beds, which are mainly sands, sandstones, limestone's, and dolomites; in the intergranular openings; or in pore spaces caused by joints, fractures, and solution activity (Buckley and Leveret). A reservoir is that portion of the trapped formation that contains oil and/or gas as a single hydraulically connected system (Froning and Leach).

Available fracture models range from constructional of primarily digenetic origin.

Each and every method has its own technical restriction and application which is dependent upon multiple factors like temperature and pressure. In some situations, more than one method is applicable within a single reservoir as shown in Figure 1(Allen et al.,1950).

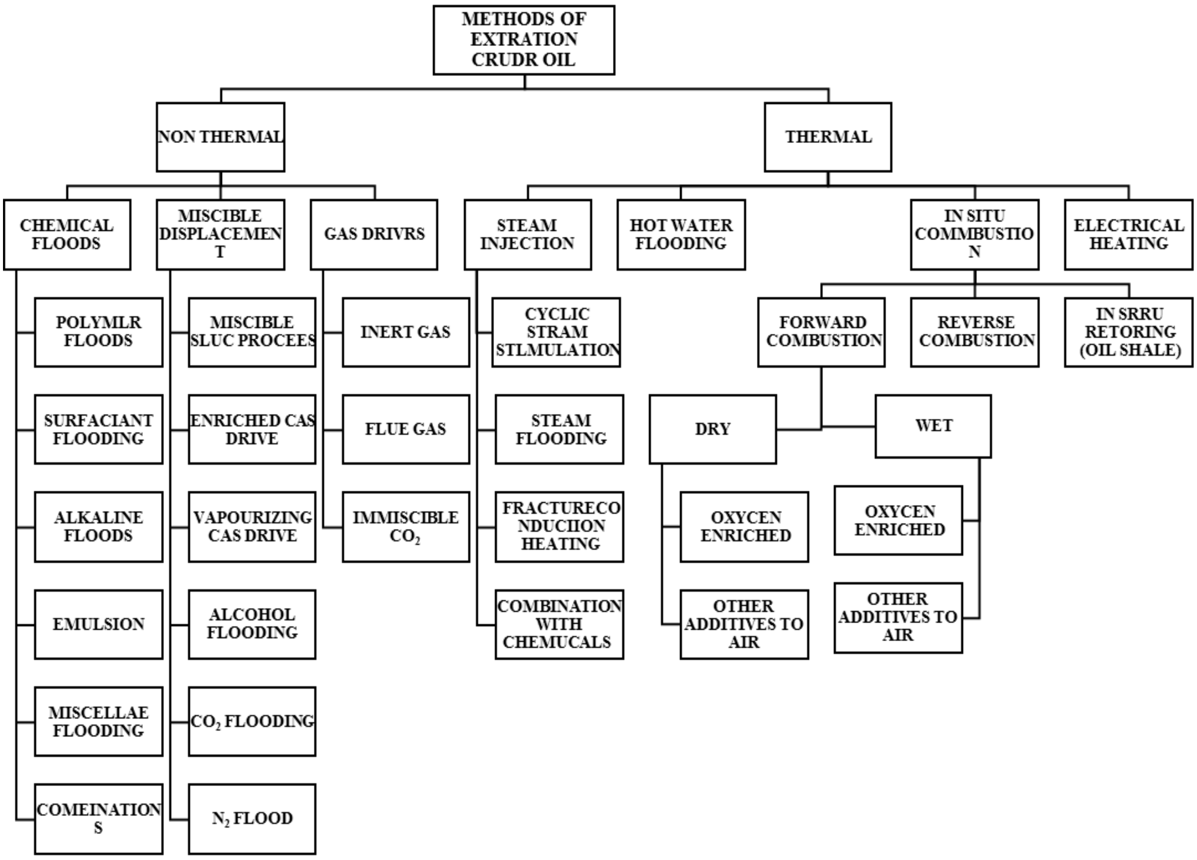

Figure 1: Different methods for extraction crude oil.

Some works were designed mathematical models to study the effect of wettability on oil recovery to improve oil displacement efficiency (Menezes et al., 1989). Depend on dense pattern conditions was produced mathematical model for reservoir (GUO Fang,2008). Researchers have been designed numerical model of three dimensions to simulate a turbid density through reservoir (Bruce A. Robinson et al.,1988) for the first time fluid flow through porous media was described by Dracy. Computational fluid dynamic using different techniques like finite elements to simulate Newtonian fluid (SudiptaSarkar,1990). Also, some works were used analytic solution to derive theoretical mathematical model to study the behavior of fluid through reservoir (Warren et al.,1963).

In 1980 Miller studied fluid flow interaction between well bore and reservoir and effects parameters on geothermal wells. In 1989 Winterfeld explained and compared between two phases of pressure build up in well bore and reservoir. In 2004 Sturm et. al., studied dynamic phenomena and used active control system.

In 2005 Belfroid et al., studied the effects of water and gas on performance of well bore. Sagen et al., studied the interaction between well, reservoir and pipe line is relevant to use commercial software. Leemhuis et al., (2008) designed PID controller to find optimum conditions. Some researchers provided high quality review of various studies about reservoir mathematical models (D.V.Ada Silva and J.D.Jansen,2015).

Arsalan et al., (2015) derived three dimensions' mathematical model for the basin of jurassic and cretaceous. M.A. Ahmadi et al., 2013 depended on actual experimental results helped to design advance models like Artificial Neural Network (ANN) to study the permeability of fluids in reservoirs.

Some researchers like Pouya Hosseinifar and Mehdi Assareh in 2016 was used the parameters of the PC-SAFT models to study the behavior of cuts and petroleum fraction parameters.

In this work we used a numerical technique to design numerical models depend on experimental result then design identification system to specify the best active parameters that effect on permeability of gasoline through earth reservoirs layers of Oman.

2. METHODOLOGY

It can be classified in three categories experimental work, mathematical model and system identification.

2.1. Experimental study

Study the effect of height, diameter and angle slope of reservoir on the adsorption of gasoline as shown in Figures 2, 3 and 4 respectively. Derive numerical model to study the effect of the residual friction length has a major influence on the adsorption of gasoline. Different length of tubes to adsorb gasoline from reservoir for 31.1 cm, 28.1 cm and 19.5 cm as shown in Figure 5.

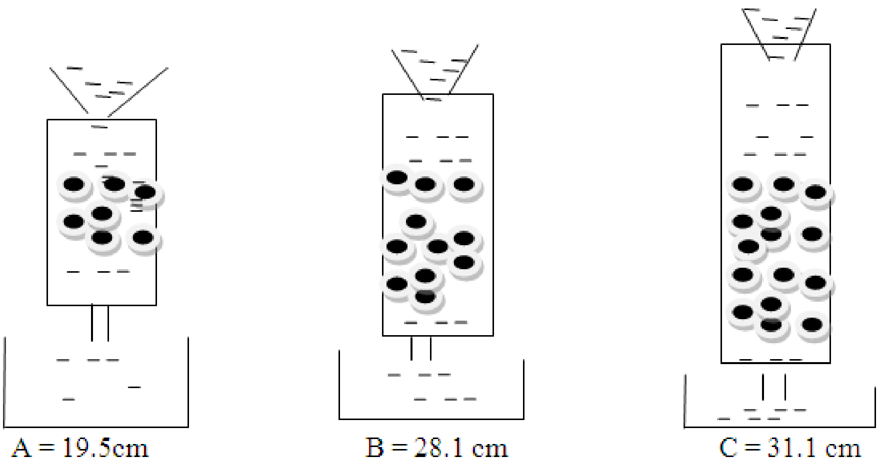

Figure 2: Different lengths of reservoir.

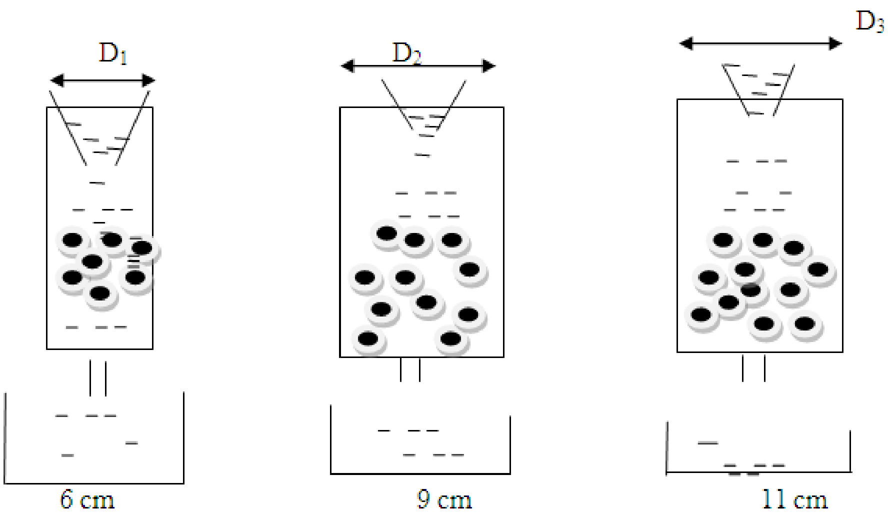

Figure 3: Different diameters of reservoir.

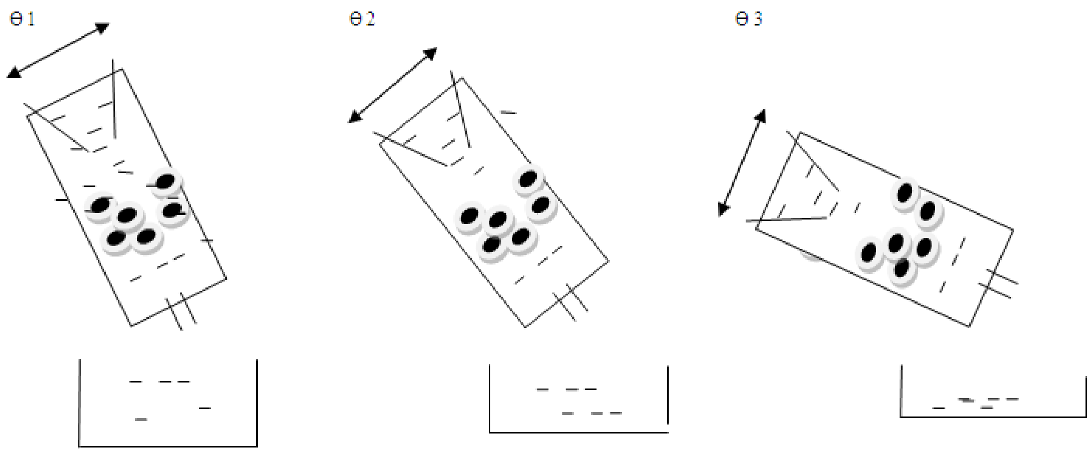

Figure 4: Different Angle of bed's reservoir.

For each tube has different bed volumes for 10%, 30%, 50%, 70% and 90% as shown in Figures 5 and Table1.

Depend on mesh results from experimental work includes three relations between bed volume, length of tubes and volume of gasoline adsorbed by composition of ground layer of reservoir as shown in Table 1.

Table 1: Results of adsorption as a function to the bed volume and length of tubes.

Bed of volume (%) / Length (cm)	10	30	50	70	90
31.1	260 mL	220 m L	345 mL	580 m L	390 m L
28.1	100 mL	120 mL	260 mL	400 m L	500 m L
19.5	120 mL	90 mL	140 mL	200 mL	290 m L

Using Lagrange interpolation method to derive a new mathematical model depends on experimental results.

$$f(bed\%, length) = \sum_{i=10}^{i=90} \sum_{n=19.5}^{n=31.1} L_i(x) L_n(y) \qquad (1)$$

$$L(X_1) = (X - 30)(X - 50)(X - 70)(X - 90) / 3840000 \qquad (2)$$

$$L(X_2) = (X - 10)(X - 50)(X - 70)(X - 90) / -960000 \qquad (3)$$

$$L(X_3) = (X - 10)(X - 30)(X - 70)(X - 90) / 640000 \qquad (4)$$

$$L(X_4) = (X - 10)(X - 30)(X - 50)(X - 90) / -960000 \qquad (5)$$

$$L(X_5) = (X - 10)(X - 30)(X - 50)(X - 70) / 3840000 \qquad (6)$$

$$L(Y_1) = (Y - 28.1)(Y - 19.5) / 34.8 \qquad (7)$$

$$L(Y_2) = (Y - 31.1)(Y - 19.5) / -25.8 \qquad (8)$$

$$L(Y_3) = (Y - 31.1)(Y - 28.1) / 99.76 \qquad (9)$$

The best optimum conditions for bed are 16.5% and 23.5 cm height of tube as shown in Figure 4.

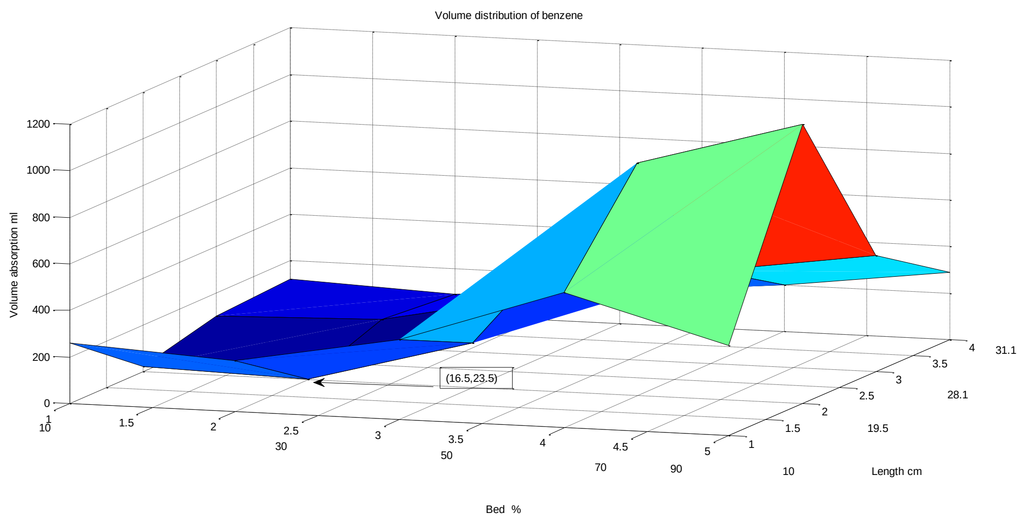

Figure 5: Best optimum conditions for bed volume % and tube length in cm.

Different diameter of tubes to adsorb gasoline from reservoir for 6, 9 and 11 cm for tubes have different bed volume percentage 10%, 30%, 50%, 70% and 90%.

Depend on mesh results from experimental work includes three relations between bed volume, diameters of tubes and volume of gasoline adsorbed by composition of ground layer of reservoir as shown in Table 2 and Figure 6.

Table 2: Results of volume adsorption of gasoline as a function to bed volume and diameter of cylindrical bottles.

Bed% / Diameter	10	30	50	70	90
11 cm	140 ml	240 ml	300 ml	380 ml	430 ml
9 cm	100 ml	170 ml	210 ml	300 ml	300 ml
6 cm	115 ml	120 ml	100 ml	190 ml	210 ml

Using Lagrange interpolation method to derive a new mathematical model depends on experimental results.

$$f(bed\ porosity\ \%, diameter) = \sum_{i=10}^{i=90} \sum_{n=6}^{n=11} L_i\,(x) L_n(y) \tag{10}$$

$$L(X_1) = (X - 30)\ (X - 50)\ (X - 70)\ (X - 90)\ /3840000 \tag{11}$$

$$L(X_2) = (X - 10)\ (X - 50)\ (X - 70)\ (X - 90)\ /\ -960000 \tag{12}$$

$$L(X_3) = (X - 10)\ (X - 30)\ (X - 70)\ (X - 90)\ /\ 640000 \tag{13}$$

$$L(X_4) = (X - 10)\ (X - 30)\ (X - 50)\ (X - 90)\ /-960000 \tag{14}$$

$$L(X_5) = (X - 10)\ (X - 30)\ (X - 50)\ (X - 70)\ /3840000 \tag{15}$$

$$\boldsymbol{Ly1} = \frac{(y-9)\,(y-6)}{10} \tag{16}$$

$$\boldsymbol{Ly2} = \frac{(y-11)\,(y-6)}{-6} \tag{17}$$

$$\boldsymbol{Ly3} = \frac{(y-11)\,(y-9)}{15} \tag{18}$$

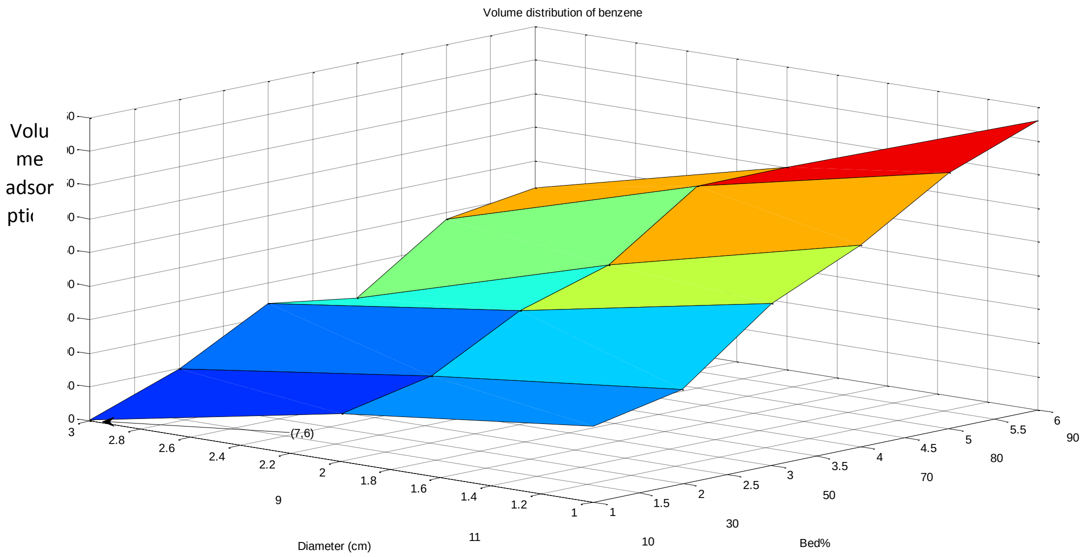

Figure 6: Best optimum conditions for bed volume % and tube diameter in cm.

From Figure above, the best optimum conditions for bed are 7% and 6 cm diameter of reservoir.

Depend on mesh results from experimental work includes three relations between bed volume, angle of slope of reservoir and volume of gasoline absorbed by composition of ground layer of reservoir as shown in Table 3 and Figure 7.

Table 3: Volume absorbed as a functions of angle of tube and bed volume.

Volume V(mL) / Angel (degree)	10% V(mL)	30% V(mL)	50% V(mL)	70% V(mL)	90% V(mL)
10°	100	220	390	460	700
30°	60	180	400	340	680
60°	120	200	400	560	640

Using Lagrange interpolation method to derive a new mathematical model depends on experimental results.

$$f(bed\%, Angel) = \sum_{i=10}^{i=90} \sum_{n=10}^{n=60} L_i(x) L_n(y) \quad (19)$$

$$L(X_1) = (X - 30)(X - 50)(X - 70)(X - 90) / 3840000 \quad (20)$$

$$L(X_2) = (X - 10)(X - 50)(X - 70)(X - 90) / -960000 \quad (21)$$

$$L(X_3) = (X - 10)(X - 30)(X - 70)(X - 90) / 640000 \quad (22)$$

$$L(X_4) = (X - 10)(X - 30)(X - 50)(X - 90) / -960000 \quad (23)$$

$L(X_5) = (X - 10)(X- 30)(X- 50)(X- 70)/3840000$ (24)

$L(Y_1) = (Y – 30°)(Y – 60°) / 1000°$ (25)

$L(Y_2) = (Y – 10°)(Y – 60°) /-600°$ (26)

$L(Y_3) = (Y – 10°)(Y – 30°) /1500°$ (27)

The best optimum conditions for bed are 10% and 32^o angle of tube due to reduce the adsorption and increase the porosity as shown in Figure 6.

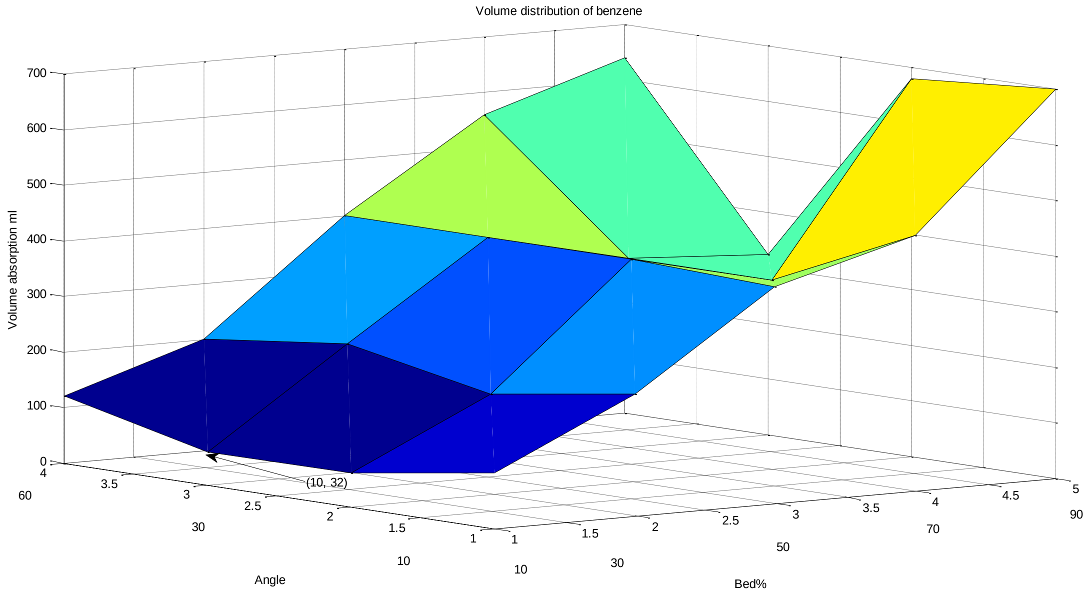

Figure 7: Best optimum conditions for bed volume % and angle of tube.

2.2. System identification study

Depends on active technique for identification system (Ahmmed Saadi Ibrahem, 2011). Figure 8 shows the input variables and output variable of the system.

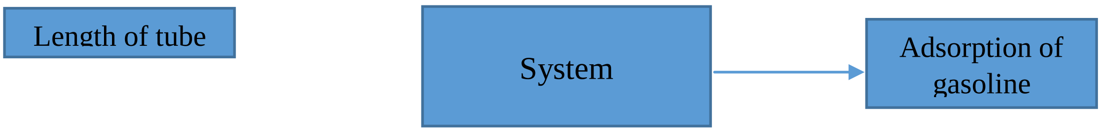

Figure 8: Variables of reservoir system.

To evaluate these three input variables on the output of the system depend on the ratio of slope deviation of the output to the input of the system to be classified as follows;

$\Theta > 20^o$ (Big effects on the system).

$20^o > \Theta > 15^o$ (Middle effects on the system).

$15^o > \Theta > 10^o$ (Weak effects on the system).

$10^o > \Theta$ (Cannot be considered).

Table 4: Computational of percent deviation for diameter toward output profile.

x	**y**	$\frac{x-x_n}{x_n}$	$\frac{y-y_n}{y_n}$	**Slope**
13	403.3	0.3	0.592	1.973
12	350	0.2	0.381	1.905
11	300	0.1	0.605	6.05
10	253.3	0	0	0
9	210	0.1	0.17	1.7
8	170	0.2	0.328	1.64
7	133.3	0.3	0.473	1.576
k_{av}				k_av=2.12
Ɵ				64.752^o
Effect %				72%

Table 5: Computational of percent deviation for length toward output profile.

x	**y**	$\frac{x-x_n}{x_n}$	$\frac{y-y_n}{y_n}$	**Slope**
36.4	549.7	0.3	1.134	3.78
33.6	432.879	0.2	0.68	3.4
30.8	335.5	0.1	0.302	3.02
28	257.551	0	0	0
25.2	199.0436	0.1	0.227	2.27
22.4	159.9738	0.2	0.38	1.9
19.6	140.3417	0.3	0.455	1.516
k_{av}				k_av=2.27
Ɵ				66.225^o
Effect%				73.583%

Table 6: Computational of percent deviation for angle toward output profile.

x	**y**	$\frac{x-x_n}{x_n}$	$\frac{y-y_n}{y_n}$	**Slope**
39	401.109	0.3	2.772×10^{-3}	9.24×10^{-3}
36	401.44	0.2	3.6×10^{-3}	0.018
33	400.81	0.1	2.025×10^{-3}	0.02025
30	400	0	0	0
27	399	0.1	2.5×10^{-3}	0.025
24	397.84	0.2	5.4×10^{-3}	0.027
21	396.5	0.3	8.75×10^{-3}	0.029
k_{av}				k_av=0.0183
Ɵ				1.05^o
Effect%				1.168%

4. CONCLUSION

This work gives a suitable technique to determine which is the most active parameters the effect on over all the system. From the results the diameter of reservoir has a big effect on the output adsorption and interaction effects between the inputs parameters. Height of reservoir has active effect on the output adsorption and interaction effects between the inputs parameters. Angle of slope of reservoir has a lower effect compare to the other inputs parameters.

REFERENCES

1. Arsalan Zeinalzadeh, Reza Moussavi-Harami, Asadollah Mahboubi, Vali Ahmed, "Basin and petroleum system modeling of the jurassic and cretaceous source rocks of the gas and oil reservoirs in Darquain field, south west Iran", 2015; 26: 419-426.
2. Ahmmed Saadi Ibrahim, "System Identification for Experimental Study for Polymerization Catalyst Reaction in Fluidized Bed", Bulletin of Chemical Reaction Engineering & Catalysis, 2011; 6(2): 137–146.
3. Allen, F. H. and Roe, R.P., "Performance Characteristics of a Volumetric Condensate Reservoir," Petroleum Transactions, AIME, 1950; 189: 83-90.
4. Buckley and Leveret, "Derivation of the fractional flow equation for a one-dimensional oil-water system", Report, 1941.
5. Belfroid, S. P. C., Sturm, W. L., Alberts, G. J. N., Peters, M. C. A. M., and Schiferli, W., "Prediction of well performance instability in thin layered reservoirs". In SPE (ed.), SPE Annual Technical Conference and Exhibition, 95835. SPE, SPE, Dallas, Texas.
6. Bruce A. Robinson, Jefferson W. Tester, Lee F. Brown, "Reservoir Sizing Using Inert and Chemically Reacting Tracers", book, 1988.
7. Darcy, "A calculation of the viscous force exerted by a flowing fluid on a dense swarm of particles", Applied Scientific Research, 1949; 1: 12-27.
8. D.V. Ada Silva, J.D.Jansen, "A review of coupled dynamic well-reservoir simulation", IFAC, 2015; 48-6: 236-241.
9. Froning and Leach, "A field test in Clear fork and Gallup reservoirs for improving oil recovery by wet ability alteration", report, 1967.
10. GUO Fang-da, CHEN, "Reservoir Determinable Modeling Basing on Dense Pattern Condition in Shuanghe Oil Field", Inner Mongolia Petrochemical Industry V, 2008; 1: 35-46.
11. Leemhuis, A.P., Nennie, E.D., Belfroid, S.P.C., Alberts, G.J.N., Peters, E., and Joosten, G.J.P. (2008), "Gas coning control for smart well suing dynamic coupled well, reservoir simulator. In SPE (ed.), SPE Intelligent Energy Conference and Exhibition, 112234.SPE, SPE, Amsterdam, The Netherlands.

12. Menezes, J. L., Yan, J., and Sharma, M. M., "The Mechanism of Wettability Alteration Due to Surfactants in Oil-Based Muds," paper SPE 18460, presented at the 1989 International Symposium of Oilfield Chemistry, Houston, TX, 1989.
13. Miller, C. W., "Well bore storage effects in geothermal wells. SPE", 1980.
14. M.A. Ahmadi, S. Zendehboudi, A. Lohi, A. Elkamel, I. Chatzis, "Application of hybrid genetic algorithm with particle swarm optimization and neural network for reservoir permeability prediction", Geophys. Prospect, 2013; 61: 582-598.
15. M.A. Ahmadi, M. Ebadi, A. Shokrollahi, S.M.J. Majidi, "Evolving artificial neural network and imperialist competitive algorithm for prediction oil flow rate of the reservoir", Appl. Soft Comput, 2013; 13: 1085-1098.
16. Pouya Hosseinifar, Mehdi Assareh, "Developing a new model for the determination of petroleum fraction PC-SAFT parameters to model reservoir fluids", Fluid Phase Equilibria, 2016; 412: 145-157.
17. SudiptaSarkar, M. NafiToksöz, and Daniel R. Burns, "Fluid Flow Modeling in Fractures", Report of Massachusetts Institute of Technology, 1995.
18. Sturm, W.L., Belfroid, S.P.C., van Wolfswinkel, O., Peters, M.C.A.M., and Verhelst, F.J.P.C.M.G., "Dynamic reservoir well interaction". In SPE(ed.), SPE Annual Technical Conference and Exhibition. SPE, SPE, Hous-ton, Texas, 2004.
19. Sagen, J., Sira, T., EK, A., Selberg, S., Chaib, M., and Eid smoen, H., "A coupled dynamic reservoir and pipe line model, development and initial experience". BHR Group Multiphase Production Technology, 2007; 13: 20-31.
20. Warren, J.E., and Root, P.J.: Sept., "The Behavior of Naturally Fractured Reservoirs", SPE Journal, 1963; 1: 245-255.
21. Winterfeld, P. H., "Simulation of pressure build up in a multiphase well bore reservoir system". SPE Formation Evaluation, 1989; 15: 247–252.