FOAM - PHYSICS OF FOAMS

General description
The Foam module was developed by the Swedish Space Corporation on behalf of ESA. The module contains three to four experiment units for the generation and study of foam under microgravity conditions. The experiment liquids are contained in motorized injection units. Separated injection units are provided for each cell thus enabling four separated experiments to be conducted in parallel.

Each experiment cell is illuminated by both a reflective and a transmissive light source. This gives the possibility to visualize the foam structure as well as determining the foam thickness by Diffuse Transmission Spectroscopy measurement. During flight the experiments can be observed by video cameras. The camera images are stored on-board and can also be down-linked during flights. The FOAMS module was flown on MAXUS 4 and MAXUS 6 where several types of aqueous and non-aqueous foams were successfully studied.

Technical characteristics:

Module height: 701 mm
Module diameter: 600 mm
Module weight: 96.5 kg

Cells: 3.4 cells, inner cimentsion 50x50x50 mm. Structure in aluminium. Front and back made of glass.
Temperataure measurements: Two points inside cell, two points in cell structure.

Cameras: 4-8 CCD cameras, max 2 cameras/cell
Illumination: Transmissive and/or reflective
On-board video storage: 2 digital VCR’s. Selectable storage sequence.
Video downlink: Selectable camera and/or 4 in 1 image.
Gas and liquid system: Gas bottles: 2 bottles, 1 l each, max 50 bar (depending on gas used)
Injection units: 25 ml, one for each cell
Pressure measurement: Individually for each cell, 0-30 bar.

Experimental units
Each experiment unit comprises an experimental cell, an injection unit and a gas system. The foam is generated in microgravity by injecting the experiment fluid in the injection unit into a gas stream passing through a porous glass filter. The foam can be removed by pressurizing the cell to kill the foam contents and then flushing out the liquid through the exhaust line. The experiment temperature is measured in two places inside the cell and the temperature gradient across the cell is measured in two places in the cell structure. To create dry foam the foam is formed at a high pressure and then expands by a slow pressure decrease. Additional liquid can be added from the injection unit at a later stage, if necessary.

The experiment cells can be pressurized up to 20 bars, using the on-board gas supply.

Customized experiment cells
Experiment cells with different geometries can also be added into the support system, thus replacing one or more of the original cells.

Conductivity measurement
A facility for measuring the conductivity in the foam can be added. The conductivity can be measured with a maximum of 6 pairs of electrodes. This feature is currently only available for custom cells.
Observation
Two cameras can be used per experiment cell, via a beam-splitter set-up. The camera output can be stored and/or down linked individually.
To facilitate monitoring of the cell status during flight a 4-in-1 compressor is provided. This enables the operator to monitor four camera outputs in one down-link image, giving full control of the experiment status. An optional high speed camera can be added.

Control system
An automated control sequence ensures the default experiment flow. All valves, injection units, cameras and illuminations can also be operator controlled during flight, overriding or disabling the automated sequence.

On-board data storage
Experiment data can be stored on-board with a frequency of up to 25 Hz. Two digital VCR’s are used to store the output from the on-board cameras. The image storage can be changed by a video switch, thus enabling any sequence of the eight cameras to be stored on the recorders, automatically or operator controlled.

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