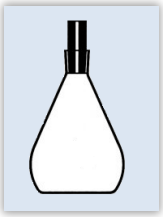
WEE-Solve GmbH

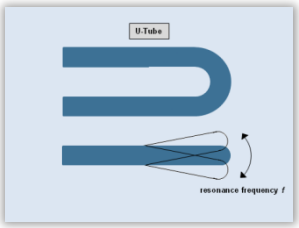
Determination of density

The density is used in different areas of application to characterize material or product properties, like the concentration. The determination of the density is one of the most used applied gravimetric procedures in laboratories. We offer the determination of the density by means of either pyknometers or the oscillation method (vibrometer).

Pyknometer:
• Volume-calibrated glass flask
• Very precise method
• Suitable for solids, powders, granules, liquids, dispersions



Oscillation method:
• Determination of the resonance frequency of the sample
• (homogeneous) liquids
• Temperature: -10 to 80°C



Methods:	
DIN EN ISO 2811/1	Paints and varnishes – Pyknometer method
DIN EN ISO 2811/3	Paints and varnishes – Oscillation method
DIN EN ISO 1183/1	Non-cellular plastics – Pyknometer method
ISO 8130/3	Coating powders – Pyknometer method
ISO 1675	Liquid resins – Pyknometer method
ISO 2781	(Thermoplastic) Elastomers
ISO 845	Cellular rubbers and plastics: Determination of apparent density

Determination of densities under elevated Pressures/ elevated temperatures

Due to thermal expansion and compressibility of matter the density depends on temperature and pressure. Our equipment consists of a pressure and temperature resistant oscillating U-tube and enables the determination of densities for temperatures up to 140°C and pressures up to 400 bar. By means of the Tait equation the values can normally be reliable extrapolated up to 1000 bar.

Service provider for polymer fractionation / purification, rheological measurements, and contract research.
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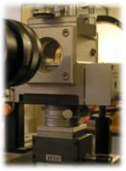

Analysis

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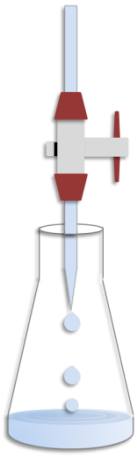
Determination of chemical characteristics



Chemical characteristic numbers are applied in many fields like quality control, research and development. Our range covers the volumetric characterization of polymers/plastics according to standardized methods.

Methods:	
DIN EN ISO 4629	Binders for paints and varnishes Determination of hydroxyl value – Titrimetric method
DIN EN ISO 3681	Binders for paints and varnishes Determination of saponification value by the titrimetric method
DIN EN ISO 1061	Unplasticized cellulose acetate Determination of free acidity
DIN EN ISO 3001	Epoxy compounds: Determination of epoxy equivalent
DIN EN ISO 2114	Plastics (polyester resins) and paints and varnishes (binders) Determination of partial acid value and total acid value
DIN EN ISO 1264	Homopolymer and copolymer resins of vinyl chloride Determination of pH of aqueous extract
ISO 14900	Plastics (Polyols): Determination of hydroxyl number
	Determination of degree of substitution for cellulose acetate according to E. Samios

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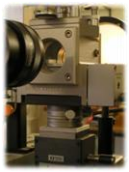


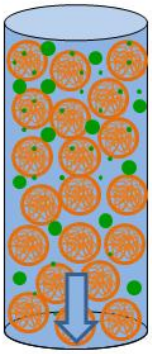
GPC/SEC

The Size Exclusion Chromatography (SEC, or Gel Permeation Chromatography GPC) is the most common method for polymer analysis. In this process the polymer is solved in an eluent and fractionated in a separation column, which is filled with porous material. The fractionation oft he polymer only bases on geometric pore effects, i.e. for this process the separation parameter is the hydrodynamic volume of the polymer. By means of different detectors the polymer can be analysed.

In the following the specifications of our SEC/GPC-apparatuses are listed:

Aqueous Gel Permeation Chromatography

- Analyte: Polyelectrolytes, non-ionic water soluble polymers, polysaccharides
- Sample amount ~100 mg
- Range of molar mass: 10^3 - 10^6 g/mol
- Eluent: aqueous salt solution, if necessary. MeOH/H_2O-mixture
- Detector: UV-Detector, RI-Detector
- Conventional calibration with dextran
  $\Rightarrow$ Molecular weight (M_w, M_n), polydispersity PDI
- Universal calibration
  $\Rightarrow$ M_w, M_n and PDI for additional polymers accessible



Organic Gelpermeationschromatography

- Analyte: in THF or toluene soluble polymers
- Sample amount ~ 100 mg
- Range of molar mass: 10^3 - 10^6 g/mol
- Eluent: Tetrahydrofuran, Toluene
- Detectors: UV-Detector, RI-Detector
- Conventional calibration with polystyrene, polymethylmethacrylate
  $\Rightarrow$ Molecular weight (M_w, M_n), polydispersity PDI
- Universal calibration
  $\Rightarrow$ M_w, M_n and PDI for additional polymers accessible

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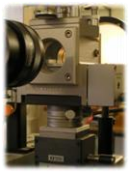
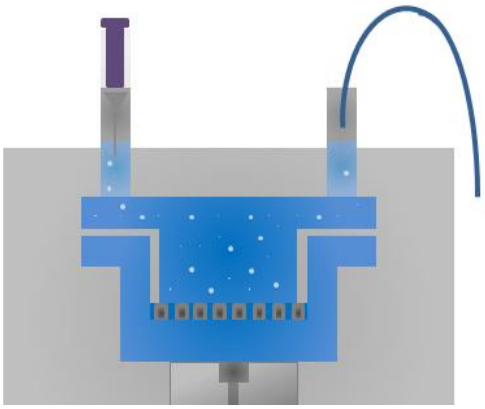


Osmometry

The membrane osmometry is a technique for the determination of molecular masses of polymers by means of osmosis. The phenomenon of osmosis describes the attempt of solvent molecules to go through a semipermeable membrane into a solution. The detection of the so originated osmotic pressure can be determined into the numer average of molecular weight M_n of the solved polymer.

In the following the specifications of our membrane osmometer are listed:

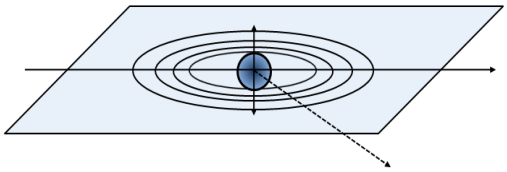
- Analyte: in water or in organic solvents soluble polymers, nanoparticle-dispersions
- Sample amount ~ 100 - 500 mg
- Range of molar mass: 10^4 – 10^6 g/mol
- Equipment: GONOTEC Membrane Osmometer OSMOMAT 090
- Solvent: Water, aqueous salt solutions, organic solvents
- Membran: Cellulose-triacetate (cut-off 5.000, 10.000, 20.000 g/mol), regenerated cellulose (cut-off 20.000 g/mol)
- Measurement of the osmotic pressure depending on the polymer concentration
  ⇒ Determination of the absolute molecular mass M_n
  ⇒ Determination of the A_2-value (2nd virial coefficient): Measure for solvent quality



Static light scattering

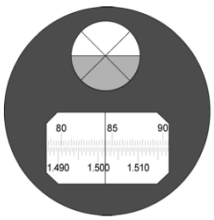
By means of static light scattering (SLS) molecules in polymer solutions can be extensively analysed. This method is an absolute methode, which detects the scattering intensity depending on the angle (average determination over the time).

In the following the specifications of our static light scattering equipment are listed:



- Equipment: modified Fica50
- Temperature: 5°C to 80°C
- Wave length of the laser: 632 nm
- Absolute molecular mass M_w
- Radius of gyration $<R_g>$
- Determination of the A_2-value (2^{nd} virial coefficient): Measure for solvent quality

Abbe-Refractometer



The refractive index in an optical material characteristic, whereupon it is a dimensionless physical quantity. It indicates for which coefficient the wavelength and the phase velocity of the light is lower in the analysed fluid than in vacuum.

For the determination of the refractive index we use a so-called Abbe-Refractometer. The measuring priciple is the fact, that the critical angle of the received total reflection at the interface is depending on the used optical materials. The refractometer, which is developed by E. Abbe, enables us to determine the critical angle of a thin liquid layer, which is filled through the glass prisms, very precisely.

The refractive index can depend according to the determined material strongly from the temperature. Therefore the measuring system is thermostated during the measurement.

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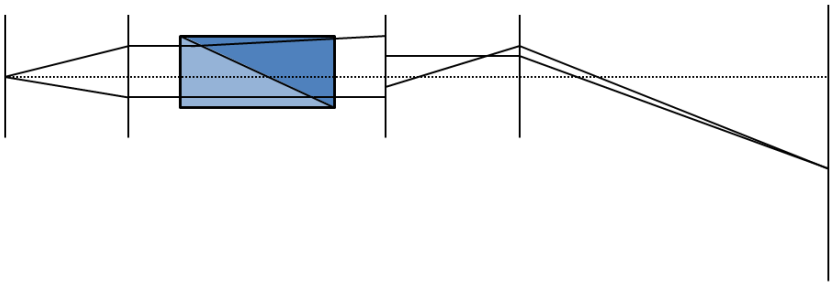
Differential refractometer

The refractive index increment dn/dc is the dependency of the refractive index to the concentration. The measuring value is needed in many areas, e.g. for the evaluation of light scattering measurements, for the determination of the sedimentation in ultracentrifuges, and for the determination of diffusion.

For these applications the preciseness of an Abbe-Refractometer is ofte not adequate enough. Therefore we use a precision differential refractometer, which was developed by O. Bodmann.



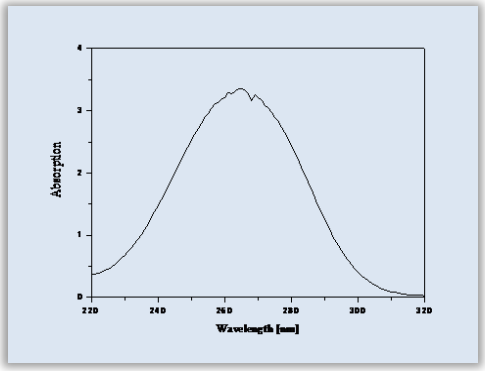
UV/Vis-Spectroscopy

Our equipment consists of a two-beam spectrometer which has a wavelength range from 190 up to 1100 nm. The two-beam optics allows us the simultaneous measurement of the sample and of the reference (pure solvent).

By means of the UV/Vis-spectroscopy we can offer the following analysis

<u>Absorption spectra</u>

The absorption spectroscopy can be established for **qualitative** as well as for **quantitative analysis**: Due to the form and the position of the absorption bands qualitative conclusions about the molecule can be made, which can e.g. be used for structure determination. An important application for quantitative analysis is the identification and characterization of specific molecular groups.



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Time-dependent measurements

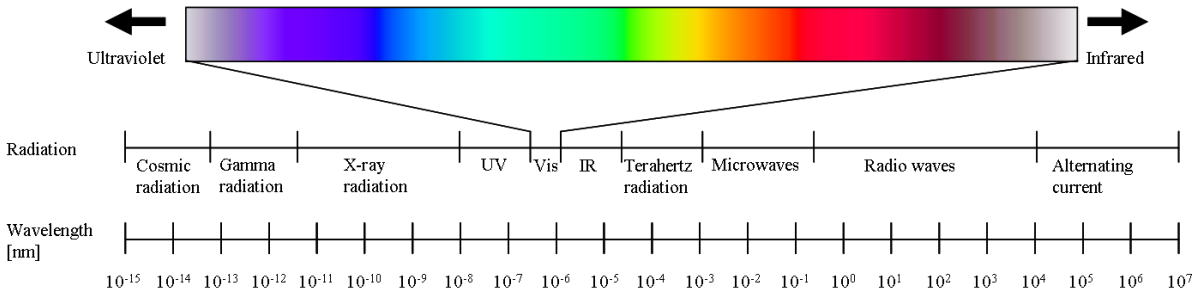
Time-dependent measurements of the absorption allow us to f**ollow the chemical reaction kinetic**. With plotting the absorption as function of the measuring time the reaction order and the reaction velocity constant can be determined due adjustment the reaction velocity law to the experimental data.

Wavelength-dependent measurements

The measurement of the absorption at different wavelengths can be used for **pureness validation** of the investigated substance. If the sample has no contamination, the ratio of the absorptions at different wavelengths stays the same. If the sample is polluted, the wavelength ratio changes on condition that the contamination also absorbs at the same wavelengths.

Determination of the concentration

The photometric concentration measurement of a sample is carred out with a calibration curve. For this purpose the absorptions of references with known concentrations are measured. These absorption data were plotted against the concentrations and the data points were interpolated with an adequate fitting curve. The originated calibration curves normally follow the Lambert-Beer law, i.e. they are lines through origin.



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