To check if the viscosity increasing agent does not exhibit elastic features, oscillation tests were performed by means of Bohlin Rheometer System. During these experiments oscillating strain was applied to samples of the pure polymer and the resulting stress was measured. Table 6.II reports values of the phase shift between the strain and stress measured at different oscillation frequencies. The relaxation times computed from relation [80]:

$$\tau = 1/(2\cdot\pi\cdot f\cdot tg\,\delta) \tag{6.6}$$

are also presented in this table.

Table 6.II. Phase shifts and relaxation times obtained for the pure polymer at 22°C.

f[Hz]	0.1	0.2	0.5	1.0	2.0	5.0	10.0
δ[deg]	88.9	87.8	87.9	87.9	88.2	88.1	87.6
τ[s]	0.0306	0.0306	0.0117	0.0059	0.0025	0.0011	0.0007

These data clearly indicate that polyethylenepolypropylene glycol behaves almost like perfectly viscous liquid; the phase shift is close to 90 degrees and the relaxation times are very short (for perfectly viscous liquid δ=90° and τ=0). It should also be noted that so-called effect of "rod-climbing" was never observed when solutions containing the polymer were agitated.

6.2.3. Density of Aqueous Solutions.

Density of aqueous solutions of polyethylenepolypropylene glycol was measured by means of glass pycnometers, previously calibrated by redistilled water.

Tables 6.IIIab show densities measured at 18°C and 25°C for the polymer contents ranging from 30 to 90 weight percents.

Table 6.IIIa. Density of the polymer aqueous solutions at 18°C.

w_P[%]	30.00	40.00	50.00
ρ[g/cm^3]	1.048	1.065	1.080

Table 6.IIIb. Density of the polymer aqueous solutions at 25°C.

w_P[%]	30.08	39.69	49.67	59.50	67.75	79.39	89.95
ρ[g/cm^3]	1.043	1.058	1.073	1.085	1.090	1.093	1.095

Data reported in tables 6.III can be approximated by the following expressions:

- at 18°C $\rho\,[g/cm^3] = 0.9836 + 0.2505\cdot w_P - 0.1150\cdot w_P^2$, **(6.7a)**

- at 25°C $\rho\,[g/cm^3] = 0.9541 + 0.3865\cdot w_P - 0.3425\cdot w_P^2 + 0.0975\cdot w_P^3$. **(6.7b)**

Both experimental results and expressions (6.7) are plotted in figure 6.3.

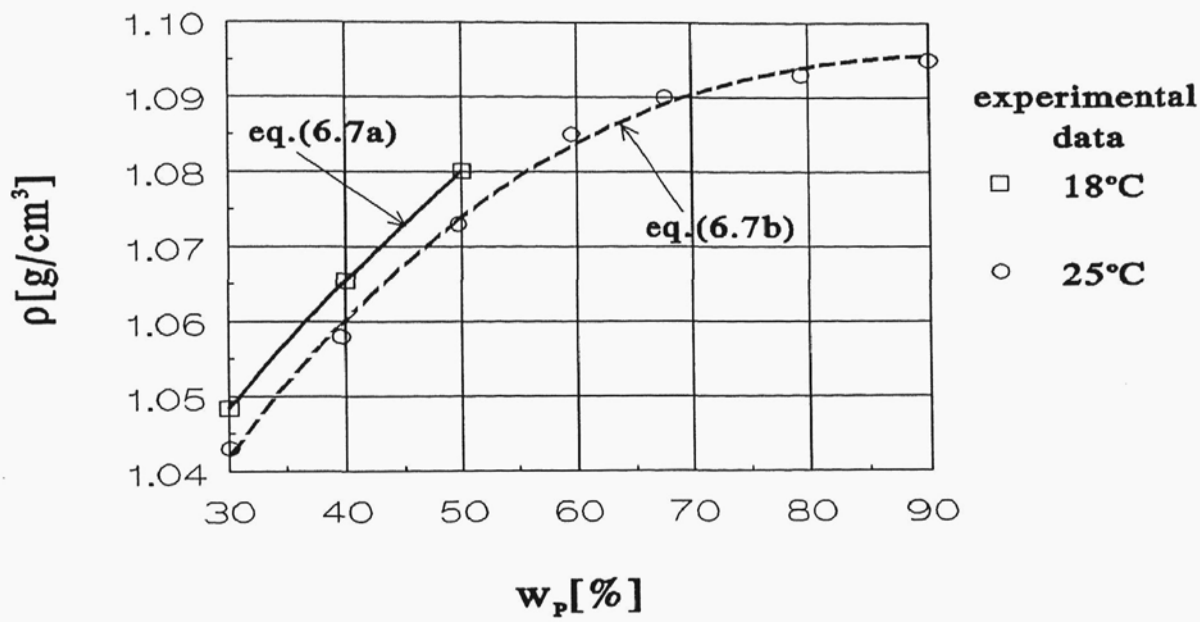

Figure 6.3. Density of the polymer aqueous solutions.

Analysis of these data indicates that even for very high contents of the polymer, density of the resulting aqueous solution increases no more than 10% of the density of pure water.
It should be noted, however, that viscosity as well as density of aqueous solutions of polyethylenepolypropylene glycol may differ slightly for various batches of the same polymer.

6.2.4. Chemical Activity.

As stated earlier polyethylenepolypropylene glycol is an aliphatic polyether. This implicates its low chemical activity at normal conditions [78]. Aliphatic ethers are in general weak bases (approximately 100 times weaker than water), because of the presence of free electron pair near oxygen atom. At elevated temperatures and in presence of catalyst polyalkylene glycol may be subjected to radical reactions eg. chlorination or oxidization. In presence of very strong bases (e.g. carbanions) aliphatic ethers take part in ion reactions leading to their decomposition according to the following scheme [78]:

$$CH_3^{\ominus} + CH_3CH_2\text{-}O\text{-}CH_2CH_3 \rightarrow CH_4 + CH_3CH^{\ominus}\text{-}O\text{-}CH_2CH_3 \qquad (6.8)$$
$$CH_3CH^{\ominus}\text{-}O\text{-}CH_2CH_3 \rightarrow CH_2{=}CH_2 + CH_3CH_2O^{\ominus}\ .$$

Very strong acids may also cause degradation of aliphatic ethers, e.g. long heating of ether with concentrated iodic acid results in