

through which water may be passed, washing out the sugar in the wood which is the result of treatment in the digester by the sulphurous acid gas. Next comes the neutralizing vat or vats in which various acids in the solution are removed or neutralized by the addition of carbonate of lime. Then comes the fermenting process and then the still room. The fermentation and distillation are precisely the same as in an ordinary distillery.

The process, as briefly described, is thoroughly to mix the sawdust with the sulphurous acid gas and water so that all parts of it are penetrated by the gas, thus converting a portion of the cellulose into sugar. This sugar, of which about 85 per cent. is fermentable, remains in the sawdust. This sawdust is then introduced into the exhaustion tanks where the water passes through them, the method being just like the making of drip coffee. The water simply passes through the sawdust, washing out the sugar.

The digester or boiler in which the wood is first treated is a revolving drum of iron, lined with lead to resist the action of the acids, then surrounded with a steam jacket by which it is heated. This drum is nearly filled with sawdust—in the experimental plant about 400 pounds being a charge. Into this is put about one-third of its weight of the acid solution. Then steam is turned on to the jacket and the drum is set revolving slowly so as thoroughly to mix the contents. The steam in the outside jacket heats the sawdust and the contents of the digester to a temperature of about 295 degrees Fahrenheit. This heat drives the gas out of the water into the wood and converts the cellulose into sugar. The gas penetrating the pores of wood and acting directly upon the cellulose. The pressure inside the digester, caused by the expansion of the gas, is 100 pounds or more to the square inch. This process takes three hours.

The sulphurous acid gas and steam are then blown off from the cylinder into absorbing tanks in the acid room, thus saving 75 to 80 per cent. of the gas, which is then ready to be used again. The digester and the surrounding steam jacket having been blown off, the cover is removed and the digester emptied of its contents, which now resembles brown coffee more closely than anything else. This material contains the wood fibre and the converted cellulose, now sugar, and various other separated and partially separated products produced by the action of the acid and the heat upon the wood. The process is not carried as far as in pulp making, to which it is somewhat similar, the object being to carry it only far enough to convert as much as practicable of the cellulose into sugar and to stop short of the point where the sugar by reversion would be destroyed.

The exhaustion battery—so called in which the sugar is washed out of the sawdust, contains ten tubs or vats, in this case of 36-gallon contents each. Here it might be said that in the commercial plant it is proposed to treat a long ton of dry sawdust at one time and there may be as many digesters and sets of exhaustion batteries as is necessary to handle the available supply of sawdust or other finely divided wood.

These vats are so connected by pipes and valves with each other and with the pump that the contents of any one tub can be pumped into another. The princi-

ple of working is to bring the fresh sawdust in contact with the solution already containing sugar in order to make a solution as strong as possible, and on the other hand to treat the nearly exhausted sawdust with pure water in order to complete the washing out of sugar. This is a continuous process, that is to say, when the contents of a vat has been treated with ten washings it is emptied out and refilled with fresh sawdust. Before emptying its charge it receives fresh water, and after refilling it receives the strongest solution.

The result of this process is a sugar solution which contains 450 to 500 pounds of sugar from a long ton of dry sawdust. This sugar is of two sorts, one of which is pentose, non-fermentable, the other part, amounting to 70 to 80 per cent., being capable of alcoholic fermentation when treated with yeast.

This solution from the exhaustion battery is pumped into a receiving tank, where it is neutralized with carbonate of lime, which is necessary to prevent the acid from killing the yeast to be added for the purpose of fermentation.

From this neutralizing tank the solution is pumped

than 25 gallons of absolute or 50 gallons of proof alcohol to the ton. This product is enough to secure the entire approval of both scientific and practical men who are familiar with the manufacture of grain alcohol and the marketing of the same, and who state that nothing more is necessary to insure profitability under the process, provided, of course, sawdust can be bought cheaper than corn on the basis of the alcohol output from each.

LOCATION IN RELATION TO SAW MILL.

The ideal location of such a plant is alongside a saw mill of large capacity with a considerable life ahead of it guaranteed by timber supplies. This location should not be in a large city where there is a good market at present existing for mill refuse, though a Classen distillery could compete for the output of saw mill waste under ordinary market conditions. In a mill which uses the greater part of its sawdust product for fuel a change would have to be made in this particular. In such cases automatic furnace feeders are used and perhaps the hog would have to be brought into requisition to supply chips to take the place of the sawdust.

The cost of plant is not heavy considering the value of its output, and with such practical results from an experimental plant a properly designed equipped and built plant on a large scale should effect economies in labor expense and should increase the output per ton.

There is claimed to be absolutely no question as to the scientific practicability of this method of producing grain or ethyl alcohol from wood, and there is no question, furthermore, of its commercial practicability, as demonstrated by the plant already in operation.

VALUE AND USE OF THE TAILINGS.

A further consideration is as to what can be done with the exhaust sawdust and what its value is. In the various processes through which it is put

it contracts in volume from 25 to 33 per cent., but, volume considered, its fuel value is apparently not changed. About one-fourth of the cellulose is removed and other properties taken out have no fuel value. Consequently, if the sawdust is still needed as a fuel it can, after treatment, be turned back to the mill and burned under the boilers as originally intended; but the residue remains unchanged and practically undiminished, the qualities which make it available for dry distillation.

The treatment of heat and acid has left it dead, inert, without apparent vitality or elasticity; consequently it can be pressed into briquettes without the use of an agglutinant or binder. A great deal has been heard lately of the manufacture of briquettes from sawdust, but invariably this process requires the use of resin, or tar, or something else, as a binder in order to hold them together. This is not necessary with sawdust after being treated with the Classen process.

These briquettes can be readily converted into a high grade of charcoal. If the process is carried on in retorts the by-products of the process can be preserved in the shape of wood alcohol, acetate of lime, wood tar, etc. The charcoal produced is of an unusually high character, both because of the purity of the material used and the uniform size of the briquettes, which make carbonization uniform.

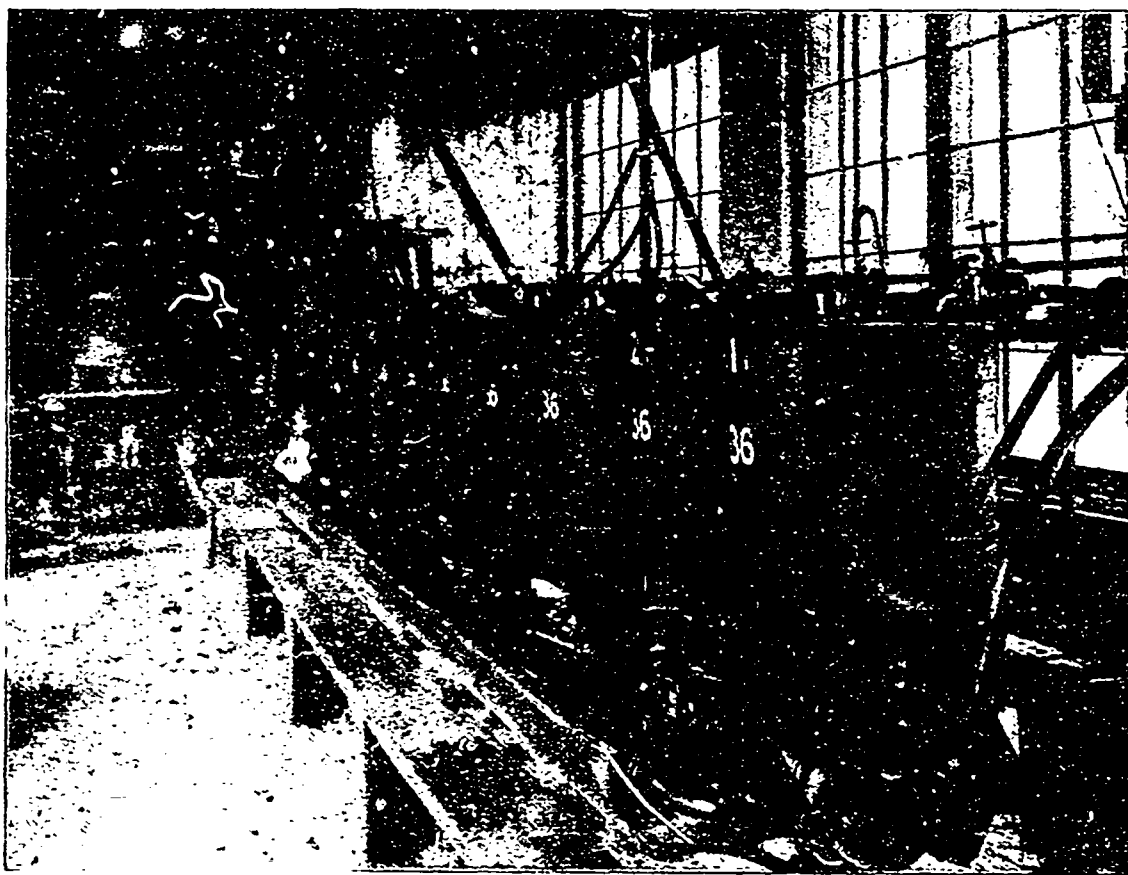


FIG. 2.—EXHAUSTION BATTERY FOR EXTRACTING SUGAR FROM SAWDUST.

into the fermenting vats and is now called "mash." Then yeast is added to the solution, which is held at the proper temperature, and in a very short time fermentation begins. When it is completed, the product passes to the still room, a view of which is given, which is equipped with still, condenser, etc., this part of the process being in no wise different from that ordinarily used in distilleries.

The result is about 50 gallons of proof alcohol or 25 gallons of absolute alcohol from a long ton of sawdust.

This plant was for three months under the oversight of J. H. Long, professor of chemistry in the medical school of Northwestern University, Chicago, and President of the American Chemical Association. This gentleman spent about one month in personal management of the plant, of which he was given complete charge, and the remainder of the three months it was under his control through an assistant. The report of Prof. Long was a strong recommendation of the process.

It should be said that something over 24 gallons of absolute alcohol have been secured from a ton of sawdust up to this date, but that improvement in the output has been so constant that it is believed that with the further development and improvement of the system probably 30 gallons and perhaps more can be secured; but the company is making no claims as yet of more