The Manufacture of Rum

Part III

Distillation of the Wort . . Batch vs. Continuous Stills . . Rum Manufacture a Selective Process

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IN a general way, distillation consists in separating, more or less completely, a volatile liquid from fixed or less volatile substances with which it may be associated. In the case of rum manufacture, the fermented mash or wort contains decanted and suspended solid impurities, most of which are of a nitrogenous nature (yeast cells, yeast gums, albuminoids, pectic substances); fixed soluble substances (organic and inorganic salts, organic acids) a whole series of volatile liquid substances (alcohols, free organic acids, aldehydes, esters, essential oils); and dissolved gases (especially carbon dioxide, hydrogen and hydrogen sulphide). The two latter gaseous products occur especially in infected mashes through bacterial action, or due to the presence of sulphites in the molasses decomposed by certain groups of bacteria into hydrogen sulphide and other products.

All of these mentioned constituents of the fermented mash exert, or may exert, their influences during the distillation process and some of those that are volatile may show their presence to a smaller or greater extent in the raw distilled liquor. Of these, some will enhance, while others detract from the taste and aroma of the raw distillate. Although from the above description of the constituents of the wort, one may judge of its complex nature, it is mainly composed of water and ethyl alcohol; the numerous other constituents appear in very small quantities. The volatile ingredients mixed with the alcohol and water vary considerably in volatility, most of them being less volatile than ethyl alcohol; exceptions to this are some of the esters and aldehydes. They exist in very minute quantities, in some cases mere traces; but in rum manufacture they are of the greatest importance, for the inherent body, aroma, and taste that differentiates rum from alcohol are largely attributable to them. The decanted and suspended nitrogenous impurities, as well as some of the fixed substances that are easily decomposed by the action of heat, will also exert their influence upon the nature of the raw distillate, and in this case in an adverse manner. The foul odor ("hogo" or "tufo") frequently noticeable in freshly distilled rums owes its origin to a very large extent, to the decomposition during distillation of some of these nitrogenous elements of the fermented mash. We shall discuss this important matter further.

Among the volatile substances, we are principally concerned, besides ethyl alcohol, with a series of organic acids (formic, acetic, propionic, butyric, valeric, capric, caprilic, lauric, etc.); aldehydes, especially acetaldehyde, propylaldehyde and burylaldehyde; higher alcohols, as propanol, butanol, pentanol and others higher in the series; esters, resulting from the metabolism of the yeast itself, or from the chemical reaction between the alcohols and organic acids mentioned above; and finally, some glycerine and essential oils, of which the one known as rum-oil constitutes one of the most valuable and important ingredients in the formation of the characteristic bouquet of a truly genuine rum. Applied then to rum manufacture, the distillation stage will have for its objective the separation from the wort of the ethyl alcohol together with desirable congeners and some of the water, leaving behind those bodies that may adversely influence the desired characteristics sought in rum of quality. Rum distillation thus is a process of a selective and rectifying nature; while distillation for industrial alcohol production means complete isolation (as far as possible) of ethyl alcohol and a little water from all of the other constituents of the wort. The care and art with which this selective process is effected during distillation will be a factor of paramount importance to the quality of the resulting rum.

The mixture of ethyl alcohol, water and desirable congeners thus obtained from the final condenser of the still is what is called the raw rum. What class of distilling apparatus is the best for rum extraction from the wort? This question is not always easily answered without a thorough survey of conditions and peculiarities inherent to each case, and above all, without an exact knowledge of the nature of the desired product. There are, however, at least three different general ways in which to effect this separation through distillation: (1) Through a series of two or more successive simple distillations; that is, using redistillation as a means of rectification. The simplest forms of distilling outfits with some sort of dephlegmatory device will serve this purpose. (2) By means of a discontinuous, or batch still, preferably provided with a total reflux condenser between the rectifying column and final condenser. (3) By means of a modern, continuous still,

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adapted (as far as possible) to rum distillation, which is the type most generally employed in large scale production.

The first method of these three is almost obsolete in American practice, except for very small scale production of a very high quality product. But we must mention this primitive process for the very fine rums that may be obtained through it by using adequate technic of operation. There is nothing strange or mysterious about this if it is remembered that the genuine cognac of France, that exquisite liquor, rarely obtained unadulterated in the trade, which is produced in the region of Charentes, is practically all produced by this simple method of distillation and what is cognac as compared to rum? Could we not call rum a brandy made from the juice of the sugar cane, as so many brandies are made from the juices of fruits? We shall never tire of repeating that there exists, by far, more points of similarity between rum and brandy manufacture than between industrial alcohol and rum manufacture. An expert maker of brandies will in a very short time become equally expert in the production of rum. The sooner this basic difference between industrial alcohol and rum methods of production is grasped and assimilated by the minds of the rum distillers, the sooner they will begin to manufacture a product of real quality, and the many cordials now being labeled and sold as genuine rums will then disappear from the market, for the greater good and benefit of all concerned. Coming back to our comparative methods of rum distillation, we find that the great drawbacks to this first method we have been discussing are the excessive space and the expense of heat and time necessary to obtain the desired finished product.

The second general method of rum distillation, that employing a batch still with rectifying column, is not used extensively in the continental United States, Cuba or Puerto Rico, but it is used almost exclusively in Jamaica and the French Antilles for the highest quality of product. This method of distillation has both advantages and disadvantages; advantages as regards quality of product, simplicity of construction of the apparatus, ease of manipulation, and flexibility of operation. This last advantage, and that of quality of product, are the two more important. Its main, and perhaps only disadvantage is of an economic nature; i.e., smaller capacity per individual unit, greater space requirements, less compactness from a mechanical standpoint, and, above all, greater expenditure of both time and fuel for similar production volume as compared to continuous stills. Otherwise, for rum production, the batch still is infinitely superior to any form of continuous system of distillation, especially when excellence of the finished product is the main object sought. The principal cause for the failure of continuous stills to produce real, high quality, genuine rum is that these systems lack provision for attaining that degree of fractionation necessary to separate the desirable from the undesirable components in the wort under treatment. They either must allow both desirable and undesirable components to pass mixed together in the raw distillate, or suppress altogether both the desirable and the undesirable congeners of alcoholic fermentation. In other words, selective extraction cannot be efficiently practiced. Hence, the distillate will always contain a variable quantity of undesirable products when attempting to distill rum in a continuous still. On the other hand, some of the desirable products, of relative high boiling points, are not allowed to distill over and are lost in the slops. When an attempt is made to eliminate the passing over of these undesirable products, then distillation must be carried at such a degree of rectification and at such a high proof of final distillate that both desirable and undesirable products are equally eliminated, and the resulting final distillate ceases to be rum (in the strict sense of the meaning) and converts itself into industrial alcohol of low quality.

As to the third method of distillation, that using continuous stills, we have just discussed its shortcomings for rum production. This method has nevertheless some advantages. In the first place, the continuous still is admirably constructed for bulk production, and due to this particular advantage is in great demand among large producers. Its economic advantages in compactness, floor economy, and high unit production with economy of time and fuel, are apparent and undeniable. The fact that the great majority of the consuming public, especially in America, has lost the power of differentiating between genuine rum and artificially prepared rum, constitutes another reason why the continuous still is in such great demand among rum producers, even when they know that quality is impaired through its use. It is simply a matter of lowering production costs at the expense of quality. The advantage for high quality will always be on the side of the small producer using the batch still, at otherwise, equal methods of manufacture and curing of the product. The inconvenience for large distillers of using the batch still may be partly solved by a combination of the two systems; that is, distilling part of the wort in discontinuous, and a greater part in continuous stills. Judicious mixings of the two distillates will greatly enhance the quality of the resulting rum without having to lose altogether the economic advantages of the continuous system. The writer, in his consulting work has always advocated the use of the batch still to the small distilleries (those producing between 300 and 1,000 proof gallons of rum per 24 hours), and the combination mentioned above of batch and continuous stills for the large distilleries, (those with capacities from 1,500 to 5,000 proof gallons per 24 hours).

Whatever the type of equipment employed for distillation of the raw

rum, the fermentation process and the post-fermentation treatment of the wort will notably influence this distillation. When the distillery is prepared to allow for a period of rest to the fermented mash varying between 24 and 48 hours, the distillation stage is thereby greatly benefited. During this period of repose most of the matter held in suspension will have an opportunity to settle. Besides, many chemical reactions and interreactions will have time to come to a finish, greatly enhancing the bouquet, while new aromatic bodies may be formed at the same time. Now, our experimental evidence has proved beyond reasonable doubt that at least 75 percent of the foul odor that frequently accompanies freshly distilled rums under present methods of manufacture originates during the distilling stage, and is due to the chemical decomposition, by the action of heat, of the nitrogenous suspended matter present in the fermented mash, and to the reducing atmosphere of the hot alcoholic vapors, acting on certain by-products of alcoholic fermentation. Therefore, as regards the distilling stage, it is of the greatest importance that these organic nitrogenous residues be eliminated as completely as possible from the fermented mash before submitting it to the distillation process. This organic suspended matter will do harm also in another way during distillation. It will be a source of incrustations on the plates of the continuous stills, or on the bottoms and walls of the kettles, when batch stills are used, and it acts also as a cementing material for other deposits of mineral salts that are often formed simultaneously. This means a poor rum in the first place, a lowering of the still efficiency, and loss of time and money in frequent shutdowns for cleaning purposes.

How are we going to get rid of this matter, that will foul both the still and the raw distillate? There are three principal ways of accomplishing its removal: (1) by decantation, with, or without addition of agents to help the process; (2) by total filtration of the fermented mash, for which specially built filters will in most cases be required; (3) by a combination of the foregoing two methods. A thorough discussion of how best to perform in actual practice any one of these three eliminatory processes is beyond the scope of this necessarily short article, but we will discuss the matter briefly. Method No. 1 is the simplest and easiest to put in practice, but it is also the most wasteful in time and material. Method No. 2 is the most expeditious and efficient in the saving of time and materials, but it is the most expensive for both initial installation and running expenses. Method No. 3 occupies a middle position between the other two, and in the opinion of the writer is the one preferable. By the use of this method the fermented mash will be allowed to settle in special decanting tanks with covers, so as to eliminate alcoholic losses through evaporation. When decantation has been accomplished as far as possible, the supernatant clear liquid is run off, and when the bottom danger zone of accumulated impurities is nearly reached, the tapping of clear wort is stopped and the remaining sludge and turbid liquid is passed through the filters, recovering in this way all of the liquid part of the mash.

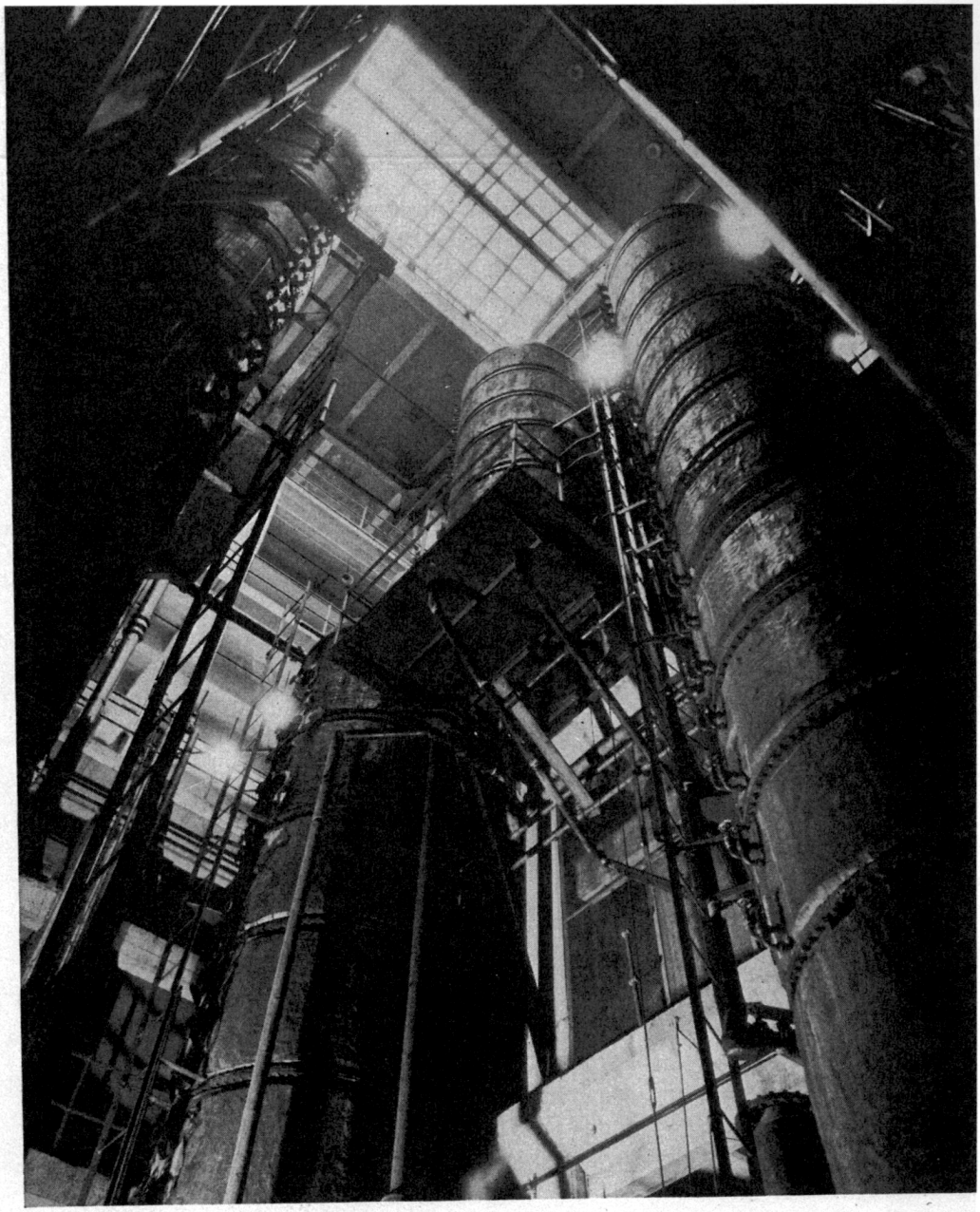
We do not know of any existing rum distillery using this practice of suspended matter removal from the fermented mash before its distillation; but we strongly recommend it, and anyone trying it once undoubtedly will make a permanent practice of it. The advantages to be gained, in our opinion, will offset the extra labor and expense involved in this operation. These advantages are: (1) keeping the efficiency of the still, especially when a continuous one is used; (2) lowering expenses for cleaning the still, and saving of time; (3) elimination to a very great extent of the characteristic foulness of odor noticeable almost invariably in rum distillation under actual conditions; (4) economy of time and labor necessary for subsequent curing. A distillate without foulness of odor will give very little trouble in its after treatment during rectification and curing or maturing. Distillation of the raw rum may be carried at lower alcoholic concentrations than are now in practice. This alone constitutes a very important gain, as will be shown when discussing the ill effects of adding diluents to the raw spirit.

If, as we have asserted, over 75 percent of the foulness of odor of raw spirits originates during distillation, how do we account for the other 25 percent? We answer, that part is fundamentally due to either of two causes, or to combinations of these causes. (1) Defective fermentation in which secondary fermentations take place gives rise to ill smelling gaseous and liquid products partly soluble in the fermenting liquid. No amount of filtration or decantation will eliminate this source of foulness. (2) Impurities exist in the raw material that are ill-smelling as such, or that are so modified by the action of certain fermentation agents as to give rise to substances producing foulness of odor. These sources of foulness in the raw distillate are completely controllable by proper selection of raw material and correct methods of fermentation. For instance, the presence of sulphites in molasses is very objectionable from the standpoint of rum manufacture.

The difference as to the origin of foulness in the raw distillate is that about 20 or 25 percent is formed during the fermentation stage (although this is entirely avoidable) and from 75 to 80 percent is formed during distillation (which is likewise avoidable). Neither has any reason to exist if proper precautions are taken. Some of these precautions may be enumerated as follows: (1) careful selection of the raw material; (2) adopting the practice of pre-treatment of this raw material; (3) mashing with as pure a water as possible, both from a chemical and a bacteriological standpoint; (4) elimination of suspended

impurities of organic nature from the fermented mash previous to its distillation; (5) choice of the batch still for effecting distillation.

How should the distillation itself be conducted for the attainment of best results? It is impossible within the scope of this article to give in detail the precautions necessary to obtain best results in the manipulation of the various types and makes of rum distilling equipments, so we shall limit our discussion to general lines of conduct to follow, which are applicable in all cases and with all kinds of apparatus. It is of the highest importance not to over-force the distillation; on the contrary, it must be slow, rhythmic, and uniform. Especially are these precautions necessary when working with batch stills (which are the proper ones to use) towards the beginning and end of distillation, for at the beginning head products are to be separated, and towards the end, the tail products are likewise to be separated from the main product or body of the raw distillate. Much practice and experience are necessary to accurately judge as to the right moment to begin collecting body and also for beginning the separation of tails. During the interval when the body is passing over it is well to keep the same volume of distillate per unit of time. Variable rates of distillation are very undesirable at any stage during the whole process. When working with continuous stills the apparent proof should be kept between 160-170; but much lower distillation proofs may be carried when batch stills are used. In cases where the distilling wort has been well fermented and treated for removal of suspended impurities, these proofs of distillation may be appreciably lowered without risk of impairing the quality of the resulting rum. Another point of importance is that of maintaining proper reflux. With batch stills, the author has found that the practice of total reflux of the ascending vapors for a definite period (to be determined in practice) previous to actual distillation is a great help towards obtaining excellent raw distillates. We must bear constantly in mind that in the case of rum, distillation is a process of selective extraction and not of total elimination of all volatile substances. But still, some of the bodies present should and must be eliminated.



Still Columns at the Pennsylvania Sugar Company

Another point of great importance in rum distillation that rarely is taken care of is the temperature of the water in the final condenser: the upper third of the condenser, where the vapors enter it, should be quite warm, (between 60-65°C.); the middle third of the condenser may have a temperature between 45-50° C.; and the lower third where the cooling water enters, will be practically at the temperature of this water. This temperature gradient may best be controlled by observing or recording the temperature of the refrigerant as it leaves and as it enters the condenser. There should always be a difference of no less than 30°C. between these two temperatures. Incidentally, a great saving of refrigerant is thus obtained. For this reason the writer favors the use of long, narrow condensers, where the zones of temperature de-

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wheel rear drive, and haul an average of six tons of cane per load. Since Kilauea, like every other plantation, is suffering from a shortage of labor, the trucks offer the added advantage that fewer men are required in the harvesting and the cost of cane at the mill is lower.

Another direction where marked changes are being made is in the harvesting methods. While the Akana rake was developed at Kilauea and has been used to eliminate hand piling, the cane has still to be cut by hand. The plantation lands are quite free of rocks and comparatively level and therefore well adapted to rake harvesting, which will be tried during this present crop; grab harvesting is also being tried. The cane is handled at the mill in the Louisiana manner; that is, it is dumped in a pile and loaded on to the feeder table with a Louisiana crane. This installation was completed during the past season and is reported to be working well. It facilitates quick unloading, opportunity for cane storage, and more uniform feed to the mills. Some improvements and new installations have been made in the mill and others are on the program. A new 400 KW steam generator, high speed centrifugals, and new cane stripping rolls are planned, and Manager Ramsey hopes that money will be available next year for new workers' homes and modernization of some of the old houses.

There is a possibility that Kipu Plantation may abandon the growing of cane and return to its original status as a cattle ranch. Senator Charles A. Rice, who owns three-fourths of the stock of W. H. Rice, Ltd., owners of Kipu, has inferred as much. The cane from Kipu is ground by Lihue and the hauling contracts are held by Grove Farm. Both of these contracts expire in the near future and at the last report had not been renewed. Senator Rice said that he was not sure what he would do, but since the shortage of labor has been so acute and under war conditions may be worse, he has been experimenting with other crops and has enlarged his herd of purebred Herefords. Kipu has about 1,500 acres of cultivated land and grows a variety of crops. In addition to beef and dairy cattle, Kipu plantation and Kipu-kai, the latter owned jointly by the five Rice brothers, have draft and saddle horses, mules, turkeys, and chickens, and is stocked with quail, guinea hens, jungle fowl and pheasants. Crops, besides sugar cane, include 200 acres of pigeon peas, molasses grass from Brazil, 300 acres of kikuyu grass, Merker, Napier, and Guinea grass, "koa haole" used as fattening pasture, and corn, grown for the Ayrshire dairy cattle. The lands have a thousand macadamia trees which are doing well, 4,200 papaya trees have been planted 8 x 8 ft. apart in a field recently cleared of cane. These cost little to plant, and if sugar prospects again appear good they can be discarded at little loss, while in the meantime there will be quantities of good fruit.

C. Brewer & Company, Ltd., recently announced three promotions for plantation men. T. K. Beveridge has been appointed assistant manager at Waimanalo Sugar Company, where he has been head overseer for ten years. William C. Irvin, who has been head overseer at Pepeekeo Sugar Company for several years, has been appointed assistant manager there, and D. G. Butchart has been made assistant manager at Onomea where he has been head bookkeeper. H. W. Robbins, for many years chief chemist of Oahu Sugar Company, has resigned and departed with his family for the mainland. Clarence W. Girvin, assistant mill engineer of Oahu Sugar Company, died recently at the Waipahu hospital after but a short illness. He was born at Wailuku, Maui, in 1883. He is survived by his wife, three sisters, and a brother. George P. Johnston, 51, former overseer for Waiakea Mill Company and recently with the Kaiwiki Sugar Company, died in Hilo, Hawaii, March 5, from a sudden illness. He is survived by a brother, James, who is manager of the Union Oil Company at Hilo.

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Louisiana's Sorghum Plan

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Galban Lobo Company, of Cuba, brought the suit against the Compania Peruana de Vapores y Dique del Callao, for $100,000, because 3,600 tons of sugar on the steamship Ucayali ended up in warehouses in New Orleans. It is alleged that the Ucayali was chartered to take the sugar from Peru to New York, but "for reasons unknown" found its way to what local pride calls "America's Most Interesting City." The New Orleans Association of Commerce doubtless would contend that the Ucayali followed a wise course. Whether the federal court will agree remains to be seen.

Receipts of offshore sugar at New Orleans during the past month comprised 191,384 bags of raws to American, 88,592 bags to Godchaux, 77,629 bags to Colonial, 47,575 bags to Supreme, 36,132 bags to Henderson, 12,294 bags to Sterling, and 19,400 pockets of refined to dealers. All the sugars were Cubas. The price of Louisiana blackstrap is unchanged at 17.50 cents per gallon, in bulk, f.o.b. plantation.

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Manufacture of Rum

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markation are easily established. The reason for this is that the refrigeration of the mixture of vapors entering the final condenser (and that once condensed will constitute the raw rum), must be so carried as to prevent condensation in an abrupt way. The condensing process must be gradual, as the vapors pass from the warmest to the coolest part of the condensing walls; otherwise sharpness of taste and aroma will be the consequence, through separation of aromatic principles and breakage of the harmonious composition of the mixture.