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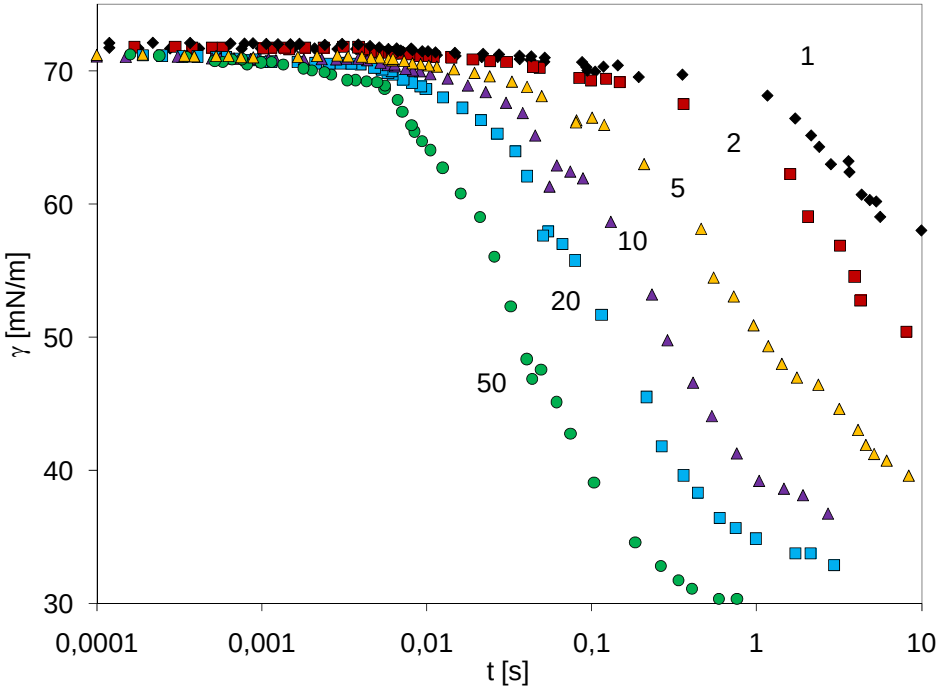
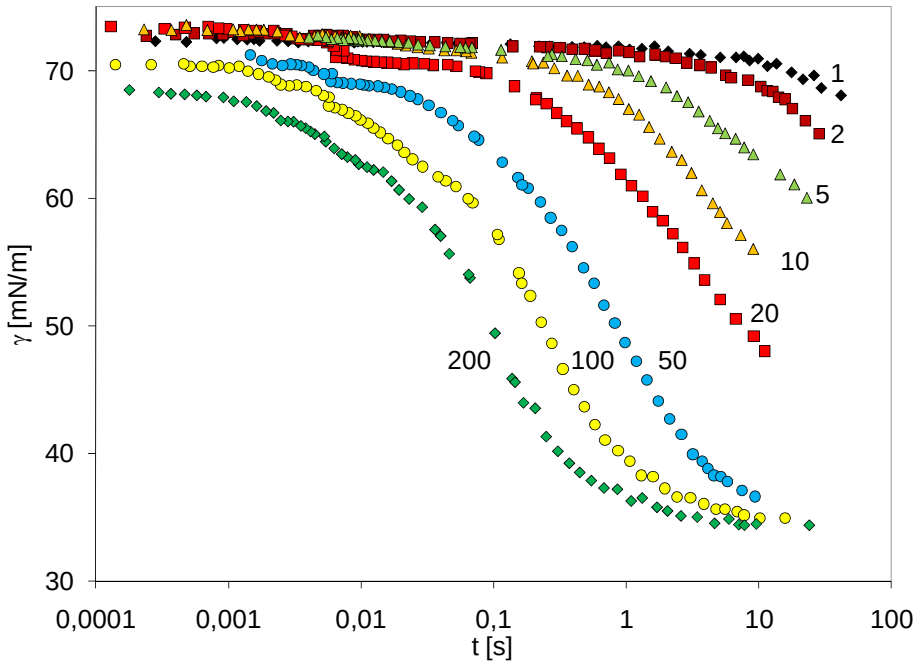
Dynamic Surface Tensions as Measured by the Bubble Pressure Analyser BPA-1S

The simple portable bubble pressure tensiometer BPA-1P dynamic surface tensions can provide measuring data only in the time range between 10 ms and 10 s (three orders of magnitude). Dynamic surface tensions in a time interval from less than 1 ms up to about 100 s (almost six orders of magnitude) are available with our BPA-1S. The instrument has quite a number of new features, such as direct determination of bubble time and dead time and respective calculation of the effective adsorption time, direct determination of the hydrostatic pressure via automatic immersion of the capillary into the liquid, and automatic correction of effects caused by gravitation and viscosity of the liquid. A comprehensive description of the bubble pressure methodology as well as the special details of our BPA-1S are described in a recently published book (V.B. Fainerman and R. Miller, Direct determination of protein and surfactant adsorption by drop and bubble profile tensiometry, in "Bubble and Drop Interfaces", Vol. 2, Progress in Colloid and Interface Science, R. Miller and L. Liggieri (Eds.), Brill Publ., Leiden, 2011, p. 218-236; ISBN 978 90 04 17495 5).
The software of the BPA-1S allows to display the results graphically via MS EXCEL, to which the data can be easily exported. The following graphics shows the time dependence of different surfactants studied by the BPA-1S. In the first two examples it was demonstrated that bubble pressure tensiometry at sufficiently short adsorption times provides information on the micelle formation/dissolution dynamics (V.B. Fainerman, V.D. Mys, A.V. Makievski, J.T. Petkov and R. Miller, Dynamic surface tension of micellar solutions in the millisecond and sub-millisecond time range, J. Colloid Interface Sci., 302 (2006) 40-46.), shown here for the non-ionic surfactants Triton X-45 (technical grade) and $C_{14}EO_8$ (a pure model surfactant).

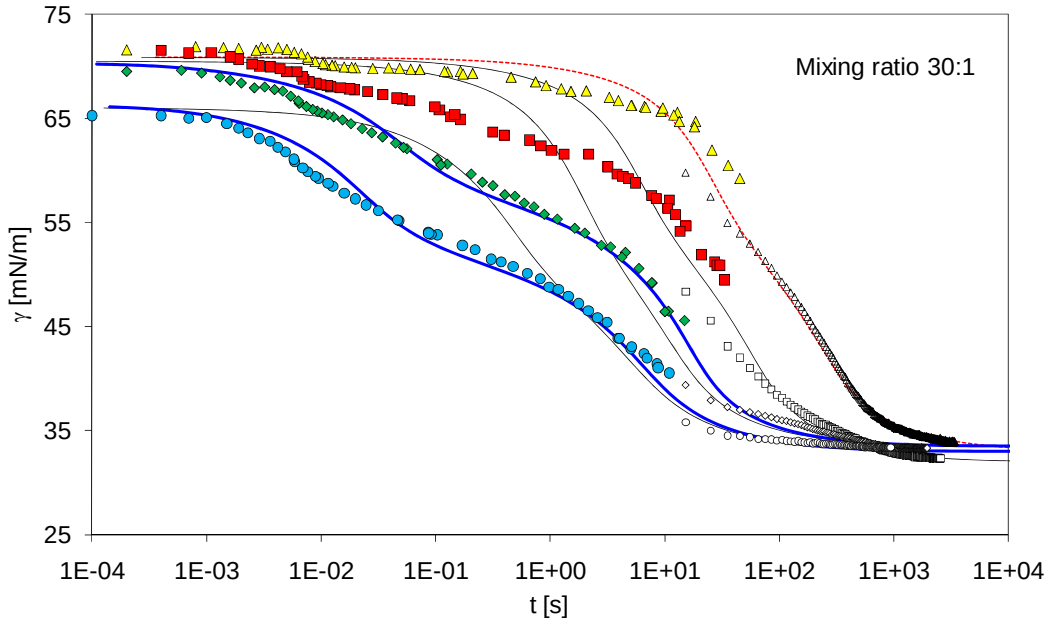


Dynamic surface tension for Triton X-45 solutions as a function of the effective surface lifetime. The surfactant concentrations are given as multiples of the CMC.



Dynamic surface tension for $C_{14}EO_8$ solutions as a function of the effective surface lifetime. The surfactant concentrations are given as multiples of the CMC

The third example shows the dynamic surface tensions of mixed solutions of SDS and $C_{12}EO_5$ at a mixing ratio of 30:1. The red curve shows the theoretical dependence for a pre-micellar solution, while the blue curves show the results of calculations using the theory for micellar solutions of the mixture.



Dynamic surface tension of mixed SDS/$C_{12}EO_5$ solutions for different molar ratio of components 30:1 and total solution concentration (top to bottom): 0.2 mmol/l (pre-micellar solution, CMC = 0.25 mmol/l); 0.5; 1.0 and 2.0 mmol/l.

In order to obtain a complete picture of the adsorption process, for the longer adsorption times (t>100 s) the PAT-1 was applied (V.B. Fainerman, E.V. Aksenenko, A.V. Mys, J.T. Petkov, J. Yorke and R. Miller, Adsorption layer characteristics of mixed SDS / C_nEOm solutions. 3. Dynamics of adsorption and surface dilational rheology of micellar solutions, Langmuir, 26 (2010) 2424-2429).

Our service:
- selection of the right experimental technique for a given surfactant
- measurement of dynamic surface tensions over a respective adsorption time
- data analysis and graphical representation
- analysis of the adsorption mechanism
- proposal of other complementary techniques if needed
- compare with standard surfactants
- reference to literature data
- literature analysis to the subject