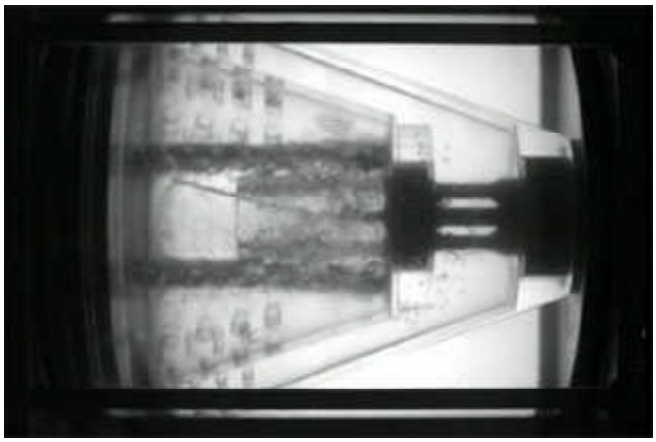
Gas/Liquid Separator Being Developed for Microgravity

Gas-liquid separator as a mixture of air bubbles and water enter the separator between the spinning cones, forming a gas core in the center.

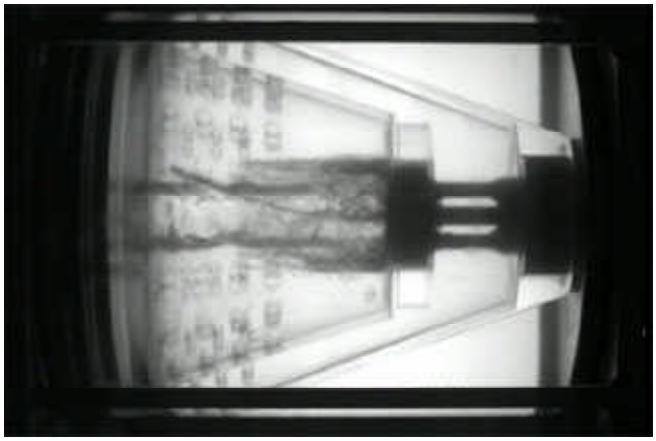


Gas-liquid separator as the air bubbles form a core in the center of the separator. The air core grows smaller as the gas is vented from the center of the separator. Bubble-free water is pumped out of the separator from the cylindrical volume outside the spinning cones.

The examination and research of how liquids and gases behave in very low gravity will improve our understanding of the behavior of fluids on Earth. The knowledge of multiphase fluid behavior is applicable to many industries on Earth, including the pharmaceutical, biotechnology, chemical, and nuclear industries, just to name a few. In addition, this valuable knowledge applies very well to the engineering and design of microgravity materials processing and of life-support systems for extended space flight. Professors Ashok Sangani of Syracuse University and Donald Koch of Cornell University are principal investigators in the Microgravity Fluid Physics Program, which is managed and sponsored by the NASA Glenn Research Center. Their flight experiment entitled "Microgravity Observations of Bubble Interactions" (MOBI) is planned for operation in

the Fluids and Combustion Facility aboard the International Space Station. They will analyze and study the physics of a sheared bubble suspension in ideal flow conditions. Plans are to measure the bubble distribution of a sheared suspension in a cylindrical couette cell and to use suspension-averaged equations of motion to compare the results with the predicted distribution. Multiple bubble suspensions will be generated during the MOBI experiment. To reduce the cost associated with delivering the many liters of water needed for the experiments to the International Space Station, researchers are developing a separator to separate the gas phase from the liquid phase and recycle the liquids.

On Earth, buoyancy causes gases and liquids to separate, with the gas on the top and the liquid on the bottom of a container. In microgravity, the buoyancy force is not present, and the separation and removal of gases from liquids requires a technical solution. A centrifugal separator concept was designed and fabricated by C. Frances Enterprises with support from ZIN Technologies and Glenn's Engineering Design and Analysis Division. The concept was successfully tested aboard the KC-135 microgravity facility in January and March of 2001.



Gas-liquid separator after the air core has grown small enough that the tip of the gas/liquid detector (the bent probe in the center of the separator) is now in water, causing the gas vent valve to close. Liquid is prohibited from exiting the separator through the gas vent.

The separator concept consists of an acrylic cylindrical chamber that houses two concentric acrylic cones with holes machined into the cone sides. The chamber is coupled to a motor that spins the cones at approximately 2500 rpm. When a mixture of gas and liquid enters the separator in the volume between the cones, the liquid is forced to the outside through the holes in the spinning cones and into the cylindrical chamber. The gas in the separator forms a distinct core at the center of the inner cone. A gas-liquid detector is mounted in the separator, and software is used for automatic operation. When gas is detected, a solenoid valve opens and the gas is removed by a vacuum pump. When liquid is detected, the solenoid valve closes so that no liquid is removed through the gas vent line. A pump is used to remove the gas-liquid mixture from the couette test chamber into the separator. The same pump pushes the bubble-free water back into the couette test chamber in preparation for making a new bubble suspension for the next experiment.

Find out more about this research
http://microgravity.grc.nasa.gov/6712/multiph/bubbly.htm.

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