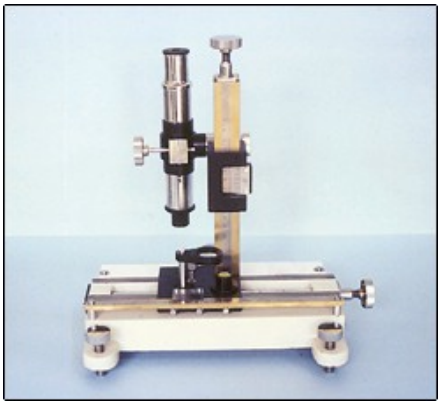
Apparatus for the Measurement of Susceptibility of Paramagnetic Solution by Quinck's tube Method

Introduction



It was established by Faraday in 1845 that magnetism is universal property of every substance. He classified all magnetic substances into two classes, viz., paramagnetic and diamagnetic. Weber, later on, tried to explain para and diamagnetic properties on the basis of molecular currents. The molecular current gives rise to the intrinsic magnetic moment to the molecule, and such substances are attracted in a magnetic field, and called paramagnetics. The repulsion of diamagnetics is assigned to the induced molecular current and its respective reverse magnetic moment. The force acting on a substance, either of repulsion or attraction, can be measured with the help of an accurate balance in case of solids or with the measurement of rise in level in narrow capillary in case of liquids. The force depends on the susceptibility K, of the material, i.e., on ratio of intensity of magnetisation to magnetising field (I/H). Evidently it refers to that quantity of substance by virtue of which bodies get magnetised. Quantitatively it refers to the extent of induced magnetisation in unit field. If the force on the substance and field are measured, the value of susceptibility can be calculated.

The value of the susceptibility K of liquid aqueous solution of a paramagnetic substance in air is given by a well know expression:

$K = 2(\rho - \sigma)gh / H^2$

where r is the density of the liquid or solution
s is the density of air
g is the acceleration due to gravity
h is the height through which column rises on switching on the field
H is the magnetic field at the centre of pole pieces

Procedure

The apparatus consists of U-shaped tube known as Quinck's tube. One of the limb of the tube is wide and the other one narrow. The experimental liquid or solution is filled in the tube and is placed in such a way that the meniscus of the liquid in narrow limb is at the centre of the magnetic field.

The level of the liquid in the narrow tube is read by a travelling microscope when magnetic field is off. The magnetic field is switched on and the new raised level of the column is again read with the travelling microscope.

The apparatus consists of the following:

- Quinck's tube with stand
- Sample: FeCl3
- Electromagnet, Model: EMU-50T
- Constant Current Power Supply, Model: DPS-50
- Digital Gaussmeter, Model: DGM-102
- Travelling Microscope

Travelling Microscope (Horizontal and Vertical)

The bed is of heavy casting, thoroughly aged, machined and is fitted with levelling screws. On the dovetail guide ways slides the horizontal carriage which can be clamped at any position by means of a thumb screw. A second sliding carriage slides along a gun metal vertical pillar fitted on the horizontal carriage. The slow motion guide bars are made of sturdy material and the motion is very smooth.

Optics

(i) True achromatic objective with 7.5 cm focussing distance
(ii) 10X Ramsden eyepiece with fine cross wire

Scale and Vernier

(i) Horizontal scale: 20cm divided at 0.5mm interval
(ii) Vertical scale: 15cm divided at 0.5mm interval
(iii) Venier scales: 50 divisions with a least count of 0.01mm

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