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Fluid Flow Simulation from Wellpad to Separator with Aspen Hysys Software Recognize Changes of Steam Fractions in 'X' Field

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ABSTRACT

Field 'X' is a geothermal field that produces two-phase fluids, namely steam and brine. The geothermal fluid produced from the well will be flowed using a pipe to the separator to separate the phases between steam and brine. The amount of steam produced is affected by the fraction of steam. The larger the fraction of steam, the production of steam produced is greater and vice versa. When the fluid travels in the separator, a phase change occurs due to pressure drop and heat loss large enough thus causing steam to condense and turn into brine. This lowers the vapor fraction. To determine the fraction of steam and brine produced after passing through the pipe, geothermal field 'X' usually uses a flow meter data. Therefore, it is necessary to simulate fluid flow from the well to the separator using the software Aspen Hysys to find out the phase changes that occur in order to know the vapor fraction automatically without having to calculate based on flow meter data. In the field well 'X' geothermal fluid is flowed from pipe A to pipe B with a pipe length of 87.7 m, an inner diameter of 0.9017 m and an outer diameter of 0.9144 m. With the pipeline data, created a Process Flow Diagram (PFD) in the Aspen Hysys Software to simulate the process. The simulation results show that the amount of steam produced is 438.92 kg/s, while the amount of brine produced is 62.74 kg/s. To determine the feasibility of using this PFD simulation in the field, it is necessary to compare the results of the simulation Aspen Hysys with actual data and the results of manual calculations. Manual calculation data using the Darcy-Weisbach method with the calculation of the amount of steam produced is 440.85 kg/s, the amount of brine produced is 61.79 kg/s. The results of the percentage error in the fraction steam from the results of Aspen Hysys software are below 10%, namely 0.5% for steam and 0.24% for brine. While the comparison between the simulation Aspen Hysys with manual calculations, the value is error below 10%, namely 0.4% for steam and 1.5% for brine. The PFD simulation carried out is declared valid and can become a recommendation to the company to facilitate monitoring of steam production, production brine routine, and steam fraction.

1. INTRODUCTION

The ‘X’ Geothermal Field is dominated by water (water dominated), high temperature, the power plant uses a system separated steam cycle. This system is used because the fluid in the well is a mixture of two-phase fluids (vapor phase and liquid phase). Therefore, separation of the fluid is first carried out, namely by passing the fluid into the separator, so that the vapor phase will be separated from the liquid phase. The vapor fraction is then flowed to the turbine, while the liquid phase separated in the separator will be directly injected and the liquid phase through the cooling process will also be injected into injection wells. The fluid from the well is directly flowed to the separator to be separated.

The process of channeling fluid from the well to the separator is assisted by pipes. When the fluid goes to the separator, there is a phase change caused by a decrease in pressure or loss of heat. So far, the ‘X’ Geothermal Field has used flow meters to monitor steam and production brine. However, sometimes on the way from the well to the separator there is a phase change, either from steam changing to Brine or vice versa.

The purpose of this paper is to determine the fraction that is lost from the well to the separator which later can help in monitoring steam production on a regular basis.

2. BASIC THEORY

There are various methods for measuring the flow rate in geothermal. Of the methods there are many that have advantages and disadvantages of each. The following is the explanation:

2.1. Flow Measurements

In this discussion, the authors obtain a flow rate measurement using 2 methods. Namely, the tracer dilution method or in its field language is a tracer flow test (TFT) and uses a flow meter installed around the production facility.

2.1.1. Tracer Flow Test (TFT)

With this method, the enthalpy and mass flow rate of the 2-phase flow are determined by measuring the dilution of the separated vapor and the phase liquid that is injected with the tracer. Samples of steam and brine separated are taken downstream from the injection point of the tracer after the tracer has mixed with the 2-phase stream. The mass flow rate of the vapor and the liquid phase can be calculated, and knowing the pressure of the pipeline, the fluid enthalpy is also obtained. In figure 1 simply shows the test procedure, Tracer Flow Test which is by injecting two different chemicals into a two-phase pipe near the wellhead.

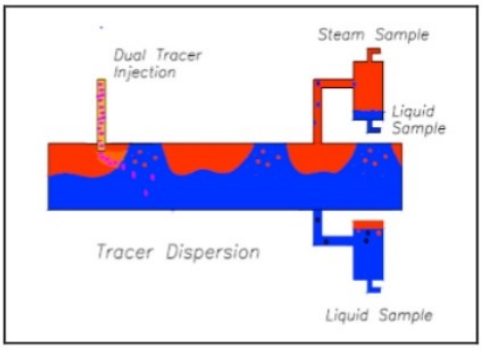

Figure 1: Work Diagram Tracer Flow Test (PT.GD Energi, 2016)

2.2. Aspen Hysys

Hysys is a software process engineering to simulate a unit process or multiunit process that is integrated, intuitive, iterative, open and extensible. Basic Steps for Simulating with Hysys.

a. Open the application Hysys which is on the start menu or desktop.
b. After that followed the menu box "Using Aspen Hysys Start, "click" New".
c. Then the new interface will appear Hysys. The Screen interface is a window base manager simulation**.** The window base manager simulation consists of a component list and a fluid package.
d. Then click **Simulation**, then the window appears **PFD (Process Flow Diagram)** which will be used to describe the process that will be simulated with Hysys. On the right side also appears the units process available in the program simulator Hysys.

2.3. Calculation of Heat Loss in the Pipe

During the passage of the geothermal fluid from the Well Pad to the separator will be experience heat loss. Heat The loss that occurs can be influenced by the temperature of the surrounding environment which is lower than the temperature in the geothermal reservoir even though in the pipeline as well an insulator is used to reduce the heat loss that will occur. To calculate the amount of heat loss that occurs, a formula is used as follows:

$$\Delta Q = \frac{2 \times \pi \times L_{actual}}{R} \times (T - T_{amb}) \quad (1)$$

where:

ΔQ : Heat loss, kJ/s
L_{aktual} : Pipe Length, m
R : Thermal conduction resistance
T : Flow Temperature °C
T_{amb} : AmbientTemperature °C

2.4. Calculation of Pressure Drop by Darcy-Weisbach Method

Pressure drop is a large scale pressure drop caused by heat loss. A pressure drop calculation is usually performed to determine the fractional changes that occur along the fluid flow. To calculate the pressure drop on a pipe, the Darcy-Weisbach equation is usually used as below:

$$\Delta P = \frac{\lambda \times L \times v^2 \times \rho_g}{2 \times ID \times x} \quad (2)$$

where:

ΔP : Pressure drop, Pa
λ : Friction factor
L : Pipe length, m
v : Flow velocity, m/s
ρ_g : Vapor density: kg/m^3
ID : Inner pipe diameter, m
x : Steam quality

2.5. Determining the Vapor Fraction

To determine the vapor fraction after the fluids from each Well Pad are combined into one in each header, it is done by calculating the enthalpy value of the fluid produced. Enthalpy is a value that states the amount of energy from a system. To determine the enthalpy value of a fraction can be determined by the following formula:

$$H = hf + x.hfg \quad (3)$$

So to determine the vapor fraction the following formula is used:

$$\text{Xsteam} = \frac{(h - hf)}{hfg} \tag{4}$$

Table 1: Value of K factor based on the type and length of the separator

Types of Separator	Separator Length (ft)	K Factor
Vertical	5	0.12 – 0.24
	10	0.18 – 0.35
Horizontal	10	0.4 – 0.5
	Other lengths	0.4 – 0.5 x $(L/10)^{0.36}$
Spherical	*All*	0.2 – 0.35

2.6. Calculation of M_{vapor} and M_{water}

To calculate the vapor and water fraction after the pipe connection, one must pay attention to the incoming mass from both sources. So, to get the values of M_{vapor} and M_{water} at the end point, namely the following formula:

$$M_{steam} = M_{Total} \times X_{steam} \tag{5}$$

$$M_{water} = M_{Total} \times X_{water} \tag{6}$$

Calculation of mass and fraction can be related to the following formula:

$$X_{steam} = \frac{\text{Msteam}}{\text{Msteam} + \text{M brine}} \tag{7}$$

2.7. Aspen Hysys

Hysys is a software process that allows you to simulate an integrated, intuitive, iterative, open and extensible unit process. The areas of use of the Hysys simulator are Conceptual analysis, Process design, Project design, Operability and safety, Automation, Asset utilization. Hysys can be used to simulate steady-state and dynamic unit processes.

2.7.1 Mass and Energy

This is the mass and energy process in Aspen Hysys. Mass flow rate is used to determine the condition of the components in the flow at the pressure (P) and temperature (T) that occur in the flow. In this flow, P and T can be set or mole fraction and pressure (P). The symbol in below is the mass flow rate condition in Aspen Hysys. We must make the process with the second arrow symbol for make the correct mass flow rate process in Aspen Hysys.

 **The data supplied to the stream is incomplete**

 **The data supplied to the stream is complete**

The energy flow is used to supply energy to the unit or absorb the energy produced from the reaction process. The energy supplied needs to be known what the heat flow rate is, while the energy absorbed only knows the type of coolant that will be used. The symbol in below is the energy condition in Aspen Hysys. We must make the process with the second arrow symbol for make the correct energy process in Aspen Hysys.

 **The data is not complete**

 **The data is complete**

2. METHODOLOGY

The author collects data for thesis preparation materials using the following methods:

The stages of research written by the author are shown in Figure 2. The following is a description of the stages of research carried out in solving the problem as follows:

a. Literature Study Literature
   Study begins by looking for existing literature sources regarding the object of research or related ones in the form of books, papers, journals and others.
b. Parameters and Assumptions
   Parameters related to this study are pressure, temperature, and flow rate. In addition, the assumptions used are that each component in the cycle is analyzed at a steady-state.
c. Data collection
   The data needed in the writing of the final project are:
   - Production data per Well Pad
   - Production data before entering the separator

- Pipe data

d. Processing and data analysis.
The data obtained were processed with Aspen Hysys software and tables. The processed data will be presented in the form of analysis results and tables which will be used to monitor steam and production brine.

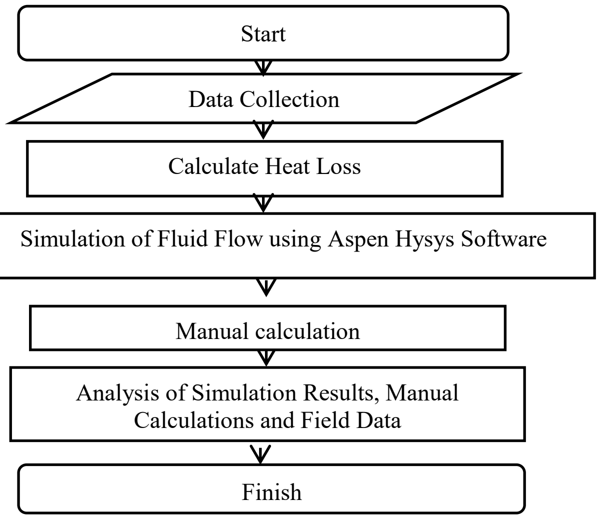

Figure 2: Stages of Research use ASPEN Hysys

4. DISCUSSION

Here is the pressure, temperature and data Mass Flow from each Wellpad which can be seen in Table 1 below:

Table 1: Well Pad Fields data

Wellpad	Parameters		
	Press	Temp	Mass Flow
	(bar)	(degC)	(kg/s)
MBB	12.4	193.59	28.46
MBA	12.5	193.40	138.69
MBD 1	12.2	190.44	64.3
MBD	12.2	194.73	111.41
MBE	11.6	192.85	12.72
WWQ	11.6	186.44	68.16
WWD	11.9	187.59	30.01
WWT	10.9	183.67	14.91

4.1. Heat Loss

The following is a calculation of the heat loss for each pipe segment. An example is for the pipe from the MBB Pad to the MBB.

L_{actual} = 87.7 m (Pipe length)

T = 193.59 °C (Temperature Well Pad)
T_{amb} = 18 °C
d_0 = ID = 0.9017 m
d_1 = OD = 0.9144 m
d_2 = d_1 + (2 × thickness of insulation) = 0.9144 + (2 × 0.055) = 1.0244 m
d_3 = d_2 + (2 × thickness of cladding) = 1.0244 + (2 × 0.0004) = 1.0252 m
r_0 = $d_0/2$ = 0.901/2 = 0.45085 m
r_1 = $d_1/2$ = 0.9144/2 = 0.4572 m
r_2 = $d_2/2$ = 1.0244/2 = 0.5122 m
r_3 = $d_3/2$ = 1.0252/2 = 0.5126 m

Thermal conduction resistance:

$$R = \frac{1}{K_{pipe}} \times \ln\left(\frac{r_1}{r_0}\right) + \frac{1}{K_{insulation}} \times \ln\left(\frac{r_2}{r_1}\right) + \frac{1}{K_{cladding}} \times \ln\left(\frac{r_3}{r_2}\right) + \frac{1}{r_3 \times \text{out coef}}$$

R = 1.9711

$$\Delta Q = \frac{2 \times \pi \times L_{aktual}}{R} \times (T - T_{amb})$$

$\Delta Q = 489.89$ kJ/s

Table 2: Heat Loss for Each Pipe Segment

Point	Heat Loss (kJ/s)
MBB Pad to MBB	**489.89**
MBA Pad to MBA	199.79
MBB&MBA to J20	727.06
MBD 1 Pad to MBD	39.52
J20 to Separator	2429.40
MBD Pad to Separator	2002.62
MBE Pad to MBE	759.84
WWQ Pad to WWQ	8.16
J1 to Separator	1416.52
WWA Pad to WWA	1517.32
WWT Pad to WWT	451.02
WWD Pad to WWD	62.14
E1 TO ESB	655.52
ESB to Separator	132.53

4.2. Simulation Aspen Hysys

The first thing to do in the simulation Aspen Hysys is input component list that will be used. In this simulation, the component list used is H2O. After inputting component list, then the selection of fluid package, fluid package used is ASME Steam. The reason for using ASME Steam is that it can be used for one component, namely H2O and using ASME 1967 Steam Tables. Next, go to the simulation section. The initial stage carried out is entering the material stream. The material stream is filled based on field data in Table 1, namely Pressure, Temperature and Mass Flow. Then enter the pipe segment. In the pipe segment, the data that needs to be filled in are pipe length, pipe diameter, and heat loss that occurs along the pipe (for heat loss based on calculation results). In this pipe segment, it is also necessary to include curves in the pipe, so that the results obtained are more the same as the conditions in the field. After all pipe segments have been worked on, the results of the simulation in Figure 3, Figure 4, Figure 5, and Figure 6 are obtained.

4.2.1. Simulation Analysis Results

a. Simulation Well Pad MBB, MBA & MBD 1

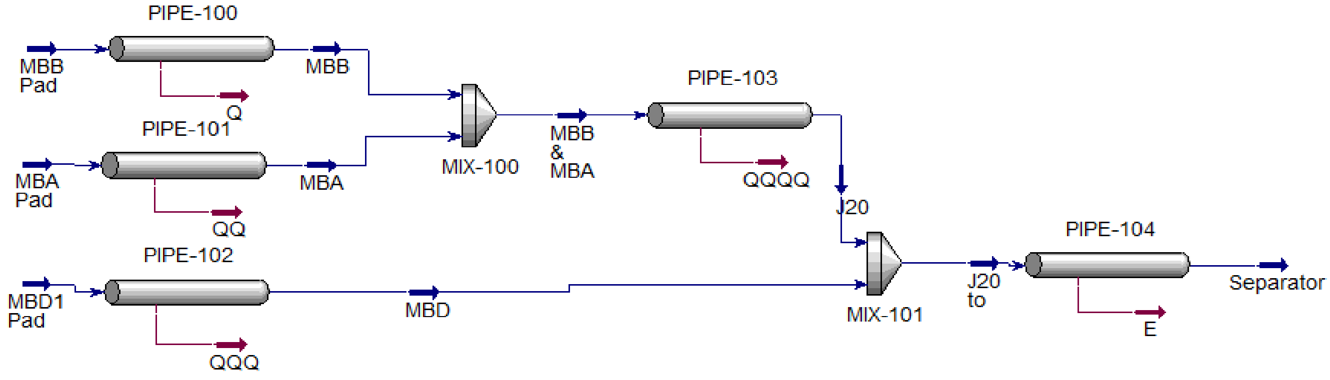

Figure 3: Simulation Wellpad MBB, MBA & MBD 1

Operation data were obtained from Hysys simulation of Well Pad MBB, MBA & MBD 1. The operational data can be seen in Table 3 below:

Table 3: Simulation Wellpad MBB, MBA & MBD 1

		Phase Fraction	Temperature [C]	Pressure [bar]	Mass Flow [kg/s]
MBB Pad	Vapour	1.00	193.06	12.40	28.46
MBB	Mixed	1.00	189.36	12.38	28.46
	Vapour	0.9962	189.36	12.38	28.35
	Brine	0.0038	189.36	12.38	0.11
MBA Pad	Vapour	1.00	193.40	12.50	138.69
MBA	Vapour	1.00	192.30	12.28	138.69
MBB & MBA	Vapour	1.00	191.28	12.28	167.15
J20	Vapour	1.00	189.07	12.06	167.15
MBD1 Pad	Vapour	1.00	192.36	12.20	63.64
MBD	Vapour	1.00	189.81	11.32	63.64
J20 to	Vapour	1.00	187.83	11.32	230.79
Separator	Vapour	1.00	179.02	9.63	230.79

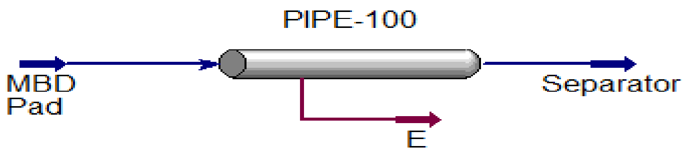

Figure 4: Simulation Wellpad MBD

b. Simulation Well Pad MBD

Table 4: Simulation Process Flow Diagram Well Pad MBD

	MBD Pad	Separator
	Vapour	Vapour
Phase Fraction	1.00	1.00
Temperature [C]	194.73	183.53
Pressure [bar]	12.20	10.57
Mass Flow [kg/s]	111.40	111.40

c. Simulation Wellpad MBE & WWQ

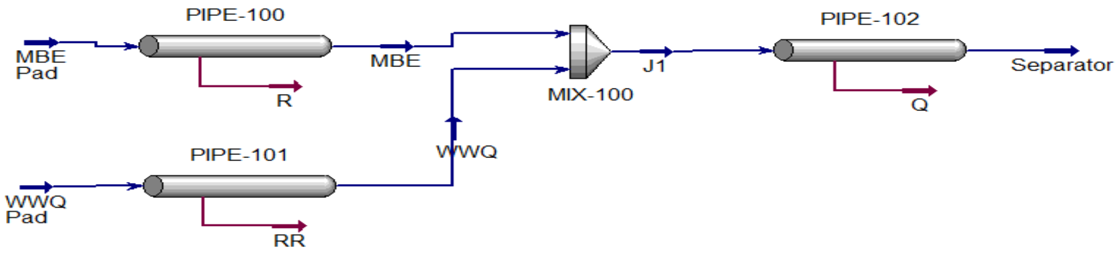

Figure 5: Simulation Wellpad MBE & WWQ

Table 5: Simulation Wellpad MBE & WWQ

		Phase Fraction	Temperature [C]	Pressure [bar]	Mass Flow [kg/s]
MBE Pad	Vapour	1.00	190.20	11.60	12.72
MBE	Mixed	1.00	186.40	11.59	12.72
	Vapour	0.98	186.40	11.59	12.40
	Brine	0.02	186.40	11.59	0.32
WWQ Pad	Mixed	1.00	186.44	11.60	68.16
	Vapour	0.78	186.44	11.60	52.93
	Brine	0.22	186.44	11.60	15.23
WWQ	Mixed	1.00	185.22	11.29	68.16
	Vapour	0.78	185.22	11.29	52.99
	Brine	0.22	185.22	11.29	15.17
J1	Mixed	0.81	185.22	11.29	80.88
	Vapour	0.81	185.22	11.29	65.40
	Brine	0.19	185.22	11.29	15.48
Separator	Mixed	1.00	182.42	10.60	80.88
	Vapour	0.80	182.42	10.60	64.86
	Brine	0.20	182.42	10.60	16.02

d. Simulation Wellpad WWD, WWT & WWA

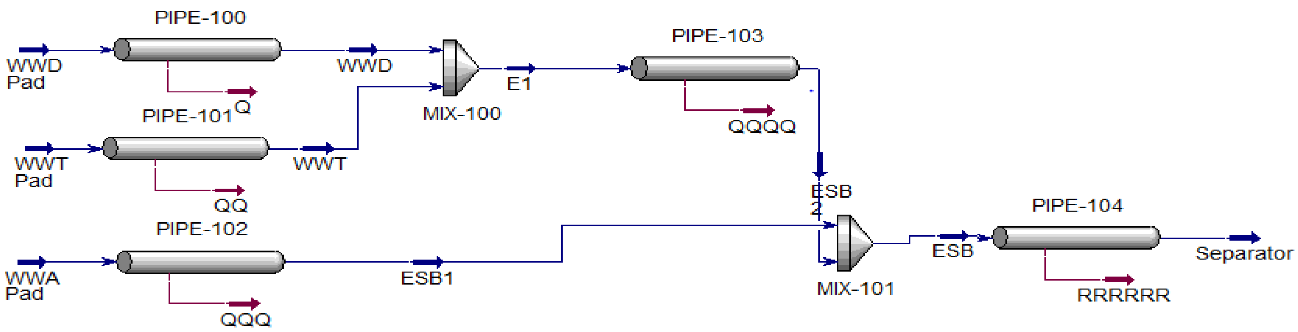

Figure 6: Simulation Well Pad WWD, WWT & WWA

Table 6: Simulation Well Pad WWD, WWT & WWA

		Phase Fraction	Temperature [C]	Pressure [bar]	Mass Flow [kg/s]
WWD Pad	Mixed	1.00	187.66	11.92	30.01
	Vapour	0.20	187.66	11.92	6.09
	Brine	0.80	187.66	11.92	23.92
WWD	Mixed	1.00	187.65	11.92	30.01
	Vapour	0.20	187.65	11.92	6.05
	Brine	0.80	187.65	11.92	23.95
WWT Pad	Mixed	1.00	183.78	10.93	14.91
	Vapour	0.31	183.78	10.93	4.64
	Brine	0.69	183.78	10.93	10.27
WWT	Mixed	1.00	183.77	10.93	14.91
	Vapour	0.30	183.77	10.93	4.42
	Brine	0.70	183.77	10.93	10.49
E1	Mixed	1.00	183.78	10.93	44.92
	Vapour	0.24	183.78	10.93	10.69
	Brine	0.76	18378	10.93	34.23
ESB2	Mixed	1.00	183.66	10.90	44.92
	Vapour	0.23	183.66	10.90	10.37
	Brine	0.77	183.66	10.90	34.55
WWA Pad	Mixed	1.00	183.74	10.92	33.67
	Vapour	0.66	18374	10.92	22.27
	Brine	0.34	183.74	10.92	11.40
ESB1	Mixed	1.00	183.33	10.82	33.67
	Vapour	0.64	183.33	10.82	21.53
	Brine	0.36	183.33	10.82	12.14
ESB	Mixed	1.00	183.33	10.82	78.59
	Vapour	0.41	183.33	10.82	31.92
	Brine	0.59	183.33	10.82	46.67
Separator	Mixed	1.00	183.20	10.79	78.59
	Vapour	0.406	183.20	10.79	31.87
	Brine	0.594	183.20	10.79	46.72

4.3. Manual Calculations

To ensure that the simulation is carried out correctly, the authors add manual calculations which will later be compared with the simulation results. The first thing to do is to calculate the pressure drop for each pipe segment. Calculation Pressure drop uses the Darcy-Weisbach method. For example, the calculation is the pressure drop from the MBB Pad to the MBB.

L = 917.7 m (Pipe Length)
ρ_g = 6.3213 kg/m^3 (viewed from the steam table)
ID = 0.9017 m
x = 1.0 (Well of vapor dominated steam)

- Flow Velocity

$$v = \frac{M}{\rho_g \times A}$$

$$v = \frac{28.46}{6.3213 \times \left(\frac{3.14}{4} \times ID^2\right)}$$

$$v = 7.05419 \text{ m/s}$$

- Reynold Number

$$Re = \frac{v \times ID}{v_g \times \mu}$$

$$Re = 2603601.7$$

- Friction Factor

$$f \text{ laminer} = \frac{64}{Re}$$

$$= 0.0000246$$

$$A = \frac{1}{\left(1.8 \times \log\left(\frac{6.9}{Re} + \left(\frac{\varepsilon}{3.7D}\right)^{1,11}\right)\right)^2}$$

$$A = 0.01278$$

$$f \text{ turbulen} = A - \frac{\frac{1}{\sqrt{A}} + 2 \times \log\left(\frac{\varepsilon}{3.7D} + \frac{2.51}{Re \times \sqrt{A}}\right)}{-\frac{1}{2} \times A^{-1.5} \times \left(1 + \frac{\frac{2 \times 2.51}{\ln 10 \times Re}}{\left(\frac{\varepsilon}{3.7D} + \frac{2.51}{Re \times A}\right)}\right)}$$

$$f \text{ turbulen} = 0.012827$$

If the Re <Re value iscritical, then the friction factor value is used f laminar. Meanwhile, if the value of Re> Re iscritical, then the value of the friction factor used is the turbulent f value (Recritical = 2300). Since the flow on the MBB Pad towards the MBB has a Re> Recritical value, then the friction factor value used is f turbulent.

$$\Delta P = \frac{\lambda \times L \times v^2 \times \rho_g}{2 \times ID \times x}$$

$$\Delta P = 2041.399 \text{ Pa}$$
$$\Delta P = 0.0204 \text{ bar}$$
$$P_2 = P_1 - \Delta P$$

$$P_2 = 12.4 - 0.0204$$

$$P_2 = 12.38 \text{ bar}$$

Table 7: Calculation Results of Pressure Drop for Each Point

Point	Final Pressure (bar)
MBB Pad to MBB	12.38
MBA Pad to MBA	12.30
MBB&MBA to J20	11.87
MBD 1 Pad to MBD	11.48
J20 to Separator	9.87
MBD to Separator	10.91
MBE Pad to MBE	11.59
WWQ Pad to WWQ	11.60
J1 to Separator	10.14
WWA Pad to WWA	10.73
WWT Pad to WWT	10.88
WWD Pad to WWD	11.88
E1 to ESB	10.17
ESB to Separator	9.5

After calculating the pressure drop, the calculation results are obtained in Table 3. Furthermore, the calculation mass flow is carried out at the end point before entering the separator. The calculation is carried out as follows:

a. Header Mass flow 1
Calculation of mass flow for header 1 is obtained from the sum of the M_{final} of each point that enters the header 1. For the amount of mass flow for each point can be seen in Table 4 below. Here:

Table 8: Mass Flow of Each Point on Header 1

Point	M_{final}(kg/s)
MBB Pad to MBB	28.46
MBA Pad to MBA	138.69
MBB&MBA to J20	167.15
MBD 1 Pad to J20	64.63

Thus, Header Mass flow 1 of 231.8 kg / s.

b. Fraction Header 1
P_{final} = 9.87 bar
H_{final} = $H_1 - \Delta H$

H_1 is the Enthalpy after the fluids from each Wellpad are combined into one in each header

$$\Delta H = \frac{\text{Heat loss}}{\text{Mass flow}}$$
$$\Delta H = 10.58 \text{ kJ/kg}$$

This calculation is taken from the pipe section after all the fluids have joined in each header (Main Pipe).

$$H_{final} = H_1 - \Delta H$$
$$H_{final} = 2787.39 - 10.58$$
$$H_{final} = 2776.91 \text{ kJ/kg}$$

In each header, the same calculation is done to find the final enthalpy. The results of the calculations can be seen in Table 9 below:

Table 9: Final Enthalpy Calculation Results for Each Header

Point	Final Enthalpy (kJ/kg)
Header 1	2776.91
Header 2	2782.91
Header 3	2383.38
Header 4	1589.47

H_f = 760.20 kJ/kg (Viewed from the steam table)
H_{fg} = 2016.425 kJ/kg (Viewed from the steam table)

- $x_{steam} = \frac{(h - h_f)}{h_{fg}}$

  $x_{steam} = 1.0$
- $x_{water} = 1 - x_{steam}$
  $x_{water} = 0$

Thus, Mobtained.$_{steam}$ and M_{water} are at the end point, namely the final

- $M_{steam} = 231.78 \times 1$
  $M_{steam} = 231.78$ kg/s
- $M_{water} = 231.78 \times 0$
  $M_{water} = 0$ kg/s

Calculation of the final mass flow and final fraction using the formula as above for each header. The results of mass flow and final fraction calculations can be seen in Table 10 and Table 11 below:

Table 10: Result of Fraction Calculation at End Point

Point	X_{steam}	X_{water}
Header 1	1	0
Header 2	1	0
Header 3	0.80	0.2
Header 4	0.4	0.6

Table 11: Result of Calculation Mass Flow at End Point

Point	M_{Total} (kg/s)	M_{steam} (kg/s)	M_{water} (kg/s)
Header 1	231.78	231.78	0
Header 2	111.41	111.41	0
Header 3	80.87	65.03	15.84
Header 4	78.58	32.64	45.95
Total	502.64	440.86	61.79

4.4. Simulation Analysis Aspen Hysys Software

From the simulation results it can be analyzed that the cause of the fraction change is due to the length of the pipe through which the geothermal fluid passes. The farther the distance traveled by the geothermal fluid, the more the fraction changes. However, pipe length is not the only determinant of fraction change. Other factors that influence also come from the pipe diameter, the number of turns and the steam quality is not the same at each point of the section. In some simulations carried out, there is no change in fraction due to changes in pressure and temperature that are comparable.
Based on the simulation results, the amount of steam produced from all wells is obtained, namely:

Q_{steam} total = Q_{steam} header 1 + Q_{steam} header 2 + Q_{steam} header 3 + Q_{steam} header 4
Q_{steam} total = 230.79 kg/s + 111.40 kg/s + 64.86 kg/s + 31.87 kg/s
Q_{steam} total = 438.92 kg/s

As for the amount of brine produced from all wells, namely:

Q_{brine} total = Q_{brine} header 1 + Q_{brine} header 2 + Q_{brine} header 3 + Q_{brine} header 4
Q_{brine} total = 0 kg/s + 0 kg/s + 16.02 kg/s + 46.72 kg/s
Q_{brine} total = 62.74 kg/s

To ensure that the simulation is carried out correctly, a comparison is made between the simulation results and field data (actual) and also a comparison between the simulation results with manual calculations. Comparison of the simulation results with field data obtained anvalue error of 0.5% for steam and 0.24% for brine. Meanwhile, the comparison between the simulation results with manual calculations obtained anvalue error of 0.4% for steam and 1.5% for brine. With thevalue error still below 10%, the simulation can be declared valid and can be a recommendation to the company to implement this simulation as a way tomonitor steam andproduction brine regularly.

5. CONCLUSION

The following are the conclusions of the study as follows:

1. From the simulation results, the amount of steam produced is 438.92 kg / s which is obtained from the sum of all the headers that enter the separator. The amount of brine produced is 62.74 kg / s which is obtained from the sum of all the headers that enter the separator.

2. From the results of manual calculations, the amount of steam produced is 440.85 kg / s which is obtained from the sum of all the headers that enter the separator. The amount of brine produced is 61.79 kg/ s which is obtained from the sum of all the headers that enter the separator.

3. In some simulations carried out, there is no change in fraction due to changes in pressure and temperature that are comparable.
4. From the comparison between the simulation and the actual, the value is error below 10%, namely 0.5% for steam and 0.24% for brine. Comparison between simulation and manual calculation, the value is error below 10%, namely 0.4% for steam and 1.5% for brine.
5. Based on the results of the analysis, the simulations carried out are declared valid and can be a recommendation to the company to implement this simulation as a way to monitor steam and production brine regularly.

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