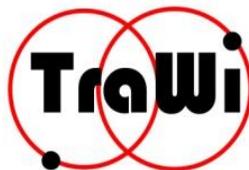




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Programm für
lebenslanges
Lernen

Instruction for students

Determination of the molar refraction of liquids

Take the measurement of the molar refraction of liquids for the determination of the quality of production of rubber

Task:

1. Determine the molar refraction of 1-butanol, toluene, acetone, ethanol, benzene and CCl₄
2. Compare the determined values with the calculated values in the tables of atomic refractions

Principle:

Refractometry is used in some cases to confirm the proposed structure of organic substances. From the measured refractive index the so-called molar refraction R_M is calculated with the formula of Lorenz-Lorentz:

$$R_M = \frac{M}{\rho} \cdot \frac{n^2 - 1}{n^2 + 2}, \text{ where}$$

M = molar mass of the substance in $\text{g}\cdot\text{mol}^{-1}$, ρ = density in $\text{g}\cdot\text{cm}^{-3}$, n = refractive index.

So determined value of the molar refraction is compared with the value that is calculated as the sum of the so-called atomic refractions and refractions of certain compounds. The atomic refraction depends not only on the nature of the atom, but also on the manner of its attachment in the molecules. The atomic and bond refractions individual elements and connections we can find in the tables.

Utilities:

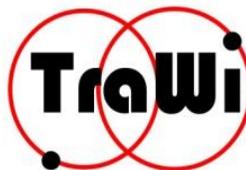
Abbe refractometer, wadding, bar, pycnometer, pipette, analytical balance

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Chemicals:

1-butanol, toluene, acetone, ethanol, benzene, CCl₄

Procedure:

1. Prepare refractometer for measurement.
2. Measure 3 times the refractive index of the above liquids.
3. Determine the density of the above-mentioned liquids pycnometrically.
4. Use the following relation for calculating the measured density pycnometrically

$$\rho = \frac{(m_2 - m) \cdot \rho_0}{m_1 - m}, \text{ where}$$

m = Mass of pycnometer,

m_1 = Mass of pycnometer with water,

m_2 = Mass of pycnometer with fluid sample,

ρ_0 = Density of water at the laboratory temperature of the tables.

5. Calculate using *Lorentz-Lorenz's* formula molar refraction of 1-butanol, toluene, acetone, ethanol, benzene and CCl₄.
6. Calculate the molar refractivity of the above-mentioned liquids, specifically as a sum of so-called atomic refractions and refractions of certain compounds.
7. Compare the values of mol refractions together.
8. Summarize results in the table.
9. Indicate all the calculations in the protocol, which are connected with the calculation of mol refractions..

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