Use of a solution of phenol in methylene chloride in the production of polycarbonates

S.A. Shevchuk, V.F. Lazarev and L.G. Lazareva
Nizhegorodskii Technical University

Phenol is currently used as a molecular weight regulator in existing production of polycarbonates. The specification envisages introducing phenol into the reaction mixture as a melt, or as a solution in hot water. Neither method is very efficient, requiring cyclic heating of the regulator being dispensed to ensure its mobility and the possibility of conveyance through pipes.

This cyclic heating leads to oxidation of the phenol by the oxygen of the air, and intensification of autoxidation. This leads to discoloration and lowering of the content of the principal substance.

To study the possibility of increasing the stability of phenol during storage and making the process more efficient, we investigated the storage of phenol in the form of a solution in methylene chloride, which is a solvent in the production of polycarbonate in the existing manufacturing process.

It seems unlikely that such a low-boiling solvent as methylene chloride (b.p. = 40°C) could be used for preparing phenol solutions that are stable during storage, but these investigations were based on the well-known studies of I.M. Korenman (Ref. 1), which presented the results of experiments in the solvation of phenol by various chlorine-containing solvents (excluding methylene chloride). A high bond energy was found in solvates of a certain composition of phenol plus chlorine-containing solvent.

We suggest that solvation of phenol by methylene chloride leads to structuring of the solution and, in consequence, to an extremal change of certain physicochemical properties.

To determine the extrema, the density and viscosity values were determined experimentally as a function of the composition of the solution (Figures 1 and 2).

Figure 1. Density as a function of the content of phenol in methylene chloride

Figure 2. Viscosity as a function of the content of phenol in methylene chloride
Two extrema correspond to the concentration limits of 22-30 wt.% and 40-44 wt.% of phenol, respectively. A solution corresponding to the second extremum, i.e. at higher concentrations, is of interest for industrial purposes.

The freezing point of solutions of phenol in methylene chloride was determined (Table 1), close to the extremum, and it was shown that this extremely important process variable has its lowest value here. This provided the basis for determining the working range of concentrations of phenol solution: 40-44 wt.%.

Stability of phenol during storage was also determined in this range (Table 2). For comparison, this also shows data for phenol that has been heated in actual production conditions. Stability was characterised by the light transmittance of solutions of identical concentration, prepared using phenol that had undergone heating cycles (sample No. 1) and that had not undergone “thermal cycling” (sample No. 2), determined using a KFO photocolorimeter.

As can be seen from Table 2, when a solution of phenol in methylene chloride was stored for a month it showed hardly any changes (sample No. 1), whereas for phenol that was subjected to periodical heating the transmittance was nearly halved (sample No. 2).

To determine the losses of methylene chloride through natural evaporation, we determined the rate of evaporation of pure methylene chloride and from a 44% solution of phenol. The respective values were 1.75 and 0.9 m³/m²·h (t = 20°C, 24 h, S_{vap} = 5.7·10⁻⁴ m²), i.e. in the extremal region the rate of evaporation of methylene chloride is almost halved.

A solution of phenol in methylene chloride of the proposed concentration was used in the production of polycarbonate at the “Karbokhim” scientific-production company in 1999 and met the production requirements in full.

**REFERENCE**


(No date given)