Effect of Reynolds Number and Concentration of Biopolymer (Gum Arabic) on Drag Reduction of Turbulent Flow in Circular Pipe

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Abstract : Biopolymers are popular in many areas, like petrochemicals, food industry and agriculture due to their favorable properties like environment-friendly, availability, and cost. In this study, a biopolymer gum Arabic was used to find its effect on the pressure drop at various concentrations (100 ppm – 300 ppm) with various Reynolds numbers (10000 – 45000). A rheological study was also done by using the same concentrations to find the effect of the shear rate on the shear viscosity. Experiments were performed to find the effect of injection of gum Arabic directly near the boundary layer and to investigate its effect on the maximum possible drag reduction. Experiments were performed on a test section having i.d of 19.50 mm and length of 3045 mm. The polymer solution was injected from the top of the test section by using a peristaltic pump. The concentration of the polymer solution and the Reynolds number were used as parameters to get maximum possible drag reduction. Water was circulated through a centrifugal pump having a maximum 3000 rpm and the flow rate was measured by using rotameter. Results were validated by using Virk's maximum drag reduction asymptote. A maximum drag reduction of 62.15% was observed with the maximum concentration of gum Arabic, 300 ppm. The solution was circulated in the closed loop to find the effect of degradation of polymers with a number of cycles on the drag reduction percentage. It was observed that the injection of the polymer solution in the boundary layer was showing better results than premixed solutions.

Keywords : drag reduction, shear viscosity, gum arabic, injection point
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