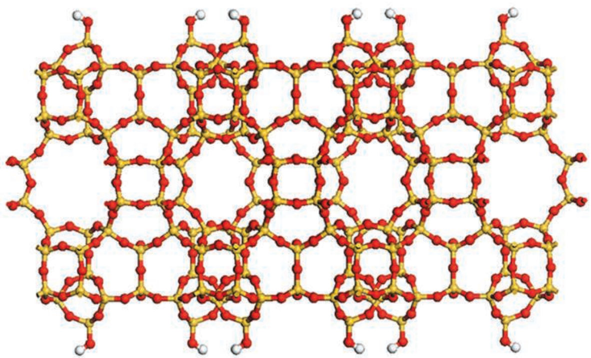
Industrial Molecules, Tailor-Made

If you ever doubt that chemistry is still a creative endeavor, just look at zeolites. This family of porous minerals was first discovered in 1756. They're formed from different arrangements of aluminum, silicon, and oxygen atoms that crystallize into holey structures pocked with a perfect arrangement of pores. Over the past 250 years, 40 natural zeolites have been discovered, and chemists have chipped in roughly 150 more synthetic versions.

This abundance isn't just for show. Three million tons of zeolites are produced every year for use in laundry detergents, cat litter, and many other products. But zeolites really strut their stuff in two uses: as catalysts and molecular sieves. Oil refineries use zeolite catalysts to break down long hydrocarbon chains in oil into the shorter, volatile hydrocarbons in gasoline. And the minerals' small, regularly arranged pores make them ideal filters for purifying everything from the air on spaceships to the contaminated water around the nuclear reactors destroyed earlier this year in Fukushima, Japan.

Zeolites have their limitations, though. Their pores are almost universally tiny, making it tough to use them as catalysts for large molecules. And they're difficult to form into ultrathin membranes, which researchers would like to do to enable cheaper separations. But progress by numerous teams on zeolite synthesis this year gave this "mature" area of chemistry new life.



Assembly required. Porous zeolite crystals are widely used as filters and catalysts. This year, researchers found new ways to tailor the size of their pores and create thinner, cheaper membranes.

Researchers in South Korea crafted a family of zeolites in which the usual network of small pores is surrounded by walls holed with larger voids. That combination of large and small pores should lead to catalysts for numerous large organic molecules.

Labs in Spain and China produced related large- and small-pore zeolites by using a combination of inorganic and organic materials to guide the structures as they formed.

Meanwhile, researchers in France and Germany discovered that, by carefully controlling growth conditions, they could form a large-pore zeolite without the need for the expensive organic compounds typically used to guide their architecture as they grow. The advance opens the way for cheaper catalysts.In yet another lab, researchers in Minnesota came up with a new route for making ultrathin zeolite membranes, which are likely to be useful as a wide variety of chemically selective filters.

This surge of molecular wizardry provides a vivid reminder that the creativity of chemists keeps their field ever young.