400-Pillutla

Evaluation of Loss Coefficient For Stand Alone Radiator

Domestic and industrial heating systems construe a big industry in cooler countries, globally. Radiators in a central heating system have been a primary source of domestic heating in the UK for several decades. Central heating radiators act as heat exchangers and heat the ambient air. Effective and efficient heating systems are essential to drive the cost of heating down.. A standalone system has a reduced number of convector fins which are replaced by a metal heating element and a pump to circulate the water within a closed loop. Each unit is self contained and may be operated individually or as part of groups of radiators.

Radiators have been analyzed for their performance by various researchers. Beck et. Al, [4] have concluded that different combinations of fluid entry and exit positions can affect radiator performance. Ward's [3] work has identified that the as the flow rate is reduced the residence time of water in the radiator increases resulting in lower return temperature. McIntyre [5] further concluded that the heat output of a radiator decreases with a decrease in flow rate of water; while Giesecke [7] has found that in a central heating radiator system frictional head loss increases with the increase in flow rate. The work aims to compute the head loss in the standalone system and establish a relationship between the loss co-efficient and Reynolds number. Head loss in a system is computed by equation 1.

$$H_f = f_c D_H \frac{V^2}{2g} = K \frac{V^2}{2g} = \frac{\Delta P}{\rho g} \qquad (1) \quad \text{Where } K = F(f_c, D_H)$$

Therefore $K = \dfrac{2 \times \Delta P}{\rho V^2}$ [Loss co-efficient] (2)

Loss co-efficient against velocity has been illustrated in the figure 1 to study the trend for the two pipe layouts in a single panel radiator. BBOE and BTOE configurations have similar trends, where the value for the loss co-efficient K drops with the increase in velocity. K at 50 % flow rate (velocity of 0.25m/s) for a single panel radiator in a BBOE layout was found to be 475.8 and 508.49 for a BTOE layout. The loss co-efficient was found to be 262.69 and 276.2 at 100% flow rate (velocity of 0.33 m/s) for BTOE and BBOE configurations respectively. The change in the loss co-efficient in a BTOE configuration is 245.96 which is higher than BBOE at 199.6. Similarly analysis have been done on double panel radiator and the loss co-efficient have been studied with respect to the Reynolds number.

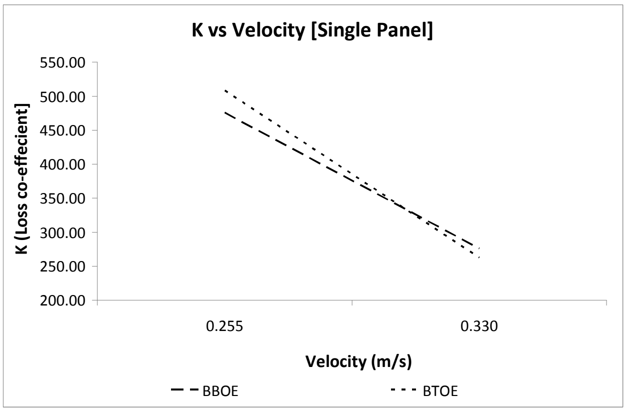

Figure 1:Constant k as a function Velocity [Single Panel]

Loss co-efficient for a 300 mm × 600 mm double and single panel radiator have been calculated for two flow configurations in a standalone system. The loss co-efficient and hence the frictional loss in the standalone system drops with the increase in the water velocity. A double panel radiator with BBOE layout has the lowest loss co-efficient suggesting it would require least pumping power. Previous work has suggested that a BTOE layout has maximum temperature drop and hence better heat output. For this configuration, flow velocity can be optimised for low K value and maximum heat output with minimal pumping power. . Further work is proposed to account for radiator size and quantify thermal dependence of the loss co-efficient. The work could be further supported by testing a transparent radiator with LDV (Laser Doppler Velocitymetery) system to quantify the fluid path.