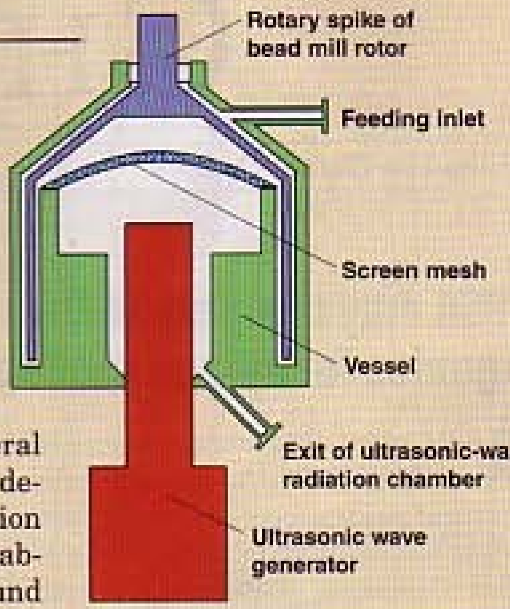


This bead mill is efficient at making nanodispersions

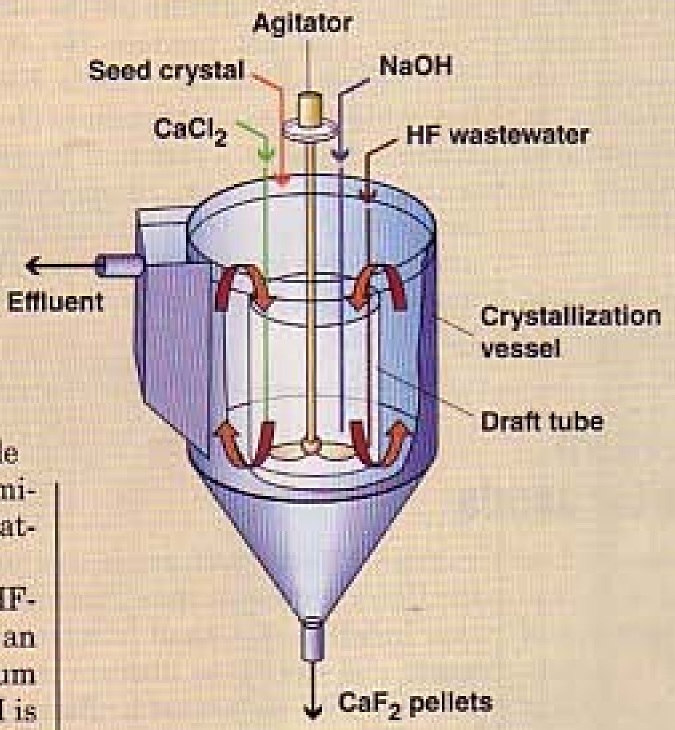
A new grinder that combines large-bead (0.3–0.5 mm) milling and ultrasound to produce nanodispersions with relatively high concentrations has been developed by Inoue Manufacturing Inc. (Isehara; www.inouemfg.com), in cooperation with the National Institute of Materials Science (NIMS; Tsukuba, both Japan). Conventional mills typically use small (0.015 to 0.05 mm) beads for making nanodispersions, but this limits the concentrations of such dispersions to below 1 vol.% because of the difficulty in separating out the small beads, and because of the high viscosities of the mixtures.

The so-called NanosonicMill uses zirconia beads that are set in motion by Inoue's "spike rotor" (diagram) to grind material. A screen mesh separates the beads from ground material that falls through into a second chamber containing an ultrasonic transducer. There, further size reduction occurs through the cavitation effects of sonication (200 kHz, 1.2 kW). The dispersion is then returned, via pump, to the inlet of the bead mill to begin another cycle. These cycles, which can last up to several minutes each, are continued until the desired concentration and size distribution are achieved. The company has established an ideal processing time of around 160 min of repetitive cycles; this has been shown to produce, for example, a 30 vol.% dispersion of titania in water in which the titania particles have a primary size of 35 nm and a distribution width of 55–60 nm. In addition to titania, the company has also made dispersions with other materials.

Inoue plans to commercialize the NanosonicMill in the near future; but first, the company is working with clients to perform tests on materials supplied by potential customers.

Making CaF_2 from HF-laden wastewater

Fluorite, the natural mineral of calcium fluoride, is a key feedstock for making fluorochemicals. In Japan, however, the cost and availability of fluorite has become problematic due to recent restrictions on its import from China. To alleviate the problem, Organo Corp. (Tokyo, Japan; www.organo.co.jp) has developed a process that recovers CaF_2 from wastewater containing high (1–9%) concentrations of hydrogen fluoride. The first large-scale plant has recently been delivered to a semiconductor manufacturer, and is now operating successfully.



In the new process (diagram), the HF-laden wastewater is continuously fed to an agitated crystallizer along with calcium chloride and seed crystals of CaF_2; the pH is adjusted to 2–3 by adding sodium hydroxide. The crystallizer features a special draft-tube baffle and a control system that results in the production of CaF_2 crystals — intermittently withdrawn from the bottom — with sizes of 30–80 microns and a narrow size distibution. The system has a fluoride recovery efficiency of 90%, and produces CaF_2 with better than 95% purity. The discharged pellets have a moisture content of 5–10 wt.%.

Up to now, the recovery of CaF_2 from wastewater has only been feasible on small scales, and limited to HF concentrations below 1%, says the firm. Organo plans to market CaF_2-recovery plants to match customer's requirements, and says the technology is suitable for other industries besides semiconductor manufacturing that use HF, such as glass making and fluorochemicals production. Plants treating 6–100 m^3/d of wastewater containing 1–9% HF will have CaF_2-production capacities of 300 to 5,000 kg/d, says the firm.

Solid-state cooling?

Conventional cooling systems rely on the properties of gases to cool, but common coolants are either harmful to people or the environment. A different approach is being investigated by researchers at the Dept. of Electrical Engineering, Penn State University (University Park, Pa.; www.psu.edu), which is based on ferroelectric polymers that exhibit a temperature change under an electric field. The researchers reported that a temperature change of about 22°F has been observed for the material studied. Such materials could be combined with a heat exchanger to provide heating or cooling.

A new F-T catalyst

A new metal carbide F-T catalyst has been developed by Oxford Catalysts Limited (Oxford, U.K., www.oxfordcatalysts.com) for making second-generation biofuel in small-scale microchannel reactors. The catalyst was produced using the company's patented organic matrix combustion method, which makes it possible to achieve high metal loadings while precisely controlling the crystal sizes. The resulting cobalt-based catalyst has the ideal size for optimal activity in a microchannel reactor. Oxford Catalysts has signed a memorandum of understanding (MOU) with a developer of small-scale F-T microchannel reactors to deploy the new catalyst in small-scale applications, including the conversion of biowaste or flare gas into liquid fuels.