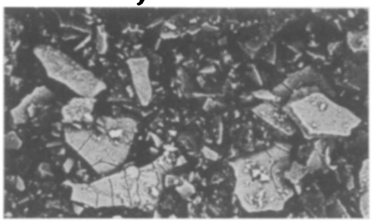
Tea scum? Try a little lemon juice


Spiro/NATURE
A scanning electron micrograph of tea scum.

Among the genteel, it's the little irritants in life that often, well . . . attract attention. Like tea scum, for instance, that nasty film that forms atop our gentlest brew, causing ever so much embarrassment in the late afternoon.

But for those who seek to conquer this blemish of civilization, two British chemists have finally gotten the problem under control. Michael Spiro and Deogratius Jaganyl, at the Imperial College of Science, Technology, and Medicine in London, report in the Aug. 12 NATURE that hard, mineralized water is to blame – and lemon is the solution.

The reason, Spiro explains, has to do with ions in hard tap water, which react with organic materials in the tea. "We found that this unpleasant scum forms when the tea is brewed in hard water, which has both calcium ions and bicarbonate ions in it," Spiro says. "If you remove either of those ions, or you brew tea in soft water, then no scum forms. But if you must brew tea in hard water – especially tap water that's passed through limestone – you should add lemon, which is acidic. The hydrogen ions of the acid react with the bicarbonate ions, which stops the scum. You could do the same thing with hydrochloric acid, but people generally don't like that in their tea."

To study tea scum quantitatively, the English scientists collected scum in a large beaker, washed it, dried it, and viewed it under a scanning electron microscope. White patches stood out, which proved to be calcium carbonate deposits. The sleuthing continued: "Matrix-assisted ultraviolet-laser desorption/ionization mass spectrometry revealed a wide range of masses," they report. To boot, the scum would only dissolve in a "highly concentrated alkali."

To track the rate of scum formation, they brewed up a pot of a popular black tea blend, Typhoo, in London tap water at 80°C, and let it sit. Scum formed continuously for many hours, proportional to the tea's surface area and the amount of oxygen in the air. (Nitrogen retarded scum growth.) Milk, too, furthered scum formation. In contrast, their control – tea brewed in distilled water – formed no scum. And there was one "unexpected" result: The more tea bags used, the less scum formed, owing to tea polyphenols, which are acidic.

Thus, Spiro and Jaganyl conclude, oxidation of tea solubles in hard water containing calcium and carbonate ions lies at the bottom of the tea scum mystery.

New process purifies high-temp ceramics

How annoying when a dinner plate cracks in the dishwasher. But what if that dinner plate were part of a jet engine?

Under intense heat and pressure, ceramics can crack. A big difference between household ceramics (like teacups or sinks) and high-temperature ceramics (like engine parts or capacitors) is purity. For a ceramic to withstand big loads and temperatures (above 1,200°C), it must be free of impurities.

Now, a new purification process promises to improve high-temperature ceramics. Developed at NASA's Lewis Research Center in Cleveland, the new method uses compounds derived from guanidine to remove sodium and potassium residues that show up when the ceramics are fired in their molds.

"These [guanidine-derived] chemicals have direct use in the aerospace industry," says senior research chemist Warren H. Philipp, who invented the process. "We can use them to form lightweight, corrosion-resistant ceramic parts leading to more efficient aircraft engines and rocket motors." The process also may improve capacitors and superconductors, he says.

Typically, ceramic parts come from powders, which are mixed with solvents, poured into molds, and fired in kilns. Usually, some sodium and potassium residues remain, compromising the ceramic's integrity. Often this imperfection doesn't matter. But at high temperatures and stress, residues can cause cracks.

The new guanidine-based process, however, removes virtually all sodium or potassium residue. The result, says Philipp: purer, stronger, and more corrosion-resistant ceramic products.

Tubules self-assemble smaller than DNA

Just think about building a perfect cylinder with only a few molecules – a tubule narrower than a helix of DNA.

Not an easy task. Yet Akira Harada and his colleagues, all chemists at Osaka University in Japan, have succeeded. As reported in the Aug. 5 NATURE, the scientists built the tiny tubules from cyclodextrin, a glucose derivative. The tubules measure 15 angstroms in diameter, with an inner core of 5 angstroms. By comparison, an average DNA helix is 20 angstroms across.

To build these tubes, the researchers took advantage of molecular self-assembly. Here, cyclodextrin rings – which look like lampshades – line up along a polymer chain (called polyethyleneoxy). "Stopper" molecules then seal off the ends, bonding the rings together. Finally, the center thread drops out, opening up the tubules. "Using self-assembly to make nanometer-sized structures with controlled sizes and shapes," says chemist Angel E. Kaifer of the University of Miami, "is interesting by itself."

Applications for these tubules lie far ahead, but Kaifer does see potential uses: as templates for building other molecules, for example, or as a filter for separating small molecules, or perhaps even as a delivery system. "You could put something inside the tubules, then break them down to release the material," Kaifer explains.

Computer memory gets a new charge

These days, machines need memories. To store information, they typically use a magnetic signal (e.g., on a cassette tape), an electric charge (e.g., in computer memory), or an optical pattern (e.g., on a compact disk).

Now comes a new memory system onto the scene. Chong-yang Liu and his colleagues at the University of Texas at Austin report a new material they've developed, which uses electrical charges and light to store information. This new memory system traps and stores charges in a thin film of photoconductive material, called ZnODEP, and does so densely and rapidly. The result: a better way to store and retrieve data. "Information, as trapped charge, can be written, read, and erased by simultaneous application of an electric field and a light pulse," the researchers, all chemists, report in the Aug. 13 SCIENCE.

Photosensitive materials generally cannot store information, Liu explains. Video cameras and copy machines, for instance, must store pictures in other forms (magnetically or digitally), since photoconductivity stops when the light stops shining.

"Photoconductivity has not been useful for memory devices," Liu says. "But this system, using an electric field plus irradiation, has advantages of an ordinary computer memory and an optical disk. Our photosensitive material is interesting because it stores charge. It has a memory that lasts."

The electro-optical memory, says Liu, may benefit computers' backup and dynamic random access memories (RAM), as well as video cameras and navigation systems.