

The Alcohol Glossary
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- A -

Å.

Abbreviation for **Ångstrom**.

Absolute Ethanol.

A pharmaceutical term for **anhydrous ethanol**. It is generally defined as having less than 1 per cent water.

Acetaldehyde.

Otherwise known as ethanal, acetic **aldehyde** or ethylaldehyde. A clear flammable liquid with a characteristic pungent odor. Chemical formula CH₃CHO. Boils at 21°C and freezes at -123.5°C. It is miscible with both **ethanol** and water. It has a narcotic effect on humans, and large doses may cause death by respiratory paralysis. It is a **congener** in the production of ethanol by **fermentation**, and is usually a major constituent of the **heads** fraction removed in **rectification**.

Acetic Acid.

Acetobacter.

A genus of **gram-negative**, aerobic **bacteria** comprising ellipsoidal to rod-shaped cells, as singles, pairs or chains. Otherwise known as acetic-acid bacteria or vinegar bacteria, they are able to oxidize **ethanol** to acetic acid. They may be responsible for loss of yield in ethanol production, if a **fermented mash** is agitated or aerated excessively.

Acetone.

Acid-Acid Process.

Acid-Enzyme Process.

Acid Hydrolysis.

The **hydrolysis** of a **polymer** by the use of acid. In the case of **starch** hydrolysis, acids may be used as an alternative to **enzymes** in either (or both) the **liquefaction** or **saccharification** processes.

Acid Washing.

A process in which **yeast** recovered from a finished **fermentation** is acidified to reduce the level of **bacterial contamination**, prior to recycling into a new fermentation.

A.D.M.

A.F.P.

A.G.

Aguardiente.

An unaged alcoholic beverage produced in Central and South America by the **distillation** of **beer** derived from the **fermentation** of sugar-cane juice or **molasses**. It is similar to a crude **rum**.

Akvavit.

Alcohol.

A member of a class of **organic** compounds containing carbon, hydrogen and oxygen. Considered as **hydroxyl** derivatives of **hydrocarbons**, produced by the replacement of one or more hydrogen atoms by one or more **hydroxyl** (-OH) groups. Under the modern IUPAC (International Union of Pure and Applied Chemistry) naming system, the name given to an alcohol is derived from the parent hydrocarbon, with the final "e" changed to "ol". Thus **methane-methanol**, **ethane-ethanol** etc. The principal alcohol in fuel and beverage use is ethanol, (otherwise known as **ethyl alcohol**.)

Alcohol-Fuel Permit (A.F.P.).

Aldehyde.

Alpha Amylase.

An **enzyme** used in the **liquefaction** of **starch**, in the grain-**mashing** process, prior to **saccharification** and **fermentation**. Alpha amylase **hydrolyzes** the long-chain **starch molecules** into short-chain **dextrins**. These are more suitable for subsequent saccharification by other enzymes to fermentable **glucose**. (Alpha amylase is an **endo-enzyme** in that it works from the inside of the **amylose** molecule, breaking it down more-or-less randomly.) In **beverage-alcohol** production, the alpha amylase enzyme may be derived from **malt** (sprouted barley), but in **fuel-ethanol** production, the enzyme is

obtained solely as a **bacterial** product. The enzyme molecule contains a calcium atom which is essential for its activity.

American Society for Testing and Materials (A.S.T.M.).

Amyl Alcohol.

The principal constituent of **fusel oil**. Otherwise known as **pentanol**. Chemical formula C₅H₁₁OH. Eight **isomers** exist, the commonest being primary **iso-amyl alcohol**.

Amylase.

The name given to any **enzyme** which **hydrolyzes** (or breaks down) **amylose**, which is a major component of **starch**.

Amyloglucosidase.

Amylopectin.

Amylose.

A major component of **starch** (together with **amylopectin**). The amylose **molecule** is composed of straight chains of hundreds of **glucose** units. In the grain-**mashing** process for **ethanol** production, amylose may first be broken down into short-chain **dextrins** by **alpha amylase**, which are, in turn, broken down into single glucose units by **amyloglucosidase**.

Anaerobic.

Anaerobic Digestion.

Ångstrom (Å).

A unit of length equal to one ten-billionth of a meter, used for measuring the diameter of chemical **molecules**. Thus, in **ethanol dehydration**, a **molecular sieve** material with holes 3 Ångstrom units in diameter, may be used to separate water, which has a 2.5 Å diameter, from ethanol which has a 4.5 Å diameter.

Anhydrous.

Antibiotic.

A chemical substance produced by **micro-organisms**, that has the capacity to inhibit the growth of other micro-organisms, or to destroy them. The antibiotic most commonly used in **ethanol** production is **penicillin**.

Antifoam (or Defoamer).

Antiscalant (or Scale Inhibitor).

Aquavit / Akvavit. (Various spellings.)

A name applied to various types of **distilled spirits** in northern Europe. In Germany it may apply to grape **brandy**. In Denmark it may apply to **grain spirits** flavored with caraway. In Sweden it may apply to grain spirits flavored with aniseed and dill.

Aqueous Solution.

Arabinose.

Arak.

Armagnac, or Armagnac (Grape) Brandy.

A **brandy** distilled in the Gers Département (county) in south-western France. The département is precisely divided into three regions, Bas-Armagnac, Haut-Armagnac, and Tenarèze, and these names may be used to further designate the armagnac product. Armagnac is normally produced in a single **pot-still distillation** of **wine** and is then aged in oak **barrels**.

Arrack / Arak. (Various spellings.)

-ase.

The suffix used to denote an **enzyme**. For example, the enzyme which breaks down **amylose** is referred to as an **amylase**.

A.S.T.M.

Atomic Weight.

Azeotrope.

The term used to describe a constant-boiling mixture. It is a mixture of two (or more) components which has a lower **boiling point** than either (or any) component alone. For example, water, which boils at 100°C, and **anhydrous ethanol**, which boils at 78.5°C form a constant-boiling-mixture, or azeotrope, at 78.15°C. The **vapor** of the mixture has the same composition as the liquid, and

therefore, no further concentration can be achieved by normal **distillation**. Under normal pressures, it contains approximately 97 per cent by volume ethanol (194° **proof**). It is very expensive in energy to attempt to reach 194° proof, so 190° proof is generally considered to be the practical, economic azeotrope limit for **fuel-ethanol** distillation.

Azeotropic Distillation.

- B -

Backset.

Bacteria (Singular: Bacterium).

Any of a large group of microscopic plants constituting the class Schizomycetaceae, having round, rod-like, spiral, or filamentous single-celled bodies that are often aggregated into colonies, are often motile by means of flagella, and reproduce by fission or by the formation of asexual resting spores. They may live in soil, water, organic matter, or the live bodies of plants and animals. In **ethanol** production, bacteria are significant in that they compete with **yeast** to ferment the available **sugars** in a **mash** to products other than ethanol, and cause losses in yield. However, some bacterial cultures may be added deliberately to **rum** fermentations, to help produce certain desired congeners. One genus of bacteria, **Zymomonas** is currently being examined commercially, for its ability to ferment sugars to ethanol.

Bacterial Contamination.

Balling (or Brix).

A scale used to measure the **specific gravity** of a liquid in relation to that of a **solution** of **sugar** in water. Each unit on the scale is equivalent to one percent by weight of sugar. Thus a **mash** of 20° balling has the same specific gravity as a 20 per cent w/w sugar solution. The scale is frequently considered to indicate the percentage of dissolved solids in a liquid, although this is only true of solutions of pure sugar. Traditionally, the term "Balling" has been used in grain **distilleries**, while "Brix" has been used in sugar mills and **rum** or **molasses**-alcohol distilleries. The measurement is accomplished by use of a Balling (or Brix) **hydrometer**.

Barbet Time.

Bargeload.

Barrel.

A liquid measure equal to 42 U.S. gallons, or 5.6 cubic feet. Or, a wooden container used for the aging and maturation of alcoholic beverages. Barrels used for **whiskey** maturation are made of oak wood, and have a capacity of about 52 **U.S. gallons**. Barrels may be used only once for aging **bourbon whiskey**, so there is a worldwide trade in used bourbon barrels for aging other alcoholic products such as **Scotch whisky** and **rum**.

Base Losses.

Batch Cooking.

Batch Distillation.

Batch Fermentation.

The fermentation of a set amount of **mash** in a single vessel, in a discontinuous operation. In the **ethanol**-production industries, batch fermentation predominates over **continuous fermentation**.

B.A.T.F.

Beer.

Beer Preheater.

Beer Still.

The **distillation** unit used for the initial removal of **ethanol** from finished **beer**. It generally consists of a **stripping section** which extracts the ethanol from the beer and a **concentrating or rectifying section**, which normally takes the ethanol up to 190° **proof** (95°**G.L.**). Beer stills may consist of a single tall **column**, or two or more columns standing side by side, linked by **vapor** pipes.

Beer-Stripping Column.

Beer Well.

Benzene.

Beta Amylase.

An **enzyme** which **hydrolyses** the long-chain **amylose molecules** in **starch** into fermentable **maltose**, the **dimer** (or double-molecule) of **glucose**. (It is an **exo-enzyme** in that it works from an outer end of the molecular chain, breaking off maltose molecules one by one.) It is found in **malt** (sprouted barley), in association with **alpha amylase**. With the advent of microbial **amyloglucosidase** enzymes, malt amylases are generally only used in the production of heavily-flavored **beverage alcohol**.

Beta Glucan.

Beta Glucanase.

Beverage Alcohol.

Binary Azeotrope.

An **azeotrope** or **constant boiling mixture** having two components, such as **ethanol** and water.

Bio-Ethanol.

Bio-Gas.

Biological Oxygen Demand (B.O.D.).

Biomass.

Blackstrap.

Blended Whisky.

Defined by the **B.A.T.F.** as a mixture which contains **straight whisky**, or a blend of straight whiskies, at not less than 20 per cent on a **proof-gallon** basis, excluding **alcohol** derived from added harmless coloring, flavoring or blending materials, and, separately, or in combination, **whisky** or **neutral spirits**. A blended whisky containing not less than 51 per cent on a proof-gallon basis of one of the (recognized) types of straight whisky, may be further designated by that specific type of straight whisky; e.g. "Blended rye whisky."

Blender Tax Credit.

B.O.D.

Boiler Efficiency.

Boiling Point.

Botanicals.

The term used to refer to the herbs, spices and other plant materials used in the production of **gin**. By definition, gin botanicals must include juniper berries and may include materials such as orange and lemon peels, iris (orris) root, coriander seed, fennel seed, angelica root, caraway seed, cinnamon bark, cassia bark, cardamom seed, etc.

Bourbon Whisky.

Brandy.

British Thermal Unit (B.T.U.).

The amount of heat required to raise the temperature of one pound of water one degree **Fahrenheit**, under defined pressure conditions. It is the standard unit for measuring heat energy in the U.S.

Brix.

B.T.U.

B.T.X.

Bubble Cap.

A contacting device used on some **distillation plates**. It consists of a cylindrical "chimney", set in a hole in the plate, covered by a dome-shaped cap, which deflects the **vapors** rising up the chimney, to cause them to pass through the liquid layer on the plate.

Bureau of Alcohol, Tobacco and Firearms (B.A.T.F.).

An agency of the Department of the Treasury entrusted with enforcing laws covering the production, distribution and use of **alcohol**, tobacco and firearms.

Bushel.

Butanol (Butyl Alcohol).

A minor constituent of **fusel oil**. Chemical formula C₄H₉OH. Four **isomers** exist. They are all colorless, toxic flammable liquids. n-Butanol may be produced as a **co-product** with **acetone** and **ethanol** by the **fermentation** of selected **carbohydrates** with the **anaerobic bacterium** Clostridium acetobutylicum. Butanols are used as **solvents** and chemical intermediates.

By-Products.

- C -

Calvados.

An apple **brandy** produced in Normandy, France, by the distillation of a fermented **mash** of apples. It is subjected to two **pot-still** distillations, and is then aged in oak **barrels**.

Canadian Whisky.

Carbohydrate.

Carbon Dioxide.

A colorless non-flammable gas. Composition CO₂. It does not support human respiration, and in high concentrations it causes asphyxiation. It is approximately 1.5 times the weight of air, and tends to accumulate in floor drains, pits and in the bottoms of unventilated tanks. It is produced by various means, notably the combustion of fuels in an excess of air, and is a **byproduct** of **yeast fermentation**. It may be recovered from fermentations and compressed to a liquid or solid ("dry-ice").

Carbon Monoxide.

Carbon Steel.

Caribbean Basin Initiative (C.B.I.).

Cassava.

A root crop with a high **starch** content, grown in the tropics and sub-tropical regions. Known in Brazil as "**manioc**", it is used there as an alternative to sugar cane, as a **feedstock** for **ethanol** production. It is also processed for food as "tapioca."

C.B.I.

C.C.C.

C.D.A.

Cell Recycle.

Cellulase.

An **enzyme** capable of **hydrolyzing** long-chain **cellulose molecules** into simple **sugars**, or into short-chain **polymers**.

Cellulose.

Celsius (or Centigrade).

A temperature scale in which (at normal atmospheric pressure), water freezes at zero degrees and boils at 100 degrees.

Centrifugal Pump.

Centrifuge.

Chemical Oxygen Demand (C.O.D.)

Chlorine Dioxide.

Chemical formula ClO₂. It is a strongly-oxidizing, yellow-to-reddish-yellow gas at room temperatures. It has an unpleasant odor, similar to that of chlorine, and reminiscent of that of nitric acid. It is unstable in light. It reacts violently with **organic** materials and is easily detonated by sunlight or heat, in concentrations greater than 10 per cent at atmospheric pressure. Boils at 11°C and freezes at -59°C. Chlorine dioxide may be used as a sterilant, and may be produced in situ for sterilizing **yeast mashes**, by addition of sodium chlorite **solution** in the presence of acids or chlorine (or hypochlorite solution). It is considerably more effective as a sterilant than straight chlorine.

Chromatography.

C.i.p. System.

Citrus Molasses.

A **by-product** of the citrus juice industry. Citrus residue, mainly peel, is treated with lime, and then passed through a press. The press liquor is then evaporated to a viscous, dark-brown **molasses**, of about 72° **Brix**. Citrus molasses is similar to cane **blackstrap molasses**, having about 45 per cent total **sugars**. However, it has more **protein** and a much lower ash content than blackstrap. Citrus molasses may be diluted and fermented for **ethanol** production, but it may need pretreatment to reduce the

content of d-Limonene, (commonly referred to as "citrus-stripper oil") which tends to inhibit **yeast** growth.

Cleaning-in-place System (C.i.p.).

Closed Receiver.

C.M.S.

Coccus (Plural = Cocci).

A type of **bacteria** whose cells are spherical in form. They may occur as single cells, clusters or long chains.

C.O.D.

Cognac or Cognac (Grape) Brandy.

Column.

Co-Mingled Tank.

The term used for **fuel-ethanol** tanks at refineries or pipeline terminals, where two or more suppliers may share the same tank for storing their **ethanol**. (This necessitates the tank owner or operator establishing quality standards for product put into the tank.)

Commodity Credit Corporation (C.C.C.).

Completely-Denatured Alcohol (C.D.A).

A term used by the **B.A.T.F.** to describe **ethanol** which has been made unfit for human consumption by addition of specified **denaturants** such as methyl-isobutyl-ketone, **kerosene** or **gasoline**.

Concentrating Column.

Condensate.

Condensed Molasses Solubles (C.M.S.).

The term used to describe **molasses stillage** which has been concentrated by **evaporation**. The molasses residue (after **fermentation** and **distillation**, may be concentrated to about 60° **Brix** (or approximately 60 per cent solids), to be sold for use as a substitute for molasses in animal feeds. Its principal use in feeds is as a caking agent and dust suppressant. It contains a high concentration of salts.

Condenser.

Congeners.

Chemical compounds which are produced together with **ethanol** in the **fermentation** process. They are frequently referred to as "impurities". Common congeners are **methanol**, **acetaldehyde**, **esters** (such as **ethyl acetate**), and **fusel oils**, (**higher alcohols**, particularly **amyl alcohols**.) Fermentation conditions may be adjusted to control congener formation, depending on the requirements for the end product.

Constant-Boiling Mixture.

Continuous Cooker.

A system into which a **mash** of water, grain and **enzymes** may be fed continuously, to be cooked and discharged to the **fermentation** system. Continuous cookers generally consist of a **slurry tank** connected by a pump to a steam-jet heater, a holding vessel or lengths of piping (to provide some residence time at the cooking temperature), one or more flash vessels (to cool the cooked mash) a holding vessel for enzymic **liquefaction**, and a **heat exchanger** for final mash cooling. Continuous cookers are more common in **fuel-ethanol** plants than in **beverage-alcohol** plants.

Continuous Distillation.

Continuous Fermentation.

Control Loop.

Conversion.

Cooker.

Cooling tower.

Cooper.

Cooperage.

A place where wooden **barrels** are made or repaired. Also used to refer to a supply of barrels (i.e. the product of the work of a **cooper**).

Co-products.

Cordials.

Corn-Steep Liquor.

Corn Whisky.

Defined by the **B.A.T.F.** as "**whisky** produced at under 160° **proof**, from a fermented **mash** containing not less than 80 per cent corn grain". If corn whisky is stored in oak **barrels**, the B.A.T.F. stipulates that the proof should not be more than 125°, and that the barrels be used, or uncharred, if new. Furthermore, the whisky cannot be subjected to any treatment with charred wood.

Corrosion.

Corrosion Inhibitor.

Co-Solvent.

Country Liquor.

Crude-Oil-Windfall-Profits Tax Act of 1980.

Cyclohexane.

A colorless, flammable, alicyclic **hydrocarbon** liquid, of chemical formula C₆H₁₂, which boils at 80.3°C, and freezes at 6.5°C. It is used as an alternative to **benzene** as an **entrainer** in the **dehydration** of **ethanol** by **azeotropic distillation**.

- D -

D.D.G.

D.D.G.S.

D.E.

Deadleg.

Dealer Tank Wagon (D.T.W.).

Decanter.

Vessel used for the separation of two-phase liquids. In a **fusel-oil** decanter, an upper fusel-oil phase is separated from a lower aqueous-**ethanol** phase. In a **benzene**-column **reflux** decanter, the upper, mainly-benzene phase is separated from the lower, mainly-water phase. See **Phase Separation**.

Deficit-Reduction Act of 1984.

Defoamer.

Dehydration.

The process of removing water from a substance, particularly the removal of most of the remaining 5 per cent of water from 190° **proof ethanol**, in the production of **absolute** or **anhydrous ethanol**.

Demethylizing column.

Denaturant.

A substance added to **ethanol** to make it unfit for human consumption, so that it is not subject to taxation as **beverage-alcohol**. The **B.A.T.F.** permits the use of 2 - 5 per cent of unleaded **gasoline** (or similar, specified substances) for use as denaturants for **fuel ethanol**. (See also **specialty-denatured alcohol** and **completely-denatured alcohol**.)

Denatured Alcohol.

Department of Energy. (D.o.E.).

Dephlegmator.

Desiccant.

Detergent Package.

Dewatering.

Dextran.

A non-fermentable, large, branched-chain **polymer** of **sucrose molecules**, produced in **molasses** by **bacterial contamination** (mainly *Leuconostoc mesenteroides*). It gives a "ropey" appearance to molasses when stirred or poured, and reduces **ethanol** yield on **fermentation**.

Dextrin.

Dextrose.

Dextrose Equivalent (D.E.).

A measure of the degree of **hydrolysis** or **saccharification** of **starch**. It is no longer considered as significant as previously in **ethanol** production, with the more general acceptance of **simultaneous saccharification and fermentation**.

Di-Ethyl Ether.

Differential-Pressure Cell (D.P. Cell).

Dimer.

Disaccharide.

A compound **sugar** which yields two **monosaccharide** units on **hydrolysis**. For example, **lactose** yields **glucose** and **galactose**, **sucrose** yields glucose and **fructose**, while **maltose** yields two glucose units.

Disc-and-Donut Column.

Distilland.

Distillate.

Distillation.

Distilled Spirits.

Distilled-Spirits Permit (D.S.P.).

Distillers Bushel.

56 lbs of any grain, regardless of volume.

Distillers Dried Grain (D.D.G.).

The dried residual **by-product** of a grain-**fermentation** process. It is high in **protein**, as most of the grain **starch** has been removed. It is used as an animal-feed ingredient. By strict definition, D.D.G. is produced only from the solids separated from **whole stillage** by **centrifuging** or screening. In practice, the term is commonly used to describe the entire dried-stillage residue, making it synonymous with **D.D.G.S.**

Distillers Dried Grain with Solubles (D.D.G.S.).

Distillers Dried Solubles.

Distillers Feeds.

Distillers Feeds Research Council.

An organization established in the U.S. in 1945, to fund and coordinate university research into the utilization of **D.D.G.** It holds an annual conference in early April to publicize its findings. It was previously a division of the Distilled Spirits Council of the U.S., which is a **beverage-alcohol**-producers organization. It is now an independent body with membership open to all **alcohol** producers. Its headquarters are in Des Moines, IA.

Distillers Wet Grain (D.W.G.).

Distillery.

Distillery-run Barrels.

Recently-emptied, used **whiskey barrels** which have not been sorted to remove those with or without defects.

DMA 67Y.

Downcomer (or Downpipe).

D.P. Cell.

Dried-Fruit Brandy.

Dry Degermination.

A process for the removal of germ from grain without the need for steeping and **wet milling**. It may involve some pretreatment of the grain to raise the moisture content before processing. It is used in Scotland for corn milling in **grain-whisky** plants, and is used in the production of corn flakes, but is not commonly used in the U.S. **ethanol**- production industry.

Dry Milling.

D.S.P.

D.T.W.

Dual-Flow Plate (or Tray).

Dunder.

A Caribbean synonym for **vinasse** or **molasses stillage**. It is commonly used to refer to vinasse which

has been stored for some time, to allow bacterial development, prior to being used as **backset**, in the production of heavily-flavored **rums**.

Dupont Waiver.

D.W.G.

- E -

Eau de vie (Plural: Eaux de Vie).

E.D.

Effect.

E.I.T.C.

Endo-Enzyme.

An **enzyme** which acts on internal portions of a large **polymeric molecule** rather than around the periphery. For example, the **alpha amylase** enzyme **hydrolyses** linkages within **amylose** and **amylopectin** molecules, as an endo-enzyme. In contrast **amyloglucosidase** acts as an **exo-enzyme** in only hydrolyzing the outermost linkages.

Energy-Investment-Tax Credit (E.I.T.C.).

Energy-Policy Act of 1992.

Energy-Security Act of 1980.

Energy-Tax Act of 1978.

U.S. federal legislation which instituted the first **excise-tax exemption** for **gasoline** blended with 10 per cent **fermentation ethanol**. It exempted the blends from the entire tax of 4 cents per gallon. It also created an **energy-investment-tax credit (E.I.T.C.)** of 10 per cent, which applied to equipment for converting **biomass** to ethanol, in addition to the standard 10 per cent investment-tax credit.

Entrainer.

Environmental Protection Agency (E.P.A.).

Enzymatic Hydrolysis.

The **hydrolysis** of a **polymer** by the use of **enzymes**. In the case of **starch** hydrolysis, an **alpha amylase** enzyme may be used in the initial hydrolysis to achieve **liquefaction**, and an **amyloglucosidase** enzyme may be used to complete the hydrolytic **saccharification** to **fermentable sugars**.

Enzyme.

E.P.A.

Ester.

E.T.B.E.

Ethanol.

Otherwise known as **ethyl alcohol**, "**alcohol**", "**grain-spirit**", or "**neutral spirit**", etc. A clear, colorless, flammable **oxygenated hydrocarbon**. Chemical formula: C₂H₅OH. It has a **boiling point** of 78.5°C in the **anhydrous** state. However, it forms a **binary azeotrope** with water, with a boiling point of 78.15°C at a composition of 95.57 per cent by weight ethanol.

Ether.

Ethyl Acetate.

Ethyl Alcohol.

Ethyl Carbamate.

Ethylene Glycol.

Ethyl Tertiary-Butyl Ether.

Evaporation.

Evaporator.

Excise-Tax Exemption.

Extractant.

Extractive Distillation.

A process in which a substance referred to as an **extractant** is added to a mixture being distilled, to

change the **volatility** of one or more components. The less-**volatile** mixture will then descend in a **continuous-distillation column**, while the more volatile components may be removed in the condensed **overhead vapors**. In the use of extractive distillation in the **dehydration** of **ethanol**, liquid extractants such as **ethylene glycol**, or **glycerol** may be used. Salts such as potassium and sodium acetates may also be used alone in molten form, or in mixtures with glycerol etc. **Anhydrous ethanol** is recovered in the overhead **condensate**, while the water combines with the extractant to emerge from the bottom of the column. (This is the reverse of the situation in **azeotropic distillation**, as with **benzene**, etc.) The extractant is then separated from the water in another column (or an **evaporator**) and is recycled.

In the production of **neutral spirit**, light **rums** or **whiskies**, extractive distillation may be used to remove **fusel oils** and some other **congeners** in the condensed **overhead vapors**. In this instance, the extractant is water, as some of the congeners which have a lower **volatility** than **ethanol** in a concentrated state, may have a higher volatility than ethanol when diluted with water, so that they rise up the extractive distillation column, while the ethanol descends.

Exo-Enzyme.

- F -

Facultative Anaerobe.

Term used to describe a microorganism such as a **yeast**, which is essentially aerobic (or air-requiring), but can also thrive under **anaerobic** (or air-free) conditions.

Fahrenheit Scale.

A temperature scale in which the **boiling point** of water is 212°F and the freezing point is 32°F. (The zero point was originally established as the lowest point obtainable with a mixture of equal weights of snow and common salt.)

Farmers Home Administration (FmHA).

Federal Excise-Tax Exemption.

Feed Plate (or Feed Tray).

The **plate** or **tray** onto which the **distilland** (liquid to be distilled) is introduced in a **distillation column**. In theory, it is the point in a column above which enrichment or concentration occurs, and below which stripping occurs.

Feedstock.

Fermentable Sugars.

Fermentation.

Fermentation Efficiency.

The measure of the actual output of a **fermentation** product such as **ethanol**, in relation to the **theoretically-obtainable yield**.

Fermentation Ethanol.

Fermenter.

The vessel in which the process of **mash fermentation** takes place. The vessel may be fabricated from steel, fiberglass, etc., and is normally fitted with an internal or external cooling system for controlling the temperature of the fermenting mash.

F.F.V.

Flame Arrester.

Flash Cooling.

Flash Point.

Flavored Distilled Spirits.

Flexible-Fueled Vehicle (F.F.V.).

Flocculation.

Floc de Gascogne.

Flowmeter.

FmHA.

Fluidized-Bed-Combustion Boiler.

Fossil Fuel.

Fractional Distillation.

A process of separating mixtures such as **ethanol** and water, by boiling and drawing off the condensed **vapors** from different levels of the **distillation column**.

Fructose (or Levulose).

A fermentable **monosaccharide**, or simple, single-unit **sugar**, of the chemical formula C₆H₁₂O₆. Its chemical structure is similar to that of **glucose**, but it has the distinction of being sweeter to the taste. It may be produced from glucose by enzymatic **isomerization**, as in the production of **high-fructose corn syrup (HFCS)**.

Fruit Brandy.

Fuel-Grade Ethanol.

Fuel Ethanol.

Usually denotes **anhydrous ethanol** or **motor-fuel-grade ethanol** which has been **denatured** by addition of 2 - 5 per cent unleaded **gasoline**, and which is intended for use as an automotive fuel in blends with gasoline.

Fungible.

Fusel Oil.

Term used to describe the **higher alcohols**, generally the various forms of **propanol**, **butanol** and **amyl alcohol**, which are **congeners**, or **by-products** of **ethanol fermentation**. Normally, predominantly iso-amyl alcohol. Their presence in alcoholic beverages is known to be a cause of headaches and hangovers. The fusel oils have higher **boiling points** than ethanol and are generally removed in the **distillation** process, to avoid accumulations in the **rectifier**. They may be subsequently added back into the **anhydrous** product for **motor-fuel-grade ethanol**.

Fusel-Oil Decanter.

- G -

Galactose.

A **monosaccharide**, of chemical formula C₆H₁₂O₆, which, with **glucose**, is a constituent of the **disaccharide lactose**. It is an **isomer** of glucose, but is less-readily fermented by **yeasts** to **ethanol**.

Gallon.

Gas Chromatography (G.C.).

Gas-Liquid Chromatography.

Gasohol (or Gasahol).

A trade name registered in Nebraska in 1973, by the Nebraska Agricultural Products Industrial Utilization Committee, which was later renamed the **Nebraska Gasohol Committee**. (The committee was responsible for laying the groundwork for the development of the present-day U.S. **fuel-ethanol** industry.) The trade name, in either spelling, covers a blend of **anhydrous ethanol** "derived from agricultural products" with **gasoline** (not necessarily unleaded). The committee has freely granted permission for commercial use of the trade name, provided it is not used for blends containing **alcohols** other than **ethanol**.

Gasoline.

Gasoline Extender.

Gay Lussac (G.L.).

The name given to a scale of the concentration of **ethanol** in mixtures with water, where each degree is equal to 1 per cent by volume (i.e. 1° G.L. is equivalent to 2° U.S. **proof**.) It takes the name from the French chemistry pioneer, Joseph-Louis Gay Lussac. The scale is used extensively in Europe, South America etc.

Gay Lussac Equation.

G.C.

Gear pump.

Gelatinization.

In reference to the cooking of starchy **feedstocks**, gelatinization is the stage in which the **starch** granules absorb water and lose their individual crystalline structure to become a viscous liquid gel. Gelatinization is significant in that it is the preliminary process necessary to render starch susceptible to **enzymatic hydrolysis**, for conversion to **fermentable sugars**.

Geneva Gin.

Gin.

G.L.

G.L.C.

Glucamylase.

An **enzyme** which **hydrolyses starch** into its constituent **glucose** units. (See **Amyloglucosidase**.)

Glucan.

Glucanase.

An **enzyme** which **hydrolyses** glucan. (See **Beta Glucanase**.)

Glucose.

Glucose Isomerase.

Glucosidase.

Glycerol (or Glycerine).

A clear, colorless, viscous, sweet-tasting liquid belonging to the **alcohol** family of **organic** compounds. It has a chemical formula of $\text{CH}_2\text{OHCHOHCH}_2\text{OH}$, having three **hydroxyl** (OH) groups. It is a **by-product** of alcoholic **fermentations** of **sugars**. It is **hygroscopic**, and may be used as an **extractant** in the **dehydration** of **ethanol**.

Grain Alcohol.

Grain Spirit.

Grain Whisky.

Grain Sorghum.

(Otherwise known as "**milo**"), a sorghum grown for grain production, as distinct from **sweet sorghum** grown for the **sugar** content of its stem. It may be used as a **feedstock** for **ethanol** production.

Gram Negative.

Gram Positive.

Gram Stain.

Grappa, or Grappa Brandy.

- H -

Hammer Mill.

Heads.

Term used to describe the impurities produced in **ethanol fermentations** ("**congeners**"), which have lower **boiling points** than ethanol. They include **methanol** and **aldehydes**.

Heads-concentrating column.

A **distillation column** used to concentrate **heads** removed in the production of **neutral spirit**, light **rums** and **whiskies**.

Heat Exchanger.

Heat of Condensation.

Heat of Vaporization.

Hemicellulose.

Hexose.

H.F.C.S.

Hiag Process.

A process developed in Germany in the 1930's for the **dehydration** of **ethanol** by **extractive distillation**, using a mixture of sodium and potassium acetates as the **extractant**.

High Boilers.

Higher Alcohols.

Alcohols having more than two carbon atoms within their **molecule**. They exist in various isomeric forms. As the number of carbon atoms increases, so also the number of **isomers** increases, but at a greater rate. The lower members of this group, namely **propanol**, **butanol** and **amyl alcohol**, are major constituents of **fusel oil**.

High-Fructose Corn Syrup (H.F.C.S.).

High-Performance Liquid Chromatography (H.P.L.C.).

High-Test Molasses (H.T.M.).

Hogshead.

A wooden **barrel** with a capacity of approximately 66 **U.S. gallons** (250 **liters**), used in Scotland for aging **whisky**. It is usually constructed from **shooked**, **bourbon-whiskey** barrels, of 52 gallons capacity, by using additional staves and larger heads and hoops.

Holland's Gin or Geneva Gin.

H.P.L.C.

H.T.M.

Hydrocarbon.

Hydrolysis.

Hydrometer.

A direct-reading instrument for indicating the density, **specific gravity** or other similar characteristics of liquids. It is generally comprised of a long-stemmed glass tube with a weighted bottom, which floats at different levels in liquids of different densities. The reading is taken at the meniscus, where the calibrated stem emerges from the liquid. The liquid temperature is normally determined when taking a reading, and reference is made to hydrometer tables to obtain a correction to a standard temperature. A **proof** hydrometer measures the content of **ethanol** in a mixture with water. A **brx** or **balling** hydrometer measures on a scale equivalent to the percentage of **sugar** by weight in an **aqueous solution**.

Hydroselection column.

Hydrous Ethanol.

Hygroscopic.

Term used to describe a substance which has the property of absorbing moisture from the air.

Anhydrous ethanol is hygroscopic, and its exposure to moist air should therefore be minimized.

Hydroxyl Group.

- I -

I.D.R.B.

I.M.F.L.

Imperial Gallon.

A measure of volume in the British system, defined in 1824 as the volume occupied by 10 pounds weight of water at 62°F and 30 inches of barometric pressure. It is the equivalent of 11/5 U.S. gallons, or 4.546 liters in the metric system.

Indian-Made Foreign Liquor (I.M.F.L.).

Industrial Alcohol.

Denotes any **ethanol** which may be intended for industrial uses, such as **solvents**, **extractants**, antifreezes and intermediates in the synthesis of innumerable **organic** chemicals. The term covers ethanol of both **synthetic** and **fermentation** origin, of a wide range of qualities and **proofs**, with or without various **denaturants**.

Industrial-Development Revenue Bonds (I.D.R.B.).

Inoculum

The portion of a culture of **yeast** (or **bacteria**) which is used to start a new culture or a **fermentation**.

Inulin.

Inulinase.

An **enzyme** capable of **hydrolyzing inulin** to its component **fructose** units.

I.P.E.

Irish Whiskey.

Iso-Amyl Alcohol.

Isomer.

Isomerase.

Isomerization.

Iso-Propyl Ether (I.P.E.).

An ether (otherwise known as di-iso-propyl ether), which is used in some **fuel-ethanol** plants as an **entrainer** in the **dehydration** process, as an alternative to **benzene** etc. It is a colorless, volatile liquid, chemical formula (CH₃)₂CHOCH(CH₃)₂, which boils at 67.5°C and freezes at -60°C. It readily forms explosive mixtures with air. Inhalation of vapors may cause narcosis and unconsciousness.

- J -

Jet Cooker.

An apparatus for the **continuous cooking** of grain **mashes**, in which the mash is pumped past a jet of steam which instantly heats the mash, to **gelatinize** the **starch**.

Jobber.

[\(Return to top\)](#)

- K -

Karl Fischer Titration.

A method to chemically determine the amount of water present in a sample of **ethanol** and/or other substances. When correctly practiced, the method can give an extremely accurate measurement of very small quantities of water in ethanol (in parts per million), even if **gasoline denaturant** is present. See **Titration**.

Kerosene.

Kjeldahl Method.

Kluyveromyces fragilis (or marxianus).

A **lactose**-fermenting **yeast** used in the production of **ethanol** from cheese **whey**.

Kubierschky Process.

The first patented process for the continuous **dehydration** of **ethanol** with **benzene**. With relatively minor variations, the process developed in 1914 on the basis of Young's earlier batch process, is still used in many **fuel-ethanol** plants.

- L -

Lactase.

Lactic Acid.

Lactobacillus.

A genus (or class) of **bacteria** which produce **lactic acid** as a major product in the **fermentation** of **carbohydrates**. They are found extensively in fermenting food products, such as souring milk and in grain dust. They are the principal cause of loss of yield in **ethanol fermentations**. Otherwise referred to as lactic-acid bacteria, they are generally **gram-positive** and controllable with **penicillin** and certain other **antibiotics**.

Lactose.

Lag Phase.

Applied to **yeast propagation**, refers to the initial period in which the yeast **inoculum** becomes adapted to the **mash**, prior to attaining the rapid increase in cell numbers referred to as the **logarithmic phase**.

Latent Heat.

Lead Phase-Out.

Lees.

Lees Brandy.

Defined by the **B.A.T.F.** as **brandy** distilled from the **lees** of standard grape, citrus or other fruit **wine**. It is designated "lees brandy", and qualified by the type of fruit from which the lees were derived.

Levulose.

Light Whisky.

Lignin.

Lignocellulose.

Lime.

Liquefaction.

The change in the phase, or conversion of a solid substance to the liquid state. In reference to **starch**, it is the stage in the **cooking** and **saccharification** process, in which **gelatinized starch** is partially **hydrolyzed** by an **alpha amylase enzyme** (or occasionally by an acid) to give soluble **dextrins**. This converts the starch **mash** into a free-flowing liquid.

Liqueurs and Cordials.

Liter (or Litre).

Loan Guarantee.

Logarithmic Phase.

Applied to **yeast propagation**, refers to the period in which cell numbers are increasing at an exponential rate, after the initial **lag phase**.

Low Boilers.

L.P.A.

- M -

Macromolecule.

Malt.

Barley grains which have been steeped in water and then allowed to germinate. The germination is normally halted by drying the grains when the sprouts are about the same length as the grains. At this stage, the malt (or "malted barley") contains considerable amounts of **alpha** and **beta amylase enzymes**, which can **saccharify** the barley **starch** and other additional starch in a **mash**, to yield **fermentable sugars**. (In Scotland, the drying may be done by exposing the malt to a flow of peat smoke. This imparts a smokey odor to the malt.) Malt is used in **whisky** production, mainly for its contribution to product flavor, while in **fuel-ethanol** production the necessary saccharifying enzymes are normally derived from microbial sources.

Malt Wine.

Malt Whisky.

In the U.S., it is defined by the **B.A.T.F.** as a **whisky** produced at less than 160° **proof** from a fermented **mash** containing at least 51 per cent malted barley, and stored at under 125° proof in charred, new, oak **barrels**. In Scotland, malt whiskies are made from a 100 per cent malted-barley mash, and may be aged in previously-used, oak barrels. Malt whiskies may be mixed with **grain whiskies**, to impart much of the characteristic flavor of blended **Scotch whisky**.

Maltase.

Maltose.

Manioc.

Mannose.

Marc Brandy.

Mash.

A mixture of milled grain or other fermentable **carbohydrate** in water, which is used in the production of **ethanol**. The term may be used at any stage from the initial mixing of the **feedstock** in

water, prior to any **cooking** and **saccharification**, through to the completion of **fermentation**, when it becomes referred to as "**beer**".

Mashbill.

McCabe-Thiele Diagram.

Meal.

Mechanical Vapor Recompression (M.V.R.).

Metabolism.

Methane.

Methane Digester (or Anaerobic Digester).

Methanol (or Methyl Alcohol).

A colorless poisonous liquid, with essentially no odor and very little taste. It is the simplest **alcohol**, and has a formula CH₃OH. It boils at 64.7°C. It is miscible with water and most **organic** liquids, including **gasoline**. It is extremely flammable, burning with a nearly invisible blue flame. It is a **congeneric** product of **ethanol fermentations**. Having a lower **boiling point** than ethanol, it tends to be a major component of the "**heads**" stream on **distillation**. Due to its miscibility with **benzene**, its presence in a hydrous ethanol feed may reduce the efficiency of **dehydration** processes where benzene is used as an **entrainer**. Methanol is produced commercially by the catalyzed reaction of hydrogen and carbon monoxide. It was formerly derived from the destructive distillation of wood, which caused it to be known as "**wood alcohol**". Methanol may be blended with gasoline, but requires a **co-solvent** such as ethanol or a **higher alcohol** to maintain it in **solution**. See **Dupont Waiver**. See **Demethylizing Column**.

Methyl Tertiary Butyl Ether (M.T.B.E.).

A colorless, flammable, liquid **oxygenated hydrocarbon**. Chemical formula (CH₃)₃COCH₃. It contains 18.15 per cent oxygen and has a **boiling point** of 55.2°C. It is produced by reacting **methanol** with **isobutylene**. Its use as an **octane enhancer** in **gasoline** has been approved by the **E.P.A.**, at levels of up to 15 per cent.

M.F.G.E.

Micro-Organism.

Milo (or Milo-Maize, or Millet, or Grain Sorghum).

Molar Solution.

Molasses.

The thick liquid remaining after **sucrose** has been removed from the mother liquor (of clarified concentrated cane or beet juice), in **sugar** manufacture. **Blackstrap** molasses is the syrup from which no more sugar may be removed economically. It has usually been subjected to at least three **evaporating** and **centrifuging** cycles to remove the crystalline sucrose. Its analysis varies considerably, depending on many factors, including sugar-mill equipment and operational efficiency, but it may contain approximately 45 - 60 per cent by weight of **fermentable sugars** and approximately 10 per cent ash (or salts). It is commonly used as an **ethanol feedstock** when prices are favorable. **High-test molasses (H.T.M.)** is not a true molasses, as it is the mother liquor from which no crystalline sugar has been removed by centrifugation, but which has been treated with acid to reduce crystallization. It may contain approximately 80 per cent by weight of sugars, and is very low in ash. It is normally only produced in years when the sugar price does not justify its recovery. It may be used as an ethanol feedstock when prices are favorable, and has the advantage over blackstrap of causing less **distillation-column scaling** due to ash. However, it requires more nutrients for **fermentation**. See also **Citrus Molasses**.

Mole.

Molecule.

Molecular Sieve.

A microporous substance composed of materials such as crystalline alumino-silicates, chemically similar to clays, and belonging to a class known as **zeolites**. The size of the pores in the substance may vary with its chemical structure, being generally in the range of 3 to 10 **Ångstrom (Å)** units in diameter. With material having a very precise pore size, it is possible to separate smaller **molecules** from larger ones, by a sieving action. For example, in **ethanol dehydration** with a **potassium**

alumino-silicate material prepared with pores of a diameter of 3Å units, water molecules with a diameter of 2.5Å may be retained by adsorption within the pores, while **ethanol** molecules of a diameter of 4Å cannot enter, and therefore flow around the material.

The term "molecular sieve" is frequently used loosely to describe the entire ethanol-dehydration apparatus which holds the beads of sieve material and includes the equipment and controls necessary to regenerate them when saturated with water.

Molecular Weight.

M.O.N.

Monomer.

Monosaccharide.

Mother Yeasting.

Motor-Fuel-Grade Ethanol (M.F.G.E.).

Motor Octane Number (M.O.N.).

M.S.W.

M.T.B.E.

Multiple-Effect Evaporator.

Municipal Solid Waste (M.S.W.).

M.V.R.

- N -

Nebraska Gasohol Committee.

A committee previously known as the Nebraska Agricultural-Products-Utilization Committee. Starting in 1973, it was responsible for initiating trials on the use of **ethanol-gasoline** blends, which led to the development of a nationwide **fuel-ethanol** industry. It is the registered owner of the trade name "**Gasohol**" or "**Gasahol**".

Net Energy Balance.

Neutral Brandy.

Neutral spirit.

Defined by the **B.A.T.F.** as "**distilled spirits** produced from any material at or above 190° **proof**". In practice, neutral spirit is purified, odorless, tasteless and colorless **ethanol**, which has been produced by **distillation** and **rectification** techniques which remove any significant amount of **congeners**. It is used in the production of beverages such as **vodka**, **gin**, **cordials**, and cream **liqueurs**.

Nitrogen Oxides.

Normal Solution.

Nox.

- O -

Occupational-Safety and Health Administration (O.S.H.A.).

Octane.

Octane Enhancer.

Octane Rating (or Octane Number).

O.F.A.

Office of Alcohol Fuels.

A division of the **U.S. Department of Energy** charged with a wide range of activities to promote the development of the production and use of **alcohol** fuels. It was established by the **Energy-Security Act of 1980**.

Oil Price Information Service (O.P.I.S.).

Oligomer.

Oligosaccharide.

Short-chain **polymers** of simple **sugars** (or **monosaccharides**), generally considered to cover the range of 2 to 8 units. Short **dextrins** produced by **hydrolysis** of **starch** are included in this category.

Omnibus Reconciliation Act of 1990.

O.P.I.S.

Organic.

Organoleptic Testing.

The quality-control process of checking samples of alcoholic products on the basis of odor and taste. It is normally performed by comparing samples of new production with older samples of acceptable quality, which have been designated for use as "standards".

Orifice Meter.

O.S.H.A.

Ouzo.

An aniseed-**flavored distilled spirit**, produced in Greece, Cyprus and other Middle-East countries.

Overhead Vapors.

Oxygenated Fuels.

Literally meaning any fuel substance containing oxygen, the term is commonly taken to cover **gasoline**-based fuels containing such oxygen-bearing compounds as **ethanol**, **methanol**, **M.T.B.E.**, **E.T.B.E.**, etc. Oxygenated fuel tends to give a more complete combustion of its carbon to **carbon dioxide** (rather than **monoxide**), to reduce air pollution from exhaust emissions.

Oxygenated Fuels Association (O.F.A.).

- P -

Packed Distillation Column.

P.A.D.D.

Abbreviation for **Petroleum Administration for Defense District**.

Pasteurization.

Patent.

Penicillin.

The collective name for salts of a series of **antibiotic organic** acids produced by a number of Penicillium and Aspergillus species molds, active against most **gram-positive bacteria** and some **gram-negative cocci**. (See **Gram stain**.) The commonest type of penicillin used in **ethanol fermentations** to control **bacterial contamination** is the potassium G form, otherwise known as benzyl penicillin potassium.

Pentane.

Pentanol.

Pentose.

Permanganate (or Barbet) Time.

A laboratory test used for assessing the quality of samples of **industrial** or **beverage alcohol**. It is the time required for an alcohol sample to decolorize a standard potassium permanganate solution. The time is an indication of the reducing (deoxidizing) power of the sample, and is considered to be a crude measure of the presence of **congeners**.

Petroleum.

Petroleum Administration for Defense District (P.A.D.D.).

P.G.

pH.

Phase Separation.

Pineau des Charentes.

Pisco.

A type of **brandy** distilled from the **wine** of muscat grapes, in South American countries, particularly Peru.

Plate (or Tray).

A contacting device placed horizontally at intervals within a **distillation column**. Plates may be simple perforated discs, with or without **downcomers**, as in the **sieve plate** and the **dual-flow plate**, or they may have **bubble caps**, **tunnel caps**, or various types of floating valves, to improve the contact

between the rising **vapor** and descending liquid. Sieve plates and tunnel caps are the most common form of plates used in **ethanol** production facilities.

Plate (or Trayed) Distillation Column.

Polymer.

Polysaccharide.

Pomace.

Pomace Brandy or Marc Brandy.

Defined by the **B.A.T.F.** as **brandy** distilled from the (fermented) skins and pulp of sound, ripe grapes, citrus or other fruit, after the withdrawal of the juice or **wine** therefrom. It is designated "pomace brandy", or "marc brandy", and qualified by the name of the fruit from which it is derived. Grape pomace brandy may be designated as "**grappa**" or "**grappa brandy**."

Positive-Displacement Pump.

Potassium Alumino-Silicate.

Potstill.

A simple **batch distillation** unit used for the production of heavily-flavored **distillates** for beverage use. It consists of a tank, (which is heated either by an internal steam coil, or by an external fire), and an **overhead-vapor** pipe leading to a **condenser**. It may be used in the production of heavily-flavored **rums** and **whiskies**.

Prefermenter.

Proof.

A measure of the **absolute-ethanol** content of a **distillate** containing **ethanol** and water. In the U.S. system, each degree of proof is equal to 0.5 per cent of ethanol by volume, so that absolute ethanol is 200° proof. In the Imperial system "proof", (or 100° proof), is equal to 57.06 per cent ethanol by volume, or 48.24 per cent by weight, while absolute ethanol is 75.25 over proof, or 175.25° proof.

Proof Gallon (p.g.).

Proof Tables.

Propagation.

Propanol (or Propyl Alcohol).

A minor constituent of **fusel oil**. Chemical formula C₃H₇OH. It exists as either of two **isomers**. Both are colorless, toxic, flammable liquids, with odors similar to that of **ethanol**.

Protein.

p.s.i.

p.s.i.g.

- R -

Rack Price.

Raki.

A name given in Turkey to a product similar to **Ouzo**.

Reboiler.

A device for supplying heat to a **distillation column** without introducing live steam. It generally consists of a shell-and-tube **heat exchanger** connected to the base of the column, with liquid from the column entering inside the tubes, to be heated indirectly by steam on the shell side.

Receiver.

Recoopered barrels.

Rectification.

Rectified Spirit.

A **distilled spirit** which has undergone some degree of **rectification**.

Rectifying Column (rectifier, rectification column, or rectifying section).

Reflux.

Reflux Ratio.

The ratio of the amount of **condensate** being **refluxed** to the amount being withdrawn as product. Generally, the higher the reflux ratio, the greater is the degree of separation of the components in a **distillation** system.

Renewable Fuels Association (R.F.A.).

Research Octane Number (R.O.N.).

Reverse Osmosis (R.O.).

R.F.A.

(R+M)-2.

R.O.

Roller Mill.

A mill for crushing or grinding grain or other solid material by passing it between two steel rollers. The rollers may be smooth, or serrated to shear the grain, and they may turn at differing speeds to increase the abrasion. Roller mills are suitable for small grains such as wheat, but do not perform as well as a **hammer mill** on corn.

R.O.N.

Rotameter.

Reid vapor pressure (R.v.p.).

Rum.

Defined by the **B.A.T.F.** as "an alcoholic **distillate** from the fermented juice of sugar cane, sugar-cane syrup, sugar-cane **molasses**, or other sugar-cane byproducts, produced at less than 190° **proof**, in such a manner that the distillate possesses the taste, aroma and characteristics generally attributed to rum." Unlike the specifications for **whiskies**, the B.A.T.F. does not require that the rum be aged in oak **barrels**. British regulations specify that rum be produced "from sugar-cane products in sugar-cane-growing countries."

R.v.p.

Rye-Malt Whisky.

Rye Whisky.

- S -

Saccharification.

The process of converting a complex **carbohydrate**, such as **starch** or **cellulose**, into **fermentable sugars** such as **glucose** or **maltose**. It is essentially a **hydrolysis**. The process may be accomplished by the use of **enzymes** or acids.

Sacc' Tank (or Saccharification Tank).

Saccharomyces.

S.B.A.

Scale Inhibitor.

Scaling.

Scotch Whisky.

Scrubber.

S.D.A.

S.G.

Shochu.

A **distilled spirit** made in Japan, using rice as the **fermentation feedstock**.

Shooked Barrel (or Shook).

A used **bourbon-whiskey barrel** which has been dismantled to reduce the space requirements for transportation.

Sieve analysis.

A laboratory test made on grain **meal**, to check that the milling process is being conducted correctly. The meal is added to the top of a stack of sieves with increasingly-finer meshes descending downwards. The sieve stack is vibrated for a standard time period, and the weight percentage

retained on each screen is determined. With **hammermills**, the sieve analysis will generally show that the meal gradually becomes coarser, as the hammers wear and need turning or replacement.

Sieve Plate (or Sieve Tray).

Simultaneous Saccharification and Fermentation (S.S.F.).

A procedure in which the **saccharification** of a cooked **starch mash** occurs in the **fermenter** (by addition of **enzymes**), simultaneously with the commencement of **fermentation** (by addition of **yeast**). This procedure is replacing the traditional process taken from the whiskey industry, in which there is a specific holding stage for saccharification with **malt** or microbial enzymes (in a **sacc' tank**), prior to the mash going to a fermenter.

Slurrying Tank.

Small Business Administration (S.B.A.).

Solute.

Solution.

Solvent.

Specially-Denatured Alcohol (S.D.A.).

The term is used to describe **ethanol** denatured with any formulation of compounds selected from a list approved by the **B.A.T.F.** The **denaturant** renders the ethanol unfit for beverage purposes, without impairing its usefulness for other applications.

Specific Gravity (S.G.).

Spent-Sulfite Liquor (S.S.L.).

Spirit Whisky.

S.S.F.

Abbreviation for **simultaneous saccharification and fermentation**.

S.S.L.

Starch.

A mixture of two **carbohydrate polymers** (**amylose** and **amylopectin**), both of which are composed of **glucose monomers** linked together by glycosidic bonds. Starch is the principal energy-storage product of photosynthesis, and is found in most plants, particularly in roots, tubers and cereal grains. Starch may be subjected to **hydrolysis** (**saccharification**) to yield **dextrins** and glucose.

Still.

Stillage.

The mixture of non-fermentable (or non-fermented) solids and water, which is the residue after removal of **ethanol** from a fermented **beer** by **distillation**. Stillage may be dried to recover the solid material, (as **D.D.G.**, in the case of grain **feedstocks**).

Stoichiometric Yield.

Stoichiometry.

Stover.

Straight Whisky.

Stripping Column (or Stripping Section).

The portion of a **distillation column** below the **feed tray**, in which the descending liquid is progressively depleted of its **volatile** components, by the introduction of heat at the base.

Sub-Octane Blending.

Sucrose.

Sugar.

Any of a class of water-soluble, simpler-**carbohydrate**, crystalline compounds that vary widely in sweetness and include the **monosaccharides** and lower **oligosaccharides**. They may be chemically reducing or non-reducing compounds and are typically optically active. Examples include the monosaccharides, **glucose**, **fructose**, **mannose** and **xylose**, the **disaccharides** **sucrose**, **maltose**, **lactose** and the trisaccharides raffinose and maltotriose.

Sulfite Alcohol.

Sulfite-Waste Liquor (S.W.L.).

An effluent produced in the sulfite-pulping process used in some papermills. It partly consists of a dilute solution of **sugars** produced by the **acid hydrolysis** of **cellulose**. It may be used as a **feedstock**

for the production of **ethanol** by **fermentation**, using selected **yeast** strains, after stripping out the sulfite (or sulfur dioxide) with steam.

Supplementary Column.

Surface Transportation and Uniform Relocation Assistance Act of 1987.

Surface-Transportation-Assistance Act of 1982.

S.W.L.

Synthetic Ethanol.

Ethanol produced by any one of several synthetic processes, such as the catalytic hydration of ethylene, the sulfuric-acid hydration of ethylene, and the Fischer-Tropsch process, in which it is a major byproduct of the synthesis of **methanol** by catalytically reacting **carbon dioxide** and hydrogen. Synthetic ethanol is chemically identical to **fermentation ethanol**, but does not qualify for U.S. federal or state incentives for blending with **gasoline**, and may not be used in the production of alcoholic beverages.

- T -

Tafia.

An unaged, Caribbean or South American alcoholic beverage produced by **batch distillation** of **beers** obtained by the **fermentation** of sugar-cane juice or **molasses**. It is similar to **aguardiente** and **rum**.

Tails.

T.B.A.

Technical Alcohol.

Tequila.

Ternary Azeotrope.

An **azeotrope** or **constant-boiling mixture** made up of three components. For example, a mixture of 74 per cent volume **benzene**, 18.5 per cent **ethanol** and 7.5 per cent of water forms an azeotrope boiling at 64.9°C.

Tetramer.

Tetra-Ethyl Lead (or Lead Tetra-Ethyl).

Theoretical Plate (or Tray).

Theoretical Yield.

Thermal Efficiency.

Thermal Vapor Recompression.

Thermophilic.

Thin Stillage.

The liquid portion of **stillage** which has been separated from the solids by screening or **centrifuging**. It contains suspended fine particles and dissolved material. It is normally sent to an **evaporator**, to be concentrated to a thick syrup which is then dried with the solids portion to give **D.D.G.S.**

Titration.

Toluene.

Total sugars as invert (T.S.A.I.).

A simple crude analytical measure of reducing **sugars** in **molasses**.

Transglucosidase.

Trimer.

Tray.

T.S.A.I.

Tunnel Cap.

- U -

Upgrading.

Ultrafiltration.

A process for the separation of colloidal or very fine solid materials, or large dissolved **molecules**, by filtration through microporous or semi-permeable membranes. The process may be used for removal of **protein** from cheese **whey** prior to **fermentation**.

United States Department of Agriculture (U.S.D.A.).

Urethane.

U.S.D.A.

U.S. Gallon.

A measure of 231 cubic inches liquid at 60°F. It is the equivalent of 3.785 **liters**, in the metric system, or 5/6 of an **Imperial gallon**.

- V -

Vacuum Distillation.

Vacuum Fermentation.

A process of operating a **fermentation** under vacuum, so that the **ethanol** or other product is **vaporized** and removed as it is formed, to avoid its concentration becoming inhibitory to the **yeast**. In a patented variation known as the "Vacuform" process, instead of maintaining the entire **fermenter** under vacuum, the fermenting **beer** is circulated through a vacuum chamber to flash off the ethanol, before returning the beer to the fermenter.

Vapor.

Vaporization (or Volatilization).

Vapor Pressure.

Vent Condenser.

Vinasse.

The term sometimes applied to the **stillage** of **molasses**, grape juice, or other liquid **ethanol feedstocks**.

Vodka.

Volatile.

Volatility.

The tendency of a solid or liquid to pass into the **vapor** state at a given temperature. With automotive fuels, the volatility is determined by measuring the **Reid vapor pressure (R.v.p.)**.

Volatilization.

- W -

Wash.

A British synonym for distillers **beer**.

Wet Milling.

Weeping.

The condition when droplets of liquid fall through the holes of a **sieve plate** in a **distillation column**. It may be caused by (a) having a steam flow that is too low, or (b) having too low a liquid flow to maintain a level on the plate, or (c) having a tilted plate, so that the liquid depth is uneven.

Wheat Whisky

Whey.

Whisky / Whiskey.

Defined by the **B.A.T.F.** as "an alcoholic **distillate** from a **mash** of grain, produced at less than 190° **proof**, in such a manner that the distillate possesses the taste, aroma and characteristics generally attributed to whisky". With the exception of **corn whisky**, it should be stored in oak **barrels**. (The B.A.T.F. uses the spelling "whisky", but the spelling "whiskey" is frequently used in the U.S. and Ireland.)

Whole Stillage.

Wine.

Wine Gallon.

A **U.S. gallon** of liquid measure, as distinct from a **proof gallon**.

Wood Alcohol.

Wort.

- X -

Xylene.

Xylose.

A **pentose** (or 5-carbon sugar), derived from the **hydrolysis** of **hemicellulose**. Chemical formula C₅H₁₀O₅. It is not fermented by normal strains of distillers **yeasts**.

- Y -

Yeast.

Any of certain unicellular fungi, generally members of the class Ascomycetaceae, (although a few are members of the class Basidiomycetaceae). Many yeasts are capable of producing **ethanol** and **carbon dioxide** by the **anaerobic fermentation** of **sugars**. Yeasts are composed of approximately 50 per cent **protein** and are a rich nutritional source of B vitamins.

Yeast Autolysis.

Yeast Cream.

Yeast Propagator (or Prefermenter).

It is a tank used for the propagation, or development, of a **yeast** culture, prior to transfer to a **fermenter**. It is normally fitted with aeration, agitation and cooling devices, and is designed for ease of cleaning and sterilization.

Yeast Recycle.

Yeast Strain.

- Z -

Zeolite.

Zymase.

Zymomonas.

A member of the Pseudomonadaceae family of **bacteria** which is characterized by being **gram negative** and non-spore-forming. The genus Zymomonas is distinguished by its **fermentation** of **sugar** to **ethanol**. The principal species being examined commercially for **fuel-ethanol** production is Zymomonas mobilis. It is, however, considered an undesirable contaminant in **beverage-alcohol** fermentations, in that it tends to produce hydrogen sulphide from sulphur compounds in the **mash**, particularly that derived from **molasses**.