TECHNOLOGY

Riches From Sugar Cane

Bagasse is what is left when sugar is extracted from cane. Valuable as a raw material for paper and wall board, its chemicals help make dynamite and other industrial products.

By WATSON DAVIS

➤ IT TAKES almost 50 billion pounds of cane sugar to help satisfy the world's sweet tooth. Thousands upon thousands of acres of tropical and semi-tropical land are planted each year to sugar cane in various parts of the world.

Half of this great crop used to be waste. The stalks of the cane, when squeezed dry of their sweet burden, were burned or left to rot.

But now what was once almost a nuisance is proving to be a source of riches. Tons upon tons of cane residue, called bagasse, are being used industrially for a variety of astounding products. The supply of bagasse is immense. For every pound of sugar produced, there is about a pound of bagasse available.

Wall board was the first large-scale product made from bagasse. Tests have shown that sugar cane waste can be used as raw material for paper for newspapers, and even more finished papers, replacing spruce and other woods.

However, in addition to the strong fibers and absorbent pith of bagasse, there are in it valuable chemical substances that are a challenge to the industrial chemist. Already a variety of products ranging from filler for dynamite to plastic for phonograph records have been produced.

The U. S. Department of Agriculture estimates that in 1951, 24,079,000 short tons of cane sugar were produced around the world. (One short ton equals 2,000 pounds.)

Sugar Now Primary Product

That year in the continental United States, some 419,000 tons of cane sugar were produced, mostly in Louisiana and Florida. The U. S. and dependencies — Hawaii, Puerto Rico and the Virgin Islands—together produced 2,811,000 tons of cane sugar in 1951.

This astounding quantity of cane sugar—almost 50 billion pounds in a single year throughout the world—all comes from the sweet juices stored in the pithy interior of sugar cane. When it is ripened in the warm sun of the lower latitudes and its pith is turgid from sugar-laden juices, the cane is cut close to the ground, collected and hauled to a processing station. There the cane is ground to squeeze out the juices, which are then collected and carried away for further processing into crystalline sugar.

There remains after extraction of the juices a tremendous quantity of ground-up cane—fiber and pith—as a by-product. When excess moisture is removed by drying, this cane residue, called bagasse, weighs about the same or somewhat more than the sugar extracted from the whole cane. "Bone-dry" bagasse on hand throughout the world from cane sugar production in 1951 has been estimated at 24,793,000 tons.

In the continental United States, some 615,000 tons of bone-dry bagasse resulted from the 1951 cane crop, while the figure was 3,127,000 tons for the U. S. and dependencies together. Cuba, the chief source of sugar for the United States, produced 7,964,000 tons of raw cane sugar in 1951, with an estimated 8,000,000 tons of bagasse as by-product.

The spectacle of such massive amounts of potentially valuable raw material, with its strong fibers, absorbent pith, composed of valuable chemical substances, has been a source of hope for increased revenue for the sugar producer and processer.

While the major tonnage of bagasse today still is used only to stoke the furnaces of sugar plants, more and more of it is being used in bold manufacutring ventures.

Two principal kinds of tissue make up the bagasse—hard, strong fibers that form the outer covering and support of the cane, and the soft inner pith.

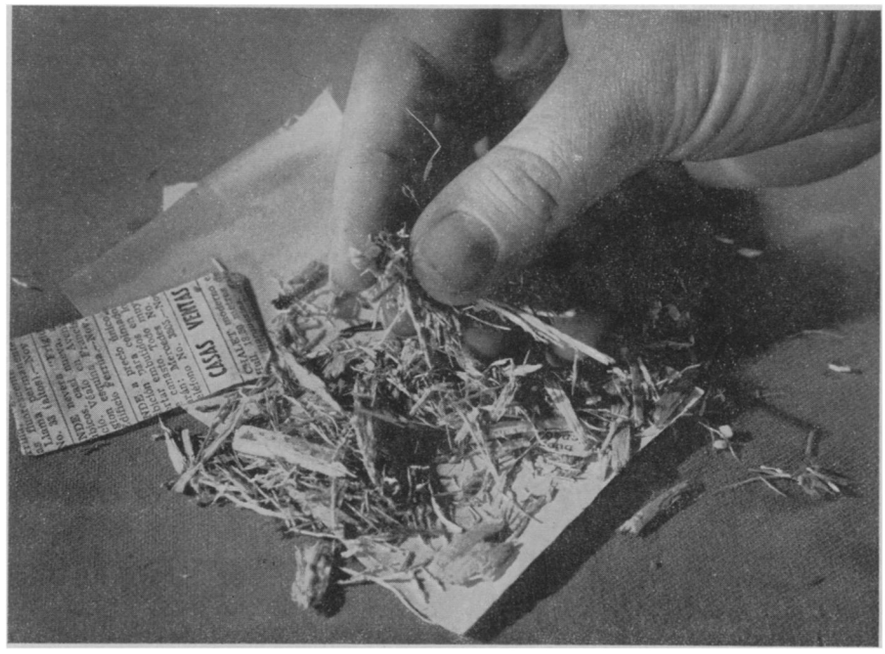
The pith, or parenchyma, represents the broken walls of the living cells in which the sugar-laden juices were stored. Chemically, the pith is made up very similarly to the fiber portion of bagasse, but the pith lacks a fibrous structure and strength.

The sturdy bagasse fibers have been found excellent for the manufacture of many kinds of paper and wall board, and in some paper-making processes the pith need not be removed. But for many purposes, pith must be separated from fiber for the best product.

In the manufacture of crystalline sugar from cane juices, there is left a residue of thick, sweet, dark-colored liquid—"black strap" molasses, or treacle. This by-product, in terms of nutritional value, makes an excellent supplementary feed for livestock, but it is difficult to ship and although animals like it, it is not easy to feed in liquid form. It is used to make cattle eat unpalatable feeds.

Bagasse has about the same food qualities as fair grade prairie hay, but it becomes palatable when it is soaked in blackstrap molasses. Cattle feed is made using ground whole bagasse, blackstrap and urea slightly dried. This gives a solid, easily-transportable supplementary feed that is relished by livestock.

Bagasse, with its long, strong fibers, its ready availability and its comparatively low



THIS IS BAGASSE—The skeletal material of sugar cane, which promises to be an important raw material for newsprint and chemicals in the future, is shown in this photograph.

cost, has long been eyed as an excellent and logical source of raw material for the manufacture of paper. One proposed process for making paper from bagasse dates back to 1838, and the Baltimore Advocate was printed on bagasse paper in 1856.

Since 1938, commercial ventures in the production of bagasse paper-making material have been successfully undertaken in England, Formosa, the Philippines, Peru, Argentina, Colombia, Brazil and India. Research is going on in the Dominican Republic at present towards bagasse paper production. In the United States, the Valite Corporation in Louisiana, when it gets into full production, is expected to turn out 50 tons of newsprint a day; limited production is already under way there.

Wall Board Industry Oldest

Approximately 2,000,000 square feet of insulating and wall board products are manufactured from bagasse every day in the continental United States. This represents the oldest successful and profitable industrial utilization of bagasse in this country. One concern, the Celotex Corporation, has been manufacturing insulating and wall board from bagasse as building materials for over thirty years. Similar building materials have been made in Hawaii, Australia, Cuba, England and Formosa.

In the production of board, bagasse is cooked in water or dilute chemicals to soften the fibers and make them more flexible. The treated fibers are cut into the desired length and thickness, suspended in water, then felted continuously into a thick mat. The wet mat is rolled through a press that squeezes out excess water.

If insulating board is to be made, the pressed sheet of matted fibers is dried out in a tunnel drier, so that air spaces run through the maze of fibers to furnish insulation. To make hardboard products, the matted fibers are packed hard together between heated plates of a hydraulic press. At present, this use of bagasse as boarding accounts for the major part of bagasse used industrially in the United States.

Fine particles of pith separated from bagasse in the production of pith-free fiber are used as a filler in low-density, permissible-dynamite explosives. Preferable to wood flour, bagasse pith has become a standard material for this task.

On the farm and garden, macerated bagasse has found wide application as chicken litter and limited use as a mulch material.

Bagasse is more than an ideal source of useful fiber. It is a natural source of certain chemicals used in the manufacture of industrial resins. These chemicals—formaldehyde, furfuraldehyde and various ketones—react with phenols and similar chemicals to make resins, important elements of the plastics industry.

Much of the original research on using bagasse, and other fibrous material such as corn stalks, as a source of plastic materials was done by scientists of the U. S. Department of Agriculture. The first practical commercial plastic molding compound was produced in 1941 by the Valite Corporation, two years after that company started out on the basis of the Agriculture Department's discoveries. The firm has since developed scores of resin products for bagasse.

Under the basic Valite process, means have been found to decompose bagasse into constituent chemicals while reacting them simultaneously with phenol, under heat and pressure. In the course of a very few minutes, there results from this mixture the formation of resins of a plastic type.

Two Kinds of Resin

In a typical case, bagasse and necessary chemical reagents are placed into a large, revolving pressure cooker, where digestion of the bagasse begins under high pressure. Soon the contents of the pressure cooker change into a black, resinous, sticky mass, bearing no resemblance to bagasse.

Digestion is continued for different lengths of time, depending on the type of final product desired. The resulting resin is treated further after removal from the pressure cooker to make it thermoplastic or thermosetting.

After this treatment, the resin is poured onto large, slowly revolving steel drums where it hardens into a brittle layer. Sharp knife-like blades chip the hardened resin off in the form of black flakes.

These are flakes of a thermoplastic resin. Under heat and pressure, thermoplastic resins can be melted and reformed into almost any shape desired. Much is used for the making of phonograph records.

Bagasse resins were first developed for use in records during World War II, when the usual shellac constituent became almost impossible to obtain. Since then, bagasse resins have become a staple material in the manufacture of a large percentage of records.

The possibilities of bagasse-derived products will increase with research. One day sugar cane may be grown primarily for bagasse, with sugar the "by-product."

Science Service has prepared a kit containing specimens of sugar cane bagasse, resin flakes, bagasse newsprint and a sample of a newspaper printed on bagasse newsprint. There are also samples of thermosetting resin and thermoplastic resin. The Sugar Cane Bagasse kits are available at 75 cents each at Science Service, 1719 N St., N.W., Washington 6, D. C.