Novel process for polymer production

A new era in man-made fibers, plastics, paints and adhesives may be opening. Industry chemists this week announced a fundamentally new process for making polymers, long chains of small molecules linked together chemically. They predict the approach will allow for new types of polymers and less expensive, less polluting polymer production. The process's first application under development is an improved acrylic finish for automobiles. Other early uses are expected in production of electronic components.

The technique is the first new polymerization method to be developed since 1953, says its inventor, Owen W. Webster of E.I. du Pont de Nemours and Company in Wilmington, Del. The process uses an initiator molecule containing an activating group. A small molecule, called a monomer, inserts between the initiator and the activating group. Then another monomer joins between the first monomer and the activator. Because the activating group is thus transferred along the chain, the process is called group transfer polymerization (GTP).

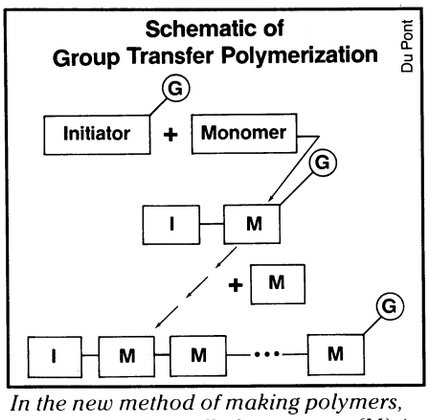
"No other method for polymerization of these monomers gives the synthetic latitude available by GTP," Webster and colleagues reported at the meeting in Washington, D.C., of the American Chemical Society. "Chain length is easy to control and you can attach functional groups that you couldn't get in by other methods," Webster says.

The Du Pont scientists call the growing chain a "living polymer" because, unless the ends are chemically inactivated, the chain continues to grow as long as monomers are available. The chemists demonstrated the "living nature" of the system by successfully adding monomers to an initiator-polymer-activating group complex that had been stored at room temperature for two days.

Specifically designed polymers can be produced by the new technique by "sequential monomer feeding." After one monomer is incorporated to the appropriate extent, and used up in the solution, a different type of monomer can be added and incorporated into the polymer.

Cost savings and reduction in pollution, as well as versatility in polymer structure, are expected from the new process, says Richard Quisenberry of Du Pont. Unlike current procedures, group transfer polymerization uses up all the monomer supplied to the system, so there is less waste of material and no monomer to be stripped out of the final product. The only thing that comes off in the end is the activating group, and that is non-toxic, the scientists say.

Another energy-saving characteristic of GTP is that the monomer is added to the system in a more concentrated solution than with other polymerization techniques. For example, in the automotive finish a 60-percent-resin solution is used instead of 20 percent. This change means that less energy, and lower temperatures, are required for evaporating the solvent, and that less solvent is released into the air. The ability to evaporate the solvent at a lower temperature will also allow more extensive use of plastics in products, such as cars, that are coated with polymers. (Currently, temperatures of about 250°F are required for drying solvents from polymerization processes.)



In the new method of making polymers, small molecules, called monomers (M), insert between an initiator (I) and its activating group (G), so that the activating group repeatedly is transferred to the last monomer of the chain.

Another innovative aspect of the technique is the use of an unusual catalyst — bifluoride ion. Fluorides have been widely used for polymer production, but this is the first report of bifluoride ion being useful in such catalysis, Webster and colleagues say. Webster says Du Pont chemist Dotse Y. Sogah made the "startling discovery" of the ion's potential when a defective moisture-proof cabinet allowed humid air to mix with fluoride ion, producing bifluoride ion, during experiments on fluoride catalysis.

So far Du Pont has concentrated its research on the class of polymers known as acrylics, but it has begun exploratory research in other areas. The company is now building a pilot plant to produce automotive finish by the new process and expects to have the finish on the market in about two years.

At the meeting in Washington, D.C., Webster and colleagues reported the details of using a chemical called methyl trimethylsilyl dimethylketene acetal (the trimethylsilyl group is the activator group) as the initiator. At room temperature they generally were able to rapidly polymerize such monomers as *alpha, beta*-unsaturated esters, ketones, nitriles and carboxamides. They conclude, "This new method offers new dimensions in the construction and design of polymer chains from these monomers."

—*J.A. Miller*

Virus-cancer cluster found in South

A generally rare human cancer called T-cell leukemia-lymphoma, which appears to be caused by a virus called the human type C retrovirus, has been found to be unduly prevalent among blacks born or raised in rural areas or small towns in the southeastern United States.

This finding comes from Douglas W. Blayney of the National Cancer Institute in Bethesda, Md., and colleagues.

The presence of the retrovirus in T-cell leukemia-lymphoma has made it the strongest contender for a virally caused human cancer to date, with Burkitt's lymphoma running second (SN: 9/9/78, p. 180). Persons in certain areas of Japan and the Caribbean basin have been found to be especially susceptible to the human type C retrovirus and to T-cell leukemia-lymphoma, implying that the virus and the cancer are endemic to these regions.

In the Aug. 26 JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION, Blayney and his co-workers report some interesting medical features pertinent to four patients with T-cell leukemia-lymphoma, their family members and healthy persons living in identical or similar geographic areas. Specifically, all four patients were black, as have been most Americans found to have this kind of cancer in the past. These findings suggest that American blacks are especially prone to this kind of cancer. All four patients had antibodies against human type C retrovirus, implying that they had been exposed to this virus. Yet none had traveled to the Caribbean or Japan, ruling out the possibility that they had acquired the virus and cancer from these regions. On the other hand, all four had been born or raised in rural areas or small towns in Georgia or Alabama, suggesting that they might have picked up the virus and cancer from these areas.

Further evidence that this was the case, in fact, came from the discovery that the apparently healthy mother of two patients, the apparently healthy brother and father of one patient and the apparently healthy wife of a patient also had antibodies against the virus in their blood, and that all five of them had also been born or raised in rural areas or small towns in the southeastern United States. (The reason why they had antibodies against the virus and no cancer may have been due to their immune systems killing the virus.) Yet more evidence that the patients had gotten the virus and cancer from rural areas or small towns in the area came from the finding that the incidence of antibodies against the virus was very low among local healthy blacks and whites in general.

Thus blacks born or raised in rural areas or small towns in the southeastern United States are "at increased risk of human T-cell leukemia-lymphoma infection,"