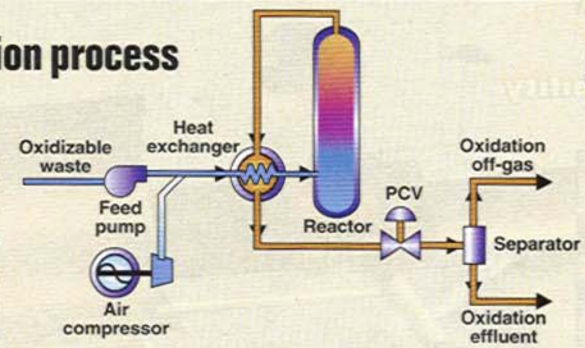
## Making porous nanoparticles

Researchers from the Chemistry Dept. at the University of Minnesota (Minneapolis; edlinks.che.com/6892-**535**) have discovered a new way to prepare monodisperse, discrete nanoparticles of silica with specific shapes, such as cubes, tetrapods and spheres. The shaped particles can be porous, and thus have enhanced surface areas, making them suitable for a number of "guest-host" applications, such as sensors and catalyst supports, says professor Andreas Stein.

The shaped silica nanoparticles are made by controlled disassembly of a solid skeleton that is built around a scaffold of closed-packed nanospheres. The skeletal structure consists of two basic units — cubes and tetrapods — which correspond to the space beteween packed nanospheres of polymethylmethacrylate (PMMA). The PMMA particle assemble themselves through close-packing of spheres into a colloidal crystal. The space between the spheres is then filled with a solution containing oxalic acid, an organosilane compound and a surfactant. After the solution hardens into a gel, the plastic spheres and surfactant are sintered away. The surfactant leaves behind tiny pores, and the gelled organosilane compound slowly converts to a solid silicon-oxide lattice that is the negative of the packed PMMA spheres. As the conversion to $SiO_2$ continues, the lattice shrinks until it breaks at the weakest points in the bridges. The resulting tetrahedral- (or octahedral-) shaped fragments contract to become nearly spherical (or cubic) particles with a worm-like pore structure.

The spongelike silica nanocubes and tetrapods can themselves be used as molds to produce similar particles of carbon or polymers.

## A thermal wet-air-oxidation process treats gasifier soot




Scheduled for startup in the second half of this year, the Long Lake integrated bitumen and upgrading project (near Fort McMurry, Alberta) now under construction by OPTI Canada, Inc. (edlinks.che.com/6892-**536**) and Nexen, Inc. (both Calgary, Alberta) is the first gasification project that that combines heavy-oil recovery and upgrading. The project applies the Shell Gasification Process (SGP), which converts liquid asphaltene byproduct of the primary upgrader into hydrogen and synthesis gas, and the proprietary OrCrude primary uprgrading process licensed from ORMAT (Reno, Nev.) to produce 60,000 bbl/d of synthetic crude oil from Canadian oil sands.

The bitumen in the sands contains relatively large quantities of vanadium, nickel and other metals, which become concentrated in the gasifier feed and, thus, in the gasifier soot. To handle this waste stream, the project will use a patent-pending Zimpro wet-air-oxidation (WAO) process — developed by OPTI and Siemens Water Technologies Corp. (formerly U.S. Filter/Zimpro, Inc.; Rothschild, Wisc.; edlinks.che.com/6892-**537**) — to convert the soot into more valuable forms.

In the Zimpro WAO process (flowsheet), the influent aqueous stream and compressed air are pumped into a heat exchanger where they are heated to initiate the WAO reactions. Because the reactions are exothermic, the heat of reaction raises the temperature to the desired value. After a residence time of approximately one hour, the effluent is cooled before being discharged through a pressure-control valve into a separator. The effluent is partially recycled to the gasifier, and the balance diverted either to deep disposal wells or for additional metals recovery and water recycling.

Although the WAO process — the aqueous-phase oxidation of organic or oxadizable-inorganic compounds at 150–320°C and 1,035–22,000 kPa — has been used commercially for high-strength, industrial-wastewater treatment for many years, this will be the first application for treating gasifier soot, says Siemens. In pilot trials, the process achieved destruction rates as high as 98% under commercial-like operating conditions. Also, the pilot tests demonstrated that the metals in the soot could be recovered using standard hydrometallurgical techniques, says the firm.

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mercial production site at Guelph, Ontario. Construction on this 200-m.t./d plant is expected to be completed this spring.

### Degradable bubblepack

Advanced Excelsior Co. (Houston, Tex.; edlinks.che.com/6892-**545**) has launched Bio-Bubble, claimed to be the world's first 100% Oxo-biodegradable bubble wrap. The material contains Degradable Polymer Products' (Toronto, Canada) d2w additive, which causes plastic products, such as those made of polyethylene, polypropylene and polystyrene, to degrade and ultimately biodegrade in a predetermined timeframe into $CO_2$, water and small amounts of biomass.

### Green chelating agent

Akzo Nobel (Amsterdam; edlinks.che.com/6892-**546**) has commercialized a biodegradable chelating agent, Dissolvine GL, as a cost-effective, green alternative to the two most frequently used agents, ethylenediamineetetraacetic acid (EDTA) and nitrotriacetic acid (NTA). The product contains L-glutamic acid (from sugar, molasses, corn or rice), which is produced biochemically to yield the pure L isomer. The amino acid is then modified using a proprietary process to produce GLDA (glucamic acid diacetic acid). In addition to having similar metal chelation properties to alternatives, the GLDA is very soluble in water over a wide range of pH. At pH 1, for example, GLDA has a solubility of about 1 mol/L (35 wt.%) compared 0.1 wt.% for EDTA. This is significant for clean-in-place applications that use cleaning products formulated at low pH, says Akzo Nobel. GLDA is also thermally stable at temperatures above 300°C (compared to <150°C for EDTA and NTA), making it suitable for reducing the effects of "hard" water in boiler systems, says the firm.