Sleuths on a Widening Track

Radioisotopes — nuclear sleuths — have already established themselves in industry, agriculture, medicine, biochemistry and chemistry. The ability they give researchers and engineers to see inside a body, a machine or a process without having to stop it or take it apart is attracting attention at a constantly accelerating rate.

They started slowly:

After World War II, Oak Ridge National Laboratory was the only producer of radioisotopes and there were only 86 users. Within 10 years, 90,000 shipments containing about 212,000 curies of radioactivity valued at $11 million were made to 4,000 users. By 1966 there were almost 10,000 users licensed by the Atomic Energy Commission. And now private industry has entered the production field and is supplying radioisotopes to users.

This past year has witnessed the development of radiation processing of polyethylene by exposing the long chains of molecules in the plastic to small doses of radiation from cobalt 60 isotopes. The chains are induced to cross over and bond in many places.

Still in the development stage is even more selective surface strengthening of plastics by similar cross-linking. For example, radioisotope researchers using krypton 85 recently were able to harden the thin outer surface of golf balls without in any way changing the interior of the ball.

Biggest reason for the gains, according to Joseph E. Machurek of the AEC is that industry, which was slow in putting the sleuths on its payroll, eventually recognized their versatility, economy, speed and convenience in a growing list of industrial operations and is now putting them to work in a wide variety of applications—a list which promises to grow.

"Industry is always motivated to cut costs and it is discovering that atomic sleuths are tailor-made for the cost-cutting job," the isotope specialist says. As an example, he pointed out that a few years back about 100 paper companies invested about $370,000 in radioisotope equipment. In one year they realized a net savings of $3 million.

Industry's slowness in putting isotopes on the payroll can best be explained by the lack of skilled personnel who knew how to handle the tricky little things. There was also a basic lag in knowledge of the nature of the substances.

Radioisotopes are atoms made unstable by the removal or addition of neutrons or protons in the nucleus. A few, like potassium 40, occur naturally, but most in use today are made in nuclear reactors and accelerators.

They emit alpha particles (helium nuclei), beta particles (high-energy electrons), and gamma electromagnetic radiation.

In a few instances beta radiation is used, particularly in gauging such things as paper and plastic, but more often it is the gamma radiation that is put to work.

The basic instrument in gauging and tracing is a radiation source and a detector to catch the subtle differences in radiation emitted. In radiography, a radiation source is used and the detector is a sensitive film which registers an image or shadow. In radiation processing, ionizing radiation is used to induce a change in a substance, and a wide range of food companies, for instance, are poised to leap as soon as the bugs are ironed out of radiation processing of foods for preservation or disinfestation.

For heat or power sources, radiography and chemical catalysis, long half-lives are needed so that the radioisotope need not be replaced frequently. But for tracers, those with short half-lives are usually desirable.

At least 86 of the elements found on earth can be doctored to radiate energy. Some of those commonly in use today include carbon 14, cesium 137, chromium 51, cobalt 60, iodine 131, phosphorus 32 and strontium 90.

In tracing applications, two important characteristics make radioisotopes useful; they can be identified and located even in minute quantities, and their chemical behavior is identical to that of a stable species of the same element. Applications include automotive engine wear, liquid flow and chemical batch analysis.

Petroleum companies in particular use the sleuths everywhere, from the oil well to the gasoline storage tank. In the well, the isotopes tell the oil driller what's present: in the pipelines (which are sometimes shared by several firms), they tell the pipeline tender which firm's oil is flowing and which tank to deposit the oil in. In the refinery, the tracers tell the plant engineer how effective the catalyst is for cracking the crude oil into various oil products.

By far the largest quantity of radioisotopes used in industry is in radiation processing—particularly with cobalt 60. In some plants, chemical reactions are being brought about more cheaply with the aid of radiation: production of biodegradable detergents; modification of cottons, woolens and plastics; making wood-plastic alloys; pasteurizing foods; sterilizing prepacked, discardable hypodermic syringes, among others.