Pulse-Flow Microencapsulation System

Microcapsules are produced continuously under controlled, sterile conditions.

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The pulse-flow microencapsulation system (PFMS) is an automated system that continuously produces a stream of liquid-filled microcapsules for delivery of therapeutic agents to target tissues. Prior microencapsulation systems have relied on batch processes that involve transfer of batches between different apparatuses for different stages of production followed by sampling for acquisition of quality-control data, including measurements of size. In contrast, the PFMS is a single, microprocessor-controlled system that performs all processing steps, including acquisition of quality-control data. The quality-control data can be used as real-time feedback to ensure the production of large quantities of uniform microcapsules.

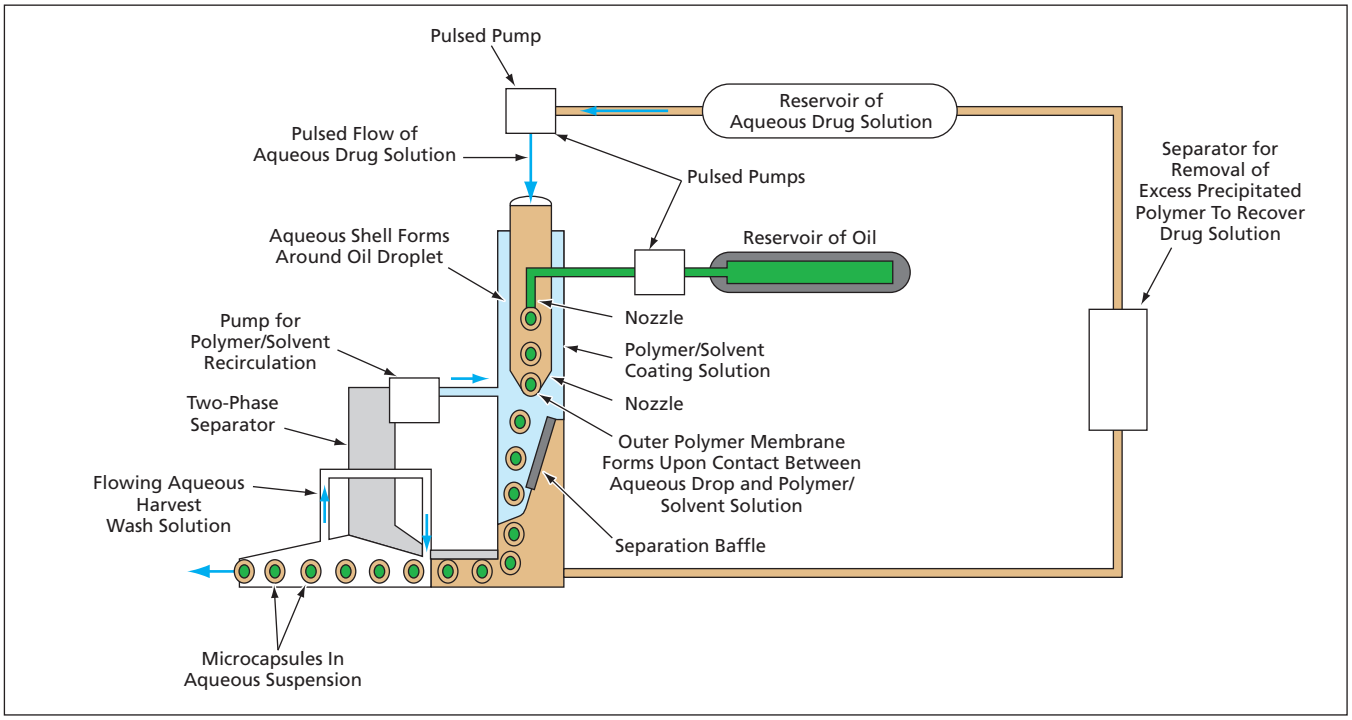
A typical microcapsule produced by this system is a multilayered balloon between 10 and 200 μm in diameter. A microcapsule can contain an inner spheroid made of oil that serves as a dense radiographic contrast agent, surrounded by a thick shell of an aqueous drug solution, surrounded, in turn, by an outer polymer membrane or wall. Optionally, the outermost liquid layer can also contain one or more ceramic ferromagnetic particles or other particles that can be activated by an externally generated magnetic or ultrasonic field to trigger the release of the therapeutic agent(s). Alternatively or in addition, the PFMS can be used to encapsulate live cells for transplantation, together with immobilized immunosuppressant agents that inhibit local immune rejection of the transplanted cells.

The PFMS (see figure) contains pumps, valves, and ultrasonic nozzles, all operated in coordination to produce multilamellar microcapsules in a continuous stream. The PFMS comprises five major subsystems:

1. A pulse-flow, dual-nozzle microcapsule dispenser.
2. A sterile treatment flow module into which the liquid microcapsules are dropped to form their outer polymer walls.
3. A fluidized bed for washing and harvesting the microcapsules produced by the combination of subsystems 1 and 2.
4. A microcapsule flow sensor, which acquires images of the microcapsules for quality control.
5. A microprocessor control module, which controls the operation of the pulse-flow microcapsule dispenser and the microcapsule flow sensor; logs the outputs of all sensors, including the microcapsule flow sensor; processes output of the microcapsule flow sensor to measure the sizes of the microcapsules, count the microcapsules, and distinguish between microcapsules and debris particles, which can be of about the same size; and effects feedback control of all pumps, ultrasonic transducers, and valves.

This work was done by Dennis R. Morrison of **Johnson Space Center**.

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-23659.



The **Pulse-Flow Microencapsulation System** generates a continuous flow of an aqueous suspension of multilamellar microcapsules.