A dose of prevention for radiation-sterilized polypropylene

A massive dose of sterilizing gamma rays can turn tough polypropylene, the stuff of ropes and carpet fibers, into a material as brittle as an eggshell. Until recently, this effect had kept medical suppliers from using radiation to sterilize plastic disposable medical devices like syringes made from polypropylene unless special conditions were met. Now, researchers at one company have found an additive that stabilizes polypropylene so that radiation can be used more widely for sterilization of plastics.

"Most of the people that were working in this arena had really thought that it was impossible to get polypropylene where it would be radiation-stable," says Joel L. Williams of the Becton Dickinson Research Center in Research Triangle Park, N.C. Last week at the annual meeting of the American Institute of Chemical Engineers in Washington, D.C., Williams presented the results of his 10-year search.

Williams and his colleagues focused on the behavior of polypropylene because of this plastic's superior qualities for medical devices. These properties include a higher melting point than polyethylene, a greater resistance to solvents than polystyrene and a higher transparency than many other polymers. At the same time, radiation sterilization is becoming increasingly important, particularly in Europe, as an alternative to using ethylene oxide gas, an extremely toxic substance (SN: 1/22/83, p. 55; 3/26/83, p. 202) that many polymers readily absorb.

Williams found that the strength of polypropylene decreased as the ionizing radiation dose increased. More serious, however, was his finding that even when the material was acceptably strong right after irradiation, within six months of just sitting on a shelf, the irradiated polypropylene had degraded into a fragile, brittle product. Williams reports, "Even a single sterilization of polypropylene may result in problems that may not develop for a period of time after irradiation." Such devices would be unsafe to use.

The culprits are radiation-generated, reactive, uncharged molecular fragments known as free radicals. The radicals form when high-energy radiation breaks covalent chemical bonds within the long polymer chains that make up polypropylene. These radicals react with oxygen molecules from the air to generate new radicals that react with other polypropylene chains to break more links. Because this process can continue for years before most of the radicals are gone, the material gradually weakens over time. The answer, Williams says, was to find a way to allow the radicals to recombine quickly so that the characteristic long chains of the polymer re-form before the radicals react with oxygen.

Williams succeeded by adding a "mobilizer" (its identity is proprietary) or a kind of lubricant to the polypropylene formulation. This substance, which is soluble in polypropylene and collects in the noncrystalline regions of the polymer, allows the free radicals more room in which to move and find each other and hence increases the chances of recombination. With the additive, Williams showed that the shelf life of polypropylene-based, radiation-sterilized medical devices could be extended considerably.

Looking back on his 10 years of work, Williams comments, "It wasn't an easy problem to solve." Other companies have also come up with answers, including the use of lower sterilizing radiation doses combined with greater care in manufacturing devices from polypropylene. About 20 percent of all disposable medical products are already radiation-sterilized. With the addition of better polypropylene formulations, that percentage is bound to increase. *—I. Peterson*

Spacelab 1 delayed another month—instead of four

It hasn't been Spacelab's fault. Assigned to the ninth flight of the space shuttle, the billion-dollar, European-built research module's maiden mission was delayed a month to Oct. 28 by checkout problems with a new communications satellite that would be relaying most of its data. Then engineers discovered that a booster-rocket nozzle used during shuttle flight 8 in September had nearly burned through its lining, which might have sent the craft dangerously off course or even caused an explosion. Rechecking the nozzle-linings for flight 9 (one of its boosters was actually changed) promised another delay. But how long would it be?

The rescheduled launch could come no sooner than Nov. 28, so that the new moon (Dec. 4) would again be in the sky to minimize reflections from earth's atmosphere that could affect nighttime observations by some of Spacelab 1's numerous scientific instruments. But other lighting conditions will be less than ideal in early December for some of the mission's atmospheric and astrophysical experiments, and the seasonal increase in cloud cover and snow could pose difficulties for photography of the surface. As an alternative, officials of the European Space Agency (ESA) and the National Aeronautics and Space Administration considered delaying the mission until late February, when the lighting will more closely resemble that of late October (SN: 10/22/83, p. 262).

But the Nov. 28 date has gotten the nod. An additional three months of delay, NASA felt, would add significantly to the mission's cost and put pressure on a 1984 launch schedule that already includes plans for 10 shuttle flights. Furthermore, says mission program manager Mary Jo Smith, 15 of the Spacelab scientists whose observations would be affected by the choice opted for November (4 of them with the proviso that their experiments could be reflown later), while only 2 expressed a February preference. NASA and ESA, accordingly, have agreed to refly seven of the experiments on subsequent shuttle missions, and a ride is being sought for an eighth.

Six of the seven have been granted space on a mid-1985 flight called the Earth Observations Mission: A far-ultraviolet telescope for astronomy is being included because it was designed for use when the sun is farther below the horizon than it will be in early December (though all eight experiments will be on Spacelab 1 as well). A device to generate artificial auroras with electron and ion beams, as well as an imaging photometer to study auroras of both the man-made and natural variety, are taking advantage of a reflight because their low-light television cameras require the shuttle to be in earth's shadow, while most of Spacelab 1's time will be spent in sunlight. Earth's airglow, at wavelengths from extreme ultraviolet to infrared, will be studied by an imaging spectrometer, whose IR observations will have been limited during Spacelab 1 by the short nights. Another kind of spectrometer, monitoring atmospheric trace gases, is on the list because it is planned for operation when the "solar beta angle" (the angle between the sun-earth line and the spacecraft's orbit plane) is greater than 60°, bigger than that of the Spacelab 1 mission. The sixth experiment in the batch is a movie camera, sent to photograph hydroxyl (OH) emissions that researchers hope will serve as tracers for the movements of certain unusual clouds in the upper atmosphere; again, Spacelab 1's nights are just not dark enough. A "very-wide-field" ultraviolet camera for UV astronomical observations — again a victim of Spacelab 1's sun not being far enough below the horizon — will also be reflown late next year on Spacelab 3.

The one experiment for which no reflight has yet been found is a metric camera, designed for high-resolution photography of the earth, particularly including northern Europe. It will take nearly as many pictures as originally planned, but the anticipated cloud cover and snow have forced the selection of more southerly targets. *—J. Eberhart*