ABSTRACT

The thesis presents an experimental study of turbulent drag reduction by polymer-polymer and polymer-fibres mixtures together with their shear stability studies.

A turbulent flow rheometer has been used for the measurement of the drag reduction and shear stability. The experiments have been conducted at various concentrations and compositions of the mixtures at Reynolds number of 14000. In most of the cases, the drag reduction caused by the mixtures shows a positive deviation from the linearly additive straight line. This effect is more prominent when the drag reduction caused by both the constituents differ appreciably.

The drag reduction caused by the mixtures is higher than the drag reduction caused by either of the constituent polymers, however, the drag reduction caused by the mixtures is less than the sum of the drag reduction caused by both the constituents at their respective concentrations in the mixture. The above difference is less when the drag reduction caused by the constituent polymers are not differing much. These mixtures do not show any synergistic effects, except the mixtures of PGG-AF. The random coil size and rigidity of the polymer molecule appear to be responsible for synergism in the case of PGG-AF mixtures.

The results indicate that the positive deviation from linearly additive straight line and synergism is strongly dependent upon the flow rates and concentration of the mixtures.

The present study indicates that when the shear stabilities of both the constituents of the mixtures are differing drastically, the incorporation of small amount of lesser shear stable drag reducing agent reduces the shear stability of the mixture drastically. However, when the shear stabilities of the constituent polymers are of the same order, there is only proportional change in shear stability of the mixture by the addition of one component into the other. This observation is true in both polymer-polymer and polymer-fibres mixtures. A fairly good correlation has been found between R (rate of shear degradation with pass number) values for mixtures and their constituents in consonance with the shear stability behaviour.

A multipurpose wind tunnel has been designed and fabrication work has been completed under the supervision of the author. The calibration results show that the flow velocity distribution in the tunnel test section is quite uniform and other characteristics of the tunnel are also good. In the present design, an annular entry

unit with new type of twisted flow straightener vanes has been incorporated by which the tunnel performance is greatly improved.

The study conducted on the aerofoil drag reduction in air stream shows that drag coefficient of an aerofoil model is decreased when polymer [poly(ethylene oxide)] solution is sprayed on the model surface. However, no change in lift force has been noticed. The drag reduction in this case has been explained on the basis of theory given by Lumley.