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STUDIES ON RHEOLOGICAL BEHAVIOUR OF LIQUID NATURAL RUBBER

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Abstract: The flow behaviour of LNR was studied with special reference to the effect of molecular weight, shear rate and temperature. The study indicated that the psuedoplastic behaviour of LNR decrease with decreasing molecular weight and reduction in viscosity with temperature is more pronounced at lower temperature.

1. Introduction

Liquid elastomers are used in a wide range of applications such as cast rubber products, moisture resistant sealants for filling voids, self sticking tapes, binder for grinding wheels and rocket propellants (Hardman and Lang 1950). They have also been tried as plasticiser for natural rubber (Bristow 1985) and nitrile rubber (Radhakrishnan Nair et al, 1989). Liquid natural rubber is unique with respect to its preparation. It is produced by depolymerisation of the high molecular weight naturally occurring polymer. Production of LNR by thermal depolymerisation has been standardised by Claramma et al (1991). Its applications are mainly attributed to the pourability and flowability of the material. The flow characteristics of LNR are important in its application. In the present work we report the flow behaviour of liquid natural rubber with special reference to the effect of molecular weight, shear rate and temperature.

2. Materials and Methods

Liquid natural rubber samples were prepared by depolymerisation of ISNR 5 effected by a combination of mechanical, chemical and thermal energies (Claramma et al, 1991). The properties of LNR are given in Table 1. The samples are characterised based on Brookfield viscosity which was meeasured using a Brookfield Viscometer model RVT, Spindle 6, 5 RPM at 35°C. Low, medium, high and very high molecular weight samples were selected as a function of their Brookfield viscosity. Viscosity studies were carried out using Rheomat-30 (Contraves, Switzerland) As the study was to investigate the effect of shear rate as well as temperature on different samples the concentric cylinders with B and C cups were used for making the measurements. Continuous shear rheometry measurements were carrieed out at 1-15 or 16-30 RPM depending on the viscosity of the samples at test temperatures. The studies were carried out in the temperature range of 20 to 140oC. The rheograms were plotted using the x-y recorder attached to the instrument.

Table 1. Properties of LNR

Ash content (%)	0.6
Volatile matter (%)	0.1
Specific gravity at 25°C	0.92
Colour	Light brown in thin films.

3. Results and discussion

The effect of shear rate on the viscosity of LNR is given in Figure 1. The reduction in viscosity for low, medium and high molecular weight samples has been plotted against the steadily increasing shear rate at a temperature of 20oC. As is evident from the figure, the samples show a pseudoplastic tendency which increases with increasing molecular weight. This is as a result of

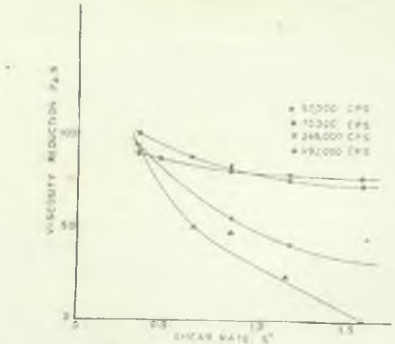

Fig 1. Effect of shear rate on viscosity

the higher amount of polymer entanglements which become significant enough to contribute to high viscosity values at low shear rates. Low molecular weight samples have relatively short chain lengths and their relative motion even at low shear rates is easy. Shear stress measurements were made over a range of shear ratios from 0.215 Sec-1 to 157.9 Sec-1 using B and C cups of Rhemat 30 so as to accommodate the effect of temperature. At high shear rates the effect of shear rate on viscosity was less significant. Results of viscosity measurements at different temperatures are given in Figure 2. Viscosity on a logarithamic scale is plotted

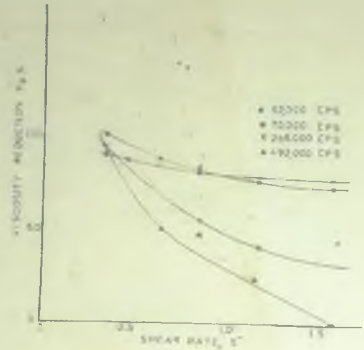

Fig 2. Effect of temperature on viscosity

against temperature. From the slope of the curves it is evident that the effect of temperature on the viscosity of LNR is very significant. In the lower temperature range of 20°C to 80°C slope is more, indicative of a larger reduction in viscosity. The sample with the highest initial viscosity developed comparatively less fluidity at 140oC than the low molecular weight samples. For low molecular weight LNR, a 30 fold reduction in viscosity was noticed when temperature increased from 20oC to 80oC Whereas it was only a six fold reduction when the temperature rose from 60 to 140oC. In the case of the sample with the highest viscosity corresponding values were 22 and 10 respectively.

4. Conclusion

The present investigations indicated that liquid rubber samples of Brookfield viscosity less than 1,00,000 cps showed Newtonian tendency while higher viscosity samples showed pseudoplastic behaviour. Reduction in viscosity due to increase in temperature is faster at low temperatures and slower at high temperatures.

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SUSPENDED SEDIMENT TRANSPORT AND SHOALING IN THE MUNAMBAM FISHERY HARBOUR, KERALA

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Abstract Results of the Monthly synoptic field observations of vertical profiles of suspended sediment concentration, current velocity and salinity carried out in the Azhicode estuary are presented with a view to understand the shoaling and siltation phenomena in the harbour region. Based on various physical and geomorphological data available on the harbour and near shore region, remedial measures are suggested to prevent the siltation and shoaling at the entrance channel and the sandbar formation at the harbourmouth. This paper also highlights various aspects of hydrodynamics in the lower reaches of the estuary.

1. Introduction

The Azhicode estuary is formed by the major arm of the Periyar river which joins the Arabian Sea at Munambam. The chalakkudy river joins the estuary about 10 km upstream from the mouth. Compared to Cochin estuary, Azhicode estuary is shallower, the maximum depth at the entrance channel being about 8 m. The width of the estuary near the barmouth is 750 m and at the inlet entrance, about 250 m. The average depth of the study area is about 3.5 m (Abraham Pylee 1987). Sedimentation in the harbour region as well as the sand-bar formation across the entrance channel is a major menace to the safe entry and berthing of the fishing boats.

2. Materials and Methods

Study are and station location area shown in Fig 1. Monthly synoptic field observation of vertical profiles of velocity, temperature, salinity and suspended sediment concentration for one tidal cycle were carried out at all stations for a period of one year.