CHEMISTRY

A New Kingdom From Sawdust

By process introduced in the U. S. by an anti-Nazi German businessman, sawmill wastes can be converted into millions of gallons of war-essential alcohol.

By HOLMAN HARVEY

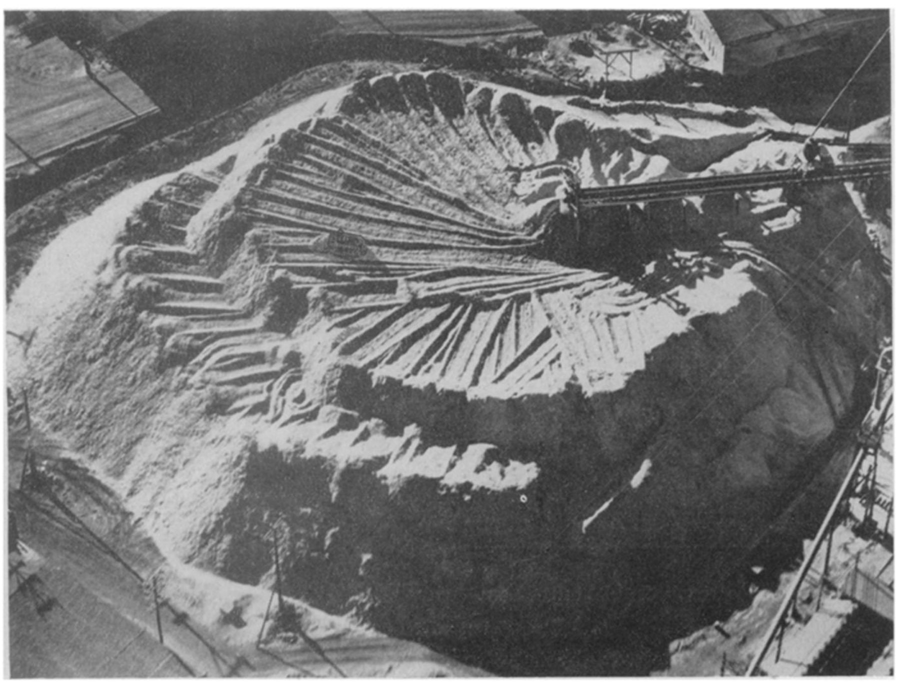
➤ NOT LONG ago, Allied production chiefs were pacing the floor, worried over a tough problem. To have plenty of smokeless powder and rubber they needed huge quantities of alcohol. But the production of this alcohol involved the use of vast amounts of grain. And they had already dipped into the world grain bin with such a heavy hand that in America alone all the wheat, corn, barley and rye grown on 10,000,000 acres were going into alcohol distilleries.

From this uneasy future the production chiefs have now been delivered by American chemists, aided unconsciously by a Nazi scientist and, very consciously, by an anti-Nazi German businessman who managed to get out of Germany with only his shirt and some very important knowledge. The Allies can now get alcohol easily and economically from sawdust, of which there is an unlimited supply.

The experiments that brought sawdust from its age-old obscurity took place on the 13th of last July, when a dozen eminent chemists assembled in a small pilot plant at Marquette, Mich. The demonstration had been arranged by Dr. J. Alfred Hall, principal biochemist of the U. S. Forest Service, acting at the request of the Chemical Referee Board—the government's supreme court in war chemistry. The Forest Products Laboratory at Madison, Wis., provided a crew of chemists to supervise the operations.

Eight hours after the observers had assembled, 500 pounds of ordinary sawdust had been converted before their eyes into 250 pounds of sugar. The demonstrators didn't bother to convert the sugar into alcohol. It would be mere routine to ferment and distill it, producing 12½ gallons of 190-proof "grain" alcohol in 24 hours.

Translating these pilot-plant figures into terms of tons, you have: Out of one ton of sawdust, a half-ton of sugar; out of the half-ton of sugar, 50 gallons of ethyl alcohol. (This alcohol, though made from wood, is not the poisonous methyl alcohol that is commonly known as "wood alcohol," which is of relatively limited usefulness.)



MOUNTAIN OF WASTE—There are some 20,000 tons of sawdust in this pile at a lumber company in Westwood, Calif. From this amount of sawdust 10,000 tons of wood sugar can be made, which will yield a million gallons of industrial alcohol. The little dark patch just left of center is a man in a bulldozer pushing the sawdust out to the edges.

Pilot Plant Hummed

Day and night for three months after that eventful demonstration the little pilot plant hummed. Truckloads of sawdust from all of the leading lumber areas of the United States were brought in and tested. No "bugs" developed. The average sugar yield was even above expectations. It was found that the softwoods — the cone-bearing evergreens, which total 75% of all American trees —produced 50 to 60 gallons of alcohol to every ton of waste. The hardwoods, or broadleafed trees, gave only 30 to 40 gallons a ton, and therefore will not be used.

There was nothing novel in demonstrating that wood can be made to yield sugar by the application of dilute sulfuric acid under the proper conditions. What the Marquette demonstration proved was that by a German process twice as much sugar can be obtained, at less cost, with simpler equipment, and in less time, than had been possible through any American process. No American process, indeed, had ever been commercially practicable.

Improved Process

The Marquette chemists went on to improve on the German process. What it had taken the German chemists 18 hours to do, the Americans finally accomplished in six hours.

To wage the war during 1944, the United States will need the staggering total of 640,000,000 gallons of ethyl alcohol, which is about five times our usual consumption. Of this, 330,000,000 gallons are earmarked for synthetic rubber. Vast quantities are needed for making explosives, medical supplies, plastics, synethetic textiles. Tens of millions of gallons are going to the United Kingdom and Russia.

To meet these urgent needs, only 590,000,000 gallons are in sight from present production—a shortage of 50,000,000 gallons.

Tons of Waste

Meanwhile, at the great saw-mill centers of the country, millions upon millions of tons of sawdust burn away in vast pyres. This year our lumber mills will produce 30,000,000 tons of waste. From 12,800,000 tons of it we could obtain all our estimated 1944 military and civilian requirements of alcohol.

Forest Service experts have already approved sites for a frontline battery of 30 conversion plants, with a combined annual alcohol capacity of 150,000,000 gallons. The sites are alongside the great sawdust piles in the Pacific Northwest and the South. At each of these 30 locations, an average of 100,000 tons of wood waste a year is immediately available. The initial plant is to be erected in the heart of Oregon's great Douglas Fir milling area.

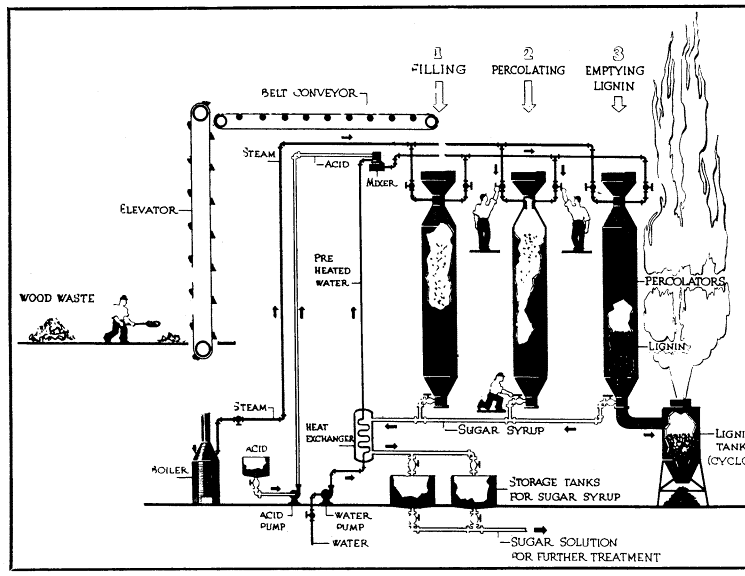
Cost of 30 Plants

The cost of the 30 plants is estimated at $90,000,000. Operating costs are reduced by using 25% of the waste itself as plant fuel, converting 75%. On a reasonable basis of amortization (10 to 15 years), alcohol could be produced to sell at from 20 to 25 cents a gallon.

For the most part our pre-war industrial alcohol was made from West Indian black-strap molasses and sold for 18 to 25 cents a gallon. The U-boats cut this source of supply—forcing the use of grain. Even with the passing of the U-boat menace the shortage persisted, because the Caribbean countries have begun to process this molasses into rum and gin.

Events Started in 1942

The events which have suddenly catapulted sawdust, an economic waif, into the national spotlight started one afternoon in November, 1942, when a stranger walked into Dr. Hall's office in the Forest Service in Washington. His name was Erwin M. Schaefer. He told Dr. Hall a strange story. In the late '20's a German chemist named Heinrich Scholler had discovered a new process for the rapid conversion of wood waste. To utilize the process, a large chemical concern, *Brennerei und Chemische Werke Tornesch,* erected a wood-sugar plant at Tornesch, near Hamburg. Schaefer was the proprietor of that



HOW IT WORKS—This diagram illustrates how wood waste can be converted into sugar solution, from which alcohol is made, and the by-product, lignin.

plant—until, in 1938, the Nazis took it over. Schaefer and other officials were marched away to a concentration camp. Scholler, an ardent Nazi, had turned informer against his associates.

The Nazis let Schaefer out of the concentration camp after a while, and he left Germany. He had been a millionaire, but when he crossed the border his entire fortune was in his pocket: the $250 permitted travelers by Nazi regulations.

Arrived in America

In 1941, after much hardship he arrived in America, determined to place his knowledge of large-scale wood-sugar production at the service of the United States. For over a year he knocked on doors, seeking an audience. But he was an enemy alien, speaking broken English, and he met only incredulity and indifference until he talked with Dr. Hall.

Hall plunged into a study of the Scholler process. The country was now at war. Scholler's 12 patents, which had long since been registered in the United States, had been taken over, along with all other German patents, by the U. S. Alien Property Custodian. Hall dug them out.

For months the two men worked together. Then Hall, with his evidence finally in hand, presented the case to the Chemical Referee Board. The Board ordered the tests at Marquette.

In making sugar and alcohol from sawdust there is an interesting and important by-product. The residue from a ton of sawdust, after it is converted into sugar, is 500 pounds of lignin, a substance that acts in the living tree as a binder for the cellulose cells. Lignin is rich in natural resins and already has been used as a raw material for numerous plastics. Compressed into briquettes, it burns with the same caloric yield as good anthracite coal, and burns without ash. Experimentally it has been used as an "extender" in rubber, as a low-cost soil improver, and in building material. A laboratory devoted to further research into its possibilities has been set up by the lumber industry in Washington, D. C.

Finland's Wood Waste

Heavily forested Finland uses its wood waste to make celluloid, artificial silk, lacquers, unbreakable glass, photographic film and numerous other products. The improved American process is expected to open up similar industrial vistas for the U. S. after the war.

Will you wake up some morning to find sugar made of wood on your breakfast table? The answer seems to be, No. It has three quarters the sweetness of table sugar and is quite nutritious, but it cannot compete in cost with cane or beet sugar.

Science News Letter, April 1, 1944

Latin American *rubber* totalling 22,380 tons was imported into the U. S. in 1943.