ANALYSIS & PERFORMANCE CHARACTERISTIC TESTING OF CUSSONS FRICTION LOSS IN PIPE APPARATUS & SINGLE STAGE CENTRIFUGAL PUMP
“Pump with Motor NEWMAN Electric Motor 18030V1/5 1,5 hp; 2850 RPM”

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ABSTRACT

CUSSONS friction loss in pipe apparatus is a piping head loss experiment facility in Fluid Mechanics and Turbo Machinery. An infrequent maintenance and a long term of use lead to a loss in performance of this system. Analysis to the head loss of the piping system and pumping system performance testing are required to restore this facility.

CUSSONS friction loss in pipe apparatus was mainly using Polyvinyl chloride (PVC) material for its piping system on a 4,65 m × 0,924 m square frame. Fittings such as long radius elbow 90°, short radius elbow 90°, elbow 45°, venture meter tube, sudden contraction pipe, and sudden enlargement pipe were included. Pressure taps were connected to a U Manometer of mercury with 13,6 specific gravity (SG). Pipe head loss is analyzed with Swamee–Jain formulae and Darcy Weisbach formulae. A single stage centrifugal pump was connected to NEWMAN electric motor 1,5 hp, 2850 RPM. Pumping system examination includes the measurement of suction pressure and discharge pressure using pressure gauges at inlet and outlet sections of the pumping unit. Flow rate was controlled by a bypass system and a discharge valve.
The maximum capacity of the pumping unit is 70 L/min, measured using a Fisher Controls 2000 flow meter. The variation of Reynolds number were from minimum to maximum capacity in the pipeline system. Flow rate varies from 10 L/min to 70 L/min for a 3/2” PVC pipe at line I, 10 L/min to 60 L/min for a 3/4” PVC pipe at line II, and 10 L/min to 50 L/min for a 1/2” acrylic pipe at line III with 2 L/min difference for each variation. System’s performance analysis was also supported by Pipe Flow Expert v5.12.1.1 software.

Friction factor (f) versus Reynolds number (Re) for a certain value of relative roughness (e/D) and coefficient of losses (K_L) versus Re was obtained from the experiment. The value of e/D for each pipeline is also obtained from experiment and measurement using Swamee–Jain equation. It is acquired that the BEP for each pipeline from measurement compared to software analysis are \( \eta_p \): 29% to 28,4%; H: 17,1 m to 17 m for pipeline I, \( \eta_p \): 26% to 26,2%; H: 18,4 m to 18,34 m for pipeline II, and \( \eta_p \): 25,3% to 23,8%; H: 19 m to 19,2 m for pipeline III. Experiment was done with Reynolds number variation in turbulent flow for a maximum flow rate of 70 L/min.

**Key words:** Head loss, Darcy Weisbach, single stage centrifugal pump, Reynolds number, friction factor.