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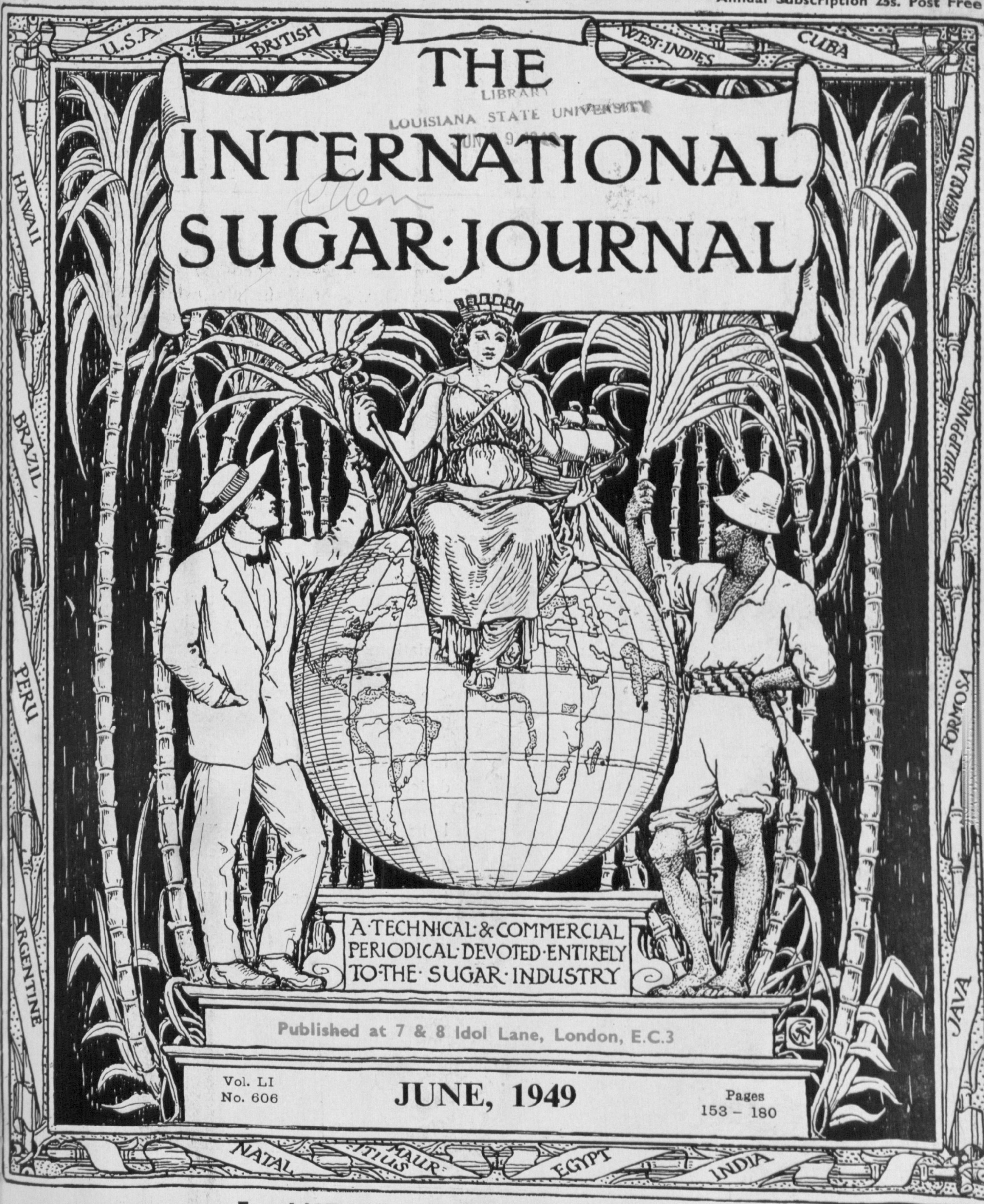

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RUM DISTILLERY YIELDS AND EFFICIENCIES: FACTORS AFFECTING THEM

By RAFAEL ARROYO, CH.E. & S.E., F.A.A.A.S.,
Consulting Chemist and Fermentologist, Río Piedras, Puerto Rico.

PART I.

SOME confusion is still prevalent when reporting distillery yields and efficiencies, due primarily to the use of different numbers and factors as basis of calculations by different distilleries. Definitions of concepts of common understanding and acceptance, and some standard practice in the writing of technical reports, are imperative in order to intelligently compare data and manufacturing results from different distilleries. There exists a too frequent tendency to express yields as proof gallons of spirits per gallon of molasses. From a scientific point of view this definition of yield means nothing when performing a comparative study of the work, methods, yields, efficiencies and general manufacturing results of a group of distilleries. The gallon of molasses varies quite appreciably in weight and in chemical composition, especially as to the contents of fermentable sugars, and in the relative ratio of sugars to non-sugars, variations that must necessarily influence the yields and fermentation efficiencies that may be obtained with different molasses. Complexity increases further if some distilleries use British standards and others the American, as the Imperial gallon is 1·2 times the capacity of the American and the British proof gallon of spirits has 1·14 times the alcoholic strength of the American and is 1·2 times greater in volume. This old expression for yields in terms of proof gallons of alcohol or rum per gallon of molasses is the natural outcome of the lack of chemical control in most rum distilleries of the Caribbean area; the only records sometimes available being those of the molasses used and proof gallons of spirits produced.

The true distillery yield (called by us the "overall yield") is dependent on (1) the fermentation yield and (2) the distillation losses. Two expressions may be, and should be, used exclusively in its definition, these being: (1) lb. of pure alcohol produced per 100 lb. of hexose sugars entering the process; or (2) proof gallons of alcohol produced per 100 lb. of hexose sugars entering the process. Expressed in either way, the term acquires real and scientific significance in comparative work. By "fermentation yield" is meant the lbs. of pure alcohol produced, and contained in the "beer" or fermented mash, per 100 lb. of hexose sugars entering the fermentation process. The "overall distillery yield" will be equal to the "fermentation yield" minus the losses incurred during the delivery of the beer to the still and its actual distillation. We believe it to be good practice to keep separate records of both the fermentation and the overall yields, as it often happens in industrial operations that a distillery obtains a very good "fermentation yield" and that the "overall yield" is rather poor. This case arises when a poorly-designed and constructed still is used, or when the distilling unit is badly or carelessly handled. The reverse case is still more common, that is, distillation of the beers is accomplished with very low losses; but the fermentation yield being poor, the overall yield also remains poor. A third case commonly found in rum distilleries is obtaining low fermentation yields coupled to excessive losses during distillation. In such cases, of course, the "overall yield" is extremely low and uneconomical.

The "overall distillery efficiency" is dependent on (1) the "fermentation efficiency" and (2) the "distillation efficiency". By fermentation efficiency is meant the ratio (expressed as percentage) between the actual yield of pure alcohol obtained on weight of total sugars (as invert) used for fermentation, and a predetermined maximum yield used as standard of comparison. This figure relates to alcohol found in the beers. Here again confusion often arises in comparative distillery work, as different distilleries will use a different standard for the maximum yield figure, some using the theoretical yield according to the equation of GAY LUSSAC for the conversion of hexoses to alcohol, or 51·11 per cent. by weight, while others use the number 48·55 per cent. as the maximum yield that may be obtained in industrial practice; still others will use 48·30 per cent. as their standard number for maximum possible yield. Since the standards used for computation of fermentation efficiency are different in different distilleries, the case may arise when three distilleries that obtain the *same figure* for "fermentation yield" will be reporting three altogether different fermentation efficiencies. We believe it is high time that a single method be used for the calculation of fermentation efficiency by all rum distilleries.

By "distillation efficiency" is meant the percentage of alcohol actually recovered after distillation, from the total amount delivered to the distillation department in the beer. The "overall distillery efficiency" will then be the product of the fermentation efficiency times the distillation efficiency. In other words, if the fermentation and distillation efficiencies are respectively 90 and 95 per cent., then the "overall distillery efficiency" will be 85·5 per cent.

Having explained how the different terms are derived, and what each actually means, we shall present some of the principal factors affecting them.

Fermentation Efficiency.

Regarding fermentation efficiency, the most important factors to be considered are : (1) the characteristics of the yeast strain used as fermentation agent ; (2) method employed in building up the yeast footing for final fermenters ; (3) chemical composition of the molasses ; (4) purity of mashing water, especially from a biological standpoint ; (5) pre-treatment and conditioning of raw material previous to mashing operations ; (6) employment of proper mashing methods ; (7) type of fermenters used ; (8) control of temperature during fermentation ; and (9) facilities available for cleaning and disinfecting the fermentation room and equipment. Let us now briefly discuss each one of the above-mentioned factors.

(1) *Characteristics of the Yeast Strain.*—Often very little attention is paid to the selection of the proper yeast strain. It is well known, however, that all yeasts have not the same power for the conversion of sugars into alcohol. In some cases the distiller is contented with using whatever adventitious yeast may be present in the raw material used for fermentation or in the fermentation room environment. Most wild yeasts are of extremely low alcohol tolerance, some strains utilizing not over 77·0 per cent. of the available sugars, and producing maximum alcoholic concentrations of between 5·0 and 6·0 per cent. by volume. Careful selection of the proper yeast strain should result in the use of a yeast capable of utilizing from 95–98 per cent. of the available hexose sugars in a period of time not exceeding 30 hours, and possessing very high alcohol tolerance, so that it will build up and stand concentrations from 11·0 to 14·0 per cent. by volume in the fermenting substrate. The ability of the selected yeast strain to stand these high alcoholic concentrations during fermentation is of the utmost importance in securing high fermentation yield and efficiency, since the high content of alcohol formed in the liquid will protect it from the development of undesirable and harmful contaminations leading to losses of alcohol or to conversion of sugars to products other than alcohol. This aside from the high economic value of high alcohol beers.

(2) *Method of Building-up the Yeast Footing.*—The proper building-up of the seed-yeast that will become the inoculum for final fermenters is one of the most important steps leading to high yield and efficiency, and, unfortunately, in most cases it is one of the most carelessly conducted. The seed-yeast must be composed of young, healthy, active cells, in the right degree of concentration and purity. It is well known that the initiation, and subsequent time taken for finishing fermentation, are influenced directly by the number of active cells contained in unit volume of mash. For purposes of high yields and efficiencies, that yeast cell concentration should be used so that it will require no further yeast growth and multiplication during the fermenting period. In this manner is precluded any diversion of carbohydrates to the development of yeast cells, resulting in a more complete conversion of the available sugars into alcohol and other products of alcoholic fermentation. The purity of the yeast footing used as inoculum for final fermenters is as important, if not more so, as its degree of cellular concentration. Keeping this seed-yeast as pure as possible, at least until the time of seeding the fermenters, should be the constant precaution and endeavour of the distiller. The idea of using a yeast machine seems at first thought to offer the most obvious solution to this problem ; however, although some of these machines serve their purpose quite satisfactorily under expert supervision, at times they become themselves a source of infection, all the more perilous on account of being the place of least suspicion. We rather recommend the starting of a new, fresh footing every day at the laboratory, and then using the yeasting machine as the first vessel of the distillery yeast propagation station.

(3) *Chemical Composition of Molasses.*—The type and chemical composition of the raw material are of paramount importance. Molasses containing high amounts of non-fermentable copper-reducing substances, ash, gums, caramel and total non-sugars will not produce high yields and fermentation efficiencies unless subjected to special processes of purification and conditioning previous to mashing operations. Molasses of high total fermentable sugars, nitrogen and phosphoric acid, and of low ash, gums and total non-sugars, will naturally produce high alcohol yields and fermentation efficiencies if judiciously mashed and fermented. This will be especially so when correct ratios of sugars to ash and of phosphoric acid to nitrogen are naturally found in the chemical structure of this raw material.

(4) *Purity of Mashing Water.*—The quality of the dilution water used during mashing operations hardly needs comment, for the important rôle played by industrial water in all biochemical processes is recognized. Particular precautions with the quality of the water used for mashing, especially from a bacteriological standpoint, should be taken. If greatly contaminated with harmful micro-organisms, the dilution water may render useless and destroy all the precautions taken for successful

fermentation. On the other hand, excessive hardness of this water, due to the content of too much mineral matter in the form of salts of calcium and magnesium, and of silicates, will raise the ratio of non-sugars to sugars in the mash with detriment to the growth and zymogenic activity of the yeast. Especially during the last stages of fermentation will this inhibiting action be felt, resulting in unduly prolonged periods of fermentation and in incomplete conversion of hexose sugars into alcohol and other products of alcoholic fermentation. The beers produced will most probably be of high residual sugars content.

(5) *Pre-treatment and Conditioning of Molasses.*—Among the most important shortcomings of blackstraps, from the standpoint of their fitness for rum or alcoholic fermentation, may be mentioned: (1) low total sugars; (2) high total non-sugars; (3) high ash; (4) high gums; (5) deficiency in yeast nutriments, especially as regards nitrogen and phosphoric acid; (6) varying degrees of microbiological contamination in the form of various bacteria, wild yeasts and moulds. All of these defects in the raw material will naturally influence adversely the high yield and fermentation efficiency. Therefore, pre-treatment of the raw material, aiming at the elimination or amelioration of these shortcomings, will undoubtedly greatly enhance its chemical structure and change it from a poor product into one of medium or even good quality. Such a procedure is followed at all distilleries under the technical supervision or counsel of the writer, with very good results. Lack of time and space prevents us from entering into details as to how the operation is effected and the results obtainable; but the reader is referred to our work entitled "Studies on Rum" published under the auspices of the University of Puerto Rico[1] and distributed gratis by the Experiment Station of this University at Río Piedras, Puerto Rico.

(6) *Proper Mashing Methods.*—Proper mashing methods are, of course, imperative, even when the best quality of raw material is available. This includes using the optimum *pH* value and total sugars concentration for the yeast in question. It also means the judicious addition of the necessary yeast nutriments so as to obtain a well-balanced ration for the nourishment of the fermenting organisms during the entire fermentation period, the final aim of adequate mashing being the preparation of the medium in such a way as will facilitate the carrying out of fermentation under optimal conditions. A thorough knowledge of the physical qualities and chemical structure of the raw material, and of the biological characteristics of the yeast used are of great importance for scientific mashing. Conditions which must be met later on during the actual fermentation of the material should influence the mashing operations. For instance, the initial sugars concentration that may be used at mashing is dependent on the method of fermentation that will be followed, especially the facilities available for the control of fermentation temperature, and on the degree of alcoholic concentration that the yeast strain employed is capable of building up and standing. Without proper consideration of these points, the residual fermentable sugars in the beers may be exceedingly high, resulting not only in the waste of valuable carbohydrates, but also precluding the obtaining of high fermentation yields and efficiencies.

(7) *Control of Fermentation Temperature.*—The control of fermentation temperature is perhaps the most important single factor influencing fermentation yields and efficiencies. This becomes especially so when very high alcoholic concentrations are desirable or necessary in the fermenting substrate. When not operating under pure culture technique, high temperatures will encourage the growth and rapid propagation of undesirable bacterial infections. In all cases, high temperatures of fermentation operate very effectively in producing endoproteolysis and autolysis of the yeast cells, bringing about the premature exhaustion of the yeast through vital over-excitement. Mechanical losses of alcohol from the fermenting mass through evaporation are also accentuated by high temperatures. In extreme cases, these high temperatures may result in producing the phenomenon of "stickiness" or paralysis of the yeast activities while considerable amounts of available sugars are still present in the substrate. All of the above-mentioned bad effects produced by high fermentation temperatures, of course, militate against the obtaining of high yields and efficiencies. Incidentally, in the case of rum fermentation, they also militate against the quality of the final product.

(8) *Types of Fermenters used.*—The type of fermenters used is another factor of no small importance. Fermenters may be large, medium-sized, or small; closed or open; wooden or metallic; with or without appliances for cooling and agitation of the contents, etc. The iron or steel fermenter, well equipped for outside refrigeration of the fermenting liquid, and for bottom agitation of the contents at the proper time, is ideal for securing high fermentation yields and efficiencies, especially when arrangements exist for bulk centrifuging of the beers immediately upon the finishing of fermentation, and the delivery of the clean beer into an aseptic beer tank or well, previous to actual distillation. The small or medium-sized fermenter in this class will be better than the very large one, due primarily to better facilities for cooling of its contents and accessibility

[1] *I.S.J.* 1946, p. 163.

and ease for cleaning and disinfecting after use. Surface evaporation of alcohol from the fermenting liquid is kept down to a minimum, and infection from surrounding micro-organisms is also almost eliminated, since the vats are not only covered but also a certain amount of pressure over the atmospheric may easily be maintained during the whole period of fermentation. When fermentation is over, and the contents are vacated, pressure sterilization may readily be applied after the fermenter is first properly cleaned by washing and scrubbing. Yields and efficiencies are also enhanced when stirring devices operating at the bottom of the fermenter are available. These should only be used towards the finishing stages of fermentation, so that the yeast which accumulates at the bottom of the fermenter may be re-suspended into the liquid and in this manner kept alive and in contact with fermentable sugars.

When open-type fermenters are used, it is preferable for them to be of iron or steel. Wooden fermenters are the least desirable, since they are the least conducive to high yields. This is so on account of the insulating effect of wood towards the heat developed within the fermenting mass ; to their proneness to leaks and general deterioration ; and to their greater susceptibility towards infections.

(9) *Facilities for Cleaning and Disinfecting.*—The facilities available for cleaning and disinfecting in the fermenting room are a primary pre-requisite for effective operation and for the obtaining of high yields and efficiencies at this stage of manufacture. The best and most modern equipment, if badly kept and carelessly used, will not lead to good and efficient operation. Not only must the fermenters and accessory equipment be kept in prime sanitary conditions, but also the surrounding walls, ceiling and floor space. Effective sterilization of pumps, mash lines, mash coolers and fermenters must be carried out whenever the opportunity arises during the day's work. Fermenters should be thoroughly washed and cleaned before steam sterilization is applied in those cases where conditions allow for steam sterilization. When steam is not available (or, being available, may not be used on account of the fermenters' construction), solutions of hypochlorites or metabisulphites, or even of 5 per cent. sulphuric acid, will be very effective for sterilization purposes. The floors should be kept clean of mash-pools, wash-waters, or any other material which may serve as the starting-point of bacterial infection. Floors should be kept both clean and dry.

It may well be realized from considering the various points mentioned and succinctly discussed above that great care and constant vigilance must be exercised to accomplish effective and first-class fermentation work at the distillery.

(*To be concluded*)

U.K. REFINING CAPACITY.

The following information regarding the sugar refining capacity of the United Kingdom has been given by the Ministry of Food.[1] (All the undermentioned figures are expressed in terms of refined sugar in tons).

	1939	End 1945	Present Time
1. Sugar refineries, annual capacity	2,100,000	1,900,000	2,300,000
2. *Beet sugar factories*—(18 factories, of which 12 are white sugar and 6 are raw sugar):			
(*a*) Campaign production based on the normal yield	500,000	450,000	500,000
3. (*b*) *Off-season refining*—(12 factories):			
(i) Potential capacity	750,000	750,000	800,000
(ii) Realistic capacity	400,000	300,000	400,000

For off-season refining "potential capacity" is a meaningless figure, as it assumes that, at each of the twelve white sugar factories, off-season refining could be carried on simultaneously without a break from February to August. In practice, this is quite impossible, owing to the large amount of maintenance and repairs which have to be carried out each year after the close of the beet campaign. Apart from this, only half of the white sugar factories are economically well situated for handling imported raw sugar. The six raw sugar factories are not equipped for producing refined sugar, either in the campaign or in the off-season, and to adapt them for refining would be a costly and lengthy business. If adapted, the potential capacity of these six factories for off-season refining would be about 450,000 tons, but a more realistic figure would be 200,000 tons.

[1] *Hansard* April 26th

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By RAFAEL ARROYO, CH.E. & S.E., F.A.A.A.S.,
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(*Continued from page* 166)

PART II.

Distillation Efficiency.

The factors affecting the distillation efficiency may be divided into two classes : (*a*) the indirect and (*b*) the direct.

(*a*) *Indirect Factors.*

The indirect factors are those which affect the distillation efficiency even before the actual distillation of the beers has taken place. These are originated by the post-fermentation treatment and methods of handling the fermented mash or beer, and by the extent of efficiency employed in the care and upkeep of fermentation-room equipment. The methods of sampling and of chemical control used at different distilleries also have some influence on the final value for the figures representing distillation efficiency.

In most rum distilleries, open-type fermenters are used, and, when fermentation is over, the beer is kept in the fermenter until the turn for its distillation arrives. It often happens that some considerable time elapses before the beer is drawn out of the fermenter for distillation. In cases of breakdowns or strikes the beer may remain undistilled for days, or even weeks. During this time losses of alcohol take place, due to mechanical and biological causes. These losses may occur through evaporation, or through leaks, or through the action of micro-organisms which come into play as soon as the yeast ceases its fermentation activities. Such losses of alcohol will militate against obtaining high distillation efficiency. Yet another source of loss is occasioned (even when the beer is distilled immediately after fermentation finishes) by the fact that some of the beer always remains in the fermenter mixed up with the "fermenter bottoms" and is washed out into the gutter during cleaning operations. The exact amount of alcohol lost by the action of this last-mentioned factor varies a great deal, the range being from nil up to 2·0 per cent. of the total contained in the original volume of beer. The magnitude of this loss depends on the shape and design of fermenters, on the equipment for the recovery of these bottoms, and on the care and responsibility of the fermentation-room attendants. Still another loss of alcohol in the beer takes place during the pumping of the beer from the "beer well" into the still feeding tank. This loss depends on the construction of the beer well and the constant level feeding tank, as well as on their respective sizes. Most rum distilleries run the beer from the fermenters into a so-called "beer-well," then pumping from this beer-well into a constant level feed tank from which the liquid is fed by gravity to the still. In some cases both the beer-well and feed tank are entirely too large, and uncovered, thus exposing a large surface to evaporation of alcohol. This evaporation is aggravated by the fact that there is a continuous return of beer from the constant level still feed tank back into the beer-well, with considerable agitation and splashing at this point. All the above-mentioned minor losses taken together will, in some cases, greatly affect the distillation efficiency number.

Untimely or careless sampling and analysis of the beer may also act adversely on the number representing distillation efficiency. In some distilleries the beer of individual fermenters is sampled and analysed for alcohol a long time before the beer is run out for distillation, the still then being charged with an amount of alcohol in beer superior to its actual alcoholic content at the time of distillation. Also, a mistake is sometimes made when calculating the number of gallons of alcohol contained in the beer by multiplying the total number of gallons of mash with which the fermenter was originally set by the percentage of alcohol in beer. The mistake comes from the fallacy of believing that the volume of beer in the fermenter equals the volume of original mash in the fermenter at setting time. The fact is that the volume of beer is always less than the volume of mash, and that, therefore, the percentage of alcohol in the beer should be multiplied by the actual amount of beer in the fermenter and not by the volume of mash in the fermenter previous to fermentation. The reason why the beer in the fermenter is less than the mash in the fermenter at setting is that the volume of alcohol formed at the expense of total sugars destruction will not compensate for the volume of original mash represented by its sugar content, since one of the two main products of fermentation (the carbon dioxide) escapes into the surrounding atmosphere. The correct procedure is to measure carefully the volume of beer produced and to use this volume and its percentage of alcohol in computing the number of gallons of alcohol actually sent to distillation. The sampling of the beer from individual fermenters must also take place in the right manner. The sample should be a continuous one obtained while the beer is being pumped to the still feed tank, since the content of alcohol in the beer will obviously vary from beginning to ending this operation. Evaporation of alcohol from the sampling device must be prevented during the collection of this continuous sample. This is of special importance when very large fermenters are used at the distillery.

In order to diminish the losses of alcohol (called by us the "indirect") in relation to the total distillation losses, the fermenters and the auxiliary fermentation-room equipment must be kept leak-proof ; and evaporation and infection losses must be reduced to a minimum by the use of metallic fermenters of the closed aseptic type. The best method of handling and treating the beers is described as follows : As soon as fermentation is completely finished, the beer is filtered in bulk through a super-centrifuge of the closed type, so as to avoid losses of alcohol through evaporation. The clean filtrate, free of all solid impurities, including the yeast cells, is delivered into a closed aseptic beer-well or tank, from which it is then pumped to a closed constant level still feed tank. From here it will flow by gravity into the column. Through this post-fermentation treatment the whole volume of beer is saved for distillation without loss of time or fear of contamination. Bulk super-centrifuging of the beer offers the additional advantages of keeping the column clean for longer periods, obtaining steam economy, and, if desired, recovering a valuable by-product—the yeast.

The direct factors influencing distillation efficiency operate during the actual distillation of the beer, and they are : (1) still design and construction ; (2) effective steam pressure and beer feed control ; (3) supply of condensing water and flexibility for its use ; (4) the use of de-foaming agent (such as Turkey Red Oil) ; and (5) the efficiency and trustworthiness of still operators. Let us discuss briefly each of the above-mentioned factors.

(1) *Still Design and Construction.*—Correct still design and construction is, of course, of paramount importance. This includes such points as capacity for the work intended to be performed ; sufficient number of exhausting plates in the beer column so as to obtain practically alcohol-exhausted slops; correct spacing of plates in accordance with the nature of the beers to be distilled ; down-pipes of the right diameter and number at each plate ; accessibility for cleaning and repairing of plates ; removable caps (if the bubble-cap type of plate is used) so that they are easily unscrewed for cleaning or repairing outside the column ; etc. The rectifying column should have the correct number of plates for attaining the required proof of distillate without undue refluxing ; ample condensing surfaces in all condensers and coolers, so that losses of alcohol due to defective condensation may be precluded ; automatic controls for steam pressure and beer-feed ; etc.

(2) *Effective Steam Pressure and Beer-Feed Control.*—If automatic controls for steam pressure and rate of beer feeding are not available, and hand operation must be relied upon, extreme care is then necessary on the part of operators. We find here one of the most common sources of trouble and loss in the operation of the still. Frequent fluctuations in the steam pressure applied at the base of the column will create conditions by which it will become almost impossible to obtain efficient distillation. This will be especially so when the perforated type of plate is used in the beer column.

(3) *Supply of Condensing Water.*—An abundant supply of cool condensing water is a great asset in distillation, as control of column reflux and proof of distillate is greatly facilitated by the judicious use of cooling water. This becomes of special importance when, through defect of design or construction, condensers are rather small and ineffective, and also, when production must be accelerated, or when extraordinarily high alcohol beers must be distilled without loss in efficiency. The supply of cooling water and the pump capacity should be quite flexible to meet all contingencies so that the rate of supplying water to the still condensers may be varied at will. Limitations in the supply of water or in the pumping capacity are factors which will greatly hamper the working of the still so that high distillation efficiencies may be secured.

(4) *Use of De-Foaming Agents.*—Turkey Red Oil, or an equivalently effective de-foaming agent, is of great value when used during distillation,[1] and will influence in no small degree the obtaining of high distillation efficiency, while increasing at the same time, when desired, the distillation capacity. It should be added in the form of a continuous small jet at the entrance of the beer into the beer heater, or if this is not feasible, at the feed tank or beer-well. About 1 gal. of the oil per 6000 gal. of beer will be sufficient in most cases. When this is done, exhaustion of the beer will proceed in foamless rhythmical manner over the plates of the beer column, and there will be no danger of

[1] *I.S.J.*, 1948, p. 87.

obtaining a so-called "packed column" with all the troubles and losses of time and alcohol that this condition involves.

(5) *Efficiency of Still Operators.*—The convenience of having the still operated by well-paid, expert and trustworthy attendants hardly needs any comment. While this is always important, it becomes much more so when the still is old-fashioned, home-made, or deteriorated from long and continual use. In these cases automatic regulations are apt to be absent, and hand control must be resorted to. Laboratory analyses of the slops, condensers and refrigerators exit waters should be effected at every change of shift, as this precaution will keep the operators alert to their duties and responsibilities.

As we have explained, the overall distillation efficiency is a product of the fermentation and distillation efficiencies and, in the long run and from an economical viewpoint, that is what really counts. In those distilleries with good chemical control when, for some reason, the overall efficiency suddenly drops, it will be a comparatively easy matter to ascertain where the trouble lies and to correct it. When chemical control does not exist (or, if existing, is not properly carried out) it often becomes very troublesome to find without much loss of time the faulty person or piece of equipment. Proper chemical and biological control in the distillery may save labour, time, and unnecessary losses and expense to distillery owners. It certainly is a great asset towards obtaining high overall distillery efficiency.

U.K. Industrial Usage.[1]

ANALYSIS OF ALLOCATIONS TO MANUFACTURERS IN CALENDAR YEARS 1947 AND 1948

Sugar as Refined For production of	*Thousand tons* 1947		1948
Chocolate and sugar confectionery	182·0	..	170·0
Preserves	190·1	..	190·0
Biscuits, cakes and flour confectionery	153·1	..	143·5
Syrup and treacle	80·3	..	86·0
Brewing	59·2	..	49·9
Soft drinks	27·2	..	32·3
Condensed milk	15·9	..	17·7
Canning	14·1	..	15·0
Medical preparations	11·7	..	8·7
Table jellies	12·2	..	10·2
Ice cream	12·2	..	10·0
Bakers' prepared materials	13·4	..	12·5
Coffee essence	5·9	..	5·7
Candied peel	3·9	..	3·7
Breakfast cereals	1·3	..	3·2
Pickles and sauces	3·5	..	3·0
Cider	4·4	..	3·7
British wines	3·4	..	3·5
Cake and flour mixtures	2·6	..	2·6
Miscellaneous	21·7	..	26·1
Export and manufactured goods	10·0	..	27·9
	828·1	..	825·2

Exports of Sugars From Peru

Total for the year 1948[3]

Metric Tons—tel quel.

Bolivia	24,108
Curazao	408
Chile	116,593
Spain	35
U.S.A.	37,750
France	252
Great Britain	77,941
Holland	2,003
Japan	35,785
Panama & Canal	91
Uruguay	58,488
	353,454

Of the above 40,120 tons were in refined, as follows:

Bolivia	23,163
Spain	35
U.S.A.	1,573
France	252
Great Britain	9
Panama & Canal	91
Uruguay	14,997
	40,120

Paper from Bagasse in Mexico.[2]—A factory for the production of fine paper and possibly newsprint from bagasse is shortly going into production at Zatapec, Morelos, in the centre of a sugar-growing area. Added strength will be given by a 20 per cent. admixture of long-fibred bamboo pulp.

Sugar Estate Mapping.—A Lockheed Lodestar aeroplane, a unit of the Canadian affiliate of the Hunting Aerosurveyors Ltd., has been engaged to map the lands of the island estates of Jamaica. In addition to its regular crew it will carry an air photographer and a ground engineer. Not only will land areas be mapped, but soil erosion tracks will be detected. and rock formations and faults undiscoverable by field geologists, as well as special soil types, will be pointed out. Afterwards the unit will proceed to Trinidad and later to British Guiana.

[1] *Hansard*, May 23rd.

[2] *Foreign Trade*, 1949 **5**, 123, p. 970

[3] Supplied by courtesy of Mr. A. N. CROSBY of Lima, Peru.