Date 31/1/2022

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DETERMINATION OF FRICTION FACTOR FOR A GIVEN PIPE

Aim :- To observe the head loss that occurs in a pipe due to frictional resistance, hydraulic gradient due to mercury manometer, flow rate and velocity of the water through the apparatus.

APPARATUS REQUIRED

1) Fluid friction Apparatus
2) Water Supply
3) Scale
4) Set up for measuring the actual flow rate.

THEORY

Frictional Resistance to flow.

- The resistance depends on the surface of the conduit or the pipe through its flow.

Frictional resistance in laminar flow. - this happens due to viscous resistance.

Friction Resistance in turbulent flow - we need two forces for this which are the surface roughness as well as viscosity.

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Frictional Resistance Varies.

* degree of roughness of surface.
* The contact of area with the fluid.
* Directly to velocity in laminar flow and square in turbulent flow
* Directly to density of fluid.
* Inversely as viscosity of fluid.

PROCEDURE

1) Connect the U-tube manometer tube to gauge points on the pipeline.
2) Measure the diameter and the length of pipeline between manometric couplings.
3) Open the inlet valve keeping outlet valve closed.
4) Remove the air bubble in manometer tube if any.
5) Open partially the out inlet valve, keeping the common inlet valve fully open.
6) Allow the flow to get stable and take the manometer reading.
7) Measure the discharge by volumetric method.
8) Repeat the steps 5 to 7 for different discharges.

FORMULA

1) Hydraulic Gradient (i)

$$i = \frac{\Delta h \, V(13.6 - 1)}{L}$$

Δh = diff manometre

L = Pipe Length

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Tabulations

S.No	Manometric Deflection 'h' (m)	Loss of head due to fric^{n} $h_f = h \times 12.6$	Rise in tank d	Volume (Area × rise) m^3	Q actual = vol / time (m^3/s)	$f = \frac{h_f \cdot 2gd}{LV^2}$	Average f	
1	13×10^{-3}	0.1638	0.05	6.1×10^{-3}	0.548×10^{-3}	0.175	0.262	Diameter 30 mm
	7×10^{-3}	0.0882	0.05	6.1×10^{-3}	0.504×10^{-3}	0.306		
	3×10^{-3}	0.0378	0.05	6.1×10^{-3}	0.2×10^{-3}	0.305		
2	27×10^{-3}	0.3402	0.05	6.1×10^{-3}	0.606×10^{-3}	0.034	0.035	Diameter 20 mm
	20×10^{-3}	0.2520	0.05	6.1×10^{-3}	0.503×10^{-3}	0.042		
	13×10^{-3}	0.1638	0.05	6.1×10^{-3}	0.548×10^{-3}	0.033		

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2) Flow rate (Q)

$$Q = \frac{V}{T}$$

V - Volume filled in the tank
T - time required to reach some level.

3) Velocity of water (v)

$$v = \frac{Q}{A}$$

4) Frictional factor (f)

$$f = \frac{i(2gd)}{V^2}$$

g - accl^n to gravity
d - inner diameter of pipe.

CALCULATION

for 20mm

$$i = \frac{\Delta h \times (13.6 - 1)}{L}$$

$$i = 0.42$$

for 30mm

$$i = \frac{\Delta h \times (13.6 - 1)}{2}$$

$$i = 0.112$$

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