Materials Science

Electron beams rub rubber the right way

Each of the two revolving tracks on a modern military tank consists of 100 or so metal slabs strung together with a rubber pad attached to each slab. The impact-buffering pads, which take a beating beneath the 70-ton behemoths, typically need replacement after 700 miles. "It's the most expensive element in the operation of a tank," says materials scientist Joseph Silverman of the University of Maryland in College Park, who notes that taxpayers shell out $100 million each year to keep U.S. tanks fitted with working pads.

Working on a federal contract to design longer-lasting rubber pads, Silverman says he has come up with a process for making pads that can last for 2,000 miles and can resist environmental wear up to 10 times longer than conventional pads.

His technique combines standard processing steps in non-standard sequences. He begins with commercial, uncured styrene-butadiene rubber (SBR), then uses a heat-and-sulfur treatment to establish enough chemical cross-links between the rubber's polymer molecules to make the material rigid enough to handle. But most of the cross-linking, or curing, takes place when this intermediate material gets blasted with a powerful electron beam. In the conventional process, most cross-links develop in the thermochemical step, and the remainder form in a preliminary radiation step.

SBR cured by either method has the same tensile strength, stiffness and number of cross-links. But Silverman's process yields materials that resist tearing at high temperatures and last far longer in laboratory degradation tests. Field tests at an Army proving ground show that pads made of Silverman's rubber last up to three times as long as standard pads.

While potentially reducing tank maintenance costs, the improved rubber could also prove useful for nonmilitary applications such as roofing material, Silverman says.

The surprising properties of Silverman's rubber suggest to him that the standard picture of rubber degradation could use some refining. For example, he says, the standard view might explain that aging windshield wipers stiffen and leave water channels behind their sweeps because environmental exposure increases the amount of cross-linking among the rubber molecules. Silverman speculates that rubber cured by his process might counter the stiffening process with a bond-breaking mechanism, keeping the total number of cross-links the same. No one really knows how rubber goes bad, he adds.

Cosmic dirt may strut asteroidal stuff

A microscopic interplanetary dust particle (IDP) snagged by a NASA research plane may help scientists determine the mineral makeup of the solar system's asteroid population, according to a report in the Feb. 1 SCIENCE.

Astronomers think most meteorites originate in the solar system's asteroid belt, with a mineral content reflecting that of their asteroidal parents. But meteorites that visit Earth may represent only a small segment of the asteroid belt, say Donald E. Brownlee of the University of Washington in Seattle and John P. Bradley of McCrone Associates, Inc., in Westmont, Ill.

IDPs show a variety of mineralogically distinct compositions, but until now, astronomers had never directly linked an IDP to a meteoritic source. Brownlee and Bradley report that one IDP from the NASA sampling contains tochnilinite, a mineral that appears only in a specific class of meteorites, suggesting a common asteroidal source for the IDP and these meteorites. This link suggests that the different mineralogy of other IDPs might reflect the composition of asteroids that have never sent meteorites to Earth. Unfortunately, proving the theory would require actual samples of these asteroids or their meteoritic messengers, and Brownlee says he isn't holding his breath for that.

Space Sciences

NASA recruits its SETI team

On Jan. 15, NASA named nine scientists to work on its Search for Extraterrestrial Intelligence (SETI) Microwave Observing Project. Using radiotelescopes, this team will listen for attempts to communicate with Earth by life elsewhere in the galaxy (SN: 5/13/89, p.296). Jill C. Tarter of NASA's Ames Research Center in Mountain View, Calif., will direct the team, which plans to begin listening for the extraterrestrial broadcasts on Oct. 12, 1992, the 500th anniversary of Christopher Columbus' landing in the Americas.

SETI researchers at Ames will focus their attention on microwave emissions from about 1,000 selected stellar sources — stars similar to the sun and within 80 light-years of Earth. At NASA's Jet Propulsion Laboratory in Pasadena, Calif., a second SETI team will manage a broader survey of the whole sky "to detect signals from directions that might be overlooked if the search were limited to nearby [sun-like] stars."

Some project scientists will labor before the listening begins:

• Peter B. Boyce in Washington, D.C., executive officer of the American Astronomical Society, will try to identify stars within about 13 light-years that may have been in the beams of Earth-based radars used to study lunar and planetary surfaces — in case such signals motivated any life forms on planets near such stars to attempt a reply.

• Several SETI team members, including Michael M. Davis, director of the Arecibo Radio Observatory in Puerto Rico, will work on configuring the project's radio receivers to automatically weed out spurious signals from Earth or nearby, including those from artificial satellites.

• Kenneth C. Turner, program director for extragalactic astronomy at the National Science Foundation in Washington, D.C., hopes to tailor the project's computer software to ignore Earth-based signals that reflect back from the moon or other bodies in the solar system.

• David W. Latham of the Smithsonian Astrophysical Observatory in Cambridge, Mass., will reevaluate the existing list of stars selected for detailed observations using a database of more modern observations.

Comet rediscovered 10 trips later

A comet "discovered" on Jan. 7 by amateur astronomer Howard J. Brewington of Cloudcroft, N.M., turns out to be the reappearance of one initially reported 84 years ago. No astronomer spotted the comet during its 10 intervening elliptical trips around the sun.

Joel Hastings Metcalf of Taunton, Mass., the comet's original observer, spotted the small object Nov. 15, 1906. Calculations from his observations and others indicate the comet orbits the sun about once every 7 years and 9 months. Brian G. Marsden of the Smithsonian Astrophysical Observatory in Cambridge, Mass., detected a similarity in the orbits of Metcalf's and Brewington's comets, then established they were identical.

Now called Metcalf-Brewington, the comet apparently brightened far more during its recent transit near the sun than during its previous 10 passes, Marsden says — perhaps 10,000 times more. He notes that independent "discoveries" made a few hours after Brewington's by Tsuruhiko Kiuchi in Japan and by William Bradfield in Australia confirm the brightening.

In fact, the comet apparently brightened rapidly, Marsden says — possibly because a surface crack developed and exposed icy comet material to sunlight. Just two days before Brewington's "discovery," Japanese astronomer Masaaki Tanaka photographed a region of the sky through which Metcalf-Brewington was passing. In that picture, the comet is less than 0.5 percent as bright as when Brewington first spied it.

Temple 1, first reported in 1867, holds the current record for consecutive unseen returns by a comet — 13 times.