Fraunhofer

IAP

FRAUNHOFER INSTITUTE FOR APPLIED POLYMER RESEARCH IAP

DETERMINATION OF SEDIMENTATION CONSTANT AND MOLAR MASSES FROM SEDIMENTATION VELOCITY EXPERIMENTS

At sufficiently high rotor speeds a sedimentation front is formed in the centrifuge cell and the progression of this front with time is recorded by absorbance or interference optics. The relation between sedimentation velocity dr/dt and centrifugation field $\varpi^2 r$ is defined as sedimentation coefficient s:

$$s = \frac{dr/dt}{\omega^2 r} = \frac{d \ln r}{d\omega^2 t}$$

Due to hydrodynamic and interaction phenomena, s depends on concentration. Therefore measurements are performed at different concentrations with subsequent extrapolation to infinite dilution according to:

$1/s_{app} = 1/s_0 + (k_s/s_0) \cdot c$,

s_0 – sedimentation constant,

unit: 1 Svedberg = 10^{-13} s

By means of s_0 the molar mass of the sedimenting species, which is in case of polydisperse systems closely related to the weight average M_W, can be calculated by one of the following methods:

- using experimentally obtained calibration relations of the type $s_0 = K M^b$
- combining s_0 with diffusion constant D by Svedberg's equation

$$M = s_o RT / D(1 - \bar{v}\rho)$$

- combining s_0 with intrinsic viscosity [η] e.g. by a modified Flory/Mandelkern/Scheraga equation

$$M_{s,\eta} = 2{,}407 \cdot 10^{25} \left(\frac{[\eta] s_o}{1 - \bar{v}\rho_o} \right)^{3/2} \cdot \left(k_{SB}[\eta] \right)^{1/2}$$

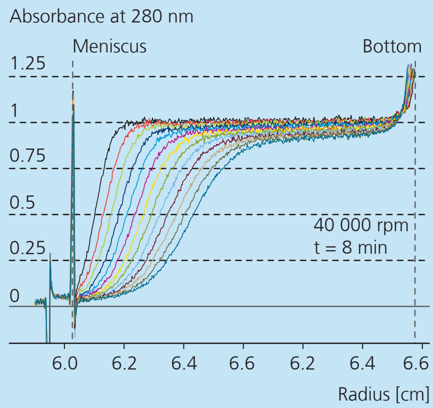

Fig. 1 Set of sedimentation curves for a vegetable protein from UV-absorbance data.

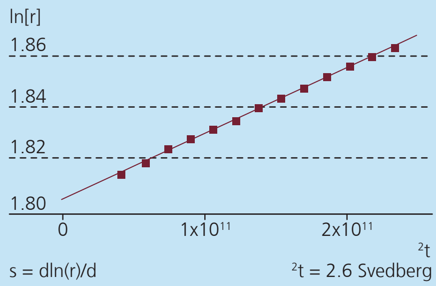

Fig. 2 Determination of the average sedimentation coefficient from data of Fig. 1.

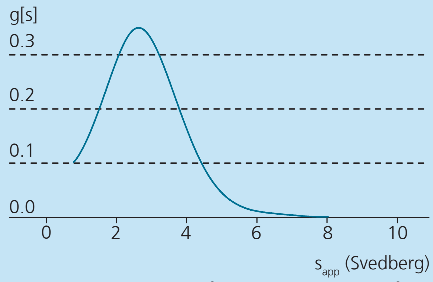

Fig. 3 Distribution of sedimentation coefficients calculated from data of Fig. 1.

Fraunhofer Institute for Applied Polymer Research IAP

Science Park Potsdam-Golm
Geiselbergstr. 69
14476 Potsdam-Golm

Contact

Dr. Erik Wischerhoff
Phone +49 331 568-1508
erik.wischerhoff@iap.fraunhofer.de

www.iap.fraunhofer.com

pioneers in polymers