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DISTANCE EFFECT BETWEEN FOUR ELLIPTICAL PIPES WITH RATIO OF 0,8 ON THE PRESSURE ARROUND PIPES

Evans Widjaya Dhinata , Astuti*
Department of Mechanical Engineering, Sriwijaya University

ABSTRACT

Tube is a component of a heat exchanger tube is usually in the form of a small circle section pipe. But do not rule out the possibility of tube using a pipe that is not circle section for example an elliptical section to aims pressure as small as possible, because of the pressure resistor is small, the resulting pressure drop means smaller. Pipes used are a modification AW wavin pipe with an outside diameter of 6 cm into the elliptical section pipe with a ratio of 0.8. Tests carried out in Test engine Subsonic Wind Tunnel Section 40, two pipe by measuring angles and two more be used to measure variations in the distance between the pipes. From the test results obtained by the value of the pressure difference (ΔP) and temperature (°C), the value obtained is inserted into the equation calculation in order to get the coefficient of pressure (CP) getting bigger, but the speed (U) and the pressure coefficient resistor (CDP) smaller as increasing the distance between the pipes.

Keywords: aspect ratio, elliptical cylinder, coefficient pressure, coefficient drag pressure.

1. INTRODUCTION

Fluid flow, although simple shaped objects actually has a complicated form of the flow field. The flow fields are also highly dependent on the shape of the object by flowing fluid, the fluid velocity and viscosity of the fluid. Tube inside the shell in a heat exchanger must also have fields flow due to fluid flowing around the tube. Different tube shape is also believed to affect the coefficient of drag pressure (pressure drag coefficient) different that will affect the pressure drop.

Fluid is a substance that has extremely small particles and even the naked eye can easily move and change shape without mass separation. Fluid can easily follow the shape of the room because of its resistance to change is very small. Fluid change shape continuously past or continue to not retain their original shape even with the pressure or shear forces slightest.
The fluid consists of liquids and gases. For distances between the molecular composition of the gas is greater than the liquid, since the gas is composed of the distance between the molecules is bigger, then the gas is a fluid which is able to press or compressible. Between the fluid molecules are not bound to each other between one molecules to another and can move freely to be able to change shape to fit the container they occupy.

The continuity equation is an equation that connects the fluid velocity to enter a pipe to the speed of the fluid that comes out. In the continuity equation the amount of fluid flowing through a cross section per unit time is called discharge.

The number of the incoming flow in a smooth line will be equal to the amount of discharge that comes out. The relationship between the cross-sectional area and the velocity of fluid flowing in a channel inversely.
Here is a general equation of continuity:

〖 A〗_1 v_1=A_2 v_2 (1)

*Corresponding author’s email: astuti_hadjar@yahoo.com

Information:

A_1 = Cross-sectional area of fluid entry (m2)
A_2 = Cross-sectional area of fluid exit (m2)
v_1 = Velocity entry of fluid (m/s)
v_2 = Velocity out of fluid (m/s)
X = distance (m)

to increase the number of Reynolds Barriers for any number of cases recorded in the image on the page near the curve constraints.

Bernoulli's principle is a term used in fluid mechanics which states that in a fluid flow, an increase in fluid velocity will cause the pressure drop across the flow. This principle is actually a simplified Bernoulli equation which states that the amount of energy at a point inside a closed flow as large as the amount of energy at another point on the same flow path.

$$P_1+ \rho g h_1+1/2\ \rho v_1^2=P_2+ \rho g h_2+1/2\ \rho v_2^2 \quad (2)$$

Information:

P_1 = Fluid pressure in (Pa)
P_2 = Fluid pressure out (Pa)
h_1 = High-end exit (m)
h_2 = Speed entry fluid (m)
v_1 = Velocity in fluid (m/s)
v_2 = Velocity out fluid (m/s)
ρ = Fluid density (kg/m3)
g = Acceleration due to gravity (m/s2)

Reynolds number is the ratio of inertial forces to viscous force that quantify the relationship between the two styles with a certain flow conditions. Reynolds number is a dimensionless number that is most important in fluid mechanics and use, such as the type of laminar and turbulent flow.

The formula used to determine the Reynolds number, is:

$$Re=(\rho v L)/\mu \quad (3)$$

Where:

Re = Reynolds number
ρ = Fluid Density (kg/m3)
v = Fluid flow rate (m/s)
μ = Absolute Viscosity (kg/ms)
L = The length of characteristic object (m)

Reynolds number is a dimensionless number, which means no units, but very influential, especially when dealing with the fluid outside the fluid flow. This is because the Reynolds number is used to determine the type of a stream, whether the flow is laminar, transitional, or turbulent.

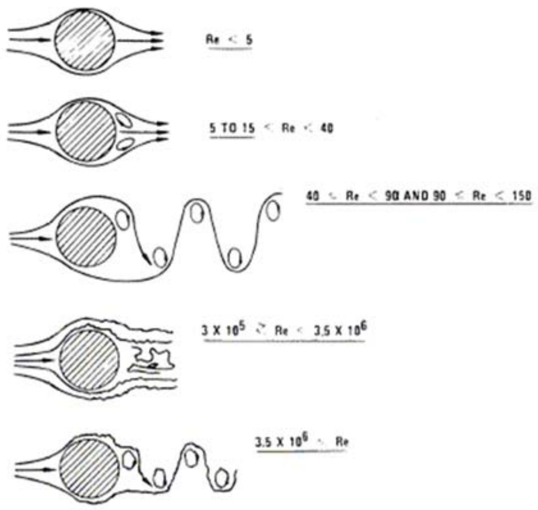


Figure1. Reynold Number in every stream

According www.org.nasa.com all served on these numbers, density, viscosity, and the diameter of the ball is the same. The flow velocity gradually increases from left to increase the number of Reynolds. Barriers for any number of cases recorded in the image on the page near the curve constraints.

Pressure drag or commonly known as form drag is the resistance generated by the normal voltage is also a function of the amount of pressure and the orientation of the surface of the element where the force of the pressure of work.

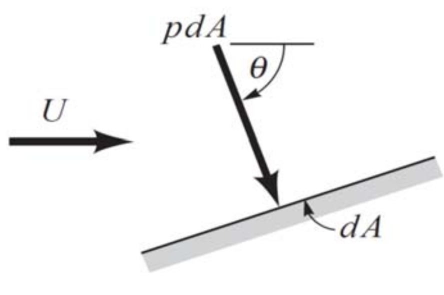


Figure. 2 Profiles pressure drag (Munson, 2009; 495)

Pressure drag can be obtained by:

$D_p=\int pcos\ \theta dA$ (2)

Coefficient of pressure drag can be obtained by:

$C_{Dp}=D_p/(1/2\rho U^2A)$ (3)

The formula used to find the pressure coefficient, namely:

$C_P=((P-Po))/(1/2\rho U^2)$ (4)

Substituting all the equations so obtained the following equation:
$C_{Dp}=1/A\int C_{(P)}cos\theta dA$ (5)

Where:
C_p = Pressure coefficient
C_{Dp} = Pressure drag coefficient
A = Area of the frontal area is subjected to flow fluid (m2)
U = Relative velocity fluid to the object (m/s)
ρ = Fluid density (kg/m3)

For find the value of the pipe pressure coefficient resistor for elliptical expression is required of an ellipse that can be substituted into the equation (5). Some equations can be substituted to find the value of the cylinder pressure coefficient resistor elliptical is:

$A=2bL$ (6)

$dA=dlL$ (7)

Substituting equation (5), (6) and (7) thus obtained:

$C_{(D_P)}=1/2b \int_0^l C_{(P)} \cos \theta\, dl$

Then enter the above equation in dimensionless variables, namely, the equation becomes:

$C_{(D_P)}=\int_0^l C_{(P)} \cos \theta\, dl^*$ (8)

Circumference $= 1/2\ \pi (2b+2a)$
Large $= 1/2\ \pi (2b \times 2a)$
r $=a \sqrt{1-e^2 \cos^2 \theta}$
dl $=a \sqrt{1-e^2 \cos^2 \theta}\ d\theta$

Where:
e= eccentrecity $\sqrt{1-\epsilon}$
ϵ= Aspect ratio
a= Half the major axis of the ellipse
b = Half the minor axis of the ellipse
r= Ellipse radius

Drag type is divided into two kinds:
Induced drag is a resistant force that occurs because of the lift or lift due to the air flow velocity banked or so-called wing vortices around the surface of the wing, the air velocity will produce lift on the aircraft. Drag that occurs because the lift going down with increasing speed, in other words the induced drags are varies inversely with speed. Parasite drag is the force that occurs when an object moves through a fluid medium (in the case of aerodynamic drag, gas media, in particular, the atmosphere). Parasite drag is a combination of form drag, skin friction drag and interference drag, Parasite drag consists of two components, namely:

1. Skin friction drag or skin friction drag, occurs because of the viscous friction that occurs in a boundary layer or boundary layer. Smoothness of the skin or the surface will be a big influence on this defense.
2. Form drag or a drag form, occurs due to the shape of the object itself and the amount of form drag depending on the shape of small objects large and additional components are mounted on the object.

Parasitic drag is proportional to the speed, which will increase in size with increasing speed. In contrast to the induced drag is inversely proportional to the speed. The pressure is a very important characteristic of the fluid field. The pressure at a point in a fluid mass may be intended as an absolute pressure. Absolute Pressure is the pressure that is calculated based on the reference pressure 1 atm. The magnitude of absolute pressure is better known by psia. Absolute pressure is always positive, but the pressure measurement can be positive or negative. If the pressure above atmospheric pressure, the pressure is positive, but if the pressure is below the atmospheric pressure is negative. A pressure measurement can also be referred to as a negative pressure or vacuum suction.

Absolute pressure means the actual gas pressure expressed in psi, the actual pressure at a particular position is called the absolute pressure and measured relative to a vacuum pressure, the pressure of absolute zero. Gauge pressure or atmospheric pressure (atm), is referring to the excess pressure of the outside air pressure or atmospheric (psig). Vacuum pressure is the pressure in the tank, referring to the lack of pressure from the outside air pressure or atmosphere. Pressures below atmospheric pressure is called vacuum pressure (vacuum pressure) and measured with a vacuum gauge that shows the difference between atmospheric pressure and absolute pressure.

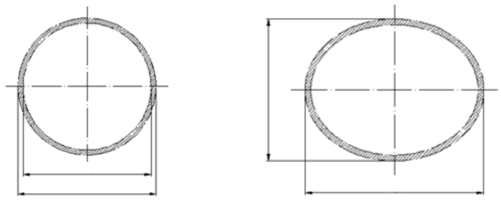
Pgage = Pabs – Patm (untuk P > Patm)
Pvac = Patm – Pabs (untuk P < Patm)

Pressure measurement can be distinguished on the nature of the pressure is: Static pressure ie if the pressure does not change (relatively) along the observation time. The term is widely used the relative pressure in the measurement of pressure, liquid surface level and flow rate.
Dynamic pressure ie if the pressure changes rapidly (fluctuating) along the observation time.

2. METHODOLOGY/ EXPERIMENTAL

Here is a method that will be done in testing, namely:

1. *Wind Tunnel* preparing peripheral *equipment, Thermo-Anemometer,* and the test object.
2. Attach the test object in the test section exists on *Wind Tunnel.*
3. Connect the hose on the test object to a manometer.
4. Turn on the electric motor and fan *Wind tunnel.*
5. Set the speed of rotation on the control panel until the desired flow rate.
6. Measure the speed and temperature of the fluid flow using a *Thermo-Anemometer.*
7. Measure the pressure difference that occurs in the test section and the pressure around the pipe with digital manometer.
8. Noting the results of measurement indicated on the manometer.
9. Analysis and processing data.



(a) (b)

Figure 3. Pipe Used. Pipe Before Modified (a) and pipe After Modification (b)

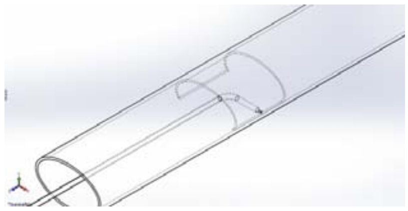


Figure 4. The installation of one of the hoses in an elliptical pipe

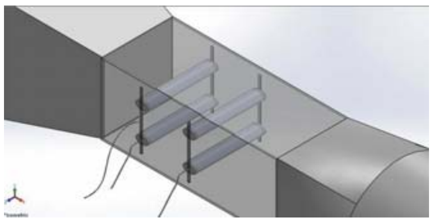


Figure 5. Elliptical pipe installation in the wind tunnel test section

3. RESULTS AND DISCUSSION

From the results of tests and calculations, the value of the coefficient of pressure of the flowing fluid on a curved surface of an elliptical cylinder that has the aspect ratio of 0.8 as shown Table 1.

Table 1. Table measuring point and angle

Pipe 1

Point Ref	ℓ	θ
1-2	8	12
2-3	7.5	27
3-4	8	40
4-5	8	54
5-6	8.5	72
6-7	7	90
7-8	8.5	104
8-9	8	122
9-10	7.5	136
10-11	7.5	152
11-12	8.5	165
12-13	7	181

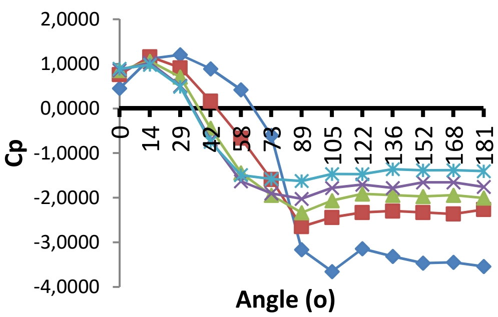
Total	94

Table 2. Table measuring point and angle of the pipe 2

Pipe 2

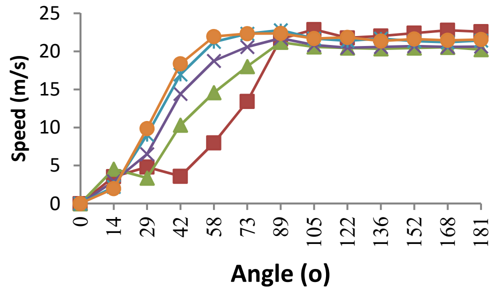
Point Ref	ℓ	θ
1-2	9	14
2-3	8	29
3-4	8	42
4-5	7.5	58
5-6	8	73
6-7	7.5	89
7-8	8	105
8-9	7.5	122
9-10	7.5	136
10-11	8	152
11-12	9	168
12-13	6.5	181
Total	94.5	

In the pressure coefficient data taken of any changes within 5, 15, 30, 60 and 100mm. From the calculation, the greater the distance between the two pipelines, the greater the value of the coefficient of pressure, and apply versa. it can be shown from the calculation results are applied to the following chart.



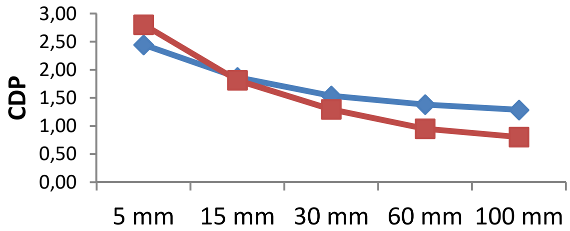
Graph 1. Graph of θ vs Cp Pipe 1 (distance 10 cm)

From the graph above can be seen when the distance between the pipe 5mm up to 100mm distance increases when the pressure began constant. For speed, from the calculation known that speed around the pipe is decreases with increasing distance between the pipes.



Graph 2. Graph of θ vs U Pipe 1 (distance 10 cm)

Similarly, the pressure coefficient resistor, increasing the distance between the pipe, the smaller the resulting pressure coefficient resistor



Graph 3. Graph CP vs the distance between the two pipes in pipe 1 (distance 10 cm)

4. CONCLUSION

After testing and analyzing the graph formed from the data calculation results for the coefficient of pressure (CP) and the coefficient of drag pressure (CDP), it can be concluded as follows:

1. The difference in the value of ℓ on direct measurement and the calculation occurs because of the precision of manual measurement factor with less precision measuring instruments.
2. The greater the distance between the two pipes, then the value of the coefficient of pressure will be greater.
3. The greater the distance between the pipe, the smaller the coefficient of inhibitory pressure.

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