Chemistry

Elizabeth Pennisi and Kathryn Hoppe report from an American Chemical Society national meeting in Washington, D.C.

Extending extended-wear contacts

New polymer blends may lead to care-free contact lenses that wearers can leave in for weeks at a time. By mixing and matching three polymer building blocks, chemists have developed a lens material that lets oxygen pass through 25 times better than current soft lenses, says Jay Künzler of Bausch and Lomb, Inc., in Rochester, N.Y. A lack of adequate oxygen can irritate the eye tissue underneath, he adds.

Several research groups seek to make new lenses based on a type of siloxane, a silicon-oxygen compound that produces strong, flexible films. But by themselves, siloxanes do not wet very easily, so they are uncomfortable. They also tend to become distorted or cloud up because they attract lipids to their surfaces, Künzler says.

To overcome these shortcomings, he and his colleagues start with siloxane building blocks that contain fluorine atoms. They then cap chains of these building blocks with another fluorinated compound. The fluorine atoms make the final film much less likely to attract lipid-based molecules, says Künzler.

In addition, the researchers chemically attach a wetting agent that changes its molecular shape when boiled in salt solutions: It opens up a ring of atoms, exposing its water-loving parts so that tears easily wet the final film, Künzler explains.

"Our hope is that this would be the ultimate extended-wear lens," he says. "The eye doesn't even know it has a lens on." But the material still needs improvement, he adds. He is working on modifying the polymer so that the new lens no longer tends to stick too tightly to the eye.

Not all cornstarches are created equal

For some uses, the best starch comes from the ugliest corn kernels. Spurred by the demand for "all-natural" consumables and by microwave and other new food products, researchers at American Maize-Products Co. in Hammond, Ind., surveyed the starches produced by 300 types of corn. They found 10 with potential as sources of starches with new capabilities, says Robert B. Friedman, a chemist with the company.

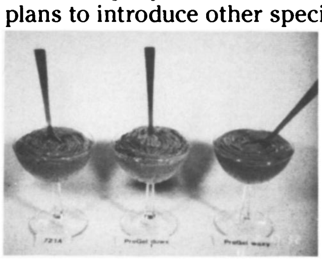
Cornstarch is a polymer used as a thickener and for making corn syrup. However, most people do not recognize that "a subtle difference in the starch's structure can give you major differences in the way these polymers behave," says Friedman.

For example, gels made with Waxy-Shrunken starch (named for the appearance of the corn kernel) are much more translucent than most cornstarch-based gels. So a Waxy-Shrunken cornstarch could replace more expensive ingredients such as tapioca in recipes calling for clear gels, he says.

Another, Dull-Waxy cornstarch, makes puddings stiffer and gives baked goods a "velvety texture," says his colleague Frances R. Katz. "It forms a better moisture-holding matrix," she adds, so cakes stay fresher longer.

Typically, corn processors enhance those stiffening and water-holding properties in common cornstarch by cross-linking the starch polymers. In this chemical reaction, new connections form among starch molecules. Dull-Waxy starch needs no such modification, possibly because of more compact branching in the starch molecules, Friedman says.

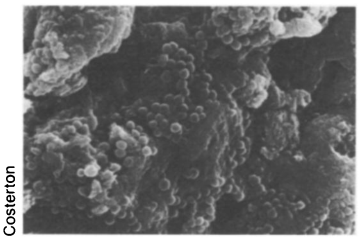
His company now sells Dull-Waxy cornstarch and eventually plans to introduce other specialty cornstarches, he adds.



American Maize-Products Co.

Loose mousse with unmodified cornstarch (right). Mousse with new Dull-Waxy cornstarch (middle) and mousse with chemically modified cornstarch (left) are the preferred stiffness.

Electrical fields help kill biofilms



Costerton

Spherical bacteria on biofilm surface. Many more dwell within the slimy matrix.

Slime beware: Researchers have developed a way to kill even the most stubborn bacterial mats, also known as biofilms.

Biofilm bacteria, which cause a variety of medical and industrial problems, grow as a thin organic layer on inert surfaces ranging from water pipes to prosthetic implants (SN: 1/6/90, p.6). Shielded by protective slime, these bacteria often withstand the traditional treatments that eliminate their free-floating counterparts, says J. William Costerton, a microbiologist at the University of Calgary in Alberta.

Costerton and his co-workers have now developed an efficient and inexpensive technique to kill biofilm bacteria. Their method uses low-level electrical fields to push antibiotics or biocide solutions through the biofilm's protective slime, directly attacking the underlying bacteria.

The method could prevent chronic infections associated with internal prosthetic devises, says Costerton. The researchers propose several applications for their technique, including the creation of a small electrical field with electrodes directly attached to an implant. Costerton believes that a few days of such postoperative treatment could prevent severe infections, which currently may necessitate a second operation to remove and resterilize the device.

The researchers have tested their technique with prosthetic devices in animals, but six to 10 years of testing remain before it can receive FDA approval for routine use in humans, Costerton says. Within a couple of years, however, the technique may be used externally to sterilize medical devices, such as endoscopic probes, dental drills, and contact lenses, he says. The process is safer than heat sterilization for delicate instruments and may take as little as 10 minutes, he adds.

Costerton also predicts that industries may soon use higher-level electrical fields in conjunction with currently used biocide chemicals. This could drastically reduce the required doses of these chemicals, which are expensive and potentially dangerous in large amounts, he says.

New strain of high-starch potatoes

Consumers may soon munch on fluffier fries and crispier chips, thanks to genetically engineered spuds developed by biologist David Stark and his co-workers at Monsanto Co. in St. Louis.

The altered tubers contain more starch and less water than their normal counterparts, and thus absorb approximately 20 percent less oil when fried. These changes translate into fewer calories and better texture, Stark says.

The researchers introduced a gene that codes for starch production — originally isolated from a common bacterium — into the familiar Idaho potato. While the new plants appear normal, they produce an average of 20 percent more starch than their unaltered cousins.

No formal taste tests have been conducted, but the scientists themselves have fried up a few preliminary chips. "They were very good," says Stark.

The researchers continue rigorous testing to identify the ideal levels of starch, since too much of it makes a potato fragile and difficult to ship.

Stark estimates that the new spuds may reach consumers by the late 1990s.