OIII-24
VISCOSITY MEASUREMENTS ON MOLTEN SALTS WITH OSCILLATING VISCOMETERS

Popescu A.M., Zuca S.
Laboratory of Molten Salts, "I.G.Murgulescu" Institute of Chemical Physic, Romanian Academy, Splaiul Independentei 202, Bucharest, 060021, Romania
E-mail: ampop@icf.ro

Molten salts are ionic liquids at high temperature and the viscosity is one of the most important transport properties of liquids, both from scientific and engineering aspects.

As generally accepted, besides the direct information supplied by spectroscopy, the thermodynamic and transport data also contribute to elucidating the complex ions presence in molten salts.

However it is rather difficult to measure viscosity at high temperature.

Therefore this paper is focuses on presenting the method of viscosity measurement by torsion pendulum method.

Using the pendulum method there have been developed two different methods using the oscillating sphere and the oscillating cup (or cylinder).

Both methods and equipments developed in our laboratory are shortly presented.

The Sephram-Photodyne ensures the detection and control of oscillations for both methods. For the oscillating sphere the acquisition of the data is made using a recording and then was processed manually combined with a special PC program using the "Verschaffelt" equation. The oscillating cup the viscometer is connected to an automatic acquisition and processing data system with a special software, using the "Tærklep-Øye" equation.

Experimental determinations of the viscosity of a number of single molten salts and complex molten salt mixtures have been carried out in our laboratory using both of the presented methods[1-6]

Some viscosity curves examples for single salts (e.g. Na_3AlF_6, $AlkNO_3$, AlkF, NaCl) and molten mixtures (e.g. $BaCl_2$-CsCl, $CdCl_2$-CsCl, $MgCl_2$-$CaCl_2$-NaCl-KCl) are presented. As a general rule, for each salt the viscosity has been measured over a temperature range about 100°C above the melting point.

The experimental data are presented in correlation with the structure of the salts (e.g. phase diagrams and molten models).

All presented data are discussed in terms of the viscous flow theory in ionic liquids (e.g. Batchinsky, Frenkel and Eyring equation which correlate the viscosity with the specific volume and fluidity of the salts, conductivity and activation energy for the viscous flow). Starting from the viscosity isotherms correlated with other thermodynamic data, the presence of some complex ions was pointed out for some melts.

The viscosity measurements presented in all those simple or complex melt confirm that the torsion pendulum method is a useful tool to study the viscous properties of melts at high temperature.

---

[1] S.Zuca and R.Borcan, *Rev.Roum.Chim.*, 1984, 29, 233-238.
[2] S.Zuca *et al. Chem.Papers* 1991, 45(5), 585-592.
[3] A.M.Popescu *et al. Proceed.XXIV Hot.Salts Chem.Comm.*, 1998, 1, 426-430.
[4] D.Tolbaru *et al. Ber.Bunsenges.Phys.Chem* ,1998, 102(10), 1-6.
[5] D.Tolbaru *et al. 1st Int.Conf.Chem.Soc.South-EastEurop.Countr.*, 1998, 2, PO555.
[6] A.M.Popescu, *Rev.Roum.Chim.*, 1999, 44(8), 765-770.