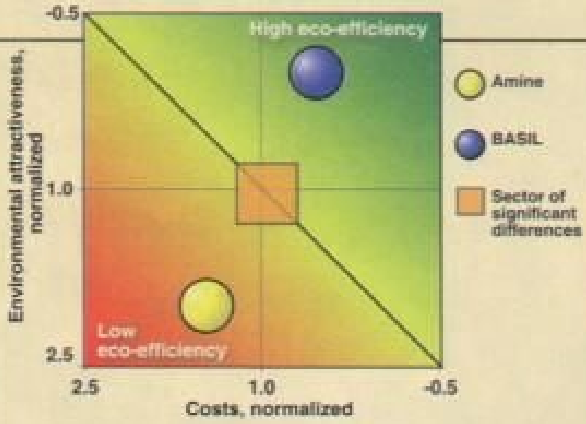
Study shows benefits for using ionic liquids

The use of BASF AG's (Ludwigshafen, Germany; edlinks.che.com/4819-**539**) Basil process for scavenging acids in the chemical synthesis of phosphorous compounds has been shown to have significant economical and environmental advantages over the conventional amine-based systems, according to an eco-efficiency analysis performed by BASF. The Basil (biphasic acid scavenging utilizing ionic liquids) process is claimed to be the first large-scale industrial application of ionic liquids. Since 2003, BASF has been using the *N*-methylimidazole (MIA) to scavenge hydrochloric acid that is formed during the production of alkoxyphenylphosphines (APPs) — precursors for synthesizing photoinitiators that are used for making ultraviolet-curable coatings.

Ionic liquids are organic salts that have a low (below 100°C) melting point, so they can be liquid at room temperature, and they have virtually no vapor pressure. The benefits of these and other properties have led researchers to conclude that ionic liquids offer a powerful new class of solvent with less environmental impact compared to traditional organic solvents (*CE*, March 2001, p. 33). Now such conclusions have been verified.



In the conventional production process for APPs, amines are typically used as acid scavengers; this results in the formation of solids which are difficult to separate from the product and require large amounts of organic solvents to keep in suspension. By substituting the amine with MIA, the scavenged acid reacts with MIA to form the ionic liquid *N*-methylimidazolium chloride (m. pt. 70°C), which can easily be separated (by decanting) and recycled. MIA has the added benefit of catalyzing the reaction. Space-time yield of the reactor can be raised by a factor of 80,000 due to the higher chemical yields and faster reaction rate, says BASF.

The study took into account costs for environmental protection, material and energy, maintenance, personnel, and depreciation, over the products entire life cycle. The results are summarized in the graph for producing 1,000 kg of phenylphosphine products.

This encapsulated catalyst combines FT synthesis and isomerization for making gasoline

The production of liquid fuels via Fischer-Tropsch (FT) synthesis is making a comeback (*CE*, May 2004, p. 23 and July 2002, p. 27), in part because it offers a way to monetize natural gas, and because the liquid product has a high cetane value with little or no sulfur, aromatics and nitrogen content. Conventional FT catalysts, such as cobalt supported on silica (Co/SiO_2), typically produce liquid fuels with a high content of unbranched paraffins, which is favorable for diesel fuel. But for the production of high-octane gasoline, an additional isomerization step is required to increase the content of *iso*-paraffins. This additional step (and the associated costs) are eliminated when using an encapsulated FT catalyst developed by researchers at the School of Engineering, Toyama University (Japan; edlinks.che.com/4819-**540**), with cooperation from two other universities.

The new catalyst is produced by a sol-gel process, which essentially coats a conventional Co/SiO_2 catalyst with a 10-µm thick membrane of an H-ZSM zeolite. The Co/SiO_2 catalyst is first dipped into an aqueous slurry of aluminum nitrate, tetraethyl orthosilicate, and tetrapropyl ammonium hydroxide. After the catalyst is coated, it is dried and calcined at 500°C.

When the catyalyst is used in a FT reactor, synthesis gas (CO and H_2) diffuses through the coating to react on the Co/SiO_2 core. The predominantly *n*-paraffins then pass through channels in the membrane, isomerizing on the way out over the acidic sites of the zeolite catalyst. The encapsulated catalyst showed 80–91% CO conversion (slightly below the 98% achieved by conventional Co/SiO_2 catalyst), but with an *iso*-paraffins to *n*-paraffins ratio of 0.37 to 1.88, depending on the how the catalyst was prepared (compared to near zero for conventional Co/Si_2). The researchers expect that the new catalyst will make it possible to make high-octane gasoline with a one-step FT synthesis with significantly lower costs; a 30% cost reduction is a rough estimate for a 5,000–10,000-bbl/d plant, they say.

Carbon-free electricity

A consortium of companies, including BP, ConocoPhillips a[...] Shell, have started the enginee[...]ing design of the world's first industrial-scale project to gene[...]ate "carbon-free" electricity fro[...] hydrogen. The $600-million pro[...]ect will use proven technologie[...] in combination that has never been tried before. If the feasibil[...] of the project is confirmed by th[...] front-end engineering design ([...] be completed by mid 2006), th[...] proposed plant could start up b[...] 2009, says BP.

The project, which could be located near Peterhead, north[...] eastern Scotland, would inclu[...] a new steam reformer to conv[...] approximately 70 MCF of natu[...]ral gas into H_2 and CO_2. The H[...] would then be burned as fuel i[...] a 350 MW combined-cycle ga[...] turbine power station, and the CO_2 pipelined 240 km offshore to a mature BP-operated oilfie[...] The platform will be adapted t[...] inject the CO_2 into the resevoi[...] to enhance the oil recovery. The life of the field could be ex[...]tended by 15–20 years, poten[...]tially producing an additional 4[...] million bbl/d, says BP.

Drying wood

Researchers at Penn State Ur[...]versity (PSU; University Park, Pa.; edlinks.che.com/4819-55[...] are developing an artificial inte[...]ligence program to improve th[...] process of drying wood. The $250-billion/yr U.S. wood indu[...]try spends as much as 80% o[...] its energy costs for drying woo[...] so a 10% reduction in energy used for drying could save the industry millions of dollars ann[...]ally, says Charles Ray, assista[...] professor of forest resources.

Conditions inside the drying kiln are monitored and the dat[...] analyzed by the program to predict future conditions inside the kiln and the properties of the wood. The information is then used to adjust the kiln for optimum drying conditions. As [...] result, considerable energy ca[...] be saved, and the quality of th[...] product improved, says PSU.

Traditional wood-drying processes have to react to pro[...]cess changes after they occur. Because it takes a long time t[...] adjust the heating in the kiln, considerable energy is wasted and wood becomes damaged by warping and other defects.