PLANT CONTROL OF THE ENGINEERING OPERATIONS
AT THE
CALVERT DISTILLERIES, RELAY, MARYLAND

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I. SUMMARY.

The completely modern distillery of the Calvert Company at Relay, Maryland was designed to facilitate operation by the use of central control stations. Liberal use of automatic recorders and regulators mechanizes process control to a highly efficient degree.

The production of alcohol by bacteriological processes requires a careful and systematic regulation which can only be maintained by complete chemical knowledge of conditions or reaction determined from tests and analysis. For this reason, the Calvert plant employs a staff of trained technicians to keep constant check on the chemical processes of the production.

The transformation of grain into alcohol involves the conversion of the grain starch to sugar and fermentation of the sugar into alcohol and carbon dioxide by the action of yeast. These reactions require careful regulation of temperatures and pressures to give maximum yields.

All raw materials, as they arrive at the plant, must be tested for quality and to meet certain standards before their use in production is permitted.

In the main process, samples are withdrawn for test at every point where it is advantageous to know the condition of the product. The preparation of fusel oil and cattle feed require observation as well.

The process of aging and blending the liquors is carried out under the supervision of the plant chemists. Careful tests
for quality control aid in the production of a uniform product.

The up-to-date equipment used and careful maintenance of control make the Calvert Distilleries one of the most modern plants in the world.
II. INTRODUCTION.

Careful and systematic control of the plant operations at the Calvert Distilleries of Relay, Maryland has been established to insure the production of a whiskey of uniform quality. The completely modern plant, situated on the Washington-Baltimore Boulevard in the valley of the Patapaco River, has adequate and up-to-date facilities for careful testing and control of the entire process from examination of the raw materials as they are received at the plant to the testing of the final product as it leaves the blending department. The plant makes liberal use of automatic recorders and regulators for complete control of all operations involved in the production of spirits of grain and the by-products, fusel oil and feed for live stock.

Obviously production of any material for human consumption requires close supervision of the purity of starting materials and careful control throughout the entire process to prevent possible contamination. In addition to the control of quality, a knowledge of the condition of the product at each stage of production is vital before proceeding to the next step. Adjustment of the operating conditions to those that have been found by experience to be superior is necessary if the plant is to operate at maximum efficiency and at the same time produce a quality product. With this thought in mind, the Calvert plant was designed to mechanize control of the engineering operations by bringing together the means of adjustment and the instrument readings on central control.
boards for each individual unit. This enables the operator to have before him all the necessary data showing the conditions of the process, and, by remote control, a way to make corrections. The operations involved in the production of distilled spirits are of the nature that require constant coordination of temperatures and pressures for optimum conditions of production.

Briefly, the production of alcohol by fermentation is a bacteriological process in which the natural starch occurring in varied types of grain is converted to sugar by the action of diastase present in malt. The sugar formed is then allowed to ferment from the action of yeast and the decomposition products, ethyl alcohol and carbon dioxide, are produced.

III. RAW MATERIAL TESTS

A. GRAIN

Starting their tests with the grain as it arrives at the plant, the Calvert chemists sample each carload to be sure that it is up to standard in every detail. These tests involve measurement of apparent grain density, moisture content, per cent dockage, bacteria count, per cent starch, etc. The density is measured by means of a standard Government balance that is calibrated to read directly in bushel weight from the weight of the fraction used. By passing a typical sample of the grain through revolving electrodes, between which there is a standard impressed voltage, it is possible to obtain an accurate indication of the
moisture present from the amount of current flowing. The grain is then passed through a sifter to separate it into particle sizes and to measure the amount of fine material present that must be discarded. This facilitates the examination for damaged kernels.

The bacteria count must be taken for every carload of grain to be sure the grain meets the standard specifications of the industry.

In order to be able to calculate plant efficiency, the starch content is determined quantitatively on an average sample of the rye, corn and malt used. This determination is made weekly.

Various other tests of a specialized nature are applied to the grains as they are received. For example, malt is extracted to measure the per cent sugars in water solution and, when needed, the quantity of diastase present is run.

The grains used must necessarily meet certain requirements or they are rejected because use of a poorer grade of raw material results in an inferior product of low yield.

B. YEAST

While the yeast may seem to be of secondary importance to the main raw material used, its preparation is one of the more difficult operations, requiring delicate control. Since it is the enzymes in the yeast that are responsible for the fermentation of sugars into the desired alcohol, it is of utmost importance that the yeast culture be free from contamina-
The yeast is first prepared in the Bacteriological Laboratory from pure cultured stock. After sufficient time, it is transferred to larger containers and allowed to ferment and grow, using malt extract as a culture medium. The final growth is carried out in 3,000 gallon tinned copper-bearing steel vessels before being planted on the bulk of the mash. A culture of lactic acid-producing bacteria is used to inoculate the fermenting mash in order to produce what is known as "lactic sour" to protect the yeast from action of common bacteria.

C. WATER.

A discussion of raw material control would be incomplete for the distillation industry without mention of the water used, for the reactions involved require large amounts. At the Calvert plant, water from five deep wells is pumped to supply a one and one-half million gallon reservoir, which can be spring fed if needed. The water is treated with coagulating alum and the floc formed is allowed to settle. From the settling basin, the water passes to the filters for further purification. Chlorination is the final process.

The boiler feed water is tested for hardness and treated in an 8,000 gallon per hour "hot lime-soda" softener for the protection of the boiler. Sodium sulfite is here added to combat oxygen that might be present in the water.

The water to be used in the blending process is distilled