Institute of Physical Chemistry
Bulgarian Academy of Sciences

Foam Films of Commercial Surfactants and Their Mixtures

Evgeniya Hristova, Khristo Khistov and Dotchi Exerowa

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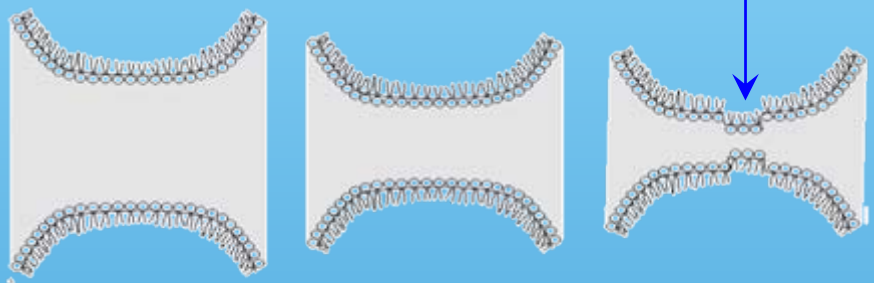
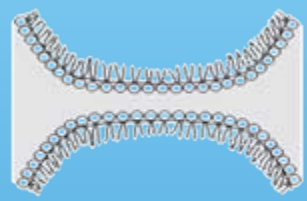
THIN LIQUID (FOAM) FILMS

Yellow Gray Gray

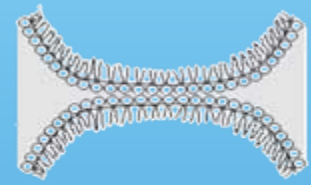
with Black Spot



Common Thin Films (CTF)



Common Black Films (CBF)



Newton Black Films (NBF)

long-range molecular interaction forces

short-range molecular interaction forces

stabilized by

Why we choose the commercial surfactants?

MATERIALS

- $C_{12}H_{25} - C_6H_5 - SO_3Na$

  Linear Alkyl Benzene Sulfonic Acid (LABS)

  MW=326 Na-salt

- $C_nH_{2n+1} -O- (CH_2-CH_2-O)_2 - SO_3Na$

  Alkyl Ethoxy Sulfate (AES)

  MW≈390 2 EO groups (n=12÷14)

- MIXTURE (MIX) AES : LABS
  3 1

AIM

- ✓ to find a conditions to study LABS, AES and their mixtures with the research from the perspective of thin liquid film
- ✓ to find a quantitative correlation between foam films and foams stabilized by AES, LABS and their mixtures

The results obtained refer to the following dependences

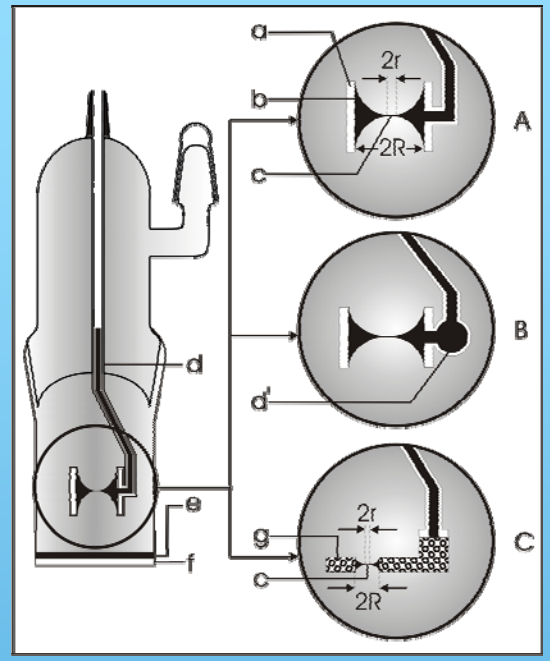
- surface tension on surfactant concentration at three different electrolyte concentrations
- film thickness on electrolyte concentration at constant surfactant concentration
- film thickness on surfactant concentration at constant electrolyte concentration
- disjoining pressure on film thickness (disjoining pressure isotherms)
- foam drainage
- foam lifetime

MICROINTERFEROMETRIC METHOD

the opportunity to measure directly the surface forces acting in foam films

the possibility to study both equilibrium and non-equilibrium films of various kinds such as foam and emulsion films and films on a liquid or solid substrate

the option to study films of different stability, covering the range of the most stable films to films with lifetimes of seconds

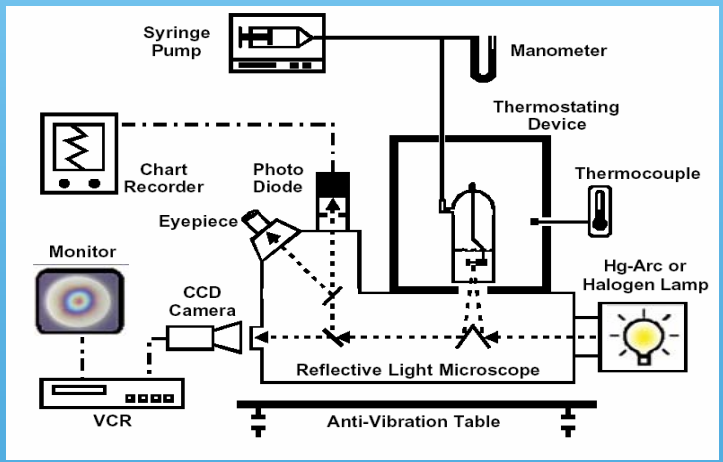


Scheme of the measuring cell for the study of microscopic foam films

A: in a glass tube;

B: with a reservoir of surfactant solution **d′**;

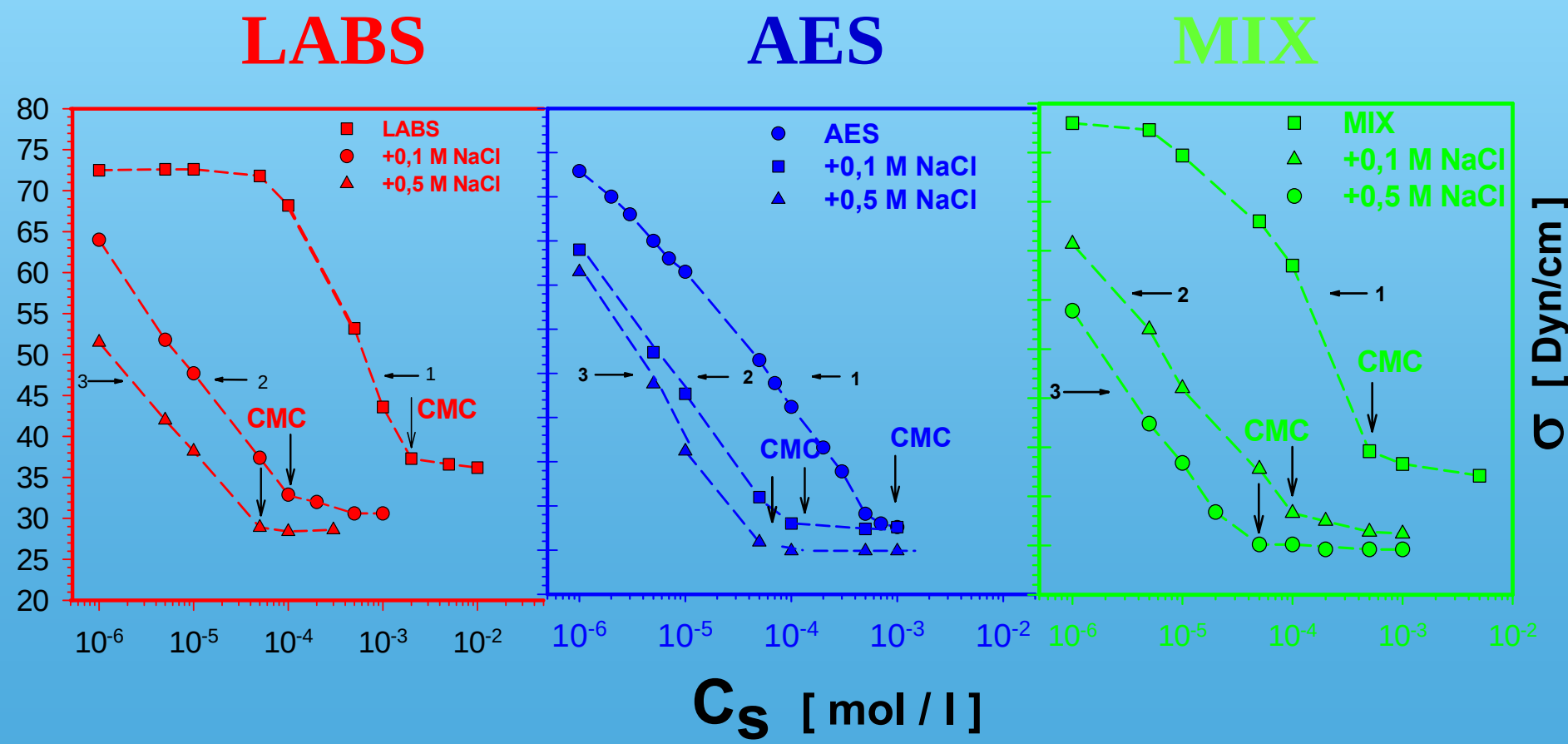
C: in a porous plate;
a - glass tube film holder; **b** - biconcave drop;
c - microscopic foam film; **d** – glass capillary;
e - surfactant solution; **f** - optically flat glass;
g - porous plate.



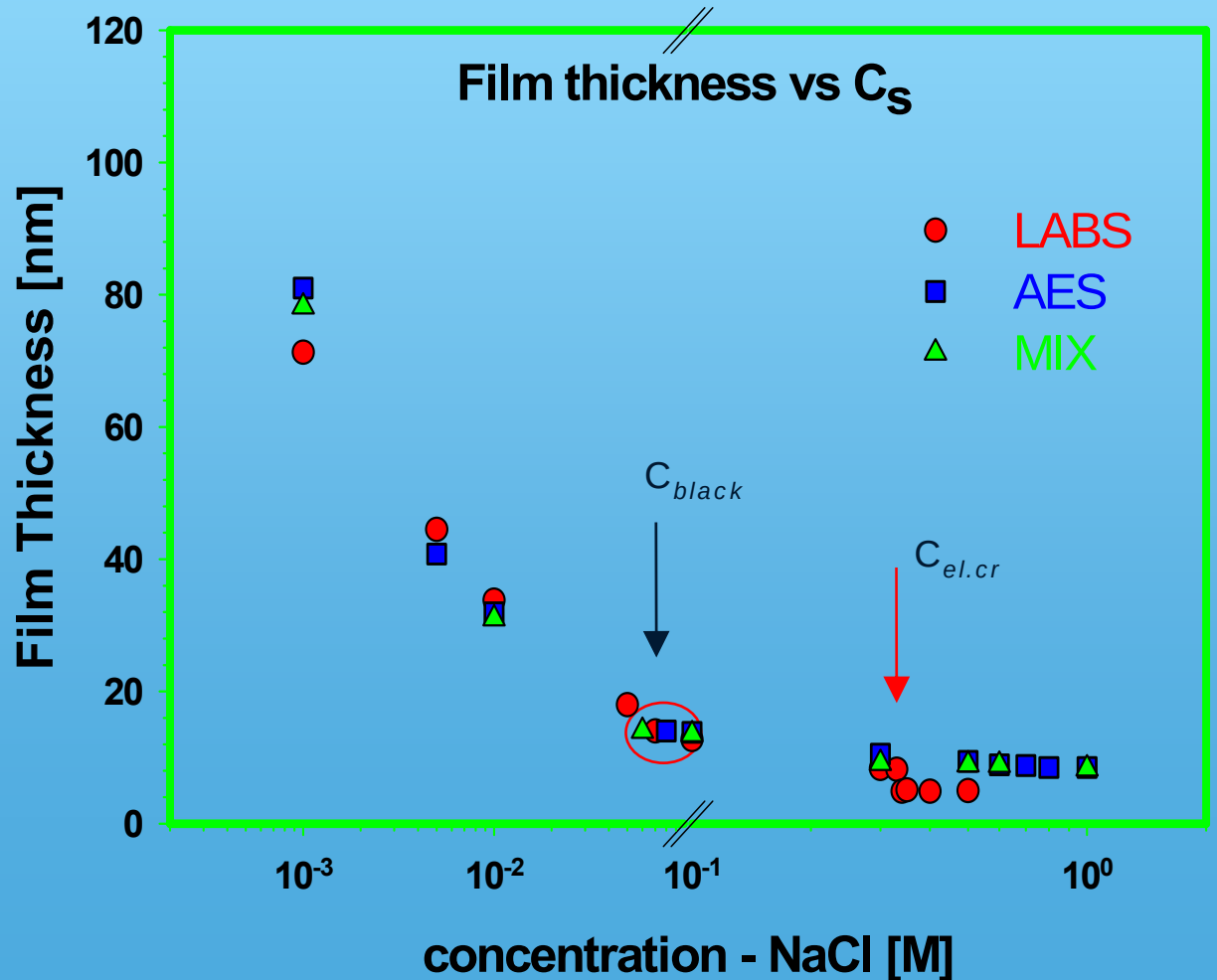
Scheme of the Thin film pressure balance technique (TFPB)

from: **D. Exerowa, P. M. Kruglyakov "Foam and Foam Films"** *Elsevier Science, Amsterdam (1998) pp. 796, ISBN 0-444-81922-3*

Dependence of the surface tension on surfactant concentration



Dependence of the foam film thickness on electrolyte concentration



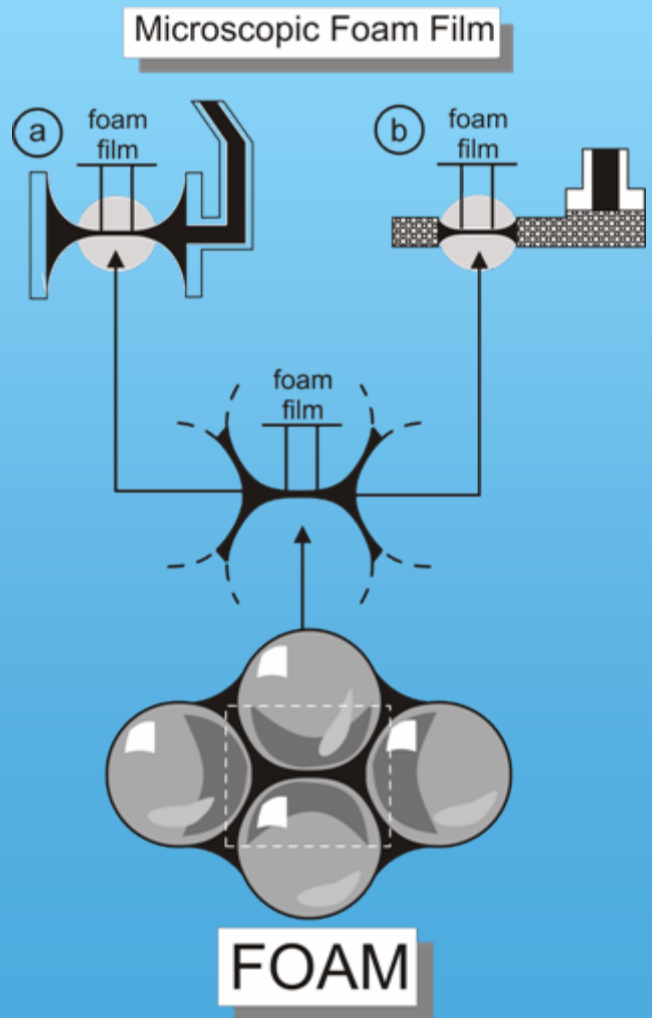
$C_{LABS} = 5.10^{-4}$

$C_{AES} = 10^{-4}$

$C_{MIX} = 10^{-4}$

MODEL APPROACH FOR THE STUDY OF FOAM STABILITY AND ANALYSIS OF THE STABILIZING FACTORS

MICROINTERFEROMETRIC METHOD

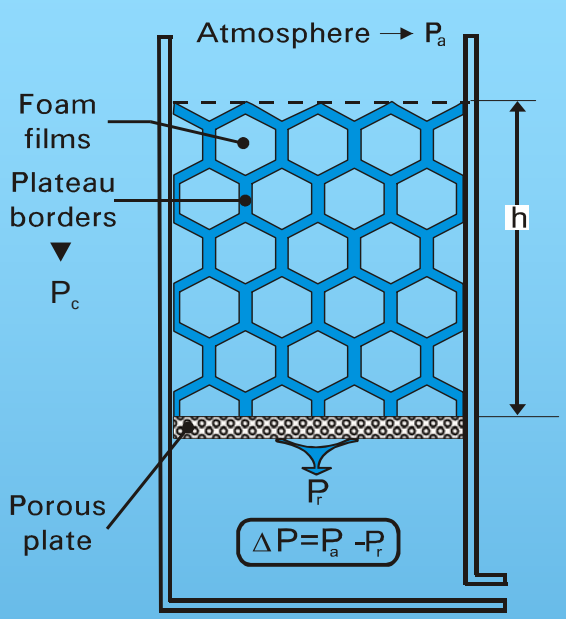


FOAM PRESSURE DROP TECHNIQUE

FOAM ANALYZER FA-1

For creating an increased and regulated pressure in the foam liquid phase

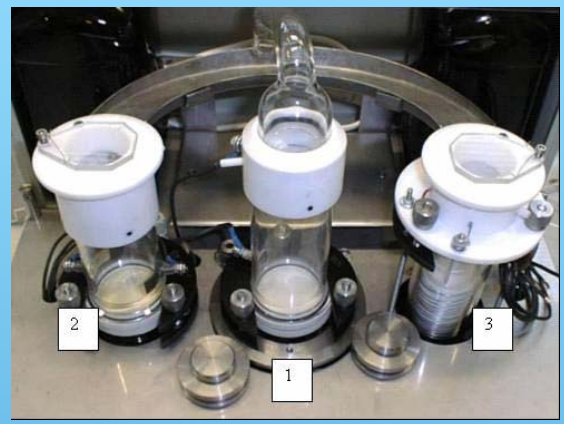
FOAM PRESSURE DROP TECHNIQUE



$$P_c = \Delta P + \rho g h$$

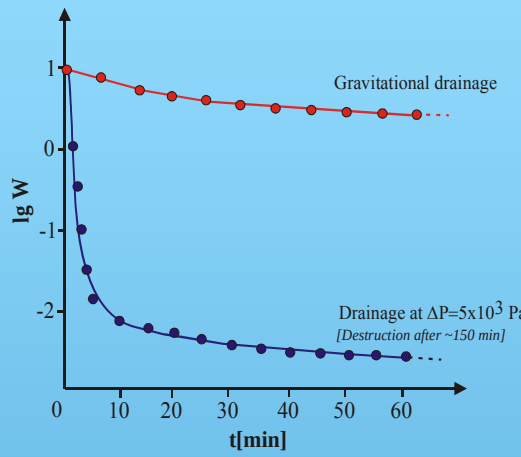
$$\Delta P >> \rho g h \Rightarrow P_c \approx \Delta P$$

Measuring Section

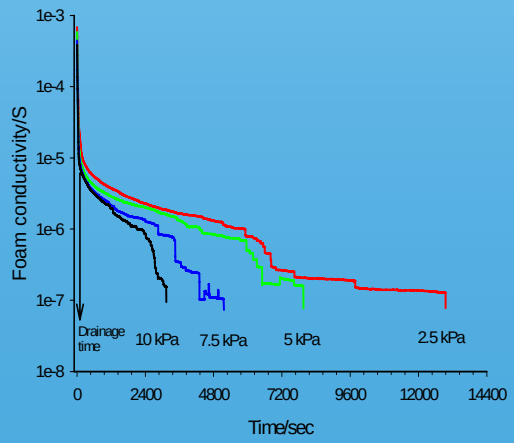


1. **Foam Generator**
2. **Drainage cell**
3. **Lifetime cell**

Foam drainage



Foam lifetime

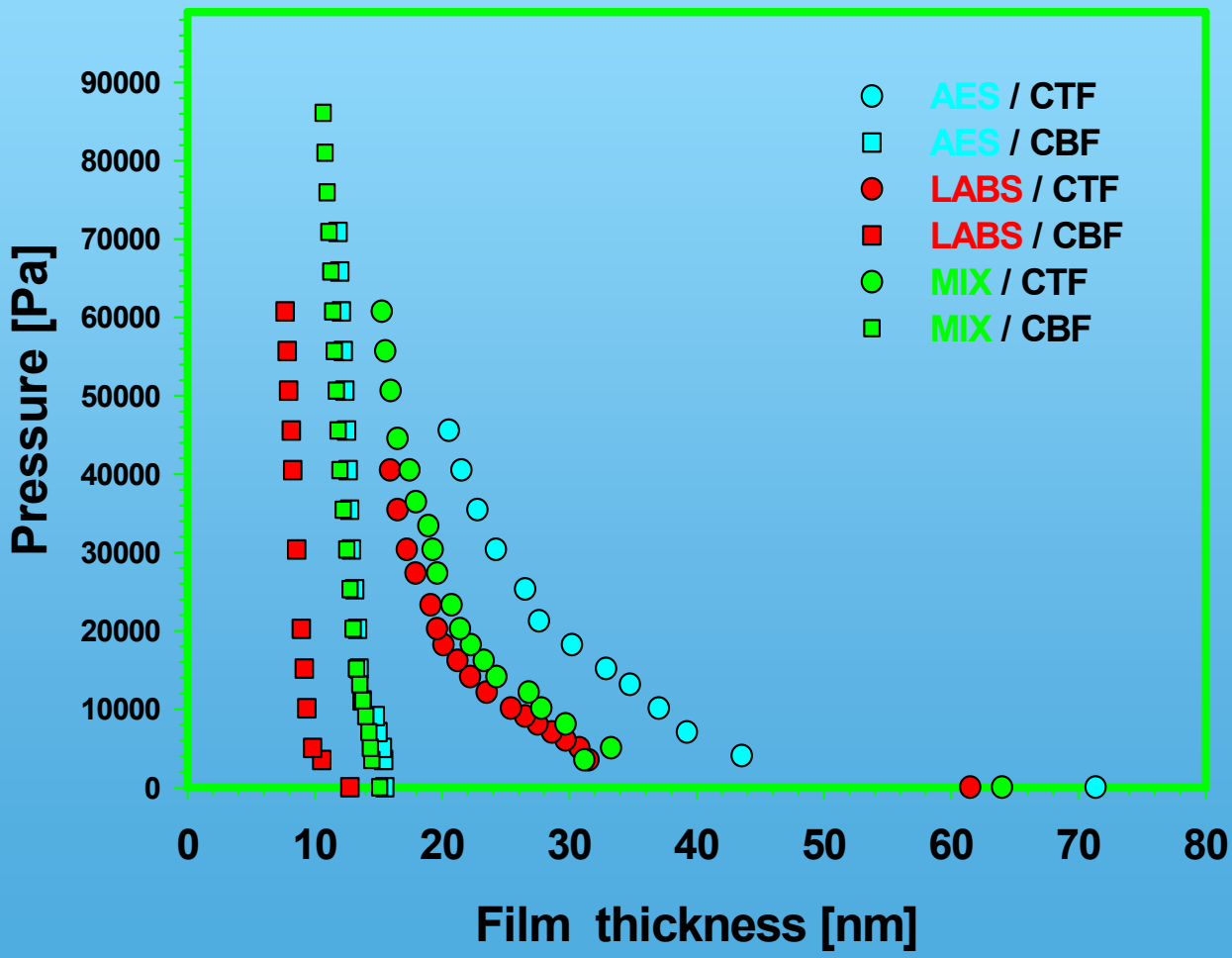


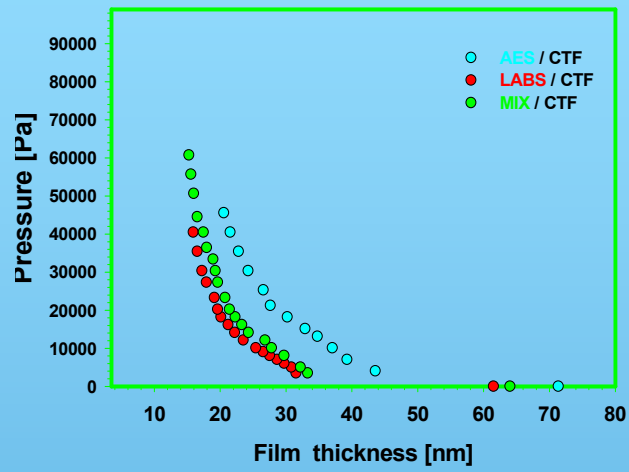
$$\mathbf{P_c} = \Delta\mathbf{P} + \rho\mathbf{gh},$$

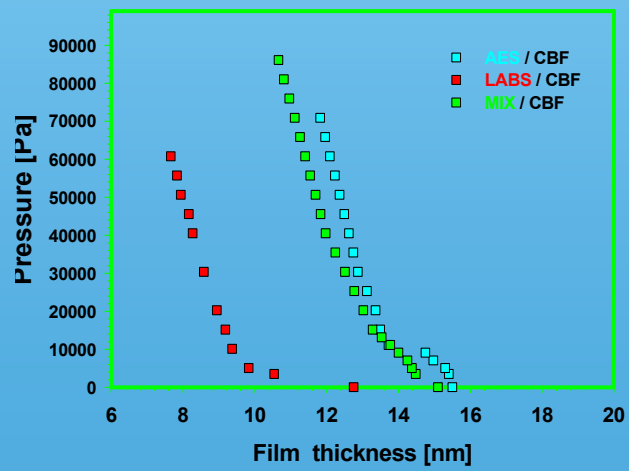
$\Delta\mathbf{P}$ - applied pressure on a foam column

τ_p - foam lifetime at constant $\mathbf{P_c}$ in Plateau borders

Dependence of foam film thickness on disjoining pressure Π(*h*) isotherms

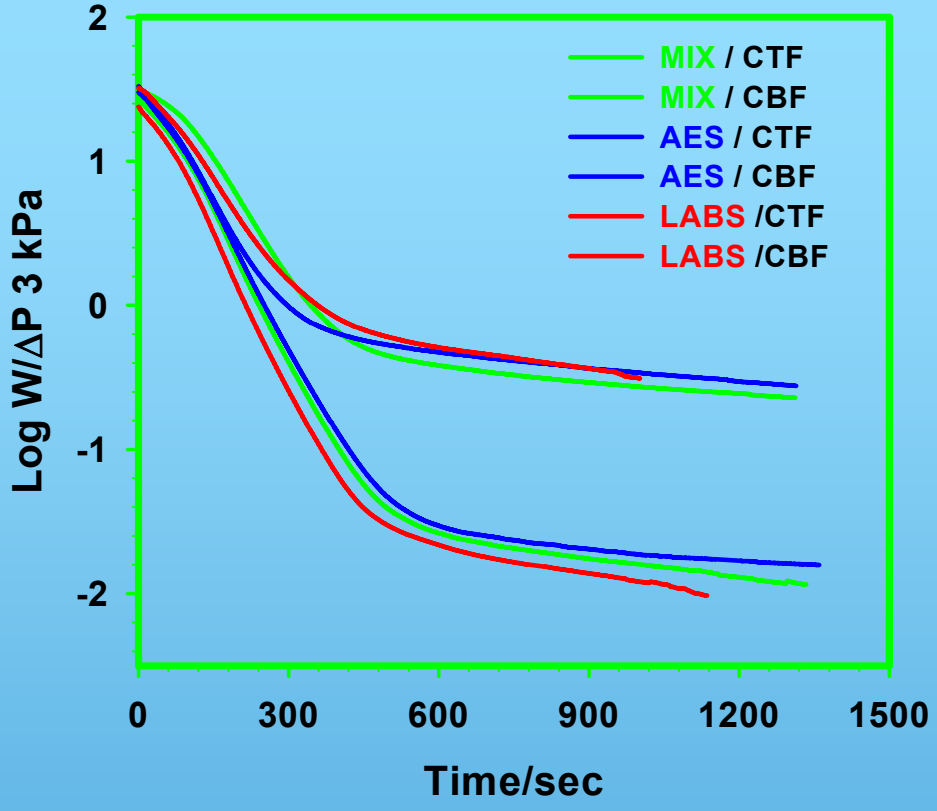






$C_s = 10^{-3}$ $C_{el,CTF} = 10^{-3}$ $C_{el,CBF} = 10^{-1}$

FOAM DRAINAGE

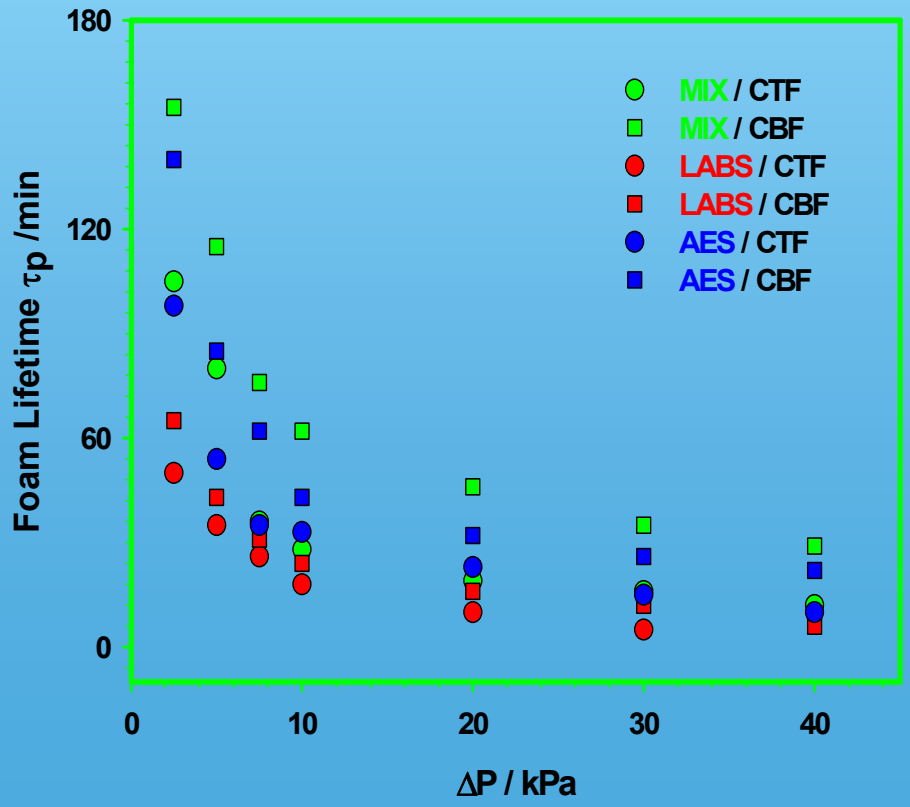


$C_s = 10^{-3}$

$C_{el,CTF} = 10^{-3}$

$C_{el,CBF} = 10^{-1}$

FOAM LIFETIME



Summary

- The results of this study of foam films stabilized by the two industrial surfactants, LABS and AES and their mixture, are an indication that in order to characterize these surfactants as foaming agents it is necessary to clarify their behavior not only at the solution/air interface but also in stabilizing foam films.

- The effect on the foam film types obtained was clearly shown that the type of foam films plays an important role in the properties of foams.

- The influence of DLVO- and non-DLVO forces was also determined. It is well known that different types of foam films are stabilized by different surface forces.

- A quantitative correlation between foam films and foam was done under strictly defined conditions.

THANK YOU