ABSTRACT: A new, simple foam test, in which a well-controlled volume of gas is introduced into a definite volume of solution, is presented along with the method of analysis. Aqueous solutions of sodium dodecyl sulfate (SDS), n-octyl-β-D-glucopyranoside, hexadecyltrimethylammonium bromide (CTAB), and n-hexanol, i.e., four systems forming metastable and transient foams, were studied. The parameter R5, defined as the ratio of the height of the foam at 5 min after formation to the initial height, is proposed for the evaluation of foam stability. Foams having R5 values higher than 50% can be considered as metastable. Lower R5 values indicate low-stability foams. Changes of R5 values with concentration are similar to those of foam half-life with concentration. Thus, instead of measurements lasting hours for the foam half-life, one can obtain similar information from tests lasting only a few minutes. With this test also one can obtain information about the solution contents in foams. This parameter can be used as an additional criterion for the evaluation of foam stability. In the case of metastable foams formed by SDS, CTAB, and n-octyl-β-D-glucopyranoside, the initial foam volume was almost equal to the volumes of the dispersed gas and the solution carried into the foam by the bubbles. This shows that there was practically no rupture of foam films at the stage of the foam formation.


KEY WORDS: Drainage, foam, foamability, foam films, foam lifetime, foam stability, foam test, solution content, solution efflux, surfactant.

Foams of very different stabilities are commonly met in many industrial processes and everyday life; however, there exists neither a general theory explaining the mechanism of their stability nor a commonly accepted test enabling a reliable determination and evaluation of foams formed by different surfactants. This is caused by the fact that foam is a complicated gas/liquid dispersed system whose properties are determined, in our opinion, by nonequilibrium adsorption coverages (1) at the very enlarged gas–solution interfaces. The Bartsch (shaking) and the Ross–Miles (pouring)

ABSTRACT: A new, simple foam test, in which a well-controlled volume of gas is introduced into a definite volume of solution, is presented along with the method of analysis. Aqueous solutions of sodium dodecyl sulfate (SDS), n-octyl-β-D-glucopyranoside, hexadecyltrimethylammonium bromide (CTAB), and n-hexanol, i.e., four systems forming metastable and transient foams, were studied. The parameter R5, defined as the ratio of the height of the foam at 5 min after formation to the initial height, is proposed for the evaluation of foam stability. Foams having R5 values higher than 50% can be considered as metastable. Lower R5 values indicate low-stability foams. Changes of R5 values with concentration are similar to those of foam half-life with concentration. Thus, instead of measurements lasting hours for the foam half-life, one can obtain similar information from tests lasting only a few minutes. With this test also one can obtain information about the solution contents in foams. This parameter can be used as an additional criterion for the evaluation of foam stability. In the case of metastable foams formed by SDS, CTAB, and n-octyl-β-D-glucopyranoside, the initial foam volume was almost equal to the volumes of the dispersed gas and the solution carried into the foam by the bubbles. This shows that there was practically no rupture of foam films at the stage of the foam formation.


KEY WORDS: Drainage, foam, foamability, foam films, foam lifetime, foam stability, foam test, solution content, solution efflux, surfactant.

Foams of very different stabilities are commonly met in many industrial processes and everyday life; however, there exists neither a general theory explaining the mechanism of their stability nor a commonly accepted test enabling a reliable determination and evaluation of foams formed by different surfactants. This is caused by the fact that foam is a complicated gas/liquid dispersed system whose properties are determined, in our opinion, by nonequilibrium adsorption coverages (1) at the very enlarged gas–solution interfaces. The Bartsch (shaking) and the Ross–Miles (pouring...
EXPERIMENTAL PROCEDURES

The apparatus used in the test is very simple and is shown schematically in Scheme 1. The setup consists of a glass column of 42-mm inner diameter with fritted glass G-2 at the bottom for gas dispersion, and a syringe for supplying a definite amount of gas into the solution to be foamed. In the majority of the experiments, 50 mL of solution and 100 mL of gas were used. The gas from the syringe was introduced into the solution through the sintered glass. Gas (100 mL) was supplied manually within a period of ca. 20 s, i.e., an average volumetric gas velocity of 18 L/h was used in most of the experiments. It is recommended as the standard procedure.

The solution (50 mL) was poured into the column in such manner that no foam was formed. If a foam layer was formed during the solution pouring, we waited until the solution mirror was seen to introduce the gas. After the gas (100 mL) was introduced, the stopcock connecting the column with the syringe was immediately closed, and the initial heights of the foam and the solution columns were measured. Then changes in foam height and solution level were determined as a function of time. The measurements were repeated 2–5 times for every solution concentration. The experiments were performed at room temperature (21 ± 1°C).

Materials. SDS, n-hexanol, n-octyl-β-D-glucopyranoside, and CTAB of commercially available highest purity (Merck, Germany) were used without any further purification. Distilled water was used for preparing the solutions.

RESULTS AND DISCUSSION

Figure 1 presents the height of the foam column formed as a function of concentration of SDS solutions for 100 and 200 cm³ of gas introduced within 20 s. This means that the average volumetric gas velocity was 18 and 36 L/h, respectively. With the higher SDS concentrations, a gas velocity of 36 L/h produced a foam volume that was approximately two times larger than with 18 L/h. This is a clear indication that the foam formed was stable and the foam films did not rupture to a significant extent during the formation of the foam column. A quite different picture is observed (Fig. 2) in the case of the transient foams formed from n-hexanol solutions. When the gas velocity was two times higher, the height of the foam column formed from n-hexanol solutions increased only by ca. 20%. Thus, this foam was much