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Full Length Research Paper

Introducing slag powder as drag reduction agent in pipeline: An experimental approach

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Main by product in ore smelting from tin production in Malaysia has become a trigger for this investigation. Slag waste can be categorized as suspended solid. Utilization of this waste in fluid transportation can reduce the pressure drop in pipelines. Experimental works had conducted in order to test slag waste in a closed loop of turbulence water flowing system with water and fuel as the transport liquid. The procedures start by pumping liquid suspended solid combination from reservoir tank with varies flow rates into two different pipe diameters (0.0127 m ID and 0.038 m D.I). The types of pipe used are PVC pipe. The testing length of this flow system is 2.0 m. The pressure drop and drag reduction were measured in varied addition concentration. The results have show percentage drag reduction (Dr%) is over 60% in certain range and condition. It is proved that slag is a potential DRA.

Key words: Suspended solid, turbulent flow, drag reducing agent, pipeline system.

INTRODUCTION

Drag reduction in turbulent flow is a very important subject in technologies utilization and significant point of interest. As known, drag reduction can be achieved by using several numbers of additives that have been widely studied such as high molecular weight polymers (Roy and Larson, 2005; Al-Sarkhi, 2010, Mowla and Naderi, 2006; Shetty and Solomon, 2009; Parimal et al., 2008; Janosi et al., 2004; Dubief et al., 2004) surfactants study by Lu et al. (1998), Bari and Yunus (2009), Bari et al. (2008) and Suali et al. (2010) and suspended solid investigation have been determined by Roy and Larson (2005) and Dyer et al. (2004). Drag reduction is defined as addition of several ppm concentrations to accelerate radically in fluid transportation (Brostow et al., 2006; Suali et al., 2010; Dubief et al., 2004; Kim et al., 2000; Parimal et al., 2008) and many more. However, there are few studies regarding suspended solid. Mechanism involved is yet still a hesitation. Many researchers investigated the idea of particles inside liquid flow channel agreed in one point, turbulent characteristic are changed in present of suspended solid (Rashidi et al., 1990; Roy and Larson, 2005; Dyer et al., 2004; Filipson et al., 1977). There are fewer studies devoted to the effects of particle additives on the mechanisms of instability and transition to turbulence in free shear flows. The flow visualizations reported by Filipsson et al. (1977) represent one of the few available experiments on this subject. In this study, the authors presented results for a jet flow of viscoelastic (Polyox WSR-301), fibre suspension (chrysotile fibres) and Newtonian (water) fluids at high Reynolds numbers. Rashidi et al. (1990) have determined predominant effects of particle size, density and concentration. Their results point out that particle density has minor effects rather than particle size in effects of drag reduction.

Presently, the usage of the suspended solid (insoluble in liquid media) as drag reducing agent has broaden accesses for enthusiastic researcher to uncover the accessibility of this insoluble condition in the drag reduction phenomena (Toonder, 1997; Mowla and Naderi, 2006). The aim of this study is to test the efficiency of slag particle as drag reducer agent on transport of fuel inside pipes. Two different internal pipe diameters were used with four different concentrations in the purpose to investigate the concentration effect. The efficiency of suspended solid was tested using diesel.

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