

Tiny bubbles help plastics take a pounding

If you have ever sat in a canoe as it snagged on a rock and split open, you know the sinking feeling of discovering that a material couldn't quite do its job. Now, research into the mechanism of fracturing promises to aid engineers in their quest to balance weight, cost, toughness and flexibility for longer-lasting products — including, perhaps, indestructible boats.

Manufacturers usually assess the toughness of a compound by measuring the amount of energy needed to break a sample in half. But a plastic's toughness also depends on how it reacts to stresses leading up to the fracture, and engineers should consider this in designing new products, assert researchers from the University of Rochester (N.Y.) in the June JOURNAL OF MATERIALS RESEARCH.

James C.M. Li and two graduate students studied acrylonitrile-butadiene styrene (ABS), a plastic commonly used in canoes, recreational vehicles, bathtubs, pipes and even TV cabinets. Companies tailor ABS for its various uses by adjusting the amount, size and structure of the particles of butadiene, a rubber mixed in to make ABS less brittle.

The Rochester group's findings about prefracture stress should help materials scientists achieve a more reasonable

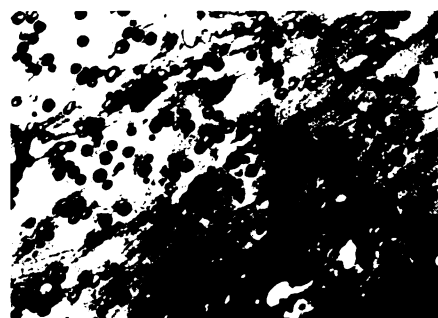
trade-off between toughness and other characteristics, says David E. Henton, an engineer with Dow Chemical Co. in Midland, Mich., which helped fund the work.

When the researchers analyzed what makes microscopic cracks worsen, they found that ABS materials vary in the amount of stress they absorb before they break. "You must put energy into it before the crack starts to go," Li explains.

ABS polymers can take up energy in any of three ways. Microscopic bubbles may form in the rubber particles. Sometimes the polymer molecules shear, slipping slightly away from those above and below. Also, a network of very fine cracks, called crazes, can develop, says Li.

He and his co-workers discovered that bubbles reduce stresses most effectively and that ABS polymers with larger rubber particles form more bubbles. This finding will aid in improving ABS because "you want to maximize the efficiency of the rubber phase," says Henton, who notes that rubber is the material's most expensive component.

Royalite Thermoplastics in Mishawaka, Ind., which makes ABS polymer for canoes, takes a different approach. Rather than alter the rubber component, the company sandwiches an ABS foam between two thin ABS layers, creating a



Zhang, M./Univ. of Rochester

ABS plastics can absorb energy and resist breakage by developing crazes (dark streaks) and by forming bubbles inside rubber particles.

material with more rubber per unit weight than a single thick layer would have, says Victor W. Lee, a technical manager with Royalite.

The resulting material satisfies most customers, according to canoe manufacturers. Nevertheless, "we keep telling them we want it stronger, stiffer and cheaper," says Wendall Easler, vice president of operations for Old Town Canoe in Old Town, Maine.

With the new report, says Henton, "one begins to better understand the critical interplay between these molecular variables." This knowledge, he says, might one day lead to a tougher ABS canoe with less rubber and perhaps a lower cost.

— E. Pennisi

Bereavement: How strength saps coping

A harmonious marriage, a solid bank account and a sense of control over life offer many rewards. But such sought-after assets also set the stage for a particularly difficult adjustment to the death of a spouse, according to preliminary data from the first large-scale study of adults both before and after bereavement.

"People with considerable [psychological and financial] resources may be at most risk for negative reactions to the loss of a loved one," says psychology graduate student Vicki Gluhoski of the State University of New York at Stony Brook. "If someone views the world as predictable and safe, bereavement may hit them especially hard."

Gluhoski, who conducted the study with Stony Brook psychologist Camille B. Wortman and sociologist Ronald Kessler of the University of Michigan in Ann Arbor, presented the findings at the annual meeting of the American Psychological Society in Washington, D.C., last week.

Their findings suggest that people involved in conflict-ridden marriages suffer less emotional distress following a spouse's death than those in stable marriages. This contradicts the traditional assumption, based on clinical

observations, that the survivor of a tumultuous relationship faces major difficulties in resolving the loss of his or her partner, Wortman points out.

The data also undermine the widespread notion that people armed with a sense of self-worth, confidence in their ability to overcome obstacles through hard work, and other emotional resources fend best in the face of severe stress, such as bereavement.

"So far, the findings fly in the face of most theories about grief," Wortman asserts. "A Protestant work ethic type of world view can be very adaptive in many settings, but apparently not after the sudden loss of a loved one."

Wortman and Gluhoski's conclusions stem from an ongoing study of a national sample of 3,617 married men and women interviewed in 1986. Participants ranged in age from 25 to 65 years. In 1989, experimenters conducted second interviews with 2,800 members of the original sample. Between the two interviews, 100 participants — mostly women — experienced the death of a spouse.

Bereaved individuals who began the study with a variety of characteristics associated with good psychological functioning — including minimal mari-

tal conflict, positive self-image, feelings of control over the direction of their lives, and high scores on tests of verbal intelligence and attention — reported substantially more depression in 1989 than did bereaved individuals displaying essentially the opposite pattern. Depression also appeared more often among those who earned the most money prior to bereavement, regardless of what their spouses earned.

The researchers have yet to analyze data on anxiety, social activities and feelings of well-being following the death of a spouse, or the influence of reported religious faith on psychological adjustment to the loss.

An important check on the study's findings will come from a similar long-term project initiated in 1988 — also headed by the Stony Brook researchers — involving about 1,500 elderly, married people living in the Detroit area. Statistical analyses should proceed in the next year or two as the number of bereaved participants increases, Wortman says.

The new research complements previous findings that many bereaved spouses and parents become depressed and do not come to terms with their loss for at least four years (SN: 2/7/87, p.84), while a substantial minority show little distress after the loss.

— B. Bower