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Initial study of production optimization in MH field using simulation software

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Abstract

There are now 18 operational wells in the MH field, an onshore oil field. The MH Field has to be developed because annual production there has dropped. Evaluation is one of the many factors that must be taken into account prior to improving production based on a production network system. The process of evaluating the MH field involves digitizing data into petroleum software. This work aims to assess the MH field prior to optimization. With the purpose of detecting issues in the MH Field and creating scenarios to boost production rates there, this assessment research was conducted at the MH Field with the use of petroleum software. To ensure that the simulation results accurately reflect the real field conditions, the first step in creating a pipe flow simulation is to characterize the actual field conditions. This demonstrates that the simulation results can be utilized as a reference for real data after simulating pipe flow in the MH Field with a variation factor less than 10%. The flow rate simulation's average variance was 0.40%, while the wellhead pressure simulation's divergence was 2.13%. These are excellent results from the MH field evaluation simulation. The MH research yielded satisfactory results, and in order to boost production rates, production optimization work needs to be continued.

Keywords: Production, optimization, simulation, fluid flow

1. Introduction

The flow of fluid that flows through the oil and surface gas production facilities usually starts from the well head, then the fluid passes through the production pipes and accumulates in the manifold, after which the fluids will be separated by the separator and ends in the collection tank. Increasing the production flow rate of a field can begin with the knowledge of the production network system on the field itself so that it can know the problems that occur on a field in order to increase the flow rate (Frank *et al*., 2019) [6]. There are some things to bear in mind when optimizing production with the production system, such as back pressure or back pressure to the well head that can suppress the production rate (Salaudeen *et al*., 2022) [11].

In the oil and gas industry, the multi-phase flow in pipes can cause different flow regimes in the flow, depending on the flow speed, density, and viscosity of the fluid (Hansen *et al*., 2019) [7] (Yadigaroglu & Hetsroni, 2018) [15] (Saputra *et al*., 2023) [12]. The predictive pressure loss values need to be known to optimize production in the field, to determine the distribution of pressure drop and to visualize flow regimes (Mouketou & Kolesnikov, 2019) [9].

Multiphase fluid flow correlation in a pipe is a mathematical method or equation to calculate the flow speed and phase distribution in the pipe (Al-Rbeawi, 2019) [2]. These correlations are used in the petroleum and gas industry to optimize oil and gas production, calculate mass transfer, and design production pipe systems (Wang *et al*., 2019) [14].

A model of nodal analysis is run for each well. The network is then created and the well is connected to the manifold. The nodal analysis of the entire tissue is then evaluated (Al-Qasim *et al*., 2019) [1]. Parameters are believed to affect the rate of production tested in different scenarios (Odjugo *et al*., 2020) [10]. Some of these parameters are tubing and flowline size, skin factor, water cut, and gas-lift surface injection pressure (Dmour, 2013) [4].

2. Methodology

In the simulation study of the flow of pipes of the production pipeline network at MH Field, an evaluation was carried out based on data obtained from the field such as production data, data of well diagrams, and data of production facilities in the field that were then processed so that the software results could represent the actual field conditions with a rate difference of less than 10%. The evaluation results will then be used to optimize the field in order to determine the best scenario that can be applied on the field to improve production.

The method used in this simulation can be seen in Figure 1 which shows the flowchart of the research. First, it collects data from both a well database and a data network for use in the digitization of data into the software used. After the deployment phase is completed, the well base is subsequently laid from the wells that are active in the field and the network is made according to the actual field data.

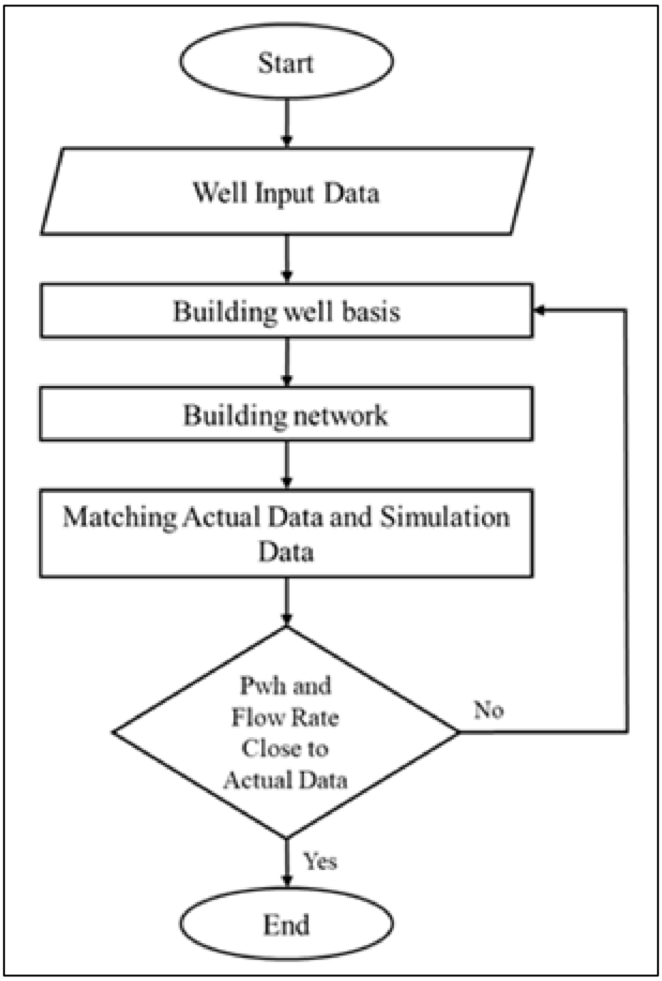

Fig 1: Research Flowchart

The first phase of this research is the study of literature based on materials used in research such as production techniques, artificial lifting techniques, reservoir techniques, underground equipment, and production facilities used as well as the basis of the use of petroleum software to evaluate production in the field. Once the field data collection phase has been obtained, then proceed to the phase of making/digitalizing data into petroleum software. In the first phase the digitization of data into oil software is carried out on a well basis. The creation of well data is done by entering physical well data such as tubular data, well trajectory data if the well is a directional well, downhole equipment data, artificial lift data, and complication data. In addition to well physical data, fluid data is also required for each production well in the field, which includes water cut, gas oil ratio, and specific oil gravity in the field. After the well base is built, a well network is created on the petroleum software to simulate the flow.

3. Result and Discussion

The first step in simulating pipeline flow on the MH Field production network is to gather data on wells such as well physical data, reservoir fluid data, and well production data. Where Table 1 shows well production and fluids data and Table 2 shows wells physical data.

Table 1: Production and Well Fluid Data

Well	Liquid Production (BFPD)	Water Cut (%)	GOR (SCF/STB)	API
MH-001	258,4	100	0	-
MH-002	695,5	100	0	-
MH-003	47,8	2,67	1165,291	31
MH-004	129,0	2,26	426,8554	31
MH-005	10,4	83,33	0	39
MH-006	18,1	44,17	0	39
MH-007	12,5	21,74	5287,286	39
MH-008	22,0	42,86	0	38
MH-009	29,6	96,15	0	39
MH-010	103,1	85,17	6606,057	39
MH-011	43,6	2,13	0	43
MH-012	130,0	92,36	0	43
MH-013	11,0	0	0	39
MH-014	12,6	8,70	28126,36	39
MH-015	23,9	12,64	19861,11	41
MH-016	150,0	10,90	0	43
MH-017	57,0	29,12	0	41
MH-018	17,9	75,00	0	41

From well physical data, reservoir fluid data, and well production data; well bases can be made using petroleum software. Figure 2 shows an example of well base in the MH field after well base construction and then nodal analysis to see if the well conditions correspond to the actual field conditions. Figure 3 shows nodal analyses of the sample of well field MH.

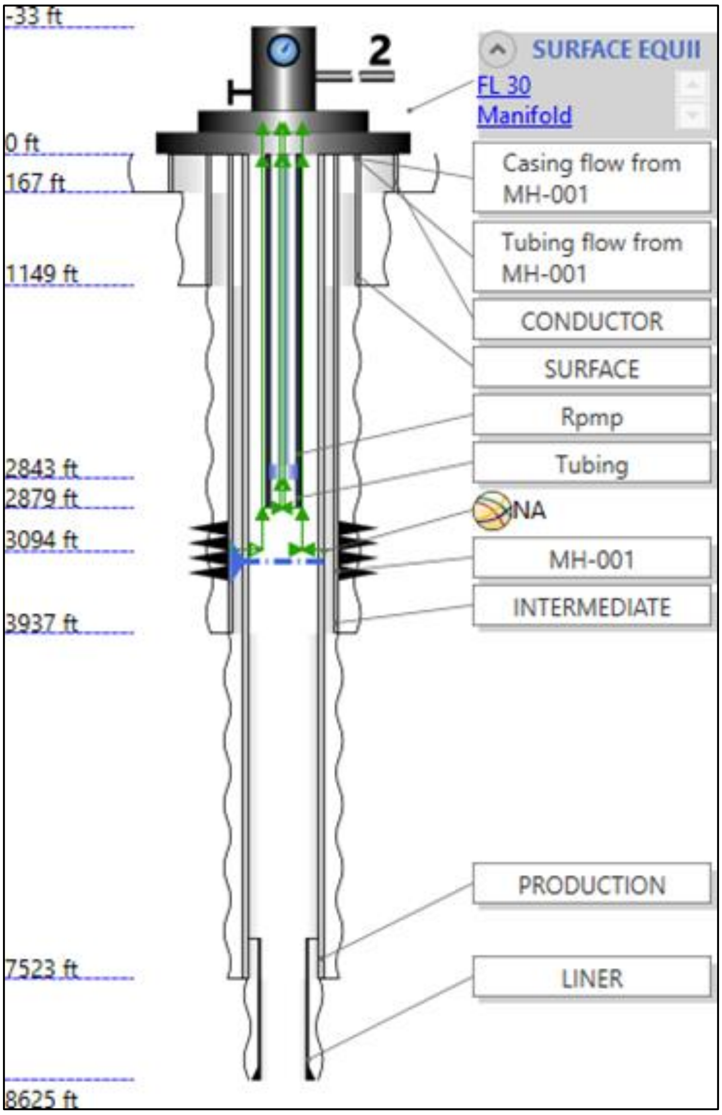

Fig 2: Well Base

In the early stages of well base production in the field MH carried out the data required in the process of digitization of well data on oil software, such as well profile data consisting of data casing, data tubing, complication data, data lifting, well trajectory data, reservoir data, fluid properties data reservoirs, as well as downhole equipment data used on each well.

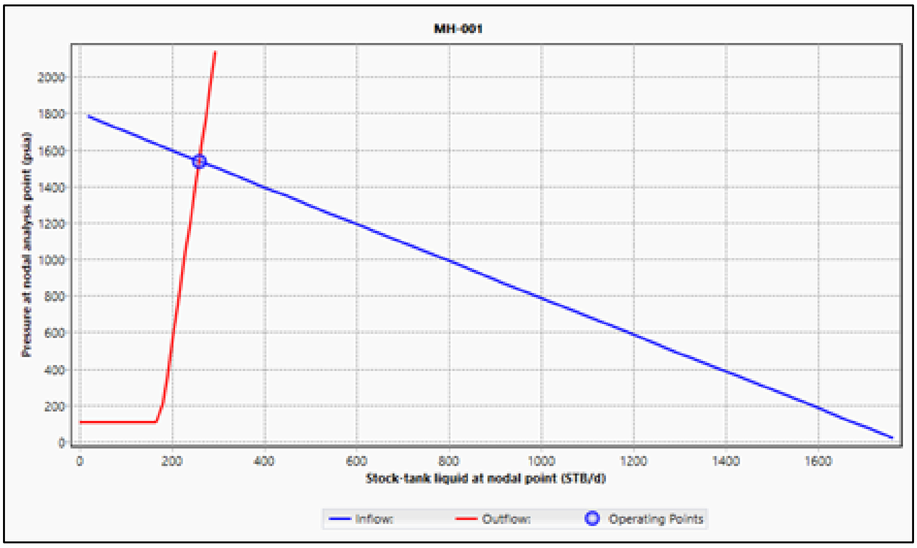

Fig 3: Nodal Analysis

The next step in simulating the production network on a field is to create a network scheme on the field. Figure 4 shows the network schema on the MH field.

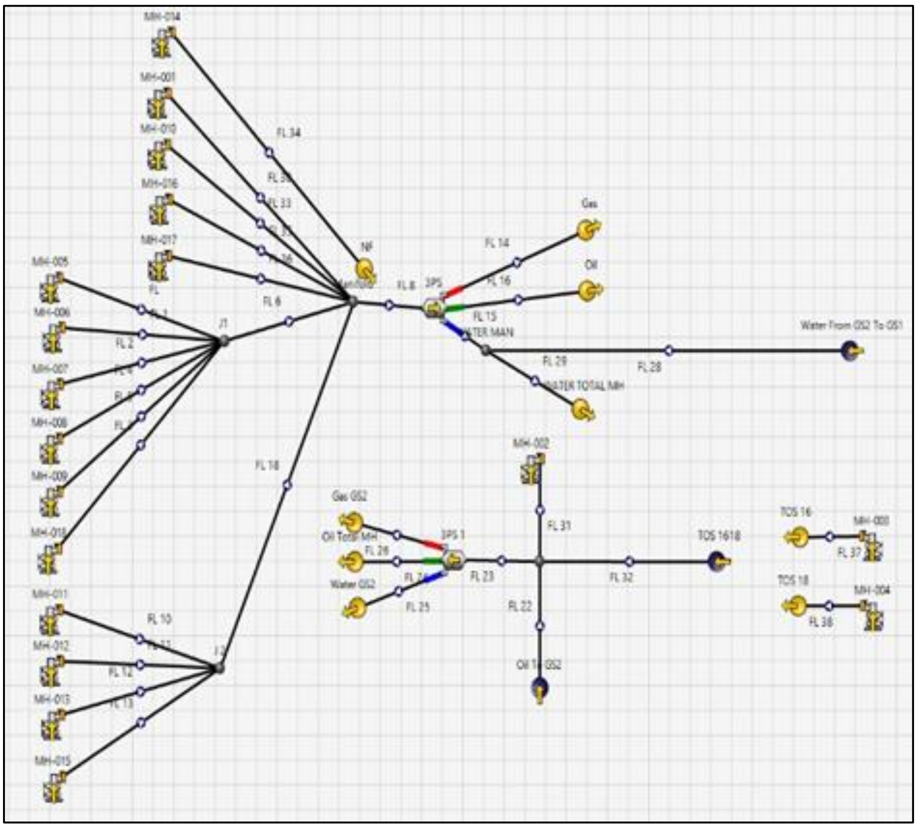

Fig 4: MH Field Network Scheme

After carrying out a simulation using the data described above, the simulation results for the flow rate obtained from each well consist of the oil flow rate, the gas flow rate and the water flow rate.

Table 3: Flow Simulation Results

Well	Q Liquid Actual (STB/D)	Q Liquid Simulation (STB/D)	Deviation (%)
MH-001	258,4	258,4	0,00
MH-002	695,5	695,5	0,00
MH-003	47,8	47,8	0,12
MH-004	129,0	129,0	0,02
MH-005	10,4	10,4	0,03
MH-006	18,1	18,1	0,03
MH-007	12,5	12,6	0,26
MH-008	22,0	22,0	0,17
MH-009	29,6	29,8	0,55
MH-010	103,1	103,1	0,00
MH-011	43,6	43,6	0,00
MH-012	130,0	130,0	0,00
MH-013	11,0	11,3	2,29
MH-014	12,6	12,6	0,00
MH-015	23,9	24,7	1,56
MH-016	150,0	149,7	0,21
MH-017	57,0	57,0	0,01
MH-018	17,9	18,0	0,22

In addition to the production rate of each well, the results of the simulation are also pressure on the well head. Table 4 below shows the matching phases of the pressure in the wellhead in actual conditions with the simulated results.

Table 4: Results of simulation of well head pressure

Well	Pwh Actual (psig)	Pwh Simulation (psig)	Deviation (%)
MH-001	13,0	13,24	1,86
MH-002	5,0	5,43	8,52
MH-003	10,0	10,00	0,00
MH-004	7,0	7,00	0,00
MH-005	23	22,69	1,35
MH-006	23	22,69	1,35
MH-007	23,5	23,30	0,86
MH-008	15	15,00	0,00
MH-009	14	14,13	0,92
MH-010	20	20,78	3,92
MH-011	18	18,92	5,13
MH-012	23	23,93	4,03
MH-013	28	28,16	0,56
MH-014	102	102,00	0,00
MH-015	28	28,20	0,71
MH-016	3,5	3,36	3,90
MH-017	8,5	8,65	1,74
MH-018	14	14,47	3,38

Based on the results contained in Table 3 and 4, the simulation of fluid flow from the well to the collector station obtained excellent results with the deviation rate below 10%. The production speed simulation result gave an excellent result with the minimum deviation in matching the production rate is 0% and the maximum deviation value in the matching of the production speed is 3.22%. The wellhead pressure simulation required to flow the fluid to the collecting station gives a good result with a minimum corresponding deviation of the pressure of the well head is 0%, and the max deviation values in the conditions of the corresponding well head pressure is 8.52%.

4. Conclusions

From the results of the research, the following conclusion were drawn:

1. Simulation of fluid flow from the well to the collection station obtained excellent results with a deviation rate below 10%.
2. The production speed simulation result yields excellent results with an average deviation of 0.40% with a maximum deviation value in the matching production rate of 3.22%.
3. Simulation of the wellhead pressure required to flow fluid to the collector station yielded good results with an average deviation of 2.13% with a maximum deviation value at wellhead matching pressure conditions of 8.52%.
4. The results of this simulation can be continued for production optimization in the MH field.

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