

ETHYL-METHYL ALCOHOL

by

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Sources of Alcohol

The principal sources of production of ethyl alcohol in the United States are:

- (a) Direct fermentation and distillation from raw products;
- (b) Recovery of ethyl alcohol as a by-product in certain forms of manufacture.

The raw materials employed under division (a) are mainly black-strap molasses and grains.

Other sources of possible production providing the price paid for alcohol is sufficiently high are sawdust and the waste sulphite liquors of paper pulp mills. Another source of manufacture has been from unmerchantable raisins in California.

The main sources of alcohol as a by-product under (b) are derived from the brewing of malt liquors now made non-alcoholic by law, from certain yeast factories and from the manufacture of acetone and butyl alcohol by the fermentation process with corn as a basis.

The map demonstrating the situation and productive capacities of the producing plants furnished by the Internal Revenue Department demonstrates the source or origin in connection with the above classification.

It should be noted that the distilleries situated at tide water use molasses exclusively as their raw material. In other words their productive capacity is nil except as they can be supplied with molasses as their raw material. They have no facilities for grinding and cooking grains and no facilities for the storage of grain as a raw material.

A number of distilleries in the middle west, however, are equipped to use both grain and molasses as a raw material.

Sources of Raw Material.

The supply of grain is, of course, obvious. Besides corn which is the principal grain used for the production of alcohol, considerable quantities of Kaffir corn are sometimes available. The corn used as a raw material may be of lower grades than those consumed in the ordinary market for either feed or food.

By far the greatest amount of alcohol manufactured in the United States is from blackstrap molasses as a raw material.

This material is produced within continental United States by the beet sugar factories as their by-product, by the raw cane sugar factories of the Southern States and by the sugar refineries, where again blackstrap molasses is a by-product of the operation of converting raw cane sugars into refined or white sugars.

The greatest source of supply of blackstrap molasses is from the raw cane sugar factories of Cuba, of San Domingo, of Porto Rico, and of the Hawaiian Islands.

The molasses produced by the beet sugar factories of the United States is treated by a subsequent process known as the Steffens process, the purpose of which is to de-sugar as far as possible this by-product. Not all of the beet sugar factories in the United States are equipped with the Steffenizing process and it is the custom of those not so equipped to ship their molasses in tank cars to the factories which have installed the process. This is particularly done when the prices of sugar are high, as the cost of transportation and by-processing is warranted under these circumstances.

At the present time the bulk of all the sugar beet molasses produced in the United States is purchased for the purpose of manufacturing yeast. Up to a few years ago commercial yeast was manufactured almost exclusively from grains but a process was developed, the result of which is that commercial yeast is now manufactured on a very great scale from beet sugar molasses preferentially, although a small percentage of cane sugar black-strap may be used in admixture with the beet sugar molasses.

The extent to which the yeast industry has developed is shown by the importation of European beet sugar molasses by the American yeast manufacturers in the last two years, in addition to the purchase of practically the entire output of the molasses produced by the beet sugar factories of the United States.

A comparatively small quantity of beet sugar molasses is used by the manufacturers of so-called sweet feeds (a mixture of grains, alfalfa, and molasses). The use of beet sugar molasses in this connection is because the green alfalfa meal practically retains its color when mixed with beet

molasses but is a deep brown when mixed with cane sugar blackstrap. Because of this characteristic of the mixture which sells at a higher price than the ordinary sweet feed a higher price is paid for the beet sugar molasses than for the cane sugar blackstrap.

Beet sugar molasses is transported from producing to consuming points, often very long distances, by means of railroad tank cars.

The cane sugar blackstrap produced in continental United States is stored on the plantations and distributed to consuming points also by railroad tank cars.

The importation of cane sugar blackstrap from Cuba, San Domingo, Porto Rico, and the Hawaiian Islands is by tank steamer, the cargoes being pumped into steel storage tanks at tide water. The information as to total storage capacity for blackstrap at these points is shown by the report of the Internal Revenue Department.

To supply this raw material to interior consumption points, railroad tank cars loaded at the seaboard tanks are, of course, necessary.

By reason of the demand created in the last few years practically no blackstrap molasses now goes to waste in the sugar producing Islands adjacent to the United States. The material is gathered from the plantations in the interior and shipped mostly by railroad tank cars and occasionally as in San Domingo by shallow river lighters to concentration storage stations at tide water. The material produced by sugar factories situated on the coast are gathered either directly from storage tanks if depth of water permits or taken coastwise to concentration stations by means of tank vessels of lighter draft. Shipment from island producing

points to American ports is by the same type of vessel as petroleum bulk carrying tank steamers. At a cost of some time and money a vessel that has carried a cargo of oil may be sufficiently cleansed to carry blackstrap molasses so that no special type of tank steamer is necessary for the molasses trade.

The present duty on blackstrap molasses imported from the foreign sources of production is one-sixth of a cent per gallon, but with a limitation of the sugar content. A higher sugar content results in an increased duty. The average production of blackstrap molasses per bag of raw sugar (325 pounds) in Cuba is about six gallons of molasses to the bag. According to the condition of the cane, this varies at certain times and in certain districts between five gallons to the bag and ten gallons to the bag, but the safe average for calculation is the six gallon average.

Competitive with domestic and imported cane sugar blackstrap as a raw material for distillation of alcohol, is the demand by the manufacturers of sweet mixed feeds for horses and cattle.

During the great war the policy of the Food Administration was to spare the corn crops as a basis of manufacture of alcohol and to insist upon the use of blackstrap molasses as a raw material for this purpose. Various attempts on the part of the Cuban Government during the great war and since to place an export duty on blackstrap molasses have met with a protest from the United States Government because of the necessity of this raw material to keep the alcohol industry of the United States at seaboard on a producing basis, these plants being restricted to the use of blackstrap as their sole

raw material. These seaboard plants constitute by far the largest producing alcohol units in the country. It was assumed by our Government that blackstrap being an essential raw material in time of war capable of sparing our corn crops, the alcohol production units based thereon must be preserved in peace over against their indispensable production in time of war.

Sources and Quantities of Production of Molasses.

The appended tables show the output of various production points of molasses available to the United States of Cuba, San Domingo, Porto Rico, the Hawaiian Islands, the American Beet Sugar Industry, the American Cane Sugar Industry, and the American Sugar Refineries. A table of imports of blackstrap molasses into the United States is also appended. (Tables for sources and quantities of production of molasses should be supplied and information kept up to date by the Departments of Agriculture, Commerce and the Treasury, the latter covering imports).

Methods of Manufacture of Ethyl Alcohol.

The mainstay of production is from the two raw materials, molasses and grains. In the case of grain, grinding and cooking machinery is necessary for the preparation of the mash for the conversion of the starches in the grains while malt made from small grains is indispensable for its so-called diastatic action on the starches which make these available for fermentation by the yeast added thereto. After fermentation has subsided in the vats on the exhaustion of the yeast, the distillation follows, and

alcohol of commercial specifications is produced therefrom. As a by-product of this distillation fusel oil is obtained. In addition thereto every well equipped distillery using grain as a basis recovers a highly valuable feed for cattle known as Distillers Grains. This is recovered by drying out the solid mass remaining of the crushed grain after it has been processed as above.

With the use of molasses as a raw material for the manufacture of ethyl alcohol, it being rather viscous (usually commercially sold on the basis of 42 degrees Beaume), from five to six times its volume in water is added together with a certain amount of acid to invert the direct sugars into invert sugars. This is done for the purpose of permitting a more homogeneous action to the yeast which is added to this mixture.

Formerly by law and Internal Revenue regulations a definite period for this fermentation was established, but this was modified during the great war in order to speed up production and at present the most rapid fermentation possible is authorized by the regulations. Attention is called to this matter because former regulations may again be restored and they should be modified if the necessities of the Defense Program should so demand.

As a by-product of Ethyl Alcohol distillation from molasses, fusel oil is also recovered.

The only other by-products recoverable from the fermentation of molasses as a raw material for ethyl alcohol, is in certain distilleries where special apparatus has been installed for the recovery of

- (a) Carbonic acid gas
- (b) Potash and Ammonium Salts.

Carbonic acid gas is a direct result of all fermentation of mashes whether grain or molasses serves as a basis of distillation.

The potash and ammonium salts are recoverable in the molasses distilleries from the evaporation of the waste material known as distillers' slop and subsequent incineration of the solids recovered therefrom.

After obtaining the distillates from the stills, alcohol is either shipped immediately or stored in copper, iron, or steel storage tanks.

Specifications.

Properly manufactured ethyl alcohol is what is known commercially as a neutral spirit. While ethyl alcohol is commonly called grain alcohol, there should be no difference in its characteristics whether made from grain, molasses, potatoes, or any of the lesser employed raw materials. As a matter of fact a properly manufactured neutral spirit on test by European as well as American chemists, has proven that it is impossible to ascertain from such test or analysis information as to the basic material from which it was manufactured.

Nevertheless great care must be exercised in the matter of specifications and tests, as it frequently occurs that there is a rum flavor or odor to alcohol made from molasses and a beverage odor from alcohol improperly made from grain, and in both cases there are frequently present aldehydes which should be excluded by proper manufacture and also there is the ever present menace of an acid spirit.

The specifications of the Ordnance Department cover these questions fully and are well known to the trade and with rare exceptions there have been no rejections by the Department of any major quantity.

Shipments.

Alcohol is shipped in railroad tank cars kept especially clean for this purpose, in drums commercially of 55 gallons each, and during the great war in large measure in drums of 110 gallons each. It is also shipped occasionally in barrels which should be suitably glued on the inside to prevent discoloration. Small quantities on specification for the Medical Department were shipped in glass bottles during the great war. Transportation by tank cars is usually in tanks of eight thousand gallons capacity although there are smaller ones of six thousand gallons capacity in use.

Imports.

Following the policy of guaranteeing the ample production of ethyl alcohol for the chemical and other industries of the country in time of peace and for this essential production in time of war, a protective tariff, now of fifteen cents a wine gallon has been imposed on all importations of alcohol of foreign origin. There are some small distilleries in Porto Rico and the Hawaiian Islands. Thus far it has been found impracticable to make bulk shipments of alcohol overseas. Sea transport is, therefore, in drums and cooperage which is unsatisfactory and expensive in a commercial sense.

In case of war, alcohol would probably again be shipped in drums. The choice will be between a 55 gallon container and one of 110 gallons. The argument in favor of the former is that it is more readily handled in transit. The argument in favor of the larger container is its possible use as a small tank or deposit in the Zone of Operations.

Other Production Requirements.

Fuel. -- A number of the largest plants at seaboard use oil as fuel. A number of these plants are not now equipped to burn coal. This consideration did not arise in the great war, when none of the distilling plants consumed oil.

Consideration will have to be given to these oil burning plants immediately on declaration of war and ample opportunity given them for conversion to coal burners should the policy of the conservation of fuel oil be deemed necessary. This is a matter which will have to be decided promptly and the necessary material for conversion of the plants to coal burners allotted, with priority.

Labor. -- In a major sense there is no labor problem. The crew of a distillery consists of the usual power house force and skilled and semi-skilled employees, few in number, who attend to the regular technical operations. As to common labor only a sufficient number is necessary to attend to packaging and loading and also to the cleansing and reconditioning of return drums. It is quite improbable that any demand would be made for assistance in obtaining labor by distilleries even in the height of their production and under war demand.

Tank Cars and Containers. -- Many of the producing plants own a considerable number of tank cars although provision may later have to be made in this regard for the smaller producing units.

The same condition obtains normally so far as 55 gallon drums are concerned, the smaller units having only a minimum supply of these containers. Procurement of these steel containers for overseas transportation and for supply of small quantities to essential industries during a war must be provided.

Tools, Apparatus, and Appliances. -- There are no special tools demanded by this industry. Copper must be provided for repairs and new construction of distilling apparatus.

The heart of a distilling plant is its boiler house and hence on any survey upon which is to be based a reliance for production, the condition of the boilers and some provision for replacement in case of accident is essential and fundamental.

New Facilities.

The present and prospective facilities for production are probably greater than any demand which the government may be required to make for a considerable period of war operations thus giving ample opportunity for the construction of additional facilities demanded by the calculated prospective demand deemed necessary for the development of the Defense Program.

Army and Navy Requirements.

If at all possible the requirements for the Army and Navy should be made jointly through a single centralized channel. As to districting,

two, or at most three, districts are sufficient for local control. The eastern and Atlantic States can all be placed in one division; the Gulf and middle western states can be placed in a second division; and the far west and Pacific States into a third division. From the point of view of transportation over the shortest routes to consuming points and for the purpose of having the necessary elasticity in this respect due to possible surges of demand, or accident to production, a single district for the Gulf and middle west production would probably be more effective.

Main requirements will, of course, be for smokeless powder for both the Army and the Navy. This of itself should be the conclusive argument for unified and centralized control of ethyl alcohol. During the concluding period of the World War the greatest demand for ethyl alcohol loomed as one of the requirements for the manufacture of mustard gas and this must be ever present, even if such gas is banned by international agreement because of the possible contingency arising from the violation of such treaty by the enemy. The demand for ethyl alcohol for the extra gas program as laid out for 1919 was at the rate of about nine million wine gallons of alcohol per month which was more than that used for the government and associated powers as the basis of the manufacture of explosives in this country.

The requirements of the Medical Department, directly or indirectly, by the purchase of tinctures including iodine and a great number of remedies into the manufacture of which alcohol enters or which are preserved

by an alcohol content. The Medical Department also will require alcohol for purposes of sterilisation and massage. Finally indirect requirements must necessarily be covered by the use of alcohol in a great many articles produced by the industries for governmental use, running from shoe polish to paints, varnishes, lacquers, aeroplane dopes and generally in the use of ethyl alcohol as a solvent in many lines of manufacture.

Requirements may also be made for alcohol in solid form for trench or similar use for cooking or heating because of its easy transportation.

In a winter campaign it may also be required as an anti-freeze in the radiators of various motors.

By reason of the above mentioned principal uses the procurement might properly function through a board or committee of which the Ordnance, the Chemical Warfare, the Medical, and the Quartermaster Departments should have control.

The following are the estimated requirements of the Army  
and Navy:

Uses.

The principal uses of alcohol can be found enumerated in the publication of the Internal Revenue Department entitled "Appendix to Regulations #6 -- Formulae for Completely and Specially Denatured Alcohol".

Production in Foreign Countries.

The greatest production of alcohol of any foreign country is in Germany where it has always been fostered by the Government as the basis of its chemical and dye stuff development. There are now over 44,000 producing units, mostly of very small productive capacity scattered through rural communities in Germany. The raw spirits made in rough fashion at these points are gathered for refining. All kinds of materials which otherwise would go to waste on the farm are fermented at these small units. No such arrangement for production can ever be paralleled in the United States in view of the danger arising therefrom by way of violation of the Eighteenth Amendment. In France the main raw material for the production of alcohol is beet molasses. At the end of the great war and subsequent thereto an accumulation of approximately 50,000,000 gallons of alcohol presented a problem to the government, which proposed by law to dispose thereof by compelling the addition of ten per cent of alcohol to all gasoline used for motor purposes. This project failed because of the inability to maintain a mixture between 95 per cent alcohol and gasoline. Arrangements were then made for the dehydration of alcohol which is miscible in all percentages with gasoline but expert

demands and internal consumption and failure on the part of the Germans to send reparations alcohol to France finally depleted the stocks so that the problem of surplus is now practically solved. In England alcohol is manufactured from molasses either imported or the by-product of the British sugar refineries. Holland manufactures alcohol mostly from beet molasses, domestic or imported. Greece formerly depended on its alcohol supply by the use of surplus or unmerchantable currants, but of late years has imported some molasses for this purpose. Czechoslovakia and neighboring countries engaged in the beet sugar industry have their own supply of beet molasses for the manufacture of their alcohol. The Spanish manufacture is negligible except as it results from the fermentation of grapes and raisins for their beverages. The Scandinavian countries to an extent use sulphite liquors and have also developed a process of making alcohol from carbide. The foreign islands adjacent to the United States by reason of the Eighteenth Amendment are tempted to produce on an increasing scale by the smuggling traffic of alcohol into the United States.

Substitutes,

Except for the purpose of use as a solvent in special cases, there is no substitute for ethyl alcohol. The possible substitute of ethyl alcohol in special solvent cases is methyl alcohol.

Of course, it is not suitable as a substitution of ethyl alcohol for the manufacture of smokeless powder, nor of mustard gas, nor for the general uses of alcohol by the Medical Department.

Methyl Alcohol.

The ordinary method of making methyl or wood alcohol is to obtain it as one of the products of the destructive distillation of wood. It is made by this process in the form known as crude wood alcohol of an average of 82 degrees test. The other products of the destructive distillation of wood, are acetate of lime and charcoal. The crude wood alcohol is refined at special refineries which produce what is known as pure methyl alcohol which tests 99½ per cent, and methyl acetone which tests 86 per cent. Wood alcohol is employed in the manufacture of some of the products used in chemical warfare. It is largely used in the manufacture of formaldehyde, in the manufacture of some of the important dye materials, as a denaturant for ethyl alcohol, in paint and varnish removers, as a vehicle for shellac and other varnishes, in the manufacture of artificial leather, celluloids, pyroxylin plastics, dopes, lacquers, enamels, stains, and for general solvent purposes.

A number of plants were created during and subsequent to the great war for the production of crude wood alcohol. At that time and at present there are sufficient facilities both for processing and storage at the existing refineries. Seasoned wood is the raw material but special apparatus has been installed in some production points where waste wood is converted, instead of specially cut and seasoned wood. Where small sized wood is used, however, the resulting charcoal is apt to be troublesome by reason of its powdery character and useful only if pressed into bricks, the successful processing of which has, at present writing not yet been commercially solved.

Synthetic Methyl Alcohol.

A recent development in in the so-called synthetic methanol. This is generally believed to be a German process. The French, however, lay claim to what they term basic patents in this development. The British claim prior knowledge and practice of the art. Some of the early German patents were seized in 1917 by the Alien Property Custodian in the United States and are among those turned over to the Chemical Foundation. These are the patents among other; challenged by the French Inventors. Briefly the process consists of a compression of a mixture of carbon monoxide gas with hydrogen gas under conditions of high temperature and high compression. In the matter of compression, the German practice at present is alleged to be at the rate of thirty-five hundred pounds to the square inch. According to the French an excess of hydrogen was discovered by them to be essential. They allege that the German thereupon corrected their practice and improved their process. Only a small portion of the gas compressed at one time unites and forms the liquid from which the synthetic methanol is recovered. It is claimed that there are other products of a merchantable character, mainly butyl alcohol. At present only a very small percentage of butyl alcohol results from the process. The Germans claim, however, that they are in the way of increasing the amount of butyl alcohol thus obtainable by a variance of their process. The question of the cost of production may now be considered as being rather vague. Cheap synthetic methanol depends upon cheap hydrogen.

Owing to the high pressures to which the apparatus is subjected extremely skilful mechanics must be employed in the engineering, manufacturing, erection, and operation. A financial statement by a prominent German connected with the process gives an estimate of the cost in this country of twenty million dollars for the production of six million gallons per year.

For several years at least the country will be dependent upon its methyl alcohol as produced by the plants using wood as the material for destructive distillation. As long as charcoal will have a demand in the market, it will probably be made by the present method with crude wood alcohol and acetate of lime as by-products which will necessarily be sold in direct competition with synthetic wood alcohol. In other words as long as there is a demand for charcoal, it will be cheaper to make charcoal with these two by-products no matter how low their market price rather than make charcoal without any by-products at all. Synthetic methanol must, therefore, compete with wood alcohol made as a by-product.

During the World War a special section or division was created by the War Industries Board to cover all the products resulting from the destructive distillation of wood. The suggestion is made that inasmuch as wood alcohol as a solvent is a partial substitute for ethyl alcohol in certain manufactures, that wood alcohol come under the same control as ethyl alcohol. The latter may be spared if necessity arises by compelling the use of wood alcohol as a substitute in a proper case. Another advantage of this control of wood alcohol by the same agency controlling

ethyl alcohol, is that as the Internal Revenue regulations call for its very extensive use as a denaturant of ethyl alcohol, (the so-called completely denatured alcohol), a control of the supply of wood alcohol for such purposes would necessarily spare a large quantity of ethyl alcohol from such extensive use by the public as for example an anti-freeze for automobile radiators.

Appended is a statement showing the amount of such anti-freeze based upon special figures of the Internal Revenue Department. In other words the simplest method of reducing this very extensive use of alcohol in automobile radiators could be readily accomplished by the control of the denaturant - wood alcohol - without which the anti-freeze mixture could not be sold under government regulations.

The present duty on wood alcohol is twelve cents a gallon, but by reason of the possible competition of synthetic wood alcohol produced in foreign countries, an application is pending to have the President exercise his authority to increase this protection by fifty per cent.

Priority.

As alcohol is an essential raw material the principles of priority are readily applicable both to the largest sources of raw material, imported blackstrap molasses, and the product itself. In connection with the molasses, the authority controlling the use of ships should be requested to release sufficient tonnage of tank steamers to cover the necessities of importations. This will involve, of course, the usual

incidentals of fuel and supplies for such ships, including replacements, dry dockage and repairs. As to the manufacture of alcohol, with the usual priorities as to fuel, repairs and replacements, the only question is the application of such priority to plants that are only partially engaged in production for the government. A special ruling will have to be made in each individual case, depending upon the volume of the production not required for government use. In other words a different question arises as to priority in case of a small plant producing say ten thousand gallons a day, five thousand of which are for government and five thousand for commercial account, and another plant producing sixty thousand gallons a day, of which thirty thousand are for government account and thirty thousand for commercial account. The question of granting the priority in either case will be the same but the question of what quantity say of fuel shall be covered by this priority is quite different in each case cited above. It has already been pointed out that the question of priority of labor will probably not arise because of the comparatively few men necessary to operate an alcohol distillery. The question of priority of transportation is next to fuel the most essential aspect of priority. It is, however, so self-evident that the greatest dispatch is necessary for prompt deliveries to powder factories and chemical warfare production that a high rating is essential. Even so, suitable provisions should be made at the receiving points for the accumulation of stocks as a protection to any break in transportation or in manufacture, and priority for the erection of such facilities should be given careful consideration.

As a matter of procedure, from the Commodity Committee should come a recommendation as to a proper priority rating, because of its special knowledge of total and partial demands of each branch. Naturally alcohol for the manufacture of powder, gas and other direct war uses, must have a direct war priority. It follows that subcontractors will have the same priorities as principal contractors. The several branches requiring material into the manufacture of which alcohol enters, report such list to the Commodity Committee. The result will be the following:

List of essential war products in the manufacture of which ethyl alcohol is necessary.

(Opposite each item will appear the branch which will make the requisition for the purpose mentioned.)

Classification of priority, within the ultimate general plan, is to be made, it being understood that temporary modifications will be made in urgent cases or crises, after request from the branch affected, and after obtaining the advice of the commodity committee.

All uses other than for war purposes will be qualified under the general rules adopted for priority sub-classification of non-war use.

This latter sub-classification to be modified on the recommendation of the Commodity Committee when it appears that a conservation program is required, by the requirements of the branches.

Allocations.

The several branches indicate their requirements by periods of alcohol either as such, or as entering into the manufacture of essential war requirements of each individual branch - first primary requirements and ultimately secondary requirements.

A sum total requirement will then be made, comparison will then be made with the total productive capacity of plants. This will determine whether there is <sup>a</sup> safe margin of productive capacity. If there appear danger of under-production immediate report must be made of the facts to the Facilities Section. If there be ample productive facilities, allocation to plants by districts must be made with relation to proximity of consuming points, for the purpose (a) of speedy delivery, (b) of conservation of traffic facilities, (c) of saving in freight rates.

Conservation.

The recommendation for the adoption of a conservation program will be based upon a shortage, actual or threatened of (a) raw material entering into the product; (b) an intermediate; (c) or the product itself.

Conservation of alcohol will be most readily procured by the curtailment of its use as an anti-freeze in motor radiators, because of the large quantity thus used. But as this use is necessarily seasonal, other restrictions must be determined at other seasons. The logical rule would be to first affect products made with alcohol which are luxuries, then non-necessities, providing by this method a sufficient quantity may be conserved.

District Organizations.

The District organizations under instructions as to allocation and priority will then function under the general plan of control established.

It will be the duty of these organizations to demand the strict performance under the contract and the priority. It will also be incumbent on the district organization to obtain such detailed and specific information from individual plants or factories as may be necessary, to determine whether the continued maximum production calculated for such plant, may be considered as assured for the proximate future.

All information gathered in the production districts demonstrating a change or a possible change in the reliability or rate of production, must be forwarded immediately through the proper channels for consideration and the recommendation of the Commodity Committee, as this will affect its data. The latter will in a proper case report to Requirement Section and ultimately the subject may have to be considered by the Facilities Section. The subjects for continued investigation in the several districts will cover the subjects of Power, Labor, Transportation, Fuel, etc., and pass

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through established channels to these control sections with comment to the Commodity Committee, so that the latter with its specific knowledge of requirement and the condition threatening supply may make its report and recommendation for action by way of (a) priority, (b) conservation, or (c) facilities. In all these cases the Commodity Committee recommends; it does not decide.

Internal Revenue Department.

Ethyl alcohol is probably the only product made, stored, packaged and delivered under direct Governmental control even in times of peace. All information as to the industry can, therefore, be obtained officially from a Governmental Bureau. Advantage should be taken of this by obtaining in first instance and later periodically, such data as is necessary for a comprehensive survey of the industry, always up to date.

Official request for the specific data required should be made to the Internal Revenue Department. Such request should be based upon figures of standard wine gallons rather than on proof gallons which latter are used as a basis of calculation of tax but not commercially. The weights of different formulae of denatured alcohol per wine gallon appear in the publications of the Internal Revenue Bureau.

Contracts.

Form of contract should be established, contemplating special specifications, and various denaturants as required.

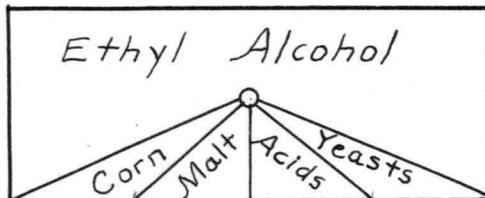
Prices should be on the basis of the unit of pure alcohol, with allowance for price of specific denaturant added. Contracts should also

cover cost of special packages, such as drums, cooperage, tins and glass containers. In the case of returnable packages such as drums in good order, contract should cover this. Freights should be for account of Government both from plant to delivery point and return of drums to plant. The bulk of purchases will probably be contracted by railroad tank car delivery.

Prices as established by competent authority. Payments in large commercial contracts are usually stipulated as due on the tenth of the month following deliveries. Some similar rule should be adopted by the Government.

Price Fixing.

The method should be as follows for Ethyl Alcohol:



The materials are:

Corn. - This is purchased by the bushel on well established gradings. The highest commercial gradings are not necessary for alcohol manufacture.

Malt. - This is either manufactured by the distiller or more usually purchased from the maltsters.

Acids. - Market purchases.

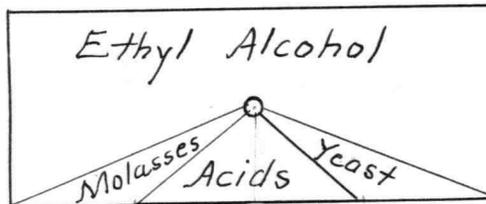
Yeasts. - These are made by the distillers in their yeasting departments. The yield on an average bushel of merchantable corn, according to

the facilities and skill of the grain distillers is from 2.50 to 2.60 wine gallons per bushel. In the determination of price the following elements must be considered. They of course vary in each plant or each company.

- 1. Conversion ( Fuel - Repairs and Maintenance  
( Labor - General Plant Expense.
- 2. Overhead.
- 3. Packaging.

Two by-products are obtained: Fusel oil (for general average production in relation to alcohol produced see table of Internal Revenue Department.)

Distillers Grains, sale price of which fluctuates with the sale price of corn.



The materials in this case are molasses. This is purchased on the standard gallon basis.

Acids - market purchases.

Yeasts - These are made by distillers in their yeasting departments.

The yield per average gallon of molasses is from .375 to .4 of a wine gallon of alcohol.

The by-product as in the case of grain fermentation and distillation is fusel oil.

Other by-products from molasses as a raw material, are in special cases derivatives from slop treatment, as potash salts, and ammonia.

From all fermentations in the alcohol process carbonic acid gas may be recovered, but only a small number of plants are equipped for this recovery.

During the Great War, the first determination was to use as much molasses as a raw material for alcohol as was procurable, in order to save the drain on the grain crops.

The price of alcohol was fixed after consulting the industry and was on an agreed basis. This was done under the jurisdiction of the Council of National Defense and its advisory committee on alcohol. This price was undisturbed by the War Industries Board. The difficult questions for decision were (a) Grain and molasses being available as raw material, should separate prices be established, one for alcohol derived from grain and another for alcohol derived from molasses. It was decided that as both grain and molasses had value in the feed industry and usually fluctuated in an equal ratio, that the price of alcohol from grain be established for that made from molasses.

(b) Should there be a distinction in price established on the basis of higher costs for small plants and lower costs for large plants? It was decided to fix one price only, mainly for the reason that the Government would be constrained to exhaust the capacities of the lower cost units, before calling upon the smaller plants. The latter would deteriorate and possibly be converted for other purposes, and therefore fail to be available in a crisis of demand. An example of conversion of an alcohol plant to other

purposes was the purchase of an alcohol distillery at Terra Haute by the British Government for the purpose of its conversion into an acetone plant, operating a fermenting process.

The wisdom of encouraging the smaller plants was proven by their availability, when late in 1918 the great demand for additional alcohol supplies was made by the gas program, a pound of alcohol being required for a pound of mustard gas.

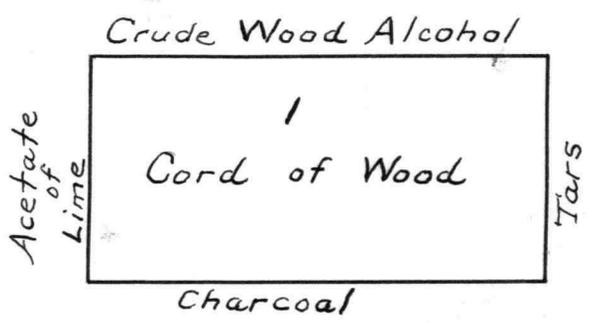
In any war emergency the first question should be the determination as to whether the Government should negotiate on a fixed price for the entire molasses crop of Cuba, as was done in the late war when the entire sugar crop of Cuba was bought by the Government.

This measure would undoubtedly (a) give greater control by reason of Government ownership of the molasses crop and hence initial power over the raw material, irrespective of the various controls, allocation, priority, and conservation; (b) it would place the raw material out of the sphere of competition and hence keep down its cost; (c) by keeping down the cost, the sympathetic fluctuation between molasses and grain will be checked and (d) as a consequence, two prices might be fixed, one for alcohol made from grain and a lower price for alcohol made from the molasses purchased and distributed by the Government.

Whatever price is fixed for alcohol manufactured by alcohol plants should be applied to recovery or by-product alcohol; but if two prices are established as above indicated, careful study should be made as to whether by-product alcohol should not bear the lower price.

The following is a guide for price fixing for methyl alcohol:

- 1. Conversion ) Fuel - Repairs and Maintenance  
                  ) Labor - General Plant Expense.
- 2. Overhead.
- 3. Packaging.



From each cord of wood there are obtained by its destructive distillation

- 10 gallons of 82° crude wood alcohol
- 200 pounds of Acetate of Lime
- 47 bushels of Charcoal.

Tars, thus far practically without market, are also obtained.

The crude wood alcohol is sent from producing points to specially equipped refineries.

From every 100 gallons of 82° crude wood alcohol there are obtained a total of 78 gallons of resultant as follows:

|                        |            |                   |
|------------------------|------------|-------------------|
| Pure methyl alcohol    | 99½ ° test | 60 gallons        |
| Methyl Acetone         | 86 ° test  | 15 gallons        |
| Impurities             |            | 3 gallons         |
| <b>Resultant Total</b> |            | <b>78 gallons</b> |

Initial Policies to be Determined on M-Day - Methyl Alcohol

- (1) Establishing price of crude.

(2) On the basis of established price of crude, to contract with the refiners, who are few in number.

Failure to control the price of the crude would result in immediate price advance, as extreme fluctuations are not uncommon in the history of this product.

Initial Policies to be Determined on M-Day -- Ethyl Alcohol.

1. Whether to purchase the entire Cuban molasses crop at a fixed price, domestic supplies to be acquired on a basis in fair relation to the Cuban price.

2. Whether oil burning distillery power plants should immediately be notified that they must change to coal as a fuel.

3. The issue of requirement certificates, if necessary, to enable the producers, despite civil contractual obligations to forthwith ship on Government allocation.

There was no scarcity of alcohol up to the termination of the Great War. In fact there was an assured supply for the Government and the allies including the export of alcohol to Europe in drums. There was likewise no scarcity for consumption by non-war requirements.

If however the full quota demanded by the gas program had been reached, additional facilities would have been required, and indeed were under construction at the time of the Armistice. Unless affected by disaster, the alcohol plants now established should amply cover Governmental needs. Raw material supply adequate for the supply of existing plants, might be the critical point. This depends largely upon keeping open the

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transportation of molasses from Cuba. An interruption of supply from this source, would endanger the productive facilities of the coastal alcohol plants which are not presently equipped to use grain as a raw material.

#### Legislation.

On the declaration of war, a law should pass authorizing producers to deliver their product on governmental requirement, despite civil contractual obligations, such certificates to serve pro tanto as a defence of force majeure, in any civil action for damages for non-delivery.

#### Contacts and Bibliography.

For a careful and exhaustive treatise on the various phases of ethyl alcohol, reference is made to the report submitted by W. C. Baker, Lt. Colonel, C.W.S.

For bibliography see list attached to "Information on Industrial Alcohol" by W. W. Skinner.

For contact on ethyl and methyl alcohol, James P. McGovern, Munsey Building, Washington, D. C.

For methyl alcohol refineries, President of Wood Products Company, Buffalo, New York.

For crude methyl alcohol, Wm. S. Gray, and Company, New York City.

Bureau of Standards and the Navy have information on the use of anhydrous alcohol as fuel.

For contact in Department of Agriculture:

H. S. Paine, Room 309B, 216 Thirteenth St., S.W.

**Treasury Department:**

Dr. Derasa, Major K. G. Riley, and Mr. R. H. Kipp,  
Building C, Sixth and D Streets, S.W. (Industrial  
Alcohol and Chemical Division).

**Foreign and Domestic Commerce:** Dr. Concannon and J. W.  
Wiseman (chemicals)

M. C. Whitaker, Vice President, U. S. Industrial Alcohol  
Company.

Editor of Oil, Paint and Drug Reporter might call for  
list of establishments which can manufacture war re-  
quirements for use in requesting allocations of  
facilities by District Chiefs.