Transfer von Erfahrungen bei der Gestaltung einer wirtschaftsnahen berufspraktischen Ausbildung in den Strukturen schulisch orientierter Ausbildungssysteme

Leonardo da Vinci Innovationstransferprojekt „TraWi“

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Programm für lebenslanges Lernen

ŠPŠCH Pardubice
Professional field of action: „Working in a chemical laboratory“
Applied chemistry

LEE2: 1. Determination of viscosity of glycerol by two methods in a cosmetic sample

You are a chemist in a beauty salon which, among other activities, analyzes glycerol for cosmetic products. Your today's task is to determine the viscosity of glycerol in a cosmetic product. You can determinate the viscosity of glycerol by two apparatuses. You will compare the measured data with tabulated ones.

Knowledge of procedure Characterization of working activity		**Expertise** Characterization of working systems	
Working steps	**Skills/abilities**	**Context of natural science**	**Context of technology**
Working tasks: • Determine the viscosity of glycerol in cosmetic products • Perform data processing and calculations		The viscosity of a fluid is a measure of its resistance to gradual deformation by shear stress or tensile stress. For liquids, it corresponds to the informal concept	• Höppler´s viscometer (falling ball viscometer), • Ubbelohde viscometer (capillary viscometer), • pycnometer,

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• Compare the obtained results with the technical requirements for the quality assurance of the product		of "thickness". Viscosity is a property arising from friction between neighboring particles in a fluid that are moving at different velocities. When the fluid is forced through a tube, the particles which comprise the fluid generally move faster near the tube's axis and more slowly near its walls. The dynamic viscosity of a fluid expresses its resistance to shearing flows, where adjacent layers move parallel to each other with different speeds Greek letter eta (*η*) is used by chemists and the IUPAC. The proportionality factor η in this formula: F = **η**.S.v/l is the viscosity (specifically, the dynamic viscosity) of the fluid. The SI physical unit of dynamic viscosity is the pascal-second (Pa·s), (equivalent to (N·s)/m^2, or kg/(m·s)). Viscosity is measured with various types of viscometers. A viscometer is an instrument used to measure the viscosity of a fluid. Standard laboratory viscometers for liquids: glass capillary viscometers - Ubbelohde viscometer, the second	• thermostat

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		viscometer is the Falling Ball Viscometer (Höppler).	
Analysis of the assignment Analysis of the task Planning and organizing work Identifying risks Identifying workplace health and safety rules.	• ability to work with information sources to find out relevant physical properties of liquids, term viscosity and its dependence on the temperature • planning the partial working steps • becoming acquainted with a measuring technique • organizing work • exact and conscientious work of the particular method • following the rules of safety and health protection • respecting workplace health and safety rules		
<u>Apparatus</u> • Höppler´s viscometer (falling ball viscometer) • Ubbelohde viscometer (capillary viscometer) • pycnometer • graduated cylinder • beaker • thermostat	• preparing lab-ware, chemicals and devices • handling properly the measuring technique • keeping the equipment and technique in a good condition • reproducing the experiment at the same condition • determination of viscosity of a liquid by measuring at constant	understanding the function of the system	

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	temperature • saving energy, water and other consumables		
Chemicals • glycerol • ethanol • distilled water	• identifying the potential risk (emphasis on H, P sentences, safety of work and environmental protection) • abiding by the respective safety regulation to minimize the risk • filling device by the solution	Potential risks of chemical substances according to GHS.	
Measuring **1.** Höppler´s viscometer:	• Set temperature of a thermostat • Temper the viscometer for 15 minutes in the thermostat at the temperature of 20 °C • Check the temperature, it must be constant through the measurement • Prepare Höppler´s viscometer • Rinse viscometer by distilled water • Put together the viscometer • Fill up the viscometer by distilled water • Measure the time of the ball falling between two marks in distilled water • Perform the measurement twice		Falling ball viscometer method is based on a simple principle of determination of measured time between two marks indicating a known volume. In order to exclude possible mistakes, use a comparative method where a liquid with known density and viscosity (distilled water) is used as a standard.

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	• Rinse the viscometer with ethanol • Let the viscometer dry up • Rinse the viscometer by small amount of glycerol (sample 1) • Fill up the viscometer by glycerol (sample 1) • Measure the time of the ball falling between two marks in glycerol (sample 1) • Perform the measurement twice • Rinse the viscometer with ethanol • Let the viscometer dry up • Rinse the viscometer by small amount of glycerol (sample 2) • Fill up viscometer by glycerol (sample 2) • Measure the time of the ball falling between two marks in glycerol (sample 2) • Perform the measurement twice • Calculate the average time for the glycerol from samples 1 and 2 and for water. •		
1. **Ubbelohde viscometer:**	• Prepare Ubbelohde viscometer, the viscometer is already clean and dry.		Capillary viscometer method is based on a simple principle of determination of measured time between two marks indicating a

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	• Rinse the viscometer by distilled water • Fill up the viscometer by distilled water • Liquid must be between the two marks in lower part of the viscometer • Use thermostat Tamson TV 2000 • Set temperature of the thermostat • Let the viscometer temper for 15 minutes in the thermostat at the temperature of 20 °C • Check temperature, it must be measured at constant temperature • Take the viscometer out of the thermostat • Measure time between two marks (one above and one below the upper bulb - indicates a known volume) • Perform the measurement twice • Calculate the average time for water • Rinse the viscometer with ethanol • Let viscometer dry up • Rinse the viscometer by glycerol taken from a stock solution		known volume. In order to exclude possible mistakes, use a comparative method where a liquid with known density and viscosity (distilled water) is used as a standard.

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	(sample 1) • Fill up the viscometer by glycerol (sample 1) • Place the viscometer to the thermostat (controlled temperature bath) • Measure time between two marks (one above and one below the upper bulb - indicates a known volume) • Calculate the average time for the glycerol (sample 1) • Rinse the viscometer with ethanol • Let the viscometer dry up • Rinse the viscometer by glycerol (sample 2) • Fill up the viscometer by glycerol (sample 2) • Place the viscometer to the thermostat (controlled temperature bath) • Measure time between two marks (one above and one below the upper bulb - indicates a known volume) • Calculate the average time for glycerol sample 2		

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3. Pycnometer	• Weigh a dried and cleaned pycnometer with a stopper (on analytical scales) • Fill the pycnometer with the distilled water approximately to the half of the neck • Let it temper for 15 minutes in the thermostat at the temperature of 20 °C • Take the pycnometer out of the thermostat and close it with the stopper • Dry the pycnometer perfectly and weigh it • Empty the pycnometer • Let pycnometer dry up • Rinse the pycnometer with glycerol and fill it with glycerol approximately to the half of the neck • Let it temper for 15 minutes in the thermostat at the temperature of 20 °C • Take the pycnometer out of the thermostat and close it with the stopper • Dry the pycnometer perfectly and weigh it	Density is a fundamental property of matter. For homogenous systems, the density is given as a proportion between mass and volume: $\rho = m/V$ where ρ is the density, m is the mass, and V is the volume. The SI unit for density is: kilograms per cubic meter (kg/m^3). The density is strongly dependent on the temperature and pressure, while the pressure influence can be neglected for solids and liquids. The most of compounds increases their volume with increased temperature and, therefore, the density decreases. The density of a liquid can be determined by several methods/apparatus, for instance: 1. Float densimeter 2. Pycnometer 3. Mohr-Westphal scale	Pycnometer method is based on a simple principle of determination of a weight of a given volume. In order to exclude possible mistakes, a comparative method is being used where a liquid with known density is used as a standard.

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	• All these steps perform with the second dry and clean pycnometer and perform measuring for water and glycerol sample 2.		
Evaluation: • All data put in an organized table. • Calculation of viscosity. • Comparison the results of viscosity obtained by two methods. • Evaluate the measurement	• carrying out all the calculations correctly and without any help • interpreting acquired data • reporting the acquired data in an organized table • comparison of measured values with tabulated value and determination most exact and least the accurate measurement of these methods • discusses the findings	Viscosity value of glycerol (100 mass%) is 1,48 Pa·s (20 °C)	
Disposal: Samples of glycerol can be put back to a flask with a stock solution.			

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