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COMPARISON OF PRESSURE DROP ON JUMPER LINE AND PRESSURE REGULATOR VALVE MANUALLY AND HYSYS SIMULATION AT PT. PERTA ARUN GAS

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ABSTRACT

BOG Compressor K-6801 C/D functions to remove excess vapor from the tank, maintain tank pressure, and provide fuel for power generators in utility units and Sent Out Gas to PLTMG Arun. The compressor recycle line temperature must be controlled, as excessive heat increases tank pressure, while suction temperatures near -100°C may cause surging and compressor failure. This study aims to analyze the effect of pipe size on pressure drop and compare theoretical and simulated results using Aspen Hysys, an engineering software for process simulation. Manual calculations show a 3-inch pipe size has the lowest pressure drop, 0.22 kg/cm², while Aspen Hysys calculates 0.13 kg/cm² at a flow of 75 m³/hr. Larger pipes reduce pressure drop, with a 2-inch jumper line showing 2.17 kg/cm² and a 3-inch line showing 2.37 kg/cm² at higher flows. These values align with the manufacturer's design pressure of 2.11 kg/cm².

Keywords: BOG Compressor, Hysys, Jumper Line, pressure drop, pipe.

INTRODUCTION

PT Perta Arun Gas (PAG) is a subsidiary of PT Pertamina Gas which is engaged in regasification and LNG hub with main activities in the form of receiving, regasification, and LNG terminals. One of the supporting units for regasification operations is the use of Boil-Off Gas (BOG) Compressor K-6801 C/D. This compressor functions to suck excess vapor from the tank, maintain tank pressure, and supply fuel for the Power Generator in the utility unit and Sent Out Gas to PLTMG Arun. The BOG Compressor operates with a normal suction pressure of 800-1000 mmH_2O, an output pressure of 14.5 kg/cm², and a recycle temperature of -150°C.

To maintain the temperature of the gas returning to the tank, an atomizer is used as a gas and liquid mixing medium. The gas comes from the compressor discharge (40°C), while the liquid is taken from the LNG circulation pump with a normal pressure of 4-5 kg/cm² and a temperature of -160°C. The atomizer temperature is

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regulated using valve TV-6880 with a set point of -150°C. Constraints on this system, such as the shutdown or disruption of the circulation pump operation, can lead to increased tank pressure, surging compressors, or the release of methane gas into the atmosphere. This not only reduces LNG volume but also increases greenhouse gas emissions.

Currently, PAG operates four BOG compressors on tanks F-6001/2 and F-6003/4, with new atomizer system modifications only on tank 3/5. To overcome operational constraints, PAG innovated by adding a jumper line and pressure regulator valve. This modification allows the atomizer to receive liquid from the LNG transfer pump (GM-2304 A/B) when the main circulation pump is off, thus keeping the compressor recycle temperature stable.

This study aims to analyze the effect of pipe diameter on pressure drop in the jumper line and atomizer system, and compare the results of manual calculations with simulations using Aspen Hysys. Based on the literature study, pipe diameter has a significant effect on pressure drop; the larger the pipe diameter, the smaller the pressure drop value.

This research is expected to provide an evaluation of the effectiveness of adding jumper lines and pressure regulator valves in maintaining optimal BOG Compressor temperatures and minimizing the release of methane gas into the atmosphere.

Pipe

Pipe is channel closed which is usually cross-section circle used For flow fluid with appearance flow full (Triatmojo , 1996). The fluid that flows through the pipe can in the form of substance liquid or gas and pressure Can more big or more small from pressure atmosphere . Selection equipment piping must consider characteristics fluid that will get through it or streamed in the form of *Specific Gravity at* 60/60, *Kinematic Viscosity* , and *Reid Vapor Pressure* . Whereas condition operations that must be carried out known is *flow* , temperature , and pressure .

Determination of Economic Pipe Diameter

Determination of inner pipe diameter a system piping very influenced by factors safety and economy , the optimum pipe diameter is *the* diameter that minimizes total costs . ensure security operation . Determination size piping based on on estimated diameter, although thickness from various pipes based on *schedule number* used , but the *outside* diameter of the pipe with same nominal *pipe sizes* is remains . This is will make it easier at the time installation *fittings* and other

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equipment on the pipe with *nominal size* is the same although the thickness of the pipe different . For get economical diameter piping can use formula as following .

$$Di = 1{,}717 \times Q^{0{,}479} \times SG^{0{,}142} \times \mu^{0{,}027} \quad \text{............(2.1)}$$

Where:

Di = diameter of the section pipe in , cm

Q = capacity , m3/hour

μ = viscosity absolute fluid , kg/m s.

SG = fluid *specific gravity* .

Determination of Pipe Wall Thickness

After us get economical diameter from a further pipe We must determine thick the pipe wall . The thickness of the wall a piping as required in the ASME B 31-3 *process piping code standard* can searching for with use formula as following :

$$t_{min} = \frac{P \ x \ Do}{2(SE+PY)} \quad \text{................(2.2)}$$

Where:

t_{min} = minimum pipe wall thickness , in.

P = pressure design , psi

Do = outside diameter of pipe, in.

S = maximum *working stress* , psi

E = longitudinal weld joint efficiency factor

Y = temperature dependent factor

For system piping will *Stainless steel* pipe is used with E value (*joint efficiency factor*). After getting it minimum thickness of the pipe wall then customized with *schedule* number on the market . For anticipate the occurrence corrosion in piping usually minimum pipe thickness added with *corrosion allowances* (limits) permissible corrosion). The nominal figure is large used For *corrosion value* is 0.1 *inch* For *carbon steel* and *low alloy steel piping* . While the materials that are possible happen level severe corrosion and or erosion from fluid That Alone can use nominal figures up to 0.25 *inch.*

Pressure Drop

Pressure drop is a the problem that occurred in system piping caused difference pressure on two point from a network of pipes carrying fluid . Speed fluid , gas pressure , rate gas flow , pipe diameter , temperature and viscosity fluid which is a number of the effect of pressure drop on flow fluid in the pipe (Syarif ., 2019).

$$\Delta p = \frac{v^2 \times f \times L \times \rho}{2D} \text{..................(2.3)}$$

Where:

Δp = pressure drop, (pa)

v = speed in meters per second (m/ s)

f = friction factor

L = pipe length (m)

ρ = density of liquid (kg/m ^{3})

D = Inside diameter of pipe (m)

High speed and high viscosity can cause increased pressure drop and force friction also increases large . Factors that affect pressure drop are :

Friction Factor

factor friction that must be passed fluid in flowing in a suspended pipe to pipe roughness , and condition flow . Friction factor defined as style friction that occurs between two surfaces that touch each other intersect . The height *friction factor* influential in a way direct to the magnitude of the pressure drop and will influence the magnitude the pressure required For flow fluid . Bond molecules in fluid Far more small than bond molecules in solids so that fluid more easy flowing and having relative barriers more small on change form consequence friction (Hariyono , 2016).

Viscosity Fluid

Viscosity is the resistance of a fluid to flow. High viscosity makes the fluid flow smaller so that the pressure required to flow the fluid through the pipe is greater than a fluid with low viscosity. With this large flow resistance, it will result in *pressure drop* Which happen the more big. Viscosity influential in determine factor friction through calculation number *Reynolds* Which greatly influences the friction factor and will affect the *pressure drop calculation* .

Long Equivalent On Pipe

Pipeline from the well production until reaching *the gathering station* consists of various bends, elevations, enlargements and reductions in pipes. These things can cause *pressure drops* to occur when the fluid flows. Length equivalent represent long Which equivalent For mark *pressure drop* that The same on *fitting* with pipe straight. So that, as if pipe become longer due to the presence of this *fitting* but the shape of the pipe is assumed to remain straight (Ghurri., 2015).

The selection of diameter must also be considered in order to optimize the production rate. Diameter pipe Which more big will make it easier fluid For flowing so that it will affect *the pressure drop* .

$$Le = K \times D \quad (2.4)$$

Le = Length equivalent , m

D = Diameter Pipe, m

K = Constants *elbow*

90˚ *elbow* K = 30

45˚ *elbow* K = 16

Tee *elbow* K = 20

Density fluid

Fluid flow is a part of fluid mechanics that plays an important role in designing piping systems. Piping is a fluid transportation tool that is widely used in industry. Fluids flowing in pipes will experience energy loss (head loss) due to friction between fluid and fluid and fluid and pipe. The loss of energy in the fluid in the piping system can also be caused by the path of the pipe passed by the fluid, such as bends in the pipe, narrowing in the pipe (contraction), and enlargement in the pipe (expansion). A fluid that has a higher density will certainly be heavier than a fluid with a low density. So that to flow it requires higher pressure with this condition, the pressure drop will be even greater because it is used to move the fluid (Puji R. et al., 2021).

METHOD

1. Tools And Material

The tools and materials used in this study include various supporting devices to ensure the success of the process. The tools used include pumps, pressure regulator valves, pressure gauges, pipes, and valves. Meanwhile, the main material used is Liquefied Natural Gas (LNG), which serves as the primary component in the analysis and simulation of the atomizer and BOG Compressor system. This combination of tools and materials is designed to support testing the effectiveness of system modifications in maintaining operational temperature and pressure stability.

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Pre-Design of Jumper line and Pressure Regulator Valve Installation Model

The analysis method used in designing the installation of the jumper line and pressure regulator valve is done by simulating the results of the calculation of the amount of pipe diameter for supply to the liquid atomizer. The problem faced in the installation of this jumper line pipe and pressure regulator valve is pressure drop. Pressure drop affects the output pressure of the flow to the inlet of the liquid atomizer pipe, the greater the pressure drop that occurs, the smaller the pressure that can come out so that the pressure does not match the design of the atomizer equipment, not according to the design will make the atomizer temperature cannot be reached according to operational needs.

Mathematical calculations are carried out to calculate, analyze and simulate the flow of liquid supply from the jumper line to the atomizer pipe with a size based on the available tool design. This thesis then compares and analyzes the pressure loss as a problem limitation so as not to deviate from the objectives and provide references to the capabilities of the liquid supply piping system to the atomizer. This research only calculates the pressure drop that occurs from the transfer pump flow to the atomizer pipe inlet.

Calculation Design Plan

The analysis method used in the preliminary design of the Jumper line Atomizer is done by comparing the preliminary design results with the existing LNG supply line atomizer . The problem faced in the installation of this jumper line liquid atomizer is pressure drop. Pressure drop affects the output pressure of the flow to the inlet line liquid atomizer, the greater the pressure drop , the smaller the pressure that can come out and the possibility of pressure not in accordance with the design will cause the temperature of the recycle gas that returns to the tank to be hot causing compressor performance to be disrupted and even have to stop operation.

To ensure that the design of the liquid atomizer jumper line piping with the available connection size meets the minimum pressure requirements so that the pressure and flow remain in accordance with the design and atomizer temperature , a calculation is carried out. The calculation aims to determine the pressure drop that occurs along the pipe from the LNG exiting the Pressure Regulator Valve to entering the atomizer header inlet pipe .

Testing Procedure

The procedure used in this study is the experimental method, which is a method used to test the use of pipe size variations on pressure drop. The experimental and testing procedures are carried out as follows:

- Carry out the research design that you want to do.
- Collecting the data needed to create a preliminary design, including pressure, temperature, flow rate and pipe size.
- Create a preliminary design of what you want to do, in this case installing the Jumper line and Pressure Regulator Valve .
- Determine the economic diameter of the pipe to be used as a jumper line for the liquid source atomizer.
- Determine the maximum pressure drop to find out whether the end point is in accordance with the normal pressure design of the atomizer.
- Calculate the total pressure drop from the pipe size that has been obtained.
- Conduct several experiments and tests on other pipe sizes to find the pressure drop value from each pipe to the atomizer, process and analyze the data obtained.
- Collect data from each experimental result into Table 3.3.
- Summarize the research results.

Equipment and Processes

LNG with a cryogenic temperature of -160 °C requires special conditions in order to store and flow it. This unit is designed to maintain the temperature of the recycle LNG that returns to the LNG tank according to operational needs, because the heat of the recycle temperature that returns to the tank can cause the compressor to surge or even stop operating.

Operational process requirements require that the compressor must not stop in order to maintain tank pressure so that there is no loss of level. LNG , for this, innovation is carried out by adding a 2-inch pipe jumper line as a connection between the transfer pump to the compressor atomizer system, then the high pressure from the transfer pump is changed through the pressure regulator valve to match the pressure of the existing circulation pump as a normal supply to the liquid atomizer.

The addition of jumper lines and variations in pipes along the atomizer line requires knowing the pressure drop value so that it remains in accordance with the design so that the atomizer temperature is maintained.

Operating System

The author plans to add LNG jumper line and pressure regulator valve by selecting the pipe size available in PT. PAG warehouse .

The presence of a 2-inch jumper line and the installation of a pressure regulator valve is expected to maintain the temperature of the recycle LNG that returns to the tank, because this liquid atomizer must remain in the fogging process so that the LNG temperature remains in accordance with the process needs, the author hopes that the pressure drop value from along the jumper line pipe to the atomizer system is not too large so that it remains in accordance with the design pressure from the manufacturer. The use of equipment using existing facilities in the PT. PAG warehouse as an efficiency of an innovation.

Utilization of a factory's condition has a strong influence on the success of an innovation. The selection of the right conditions must be considered because it will be related to production costs and adjustments to factory operations. Based on that, the solution to the dominant cause of the problem in the form of the absence of a liquid atomizer back-up facility is to provide a jumper line facility and install a pressure regulator valve so that LNG can still be supplied to the atomizer in order to maintain the temperature of the recycle LNG that returns to the tank.

RESULTS AND DISCUSSION

Observation Data and Calculation Results

Observations were made on the condition of the GM-2304 AB Pump Flow in Storage Loading Regasification, the following observation results were obtained:

Table 1 Actual Condition Data of LNG Circulation

Data	Unit	Value
Flow Rate Pressure	$Kg/^{cm2}$	63
Pressure Regulator Valve Outlet Pressure	$Kg/^{cm2}$	4.5-5
Volume Flow Rate Transfer Pump (GM-2304AB)	$m3^{/}hr$	75-80
Molecular Weight	Kg/Kmol	16.83
Density	$Kg/^{m3}$	459.6
Viscosity (μ_{mix})	cP	0.1514
Temperature	°C	- 158.00

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Table 2 Pipe Diameter

Data	Unit	Value			
NPS	inch	2	3	$1\frac{1}{2}$	1
O.D.	mm	60.3	88.9	43.3	33.4
ID	mm	49.5	77.92	40.49	26.61
Sch. No.		80	40	40	40
Thickness (t_{table})	mm	5.5	5.49	3.68	3.38

Data	Unit	Value			
NPS	inch	3	3	$1\frac{1}{2}$	1
O.D.	mm	88.9	88.9	43.3	33.4
ID	mm	73.9	77.92	40.49	26.61
Sch. No.		80	40	40	40
Thickness (t_{table})	mm	7.6	5.49	3.68	3.38

Table 3 Number of Connections

Data	Number of Connections			
	2" Sch 80	3" Sch 40	$1\frac{1}{2}$"Sc 40	1" sch 40
Elbow 90^0	7	5	1	
Elbow 45^0	2			
Tee Elbow	1			
Equivalent Length of Pipe	12.9 m	11.6 m	1.21 m	0 m

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Table 4 Data on the results of pressure drop calculations for pipe size 2" Sch 80 inches with a flow of 75 m ^{3}/hr as follows:

Data	Unit	Remark
Inside pipe diameter	**mm**	49.5
Pipe Surface Area	**m ^{2}**	0.001923
Velocity	**m/s**	10.83
Reynolds number		1,627,563.91
Friction factor		0.014
Pressure drop along 2" sch 80 pipe	**Kg/ ^{cm2}**	2.76

Table 5 Data on the results of pressure drop calculations for pipe size 3" Sch 40 inches with a flow of 75 m ^{3}/hr as follows:

Data	Unit	Remark
Inside pipe diameter	**mm**	77.92
Pipe Surface Area	**m ^{2}**	0.004764
Velocity	**m/s**	4,373
Reynolds number		1,034,203.00
Friction factor		0.015
Pressure drop along 3" sch 40 pipe	**Kg/ ^{cm2}**	0.22

Table 6 Data on pressure drop calculation results for pipe size 1.5" Sch 40 inches with a flow of 75 m ^{3}/hr as follows:

Data	Unit	Remark
Inside pipe diameter	**mm**	40.49
Pipe Surface Area	**m ^{2}**	0.001287
Velocity	**m/s**	16.18
Reynolds number		1.989736,07
Friction factor		0.014

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Pressure drop along 3" sch 40 pipe	**Kg/ cm2**	0.52

Table 7 Data on the results of pressure drop calculations for pipe size 1" Sch 40 inches with a flow of 75 m ^{3}/hr as follows:

Data	Unit	Remark
Inside pipe diameter	**mm**	26.61
Pipe Surface Area	**m ^{2}**	0.000556
Velocity	**m/s**	37.48
Reynolds number		3,027,599.16
Friction factor		0.013
Pressure drop along 3" sch 40 pipe	**Kg/ cm2**	1.59

Table 8 Data on the results of pressure drop calculations for pipe size 3" Sch 80 inches with a flow of 80 m ^{3}/hr as follows:

Data	Unit	Remark
Inside pipe diameter	**mm**	73.9
Pipe Surface Area	**m ^{2}**	0.004287
Velocity	**m/s**	5.18
Reynolds number		1,162,860.28
Friction factor		0.015
Pressure drop along 3" sch 40 pipe	**Kg/ cm2**	0.52

Table 9 Data on the results of pressure drop calculations for pipe size 3" Sch 40 inches with a flow of 80 m ^{3}/hr as follows:

Data	Unit	Remark
Inside pipe diameter	**mm**	77.92
Pipe Surface Area	**m ^{2}**	0.004764
Velocity	**m/s**	4,665
Reynolds number		1,103,149.87

Friction factor		0.015
Pressure drop along 3" sch 40 pipe	**Kg/ cm2**	0.25

Table 10 Data on pressure drop calculation results for pipe size 1.5" Sch 40 inches with a flow of 80 m^3/hr as follows:

Data	Unit	Remark
Inside pipe diameter	**mm**	40.94
Pipe Surface Area	**m^2**	0.001287
Velocity	**m/s**	17,267
Reynolds number		2,122,385.15
Friction factor		0.014
Pressure drop along 3" sch 40 pipe	**Kg/ cm2**	0.59

Table 11 Data on pressure drop calculation results for pipe size 1" Sch 40 inches with a flow of 80 m3 / hr as follows:

Data	Unit	Remark
Inside pipe diameter	**mm**	26.61
Pipe Surface Area	**m^2**	0.000556
Velocity	**m/s**	39.97
Reynolds number		3,229,439.10
Friction factor		0.013
Pressure drop along 3" sch 40 pipe	**Kg/ cm2**	1.79

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Table 12 *Pressure Drop* for Each Pipe Size and Flow

Flow	PRV Pressure	Pipe Size	*Pressure Drop*	Unit
75 m3 / hr	4.5 kg/ cm2	3 inches	0.22	Kg/ cm2
		2 inch (Jumper Line)	2.76	Kg/ cm2
		1.5 inches	0.52	Kg/ cm2
		1 inch	1.59	Kg/ cm2
Flow		Pipe Size	*Pressure Drop*	Unit
80 m3 / hr	5 kg/ cm2	3 inch (Jumper Line)	0.52	Kg/ cm2
		3 inches	0.25	Kg/ cm2
		1.5 inches	0.59	Kg/ cm2
		1 inch	1.79	Kg/ cm2

Table 13. *Pressure Drop* for Each Pipe Size and Flow Using Aspen Hysys

Flow	PRV Pressure	Pipe Size	*Pressure Drop*	Unit
75 m3 / hr	4.5 kg/ cm2	3 inches	0.13	Kg/ cm2
		2 inch (Jumper Line)	1.2	Kg/ cm2
		1.5 inches	0.39	Kg/ cm2
		1 inch	0.68	Kg/ cm2
Flow		Pipe Size	*Pressure Drop*	Unit
80 m3 / hr	5 kg/ cm2	3 inch (Jumper Line)	0.33	Kg/ cm2
		3 inches	0.16	Kg/ cm2
		1.5 inches	0.43	Kg/ cm2
		1 inch	1.70	Kg/ cm2

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Table 14 Experimental Results Data for Calculating Total *Pressure Drop* on a 2" Sch 80 *Jumper Line Pipe Flow 75 m* ^{3}/hr and PRV Pressure 4.5 Kg/cm ^{2}

No.	Piping	Pipe size	Pipe length (m)	Pressure drop every 1 m (kg/cm ^{2})	Total pressure drop (kg/cm ^{2})
A	Jumper Line Pipe to *Pressure Regulator Valve*	2	35	0.0788	2.76
B	Compressor *Atomizer Header*	3	25	0.0088	0.22
C	*Atomizer* system *Liquid Inlet* Pipe	$1\frac{1}{5}$	2.5	0.208	0.52
D	Inlet pipe to spray atomizer nozzle	1	1	1.59	1.59
E	Total pressure drop along the pipe = B+C+D				2.33
F	*Liquid* Pressure to *Atomizer* to Compressor = GE				2.17
G	*Pressure Regulator Valve Outlet* Pressure				4.5
H	*Pressure Liquid Atomizer Design* by Chiyoda				2.11

Table 15 Experimental Results Data for Calculating Total *Pressure Drop on Jumper Line* Pipe 3" Sch 80, *Flow* 80 m ^{3}/hr and PRV Pressure 5 Kg/cm ^{2}

No.	Piping	Pipe size	Pipe length (m)	Pressure drop every 1 m (kg/cm ^{2})	Total pressure drop (kg/cm ^{2})
A	Jumper Line Pipe to *Pressure Regulator Valve*	3	41	0.0126	0.52
B	Compressor *Atomizer Header*	3	25	0.01	0.25
C	*Atomizer* system *Liquid Inlet* Pipe	$1\frac{1}{5}$	2.5	0.236	0.59
D	Inlet pipe to spray atomizer nozzle	1	1	1.79	1.79
E	Total pressure drop along the pipe = B+C+D				2.63
F	*Liquid* Pressure to *Atomizer* to Compressor = GE				2.37
G	*Pressure Regulator Valve Outlet* Pressure				5

H	*Pressure Liquid Atomizer Design* by Chiyoda	2.11

Discussion of Calculation Results

Based on the calculation results, it can be seen that the pipe diameter and the length of the piping distance greatly affect the *pressure drop value* , this is caused by the greater friction of the fluid flow that occurs on the pipe wall, causing *the pressure drop value* to increase. Based on Table 14, it can be seen that there is *a pressure drop* along the pipe of 2.33 kg / cm ^{2} , when viewed from the manufacturer's *design* , the minimum *atomizer pressure* is 2.11 kg / cm $^{2.}$ The results of this *innovation calculation* provide a *pressure value* entering *the atomizer* of 2.17 kg / cm ^{2} , this means that the pressure is still in accordance with *the design* . This means that *the jumper line* and *Pressure Regulator Valve* have succeeded in maintaining the temperature of *the recycle gas* returning to the tank according to the operational temperature. Meanwhile, in Table 4.15, it can be seen that there is *a pressure drop* along the pipe of 2.63 kg / cm ^{2} , after being reduced by the *outlet pressure of the Pressure Regulator Valve* by varying the pressure by 5 kg / cm ^{2,} the pressure entering *the atomizer* is 2.37 kg / cm ^{2} . From the results of this calculation, it can be seen that if *the jumper line* and *pressure regulator valve are replicated* to the K-6801 A/B, it is very capable of providing pressure according to the manufacturer's *design* , so that the *recycle temperature* that returns to the tank remains in accordance with the operational temperature.

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Simulation Results Using Hysys

The results obtained from the simulation are as follows:

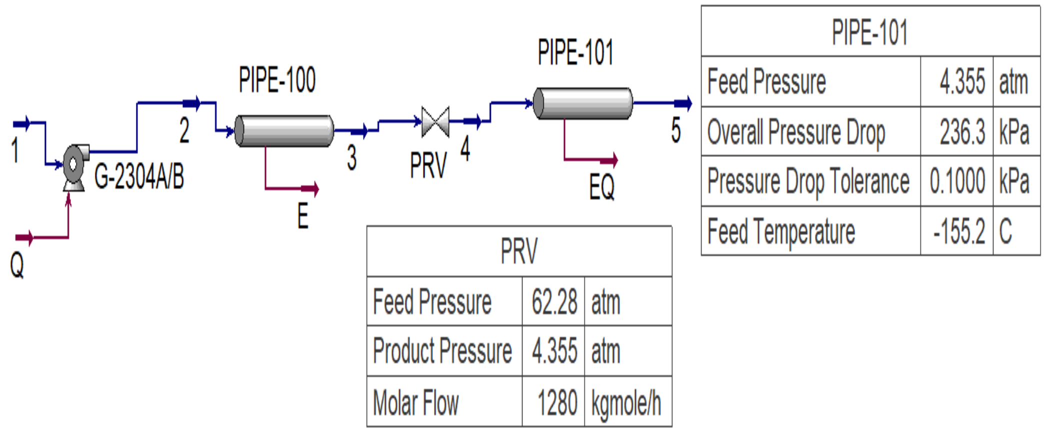

Figure 1 *Pressure Drop of* Piping System with 2 inch *jumper pipe size* , *flow rate of* 75 m3 / hr and *Pressure Regulator Valve setting* at 4.5 kg/ cm2 .

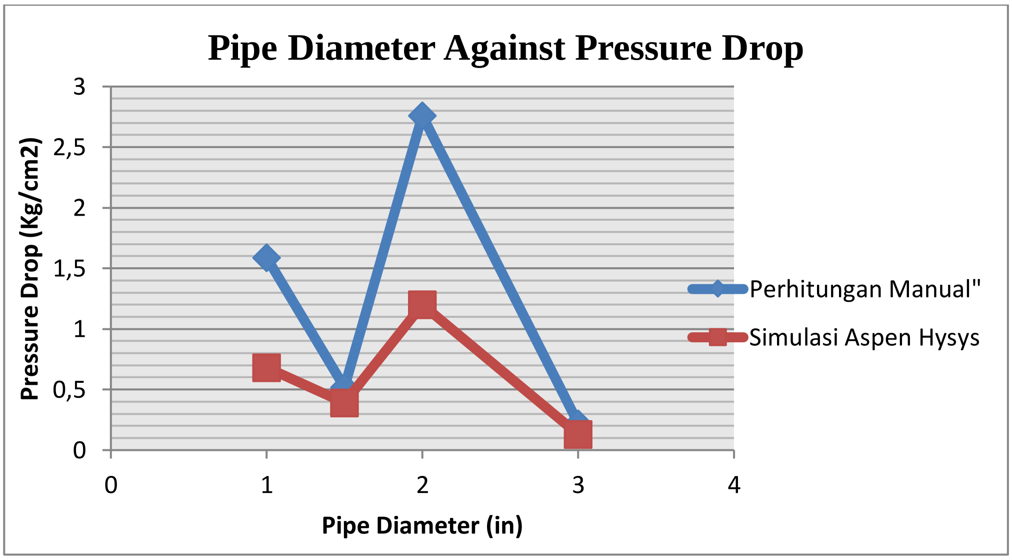

Figure 2 Graph pipe diameter to pressure drop value at flow 75 m3 / hr jumper line 2 inches and *Pressure Regulator Valve setting* at 4.5 kg/ cm2 .

In Figure 1, the pressure at the inlet to the *2-inch jumper line pipe* is 63 kg/cm2 with a flow rate of 75 m3 / h, then regulated *on the pressure regulator valve* at a pressure of 4.5 kg/cm2 . From the 63.5 m length of the liquid atomizer pipe, it produces a pressure drop of 236.3 kPa (2.41 kg/cm2) , if adjusted based on the manufacturer's *design* with a minimum pressure of 2.11 kg/cm2 , the pressure from the simulation with the *aspen hysys* application is still in accordance with the design. This

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means that the *atomizer pressure* is able to maintain the tank temperature according to the operational temperature. From Figure 4.2, it can be seen that the graph shows the *pressure drop value* along the pipe flow from the two calculation methods, both manually and with the *aspen hysys simulation, showing that the pressure drop* value is getting bigger with the reduction in the pipe diameter. The calculation values with these two methods still have slight differences, where the manual value is bigger than using the *aspen hysys simulation.* The 3 inch pipe size has the smallest *pressure drop* and *head loss values among other pipe sizes, while the largest pressure drop* occurs in the 2 inch pipe measuring 35 meters long, meaning that the length of the pipe affects the *pressure drop value* .

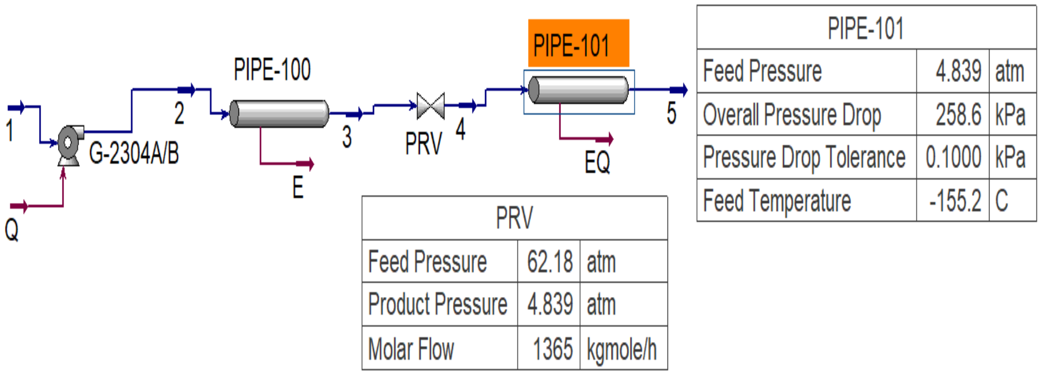

Figure 3 *Pressure Drop of* Piping System with 3 inch *jumper pipe size* , 80 m3 / hr *flow rate* and *Pressure Regulator Valve setting* at 5 kg/ cm2 .

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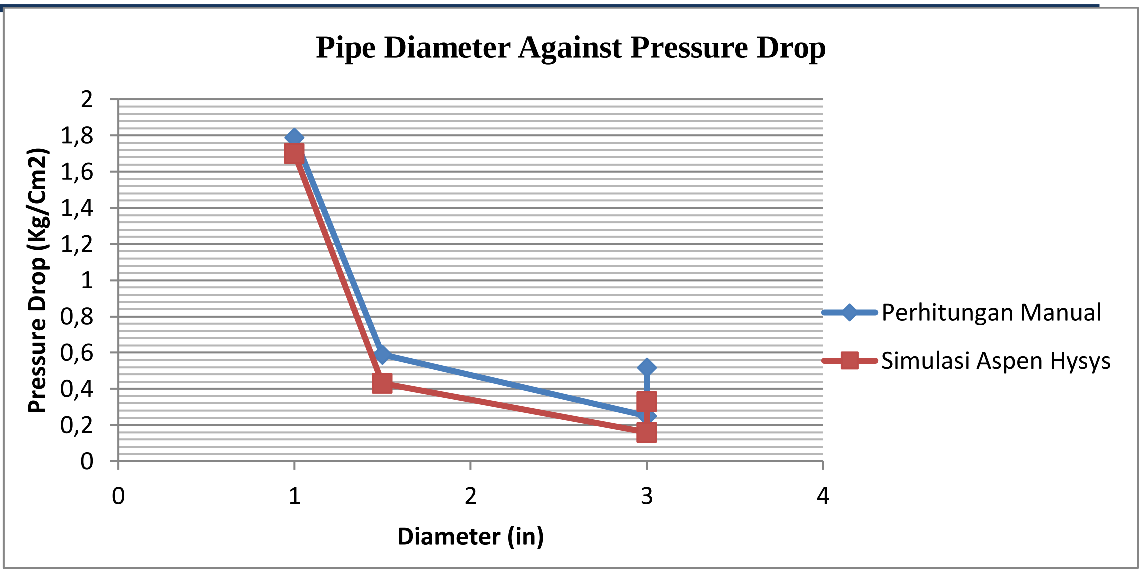

Figure 4 Graph pipe diameter to pressure drop value at flow 80 m3 / hr jumper line 3 inches and *Pressure Regulator Valve setting* at 5 kg/ cm2 .

In Figure 3, the pressure at the inlet to the *3-inch jumper line pipe* is 63 kg/cm2 with a flow rate of 80 m3 / h, then regulated *on the pressure regulator valve* at a pressure of 5 kg/cm2 . From the 69.5 m length of the liquid atomizer pipe, it produces a pressure drop of 258.6 kpa (2.63 kg/cm2) , if adjusted based on the manufacturer's *design* with a minimum pressure of 2.11 kg/cm2 , the pressure from the simulation with the *aspen hysys* application is still in accordance with the design. This means that the *atomizer pressure* is able to maintain the tank temperature according to the operational temperature. If this innovation parameter is replicated on the K-6801 A/B, the atomizer can continue to work optimally. From Figure 4.4, it can be seen that the graph shows *the pressure drop value* along the pipe flow from two calculation methods, both manually and with the *aspen hysys simulation*, *showing that the pressure drop* value is getting bigger with the reduction in the pipe diameter. The calculation values with these two methods still have slight differences, where the manual value is greater than using *aspen hysys simulation.* The 3 inch pipe size has the smallest pressure drop and head loss values among other pipe sizes.

CONCLUSION

1. The results obtained from the calculation show that the diameter of the pipe and the length of the piping distance affect the pressure drop value, this is because the greater the friction of the fluid flow that occurs in the pipe wall, causing the pressure drop value to increase. This shows that the pressure entering the atomizer system is 2.17 kg / cm2 at a flow of 75 m3 / hr and 2.37 kg / cm2 at a flow of 80 m3 / hr, while the manufacturer's design pressure is 2.11 kg / cm2, this means that the pressure drop value along the pipe flow is still in accordance with the manufacturer's design. The highest pressure drop value is by using a 1-inch pipe with a pressure drop value of 1.59 and 1.79 kg/cm2 in the pipe entering the spray atomizer nozzle.

2. The results obtained from the simulation using Aspen Hysys obtained the pressure drop value at a flow of 75 m3 / hr setting PRV at 4.5 kg / cm2 of 2.41 kg / cm2, while at a flow of 80 m3 / hr setting PRV at 5 kg / cm2 of 2.63 kg / cm2 shows the simulation results from Aspen Hysys are still in accordance with the manufacturer's design and close to manual calculations. The pressure drop value obtained from manual calculation and Aspen Hysys simulation still has a difference, with the average result using manual calculation the pressure drop obtained is greater in value than the simulation results using Aspen Hysys.

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