Introduction

An antibubble is composed by a thin air spherical shell (<3 μm) immersed in a liquid mixture.

It has been shown [1] that the lifetime of an antibubble is driven by the drainage of the air from the bottom to the top due to the hydrostatic pressure gradient. The air flow was considered to be Poiseuille-like [1,2] in order to estimate the lifetime of an antibubble.

In this work, we consider the influence of the nature of the surfactant on the antibubble lifetime.

Experimental results

Surface viscosity and model

The asymptotical values for the surface viscosity \( \mu_s \)

\[ \text{SLES+CAPB: } -3 \text{ mPa.s.m} \]

\[ \text{SLES+CAPB+MAC: } -7 \text{ mPa.s.m} \]

The surface viscosity of the C12E6 is below the apparatus resolution. The NaCl salt seems to increase the surface viscosity.

The duration corresponding to \( F=0.9 \) are used to evaluate the surface viscosity (dilatational of shear).

Surface viscosity: DIRECT measurements using Antón Paar MCR

Surface viscosity: INDIRECT measurements using antibubbles

The nature of the surfactant influences the lifetime of the antibubble. The model based on the influence of the surface viscosity on the lifetime allows to explain the difference of antibubble lifetime between SLES+CAPB and SLES+CAPB+MAC. However, the lifetime obtained for the C12E6 measurement remains unexplained as the distribution of the lifetime changes compared to SLES+CAPB systems and the surface viscosities are very low.

Acknowledgement

SD and BS thank F.R.S-FNRS for financial support. This work was possible thanks to FRPC ODELE. BS thanks the Brussels Region for support through the program «Brains Back to Brussels».

References

4. Additional movies at http://www.youtube.com/stephanedorbo

Experimental details

<table>
<thead>
<tr>
<th>Name</th>
<th>Viscosity (mPa.s)</th>
<th>Surface modulus (mN/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLES+CAPB [3]</td>
<td>0.9</td>
<td>4.2</td>
</tr>
<tr>
<td>SLES+CAPB+MAC [3]</td>
<td>0.91</td>
<td>305</td>
</tr>
<tr>
<td>C12E6 (10 CMC)</td>
<td>1</td>
<td>unknown</td>
</tr>
<tr>
<td>C12E6 + NaCl (0.2M)</td>
<td>1</td>
<td>unknown</td>
</tr>
</tbody>
</table>

SLES: Sodium Lauryl-dioxyEthylene Sulfate; CAPB: CocoAmidopropyl Betaine; MAC: Myristic Acid

A small quantity of glycerol is added to the antibubble to surpass the buoyancy. A glycerol gradient of concentration is set in the vessel in order to stop the antibubble at a given depth under the surface.

The NaCl salt seems to increase the surface viscosity.

The asymptotical values for the surface viscosity \( \mu_s \)

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\[ \text{SLES+CAPB+MAC: } -7 \text{ mPa.s.m} \]

For \( \mu_s \) (μPa.s.u), the compressible and incompressible cases are compared.

According to the lifetime found experimentally, the viscosity can be estimated.

The ratio between the surface viscosities of SLES+CAPB systems is compatible with the direct measurements of the surface viscosities.

Cumulative Distribution Function of the antibubble lifetime

Surface viscosity: DIRECT measurements using Antón Paar MCR

Surface viscosity: INDIRECT measurements using antibubbles

see B. Scheid O-18, Tuesday at 11:00

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