Physics

Dimples give batters more power

Jeffrey Di Tullio of the Massachusetts Institute of Technology came up with his latest batty idea while sitting in a traffic jam. "I was sitting there, stuck in traffic, thinking about the work I'd been doing with my students," he said, "when I realized that if you could reduce the drag on a bat you might be able to swing it faster."

Conventional, cylindrical bats are not aerodynamic. Much of the energy required to swing such a bat actually goes into pushing air out of the way. Improving air flow around a bat, reasoned Di Tullio, would enable a person to swing it faster. A faster bat would strike the ball harder and send it farther.

Although air flows almost all the way around airplane wings, it gets trapped in energy-consuming tornadoes, vortices, and swirls around the sides and back of a bat. Professional baseball isn't likely to change the shape of bats used by players, Di Tullio notes wryly, but adding bumps or dimples to a bat's surface would make it a little more aerodynamic.

The advantages of bumps and dimples have been known for a long time, says Di Tullio. Whenever an object is moved through the air, a very thin layer of air sticks to its surface. The layers just above this move very slowly and contain very little energy — not enough to swish all the way around a bat.

Surface roughness mixes the slower bottom layers of air with the faster upper layers. "The net result is that [the dimples] add energy to the air right on the surface and give it that little extra [push] it needs to follow the contours of the bat," says Di Tullio. Because less air now needs to be moved out of the way, the bat moves faster.

Di Tullio tested bats with dimples rather than bumps because bumps might affect the trajectory of balls hit. He pressed the dimples into the bat — rather than cutting them out, which might lighten the bat — from about 18 inches above the handle to the end.

Di Tullio timed semiprofessional baseball players as they swung various bats in air tunnels at MIT. He found that they swung dimpled bats 3 to 5 percent faster than normal bats of the same dimensions.

This increased speed added 10 to 15 feet to a fly ball, says Di Tullio, which might translate into more home runs.

Molecular clusters imitate laser snow

"Laser snow" was so named in the 1970s, when researchers discovered that chemical collisions induced by lasers caused white precipitates, later found to be polymer chains, to drift out of some mixtures of gases (cesium and hydrogen, for example, or carbon disulfide).

Now, John C. Miller of Oak Ridge (Tenn.) National Laboratory and colleagues at the University of Tennessee have discovered a newer form of laser snow. They reported their results at the American Physical Society's annual meeting in late April.

Miller's group began with small clusters, or "snowballs," of carbon disulfide. A low-pressure, low-density gas containing these clusters was irradiated inside a mass spectrometer. After analyzing the products of the reaction, the researchers found that similar polymerizations had occurred. But this time, the crashes of excited molecules were not responsible.

Because of the low density, the carbon disulfide clusters did not collide. Instead, says Miller, "an initially ionized molecule 'eats' its way through the cluster like a molecular Pac Man, creating bigger and bigger polymers with each bite."

These reactions are unique: Even though they are caused by a laser, they take place solely within the cluster, says Miller. Cluster chemistry is a burgeoning field — witness the rise of the buckyball — and these "clustering within a cluster" chemical reactions may shed additional light on this area of investigation, he adds.

Science & Society

Tina Adler reports from Birmingham, Ala., at the 45th International Science and Engineering Fair

Teenage scientists show off projects

More than 900 high school students displayed their experiments at the 45th International Science and Engineering Fair, competing for scholarships, awards, prizes, and trips valued at nearly $400,000. Their projects covered 14 categories and ranged from homemade cyclotrons to self-cooling lunch packs. Science Service, which publishes SCIENCE NEWS, sponsors the annual event. Some examples of projects:

• Reed L. Levine, 16, of John F. Kennedy High School in Bellmore, N.Y., examined whether magnetic resonance imaging (MRI) alters the spatial-learning abilities of mice and the concentrations of melatonin in their blood. Other studies show that the brains of mice, humans, and turtles contain magnetized particles and that magnetic fields in the environment affect melatonin concentrations, he writes in an abstract.

Mice that underwent MRI failed to learn how to negotiate a maze as well as mice not exposed to a magnetic field, but their melatonin concentrations remained unchanged. The MRI's effect on the brain's magnetized particles may have impaired the animals' spatial skills, Levine suggests.

• Robert D. Smith, 18, of Poplarville (Miss.) Senior High School, sought to develop hardier strawberries. Among small fruits, strawberries rank as the most prone to disease. They are quite susceptible to *Colletotrichum,* a fungus, Smith says.

He exposed small pieces of strawberry and strawberry seedlings to different concentrations of a toxin released by the fungus. He is now using the surviving cells and seedlings to grow what he hopes will become disease-resistant plants. The usual test for fungal resistance involves spraying plants with the fungus, which is more dangerous to plants than the toxin.

• Yvonne Ou, 17, of Lexington (Mass.) High School, went in search of a "low-cost, environmentally safe, interim road deicer," she explains. Researchers have developed a good replacement for the corrosive and environmentally unfriendly rock salt (NaCl). But that alternative, calcium magnesium acetate (CMA), is too expensive for wide use. So Ou decided to test the effectiveness of a mixture of the two compounds.

She measured how various blends influenced ice melt and grass growth and how much they corroded metal. To find the best combination of the two ingredients, she developed a computer model of the different blends' effects.

"Results of laboratory experiments indicated that CMA/NaCl deicer mixtures are an attractive alternative," Ou writes in her project abstract. The mixtures' ice-melting abilities equaled those of rock salt. In some cases, the blends proved less likely than rock salt to suppress vegetation. Her results on the mixtures' corrosiveness proved inconclusive, but other studies suggest it rivals CMA in this category, she says.

For states in New England and the Midwest, the cost of using CMA by itself would amount to $8.3 billion annually, while the tab for rock salt runs to a mere $2.4 billion. The mixture would come in with a $4 billion price tag, she calculates. It should be used in environmentally sensitive areas and on bridges, she argues.

• Eddie Chon-wai Wu, 17, of Los Gatos (Calif.) H.S. examined the accumulation of vanadium, a metallic element found in tunicates, also called sea squirts. Certain types of tunicates have a high concentration of vanadium in their blood cells, says Wu. In fact, it's much higher than the concentration of vanadium in the seawater where they live.

He found that a previously unknown, siderophore-like compound accumulates the vanadium in tunicates. Siderophores are molecules that concentrate metals in a bacterium. Wu detected the compound using a variety of approaches, including dissecting the tunicate and filtering its cells. He analyzed it using MRI, among other methods, and compared it to known siderophores, he writes.

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