Dynamic Surface Tensions Obtained by the Drop and Bubble Shape Tensiometer PAT-1

Using the PAT-1 instrument, dynamic surface tensions can be obtained. During the experiments either the drop volume or the drop surface area can be kept constant. Experimental data obtained with constant surface area are advantageous for a quantitative data analysis.

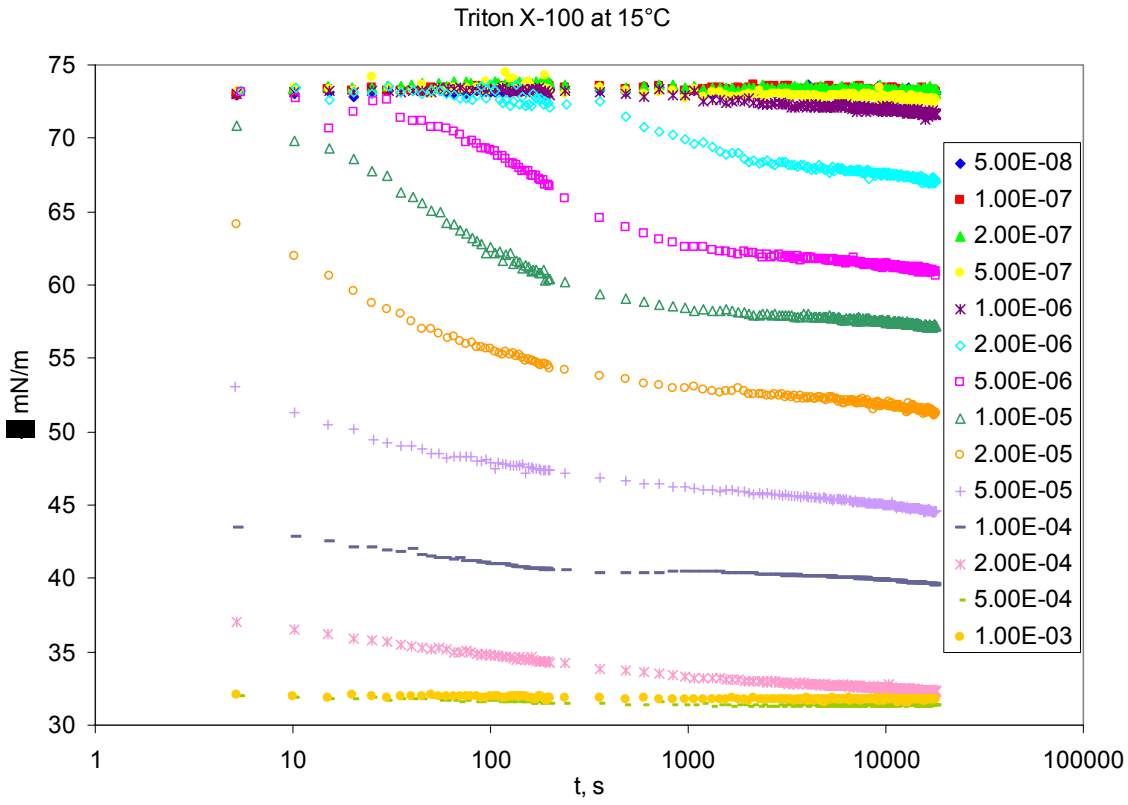
The principle type of data obtained from PAT-1 with the format *.fit are given in a text format and can be imported into any graphic tool. Typically, only the adsorption time and the surface tension are needed. The data obtained for a solution of $1 \cdot 10^{-5}$ mol/l Triton X-100, a frequently use nonionic surfactant, are shown in the following table, measured in a time interval from 5 s up to 3000 s.

Solution: 1e-5 Triton X-100

T sec	ST mN/m	T sec	ST mN/m	T sec	ST mN/m	T sec	ST mN/m
5,158	70,85466	85,186	63,03482	165,208	61,03481	1200,18	58,31822
10,208	69,878	90,221	62,80622	170,179	61,0064	1320,307	58,27766
15,305	69,32166	95,093	62,17895	175,425	60,87927	1440,238	58,24809
20,206	68,54662	100,331	62,57637	180,215	60,79712	1560,085	58,30734
25,311	67,73592	105,232	62,21764	185,11	61,02009	1680,319	58,20454
30,238	67,41765	110,315	62,31194	190,555	60,31622	1800,258	58,15694
35,467	66,35294	115,202	61,65451	195,182	60,42548	1920,259	58,11392
40,272	65,97563	120,298	62,03152	200,189	60,41318	2040,164	58,07932
45,299	65,55824	125,212	62,18406	240,198	60,16499	2160,322	57,97258
50,206	65,03982	130,134	61,4915	360,227	59,34108	2280,248	57,93842
55,359	64,96102	135,233	61,69872	480,255	59,0863	2400,222	58,0633
60,238	64,26985	140,256	61,54351	600,195	58,87928	2520,224	58,0225
65,594	64,12148	145,271	61,15505	720,278	58,66584	2640,294	57,96605
70,317	63,76798	150,325	61,34438	840,207	58,58559	2760,24	58,01006
75,156	63,51244	155,279	61,27311	960,269	58,4748	2880,264	57,97573
80,175	63,19501	160,249	60,92351	1080,159	58,27269	3000,297	57,88404

A suitable software to display the results graphically is MS EXCEL. The data can be easily imported into an EXCEL worksheet. The following graphics shows the time dependence of 14 different concentrations of Triton X-100. The typical S-shape obtained when plotted versus the logarithm of time is caused by the adsorption process of the surfactant molecules to the solution-air interface. At lowest concentrations ($c < 5 \cdot 10^{-7}$ mol/l) there is no remarkable decrease in surface tension measured over the time interval of 18000 s = 5 hours. For increasing concentrations the surface tension decrease starts earlier and earlier. For the highest concentrations we can see only the end of the surface tension change, the end of the

adsorption process. For the studied surfactant concentrations up to $2 \cdot 10^{-5}$ mol/l can be perfectly studied by PAT-1, for the higher concentrations, additional experiments with faster techniques are required, for example bubble pressure tensiometry.



Using a theoretical model, the adsorption mechanism of the studied surfactant can be analysed. Algorithms and procedures for such an analysis have been described in a book recently published (*Surfactants – Chemistry, Interfacial Properties and Application, Studies in Interface Science, V.B. Fainerman, D. Möbius and R. Miller (Eds.), Vol. 13, Elsevier, 2001*).

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