ALCOHOL FROM SAWDUST.

BY OUR BERLIN CORRESPONDENT.

A highly-promising process for utilizing saw-mill refuse has been developed by Prof. Alexander Classen, of the Aix-la-Chapelle Technical High School, in Germany. As the tests made in an experimental plant have given satisfactory results, an industrial plant where alcohol is produced from sawdust on a large scale has recently been erected in this country.

The production of glucose or sugar from cellulose, and its eventual conversion into alcohol, is a process by no means novel. In fact, this was done by Mr. Braconnet as early as 1819, by treating the cellulose with heated sulphuric acid. The sulphuric acid, however, being a liquid, could not be removed from the resulting solution without great difficulty, and only at an expense which rendered the process impracticable for industrial purposes.

Prof. Classen conceived the idea of using, in the place of the liquid sulphuric acid, gaseous sulphurous acid, as this will readily escape on the application of moderate heat, thereby leaving the treated wood practically free from any substances liable to prevent fermentation of the sugar therein. A plant for the manufacture of alcohol from sawdust includes an acid apparatus, in which the necessary solution of the sulphurous acid gas in water is made, and where the gas when escaping from the boiler or digester is reabsorbed in the water, and thereby saved for further utilization; a revolving boiler or digester similar in construction to those used in making chemical pulp; an exhausting battery, consisting of a series of tanks through which water may be passed, and in which the sugar that has been produced in the digester by the sulphurous acid gas may be washed out; neutralizing vats, in which the various acids in the solution are removed or neutralized by the addition of carbonate of lime; and finally, fermenting and still rooms, where the process is completed exactly as carried out in an ordinary distillery.

The sawdust is thoroughly mixed with the sulphurous acid gas and water, thus converting a portion of the cellulose into sugar. This sugar, of which about 85 per cent is fermentable, remains in the sawdust, which is then introduced into the exhaustion tank. Here the sugar is simply washed out.

The digester or boiler in which the wood is first treated consists of a revolving drum of iron, lined with lead to resist the action of the acid, and surrounded with a steam jacket, by means of which it is heated. This drum is nearly filled with sawdust. In the experimental plant one charge consisted of about 400 pounds of the material. To this is added a weight of the acid solution equal to about one-third of that of the sawdust. The steam is turned into the jacket and the drum set to revolving slowly, in order thoroughly to mix the contents. The steam in the outside jacket heats the contents of the digester to a temperature of approximately 295 deg. F. The gas is driven out of the water into the wood, so that it is caused to act directly on the cellulose, converting it into sugar. The pressure inside the digester, due to the expansion of the gas, rises to 100 pounds or more to the square inch. This part of the process lasts three hours.

The sulphurous acid gas and steam are then blown off from the cylinder into absorbing tanks in the acid room, where 75 to 80 per cent of the gas is saved, and may be used again. The digester and the surrounding steam jacket having been blown off, the cover is removed, and the digester is emptied of its contents, which now resemble ground coffee. This material contains the wood fibers and the converted cellulose, now sugar, and various other separated or partially separated products produced by the action of the acid and the heat on the wood. The process is not carried out as far as it is in pulp making, to which it bears some similarity. The object is to convert only as much of the cellulose into sugar as is practicable, and to bring the process to a stop short of a point where the sugar would be destroyed by a reversion.

The digester shown, while a somewhat crude arrangement mechanically, contains all the essential connections and accessories. The gages are used for recording the steam pressure in the jacket and the pressure on the inside of the drum, and the temperature of the same. There are pipes for introducing the gas and the steam, and blow-off pipes for the same.

In the experimental plant the exhaustion battery, as the outfit for washing the sugar from the sawdust is called, contains ten tubs or vats capable of holding 36 gallons each. It may be said here that in the commercial plant, it is proposed to handle a long ton of dry sawdust at a time, and the digesters and exhaustion batteries will be proportioned according to this supply of sawdust or other finely-divided wood. Sawdust is considered the best material, but particles of wood up to a quarter of an inch cube, or a quarter of an inch thickness, if in chip shape, appear to be treated as successfully as the former. Each of the tubs in the exhaustion battery in a plant of commercial size would be enlarged to agree with the increased size of the digester. They will be of a different shape from those shown in the illustration, being higher and smaller in diameter in proportion to their height. It is now thought that this should be about nine feet, the diameter five.

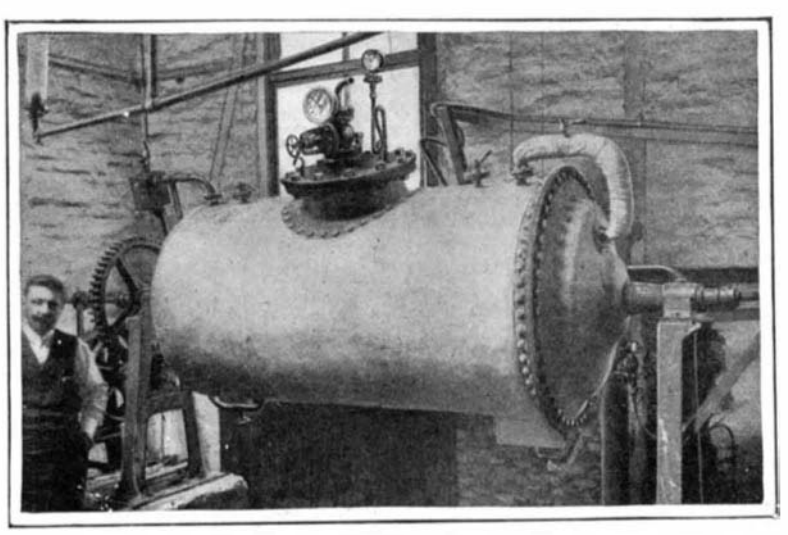
These vats are so connected by pipes and valves with each other and with the pump, that the contents of any one tub can be emptied into any other. The principle of this part of the process is to bring the sawdust in contact with the solution already containing sugar, in order to make the solution as strong as possible, and further, to treat the nearly exhausted sawdust with pure water in order to complete the washing thoroughly. The process is continuous, and when the contents of a vat has been treated with ten washings, it is emptied out and refilled with fresh sawdust. Just before emptying, its charge receives fresh water, and after refilling, receives the strong sugar solution.

The result of this process is a solution which contains 450 to 500 pounds of sugar from a long ton of dry sawdust. This sugar is of two kinds, pentose, which is non-fermentable, and the other, amounting to 70 to 80 per cent, capable of alcoholic fermentation when treated with yeast. The solution from the exhaustion battery is pumped into a receiving tank, where it is neutralized with carbonated lime. This is necessary to prevent the acids, either the remains of the sulphurous acid, or certain acids derived from the wood itself, from killing the yeast which is later added for the purpose of fermentation.

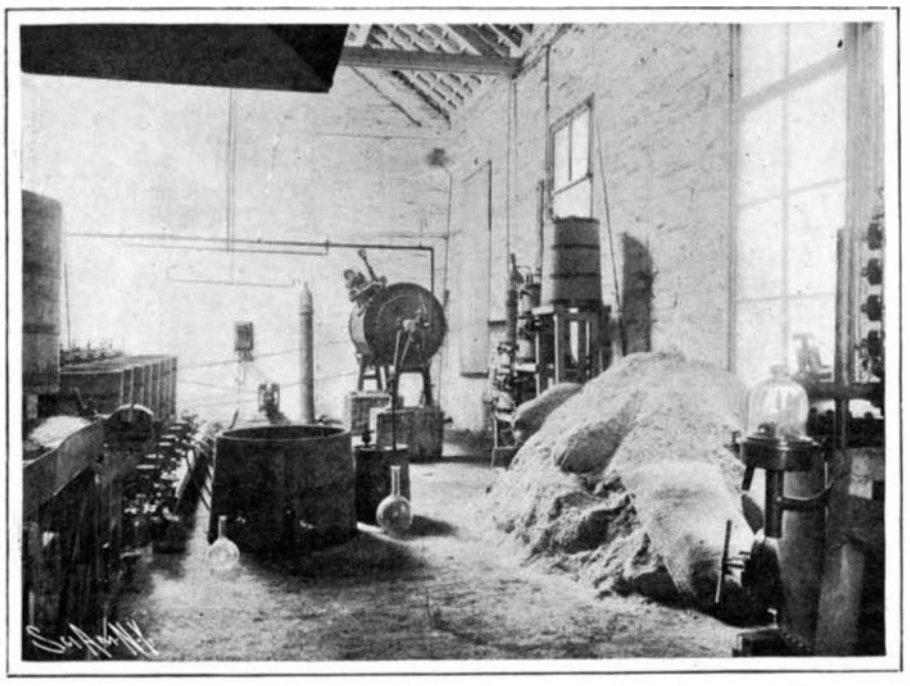
From this neutralizing tank, the solution is pumped into a fermenting vat. To the solution, now called "mash," yeast is added. It is kept constant at the proper temperature, and fermentation commences in a very short time. When it is completed, the product passes to the still room, equipped with still condensers, etc., as shown in the illustration. As aforesaid, this part of the process is in no wise different from that ordinarily used in distilleries. The result is about 50 gallons of crude alcohol or 25 gallons of absolute alcohol from a long ton of sawdust.

The improvement in the output has been so constant that it is believed that in time the further development of the system will enable the manufacturer to obtain 30 gallons, and perhaps more, from a ton of sawdust; but the results obtained so far are quite sufficient to secure the entire approval of scientists and of practical men who are familiar with the manufacture and marketing of grain alcohol. Comparing the original cost of sawdust with that of grain, and the output of alcohol from the former with that from the latter, it seems that the new process is destined in time entirely to supersede the older one.

One of the most important features of the process is the utilization of the sawdust after leaving the exhaustion battery. While passing through the various stages of the process it contracts in volume from 25 to 33 per cent, while volume for volume its fuel value is apparently unchanged. As a matter of fact, apart from the cellulose which is removed, no other component having a fuel value has been taken out. If it is desired to use the sawdust as a fuel, it can accordingly be turned back to the mill and burned under the boilers after treatment, thus retaining the original intention. The residue, however, retains unchanged and practically undiminished in quantity such components as make it available for dry distillation. The treatment by heat and acid has left it dead and without apparent elasticity. It can consequently be pressed into briquettes without the use of a binder, and this in itself is an exceedingly valuable property.



Digester for Converting Sawdust (Cellulose) Into Glucose (Sugar).



The stills and apparatus for preparing sulphurous acid are seen at the right.

General View of the Aix-la-Chapelle Plant.

At the right: Exhauster for extracting sugar formed in digester. At the left: Alcohol stills.

The Aix-la-Chapelle Experimental Plant.

PRODUCTION OF ALCOHOL FROM SAWDUST.

The first award of the John Fritz medal, which was established by the professional associates and friends of John Fritz, of Bethlehem, Pa., on August 21, 1902, his eightieth birthday, to perpetuate the memory of his achievements in industrial progress, has been to Lord Kelvin.