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Experimental investigation on momentum and drag reduction of Malaysian crop suspensions in closed conduit flow

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Abstract. The study of frictional losses in fiber suspension flow is one of the significant scientific interests as the characteristics of suspension flow considerably changes with shear stress, fiber source, and treatments applied on fibers. Pressure drop measurements were obtained for different Malaysian crop fiber suspensions flowing through a closed conduit. The generated data were gathered over a range of flow rates and suspension concentrations. It was found that the magnitude of the pressure drop of the fiber suspensions is dependent on the concentration, characteristics, and fiber source. Considerable drag reduction is obtained for concentration of 0.6 wt. % at high flow rates. Such a reduction of pressure drop at the particular concentrations and the flow rates is interesting and useful as these data can be used for design and optimization of fiber handling equipment and piping systems. Furthermore, the effect of different fibers, fiber properties, and flexibility on pressure drop were studied.

1. Introduction

Fiber suspension flow is different from Two-phase flow occurs in the transportation of oil and gas, mining, petrochemical process, boilers and condensers as fibers are flexible and asymmetric. Usually fibers suspensions flows are occurring in many applications, such as pulp and paper, textile, fiber composites etc. Studies conducted on fiber suspensions flow and their characterization and correlations are mainly wood pulp fibers. The physical characteristics of the fiber suspensions as well as the properties of the end products, are dependent on the hydrodynamic behavior and structure of the suspensions [5]. Features, such as consistency, flow conditions, interactions and fiber properties affect the hydrodynamic behavior and structure of the suspensions flow. The investigations conducted on fiber suspensions flow and characterization of fiber suspensions are mainly wood pulps and polymeric fibers [4-8].

Due to increasing demand for fibrous materials, limitation of the wood source and environmental concern, the study of non-wood fibers suspensions has become imminent. Crops based fibers attracting the focus of pulp and paper industry as well as researchers, as it is recognized as an alternative source of wood fibers. Kenaf, crop-based fiber reported as an alternative source of wood for the pulp and paper production that have two distinctive stem regions, the outer portion or Bast is