Centrifugal Adsorption Cartridge System

Notable features include efficient collection of bioproducts and removal of bubbles.

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The centrifugal adsorption cartridge system (CACS) is an apparatus that recovers one or more bioproduct(s) from a dilute aqueous solution or suspension flowing from a bioreactor. The CACS can be used both on Earth in unit gravity and in space in low gravity. The CACS can be connected downstream from the bioreactor; alternatively, it can be connected into a flow loop that includes the bioreactor so that the liquid can be recycled.

A centrifugal adsorption cartridge in the CACS (see figure) includes two concentric cylinders with a spiral ramp between them. The volume between the inner and outer cylinders, and between the turns of the spiral ramp is packed with an adsorbent material. The inner cylinder is a sieve tube covered with a gas-permeable, hydrophobic membrane.

During operation, the liquid effluent from the bioreactor is introduced at one end of the spiral ramp, which then constrains the liquid to flow along the spiral path through the adsorbent material. The spiral ramp also makes the flow more nearly uniform than it would otherwise be, and it minimizes any channeling other than that of the spiral flow itself.

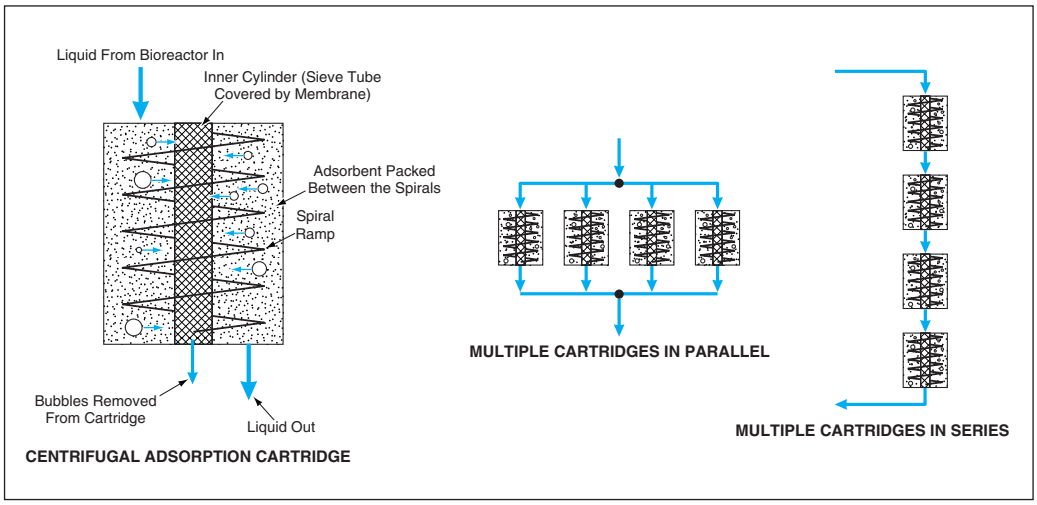
The adsorbent material is formulated to selectively capture the bioproduct(s) of interest. The bioproduct(s) can then be stored in bound form in the cartridge or else eluted from the cartridge.

The centrifugal effect of the spiral flow is utilized to remove gas bubbles from the liquid. The centrifugal effect forces the bubbles radially inward, toward and through the membrane of the inner cylinder. The gas-permeable, hydrophobic membrane allows the bubbles to enter the inner cylinder while keeping the liquid out. The bubbles that thus enter the cylinder are vented to the atmosphere. The spacing between the ramps determines rate of flow along the spiral, and thereby affects the air-bubble-removal efficiency. The spacing between the ramps also determines the length of the fluid path through the cartridge adsorbent, and thus affects the bioproduct-capture efficiency of the cartridge.

Depending on the application, several cartridges could be connected in a serial or parallel flow arrangement. A parallel arrangement can be used to increase product-capturing and flow capacities while maintaining a low pressure drop. A serial arrangement can be used to obtain high product-capturing capacity; alternatively, series-connected cartridges can be packed with different adsorbents to capture different bioproducts simultaneously.

This work was done by Steve R. Gonda of **Johnson Space Center** *and Yow-Min D. Tsao and Wenshan Lee of Wyle Laboratories.*

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to the Patent Counsel, Johnson Space Center, (281) 483-0837. Refer to MSC-22863.



In a **Centrifugal Adsorption Cartridge**, the liquid effluent from a bioreactor is channeled along a spiral flow path through a selectively adsorbent material. The length of the spiral path contributes to efficient collection of a bioproduct suspended or dissolved in the liquid. Multiple centrifugal adsorption cartridges can be connected in series or parallel.

Ultrasonic Apparatus for Pulverizing Brittle Material

Characteristics include light weight, low preload, and low power demand.

NASA's Jet Propulsion Laboratory, Pasadena, California

The figure depicts an apparatus that pulverizes brittle material by means of a combination of ultrasonic and sonic vibration, hammering, and abrasion. The basic design of the apparatus could be specialized to be a portable version for use by a geologist in collecting powdered rock samples for analysis in the field or in a laboratory. Alternatively, a larger benchtop version could be designed for milling and mixing of precursor powders for such purposes as synthe-