TECHNOLOGY

Wood Goes Atomic

A new peaceful use for the atom is being developed that promises to bring a new age for wood and add new life to an age-old industry.

By RUBY YOSHIOKA

➤ AN ATOMIC WOOD that is better than ordinary wood has been produced with the help of gamma rays.

This new wood is a combination of wood and plastic treated usually by cobalt 60. Listed as one of the 10 top scientific advances of 1964 by SCIENCE SERVICE, the wood-plastic material was first produced under a U.S. Atomic Energy Commission contract at the University of West Virginia. The new family of wood-plastics has many potential applications in the wood products industry.

Use of the term "novawood," previously employed by AEC to describe the wood-plastic combination, was discontinued to avoid confusion with proprietary terms used in industry.

Stronger and harder than natural wood, the novel wood-plastic combination could help make wood again a leader in a field in which it has to some extent been displaced by materials such as steel, aluminum and especially plastics.

AEC Development Program

To study this aspect and to develop technology that would make the wood-plastic composite commercially feasible, AEC has sponsored a development program for the last several years. The major portion of the research for this project has been done by Dr. J. A. Kent, associate director of the Engineering Experiment Station, West Virginia University, Morgantown.

The American Novawood Company, Lynchburg, Va., and Lockheed-Georgia Company, Marietta, Ga., are the first plants that are producing the wood-plastic combination for test purposes. They are, at present, making samples available to wood processors for evaluation, primarily in product development for commercial purposes in the hopes of having the first wood-plastic products on the market before long.

What is the nature of this new material and how is it made? The process itself is fairly simple. Basically, it is the formation of giant molecules (polymers) within a wood by linking single molecules (monomers) into long chains.

These long-chain macromolecules are essentially a plastic; the kind of plastic depending upon the monomers used. Thus, a wood permeated with a plastic within its structure is created.

How is this chemical magic accomplished? By simply bombarding wood impregnated with the desired plastic-forming monomer with ionizing radiation, and stripping some of these molecules of an electron.

Ionizing radiation is a phenomenon that ejects an electron from an atom or a molecule. The monomers, thus deprived, become electrically charged and navigate within the fluid as free radicals looking for other monomers to which they can become attached.

When one of the monomer molecules, which consist mainly of carbon and hydrogen, is captured and becomes linked to the radical, an odd electron is left on one of the carbon atoms. The linked monomers now act together as a free radical and attack another monomer in the same way and a free bond is left on the newly acquired molecule. This process is repeated many times and can continue until thousands upon thousands of monomers are added one after another in a long chain. As many giant molecules of various chain lengths form, this reaction, known as polymerization, turns the liquid monomer gradually into a hard and tough polymer, or plastic.

Wood Soaked in Solution

In the actual process, the wood to be treated is cut into appropriate lengths and thicknesses and vacuum-impregnated or pressure-impregnated in a solution of suitable liquid monomer. After soaking, the saturated wood is packaged to help prevent monomer evaporation. The encased wood is then exposed to radiation, such as from a cobalt 60 source.

During the impregnation, the plastic-forming monomer penetrates the porous wood, filling the tiny spaces in the cells of the wood. When the ionizing rays of cobalt 60 hit the molecules, they become linked to each other throughout the wood, forming a network of polymer that winds around the microscopic cells and encloses them in a tight seal of hard plastic.

This plastic-reinforced wood is harder and stronger than natural wood, taking on some of the qualities of the plastic impregnated in it. It absorbs water more slowly than untreated wood and is more resistant to blows and scratches.

Polymer chemistry and ionizing radiation already have had other applications. For instance, polymer chemistry is responsible for many of the new materials we know today, such as the variety of man-made fibers, the many types of plastics materials, and numerous films and coatings, as well as rubber.

Although the final products may differ widely among polymers, all have many similar basic chemical and physical properties.

Radiation for chemical processing has been used in many areas, such as for cross-linking polyethylene film, shrinkable food wrap and medical supply sterilization.

In the present application, the radiation takes the place of the usual chemical catalyst or other activating agent ordinarily used to initiate the linking of molecules. Radiation activates the monomers themselves, so that they become the free radicals that initiate polymerization.

U.S. Atomic Energy Commission

MONOMER IMPREGNATION—A student at West Virginia University's Engineering Experiment Station places samples of wood in tubes for impregnation with a liquid monomer, the first step in the production of the wood-plastic combination. The cans above the tubes contain the monomer.

Atomic energy has thus achieved another milestone toward peaceful application, not only by producing a better wood, but perhaps providing new impetus to an age-old industry.

In addition to improved mechanical properties, wood-plastic composites retain their natural wood grain and color since the process can be accomplished at room temperature, and the cellular structure of the wood is not changed. Actually, the process enhances the wood grain, adding to its beauty.

The wood-plastic "alloy," although tough and hard, can be readily sawed, drilled, turned and sanded and gives a hard, smooth and satiny finish. It can be machined on conventional woodworking equipment.

Wood Has 'Built-in' Finish

For the housewife, this composite may have another advantage. Because the plastic extends throughout the wood, it has essentially a "built-in" finish. Therefore, if a stain or burn should occur on a piece of furniture made of the wood-plastic combination, sanding with steel wool and rebuffing might be all the refinishing that would be required.

Wood-plastic composites can also be produced in color. And the color, like the plastic, extends throughout the wood since the dye can be added to the liquid monomer during the impregnation process. Thus, the wood can have not only a built-in finish, but also a wide variety of built-in colors that would not wear off or chip as do surface paints and stains. The potentials for such a combination are enormous.

Also, the wood can be made fire-retardant by adding the proper chemical.

The treatment of wood by ionizing radiation is extremely flexible. The plastic can be picked for the particular wood that is to be used and the extent of impregnation and polymerization can be adjusted to suit the final product. Since no chemical catalyst is necessary, no foreign matter will contaminate the plastic and polymerization is more easily controlled.

Large sections and non-uniform woods can be treated rapidly with reasonable uniformity with gamma rays. Although most of the research work has been done with white and yellow pine, sugar maple, white oak and birch, almost any wood can be converted into the wood-plastic combination.

Thus, by carefully selecting the wood and finding the plastic most suited to it, woods for special purposes can be custom-made to suit the need. An unlimited horizon lies ahead for research in this field.

The plastics involved in the research by Dr. Kent have been primarily polymethylmethacrylate, polyvinylacetate and polystyrene.

Products from speakers' gavels to salad bowls are possibilities with the composite. Potential applications include door thresholds, doors of various types, mar-resistant surfaces, window sashes, hardwood flooring, flooring for trucks, paneling and a variety of other uses.

Pilot production in underway at Lockheed-Georgia Company, Dawsonville, Ga., which has produced a 325-square-foot floor of the wood-plastic composite to be installed in the Federal Science and Engineering Exhibit at the World's Fair in New York.

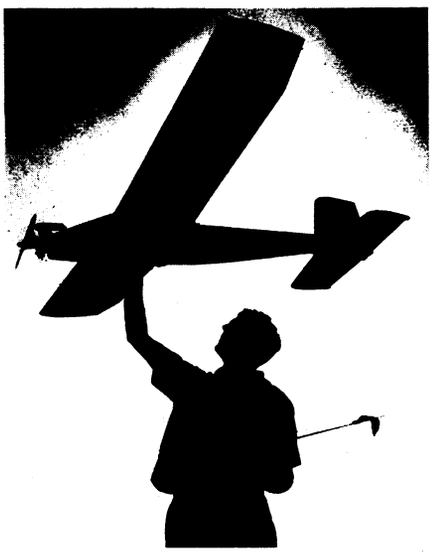
The American Novawood Corporation is also participating in the Federal Science and Engineering Exhibit. Various wood-plastic items will be exhibited including an arrow, cabinet-leg, electric switch plates, shoe heels, hammer and knife handles, parquet and strip flooring and a sculptured piece.

Other studies are being conducted. In Durham, N.C., Research Triangle Institute is conducting a materials testing program in conjunction with North Carolina State University to supplement work done at West Virginia University where AEC's primary research and development effort is centered.

AEC studies will include analysis of the potential market, locating manufacturers, determining products for which this material is suitable and estimating annual production volume.

Other companies taking part in the various aspects of the research are Vitro Engineering Company, N.Y., and AEC's Pacific Northwest Laboratory, Hanford, Wash. To identify marketing potentials Arthur D. Little, Inc., Cambridge, Mass., conducted a market survey and found six major areas of interest in the potential market: construction, furniture, industrial materials, sporting goods, toys and specialties.

• Science News Letter, 87:394 June 19, 1965



Fremont Davis

WORLD RECORD — Maynard L. Hill, seen above, tentatively established a new world record for radio controlled model aircraft by flying his eight-foot-span model a distance of 174 miles in a closed course. The previous record was 135.4 miles held by N. Malinkov of Russia. This is the third international record broken by Mr. Hill in the past two years.

TECHNOLOGY

Learn, Vote by Computer

➤ COMPUTERS accessible by telephone could both improve teaching and make voting easier, Dr. William M. Evan of the Massachusetts Institute of Technology suggested in Cambridge, Mass.

Dr. Evan took advantage of a multi-access computer at MIT recently to conduct a demonstration experiment. It could be operated over a telephone line from a separate room.

Dr. Evan circulated a questionnaire among the 70 engineers and managers in the audience and had their replies analyzed by the computer. It took the machine only 1.29 minutes to make computations that he estimated would have taken about 123 hours with a desk calculator, and he was able to present the results to his audience before the meeting ended.

The experiment suggested further possibilities to him which he discusses in an article entitled "Swift Feedback in Survey Research" in MIT's Technology Review, June 1965.

"In high school or university courses where large numbers of students are involved," he said, "the material presented by the instructor could be punctuated every 20 minutes by a test question. The students in the audience could record their answers to the question on a data input keyboard and a computer program could process the answers to inform the instructor, and perhaps also the students, as to the proportion of the answers that was correct.

"Depending on the proportion of the students answering the test questions correctly, the instructor could decide whether to proceed at the same pace, to increase or slacken his pace, or to explain again some of the material he had presented to make sure that more of the students understood it thoroughly."

Looking still farther ahead to a day when people everywhere will be able to deal with a computer the way M.I.T. researchers can now, Dr. Evan points out: "With the help of a magnetic card—now being developed for economic transactions—which could be inserted into a special telephone set and which a computer program would recognize if it bore a legitimate number, every registered voter could vote in his own home without worrying about the weather."

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Do You Know?

The irridescent coloring of the *hummingbird* is produced not by pigmentation but by "interference phenomena," like the rainbow effect of a soap bubble or drop of oil on a wet pavement.

New *grapefruit* juice powder may aid the expansion of grapefruit industries.

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