

# Liquids commonly pumped by Rotary Positive Displacement Pumps

Rotary pumps can handle a wide variety of liquids, each with its own characteristic

## ACETONE

Other Names: Dimethylketone

Formula:  $\text{CH}_3\text{COCH}_3$ .

Sp. Gr.: 0.8

Viscosity: Water-thin

Remarks: Acetone is an extremely flammable, colorless liquid, b.p.  $56^\circ\text{C}$  /  $133^\circ\text{F}$ ; miscible with water, alcohol, ether, chloroform, and most oils. Used in making acetic anhydride; solvent for cellulose acetate; solvent in paints, lacquers, and adhesives; also used as a solvent in epoxy resins and pharmaceuticals; used in purest form to clean and dry precision parts.

Pump Notes: Cast iron construction, PTFE, Kalrez or EPR elastomers are recommended. Shaft sealing is critical due to the hazardous nature of the liquid; use either a mechanical seal or a sealless pump design.

## ADHESIVE

A name for a group of substances capable of holding materials together by surface attachment.

Other Names: Cement, glue, mucilage, paste

Remarks: Adhesives are made from many different basic materials, among them dextrin, latex, liquid rubber, resin, sodium silicate, and starch. Adhesives are used in the manufacture of cardboard boxes, plywood, furniture, paper bags, pressure sensitive tapes and many industries including automotive, printing, manufacturing, etc.

Pump Notes: Pump construction varies from cast iron to stainless steel depending on the corrosive nature of individual adhesives. Elastomers also vary depending on individual solvents used in the adhesive. Shaft sealing may be packing or mechanical seals. Generally, adhesives are very viscous and the pump design must be capable of handling those viscosities. Adhesives may also contain abrasives and the pump design must be capable of handling particulate.

## ALCOHOL

Normally considered to mean Ethyl Alcohol, q.v. For other alcohols, see specific names, such as [methyl alcohol](#), [butyl alcohol](#), [isopropyl alcohol](#), etc.

## ALKYD RESINS

Resins made by the union of dibasic acids, or anhydrides such as phthalic anhydride with a polyhydric alcohol such as glycerol.

Viscosity: May range from 100 cPs. to over 1000 cPs. depending on temperature and make-up of particular alkyd resin.

Remarks: Alkyd resins may be varied or modified by the use of other anhydrides, glycols, polyols, or other liquids, the most common of which are natural oils. Alkyd resins are easy to apply, retain their initial appearance after long exposure to weather and have good heat resistance, color retention, toughness, adhesion and flexibility. They are used as protective and decorative coatings for metals, wood, paper, textiles; are used in adhesives, printing inks, floor coverings; as vehicles in automotive and industrial finishes; and in oil and water paints, lacquers, and enamels.

Pump Notes: Construction recommendations depend on individual formulations. Mechanical shaft seals may be used depending on viscosity and temperature.

## AMMONIA

Other Names: Anhydrous Ammonia; see also [Ammonium Hydroxide](#)

Formula:  $\text{NH}_3$

Sp. Gr.: 0.64 @ 0°C / 32°F

Viscosity: 0.3 cPs. / 2.13 SSU

Remarks: Ammonia is a colorless gas or liquid, has a pungent odor, is lighter than air as a gas, is easily liquefied by pressure, is very soluble in water or alcohol and has a b.p. -29°C / -20°F, freezing point -78°C / -108°F. The largest volume of ammonia is used for fertilizers. Other uses include production of nitric acid, urea, acrylonitrile; refrigeration; solvent. Ammonia liquid causes burns; the gas is extremely irritating, causing nausea and difficulty in breathing.

Pump Notes: Cast iron construction, neoprene or buna n elastomers are recommended. Double mechanical seals with oil reservoir are normally used for shaft sealing. Pump design should be suitable for a thin, non-lubricating liquid.

## **AMMONIUM HYDROXIDE**

Other Names: Aqua ammonia; aqueous ammonia, ammonia solution, ammonium hydrate

Formula:  $\text{NH}_4\text{OH}$

Sp. Gr.: Slightly less than 1.0

Viscosity: Water-thin

Remarks: Colorless liquid, strong characteristic odor. Ammonium hydroxide is made by dissolving ammonia gas in water. Concentrations of solution range up to about 30%. Used in making textiles, rayon, rubber, fertilizer, plastics, ammonia soaps, lubricants, ink, explosives and in the saponifying of fats and oils, as a detergent and household cleanser. Ammonia window cleaners are weak solutions of ammonium hydroxide.

Pump Notes: Cast iron construction, neoprene or buna n elastomers are recommended. Pumps that have been used for handling ammonium hydroxide will rust badly when they are drained; fill with liquid or drained and fill with oil to prevent rusting. Standard seals have a tendency to dry out and harden if left exposed to air for any length of time.

## **AMYL ACETATE**

Other Names: Amylacetic ester, banana oil

Formula:  $\text{CH}_3\text{COOC}_5\text{H}_{11}$

Sp. Gr.: 0.88

Viscosity: Slightly greater than water

Remarks: Colorless liquid. Very slightly soluble in water; miscible with alcohol and ether; vapor is heavier than air. Flammable as a liquid. Solvent for lacquers and paints, used in dry cleaning preparations, as a flavoring agent and in printing and finishing textile fabrics.

Pump Notes: Cast iron construction, PTFE or Kalrez elastomers are recommended. Mechanical shaft seal is recommended. Pump design must be suitable for handling a thin liquid.

## AMYL ALCOHOL

Other names: n-amyl alcohol, primary; n-butyl carbinol

Formula:  $\text{CH}_3(\text{CH}_2)_4\text{OH}$

Sp. Gr.: 0.81

Viscosity: Water-thin

Remarks: Amyl alcohol may exist with the same formula in several different molecular structures. Information given here pertains particularly to the alcohol identified as n-amyl alcohol, primary. A colorless liquid with a mild odor, slightly soluble in water, has a b.p. 13°C / 280°F, freezing point -79°C / -110°F, flash point (open cup) 48°C / 118°F. Used as a raw material for pharmaceutical preparations.

Pump Notes: Cast iron construction, EPR elastomers are recommended. Mechanical shaft seal is recommended. Pump design should be capable of handling a thin liquid.

**ANIMAL FATS** - See [Fats](#)

**AQUEOUS AMMONIA** - See [Ammonium Hydroxide](#)

**AROCLOR** - See [Heat Transfer Liquids](#)

**AROMATIC SOLVENT** - See [Solvents](#)

## ASPHALT

Other Names: Asphaltum, bitumen, pitch, Trinidad pitch, mineral pitch, petroleum asphalt

Viscosity: Varies widely with type and temperature, normally handled in the 150 to 205°C / 300 to 400°F range at which temperature viscosity is usually in the 100 cPs. to 5000 cPs. range.

Remarks: A dark brown or black solid or semi-solid material made up primarily of bitumens, which occur in nature or are obtained as residuals in refining petroleum. Asphalt is used for paving roads, roofing, waterproofing, paints, softener in rubber blends, and fungicides.

Pump Notes: Cast iron construction is recommended. Normally, packing is used for a shaft seal but mechanical seals have also been used with success. Pump jacketing is normally required to keep the product at temperature. Asphalt is a solid at room temperature which necessitates bringing the pump to temperature before operating.

## **ASPHALT, CUT-BACK**

Asphalt which has been diluted to a liquid or semi-solid with a petroleum thinner.

Viscosity: Variable, depending on dilution and temperature, normally 22 to 220 cPs. / 100 to 1,000 SSU in the 21 to 93°C / 70 to 200°F range.

Remarks: Cut-back asphalt is used for coating road surfaces.

Pump Notes: Cast iron construction is satisfactory. Packing is the normal shaft seal.

## **ASPHALT, EMULSIFIED**

A suspension or emulsion of asphalt in water.

Viscosity: Usually relatively thin; almost water-like

Remarks: Can often be used without being heated. Asphalt emulsions can be applied in the same manner as asphalts; after the water has evaporated, the asphalt hardens into a continuous film. Used for coating roadways, cement waterproofing and roofing compounds.

Pump Notes: Cast iron construction is satisfactory. Packing is the normal shaft seal. Special construction features are required depending on the particular pump design.

## **BARIUM SULFATE SLURRY**

Other Names: Barite

Formula: BaSO<sub>4</sub>

Sp. Gr.: 4.4 (Powder)

Viscosity: Varies with concentration and liquid used to make slurry

Remarks: A fine, white, odorless powder. Practically insoluble in water and solvents; soluble in concentrated sulfuric acid. It is used as a pigment for paints, filler for plastics and inks and in the medical industry. Barium sulfate is abrasive.

Pump Notes: Cast iron construction is satisfactory. An abrasion resistant mechanical seal should be used for shaft sealing. Due to the abrasive characteristics of the liquid, design features to combat abrasion must be used.

## **BEER**

Remarks: Beer, beer wort, spent beer and yeast q.v. can have a wide variety of properties depending on particular brewery or stage of process.

Pump Notes: Positive displacement pumps usually do not handle beer in its drinkable form. Related products such as beer wort and spent yeast may be handled. Contact individual pump manufacturer for specific recommendations.

**BEESWAX** - See [Wax](#)

## **BENZENE**

Other Names: Benzol

Formula: C<sub>6</sub>H<sub>6</sub>

Sp. Gr.: 0.88

Viscosity: Water-thin

Remarks: Clear, colorless, flammable liquid; boiling point 80°C / 176°F; melting point 5°C / 41°F; flash point (closed cup) -11°C / 12°F. Miscible with alcohol, acetone, carbon tetrachloride; slightly soluble in water. Benzene is used in making styrene, synthetic detergents, insecticides, fumigants and solvents. Benzene is extremely flammable; the vapor is harmful; the liquid is poisonous.

Pump Notes: Benzene is a hazardous liquid to handle. Consult individual pump manufacturer for recommendations.

**BENZOL** - See [Benzene](#)

**BIPHENYL** - See [Heat Transfer Liquids](#)

**BITUMEN** - See [Asphalt](#)

## **BLACK LIQUOR SOAP**

Other Names: Black liquor skimmings

Viscosity: Ranges from 22 cPs. to 25,000 cPs.

Sp. Gr.: Ranges around 0.95

Remarks: Black liquor soap (skimmings) is the fatty and rosin acid content of black liquor that floats to the surface after partial evaporation of the water content.

Viscosity varies widely and the product is shear thinning. Black liquor soap is a raw material for tall oil.

Pump Notes: Cast iron or stainless steel construction may be appropriate depending on individual requirements. Pump jacketing may be required if the product is handled at elevated temperature.

## **BLACK STRAP MOLASSES** - See [Molasses](#)

## **BLOOD**

Other Names: Animal Blood

Sp. Gr.: 1.0

Viscosity: Slightly more than water

Remarks: Blood is somewhat corrosive. Blood from packing houses is used for fertilizer, adhesives, and feed for hogs and chickens.

Pump Notes: The pump recommendation above is not intended for handling human blood. For packing house service, the construction described should be considered expendable. Consider steel fitted pumps if dirt or sand can get mixed in with the blood. Pumps operate best if slowed down to better handle the foreign materials.

## **BRIGHT STOCK**

Viscosity: Highly viscous; check with individual manufacturers for specific viscosity

Remarks: Bright stock is a lubricating oil of high viscosity, obtained from residues of petroleum distillation. Used for blending with neutral oils in preparing automotive engine lubricating oils.

Pump Notes: Cast iron construction is satisfactory. Buna n is usually suitable for elastomers. Packing must be used due to viscosity.

## BRINE

Other Names: There are many types of brine, such as calcium chloride and sodium chloride. Look for the specific type if known.

Remarks: Normally brines are water-thin and may be either acid or alkaline in nature. Brine is used in some cooling systems, for food preservation, and for cleaning some products or systems.

Pump Notes: Iron pumps handling brine will corrode rapidly when exposed to air. Check equipment construction in the rest of the system for guidance on selecting pump construction. To reduce possibility of electrolytic corrosion, do not use dissimilar metals.

**BUNKER "C" FUEL OIL** - See [Fuel Oil #6](#)

## BUTADIENE

Other Names: Vinylethylene

Formula:  $H_2C:CHHC:CH_2$

Sp. Gr.: 0.62

Viscosity: Water-thin

Remarks: Colorless gas with mild aromatic odor, easily liquefied, 1.21 BAR / 17.6 PSI, extremely flammable, soluble in alcohol, polymerizes easily, b. p.  $-5^{\circ}C / -23^{\circ}F$ , vapor pressure 17.6 PSI @  $0^{\circ}C / 32^{\circ}F$ . Used in the formulation of styrene-butadiene and nitrile-butadiene rubbers; latex paints; rocket fuels.

Pump Notes: Cast iron construction is satisfactory. Viton elastomers are recommended. Use a mechanical seal or sealless design because of the hazardous nature of this product.

## BUTANE

Formula:  $C_4H_{10}$

Sp. Gr.: 0.58

Viscosity: 0.1 cPs. / 0.78 SSU

Remarks: Colorless gas; has no corrosive action on metals; boils under atmospheric pressure at about  $-1^{\circ}C / 31^{\circ}F$ . Used for making synthetic rubber, high-octane fuels, mixed with propane for household and industrial fuels. Is one of the liquids referred to as LP-Gas, although propane is more frequently referred to as LP-Gas. Butane will form explosive mixtures with air.

Pump Notes: Cast iron construction is satisfactory. Buna n or Viton elastomers are recommended. A mechanical seal pump must be used due to the hazardous nature of this liquid. Investigate pump manufacturers offering UL listed pumps for this service.



**BUTANOL** - See [Butyl Alcohol](#)

## **BUTYL ALCOHOL**

Other Names: 1-butanol

Formula:  $\text{CH}_3(\text{CH}_2)_2\text{CH}_2\text{OH}$

Sp. Gr.: 0.81

Viscosity: Water-thin

Remarks: Colorless liquid, b.p. 118°C / 244°F, used in preparation of esters and butyl acetates; solvent for resins and coatings; plasticizer; detergent formulations; some urea and melamine resins. Avoid prolonged breathing of vapor and contact with skin.

Pump Notes: Cast iron construction is satisfactory. Buna n or Viton elastomers are recommended. Use of a mechanical shaft seal is recommended.

## **CALCIUM CHLORIDE BRINE**

Formula:  $\text{CaCl}_2$

Sp. Gr.: 1.1 to 1.3

Viscosity: Water-thin

Remarks: Calcium chloride is a white, deliquescent crystal that can combine with different amounts of water. In all forms, it is soluble in water and alcohol. The water solution is normally neutral or slightly on the alkaline or basic side. Used for dust-proofing roads, thawing snow and ice, freeze-proofing coal or sand, concrete conditioning; paper and pulp industry; as refrigeration brine; as a ballast for weighting implement tires and in pharmaceuticals.

Pump Notes: Rapid corrosion will take place when an iron pump that has handled brine is exposed to air. Avoid the use of dissimilar metals to reduce tendency for electrolytic corrosion.

## CALCIUM STEARATE

Formula:  $\text{Ca}(\text{C}_{18}\text{H}_{35}\text{O}_2)_2$

Viscosity: Depends on concentration, but normally varies from 44 cPs. 200 to 200 cPs.

Remarks: A white powder, insoluble in water and slightly soluble in hot alcohol, m.p. 150°C / 300°F. Decomposed by many acids and alkalis. Used as a water repellent, flattening agent in lacquers, in varnishes, paints, enamels, plastics; as a lubricant; in emulsions, cements, wax crayons; as a stabilizer for vinyl resins and as an anti-caking agent in foods. May be abrasive if handled as a slurry

Pump Notes: Cast iron construction is usually satisfactory. User may request other metallurgies, depending on end use of the liquid or the solvent if used in a solution Jacketed features may be helpful when handling molten calcium stearate.. Slurry form may require abrasion-resistant features. Check on the abrasive nature of liquid or possible corrosive attack on seal materials.

**CANE SYRUP** - See [Sugar Syrup](#)

**CARBOLIC ACID** - See [Phenol](#)

## CARBON DISULFIDE

Other names: Carbon Bisulfide

Formula:  $\text{CS}_2$

Sp. Gr.: 1.3

Viscosity: Water-thin

Remarks: Clear, colorless, flammable liquid; strong disagreeable odor; b.p. 46°C / 115°F; soluble in alcohol, benzene and ether, slightly soluble in water. Used in making viscose rayon, cellophane, carbon tetrachloride and flotation agents; as a veterinary medicine; as a solvent for fats, resins, rubber, waxes and other chemical products; in varnishes, lacquers, paint and varnish removers; and in making rubber textiles, fumigants, matches, preservatives, and pesticides. Liquid is poisonous, extremely flammable, highly volatile, and has a harmful vapor.

Pump Notes: Cast iron construction is usually satisfactory. Other construction may be specified due to end use of the product. Viton elastomers are recommended. Mechanical shaft seal is recommended.

## **CARBON TETRACHLORIDE**

Other Names: Tetrachloromethane, perchloromethane

Formula:  $\text{CCl}_4$

Sp. Gr.: 1.6

Viscosity: Water-thin

Remarks: Colorless liquid; vapor is heavier than air. Non-flammable, poisonous. b.p.  $77^\circ\text{C} / 170^\circ\text{F}$ , f. p.  $-23^\circ\text{C} / -9^\circ\text{F}$ , vapor pressure 91 mm at  $20^\circ\text{C} / 68^\circ\text{F}$ ; no flash point. Miscible with alcohol, ether, chloroform, benzene, naphtha; slightly soluble in water. Used for refrigerants and propellants, metal degreasing, grain fumigants and insecticides, fire extinguishers, dry cleaning solvents, and general solvents. Vapor and liquid are hazardous. May be fatal if inhaled or swallowed.

Pump Notes: Cast iron construction is usually satisfactory. If contaminated with moisture, carbon tetrachloride can form hydrochloric acid which is corrosive to cast iron pumps. Be sure that system is clean and free of water to avoid corrosion problems indicated above. Liquid needs to be Adry- or anhydrous. Viton elastomers and a mechanical shaft seal are recommended.

## **CASTOR OIL**

Other Names: Ricinus oil

Viscosity: 44 cPs. to 660 cPs. / 200 to 3,000 SSU

Sp. Gr.: 0.96

Remarks: Pale, yellowish color, transparent, mild odor, nauseating taste; solidifies at  $-10^\circ\text{C} / 14^\circ\text{F}$ ; soluble in alcohol, ether, benzene, chloroform and carbon disulfide. Used in protective coatings, plastics, lubricants, fatty acids, textiles, rubber, hydraulic fluids, cosmetics, pharmaceuticals, flavoring, and insulating compounds.

Pump Notes: Cast iron construction is usually satisfactory but may vary depending on end use of product. Buna n elastomers are satisfactory. Mechanical shaft seal is recommended.

**CAUSTIC** - See [Sodium Hydroxide](#)

**CAUSTIC POTASH** - See [Sodium Hydroxide](#)

**CAUSTIC SODA** - See [Sodium Hydroxide](#)

## CHLORDAN

Other Names: Chlordane

Formula:  $C_{10}H_6Cl_8$

Sp. Gr.: 1.6

Viscosity: 22 cPs. @ 38°C / 100 SSU @ 100°F

Remarks: Colorless, odorless, slightly viscous liquid, b.p. 175°C / 347°F; soluble in many organic solvents, insoluble in water; miscible in kerosene. Used as an insecticide in oil emulsions and dispersible liquids. Liquid is harmful if swallowed; can be absorbed through the skin. When used as an insecticide, Chlordan is reduced with water and becomes water-thin.

Pump Notes: Cast iron construction is satisfactory. Will cause rapid rusting of iron parts when pump is left exposed to air. Keep full of liquid or flush and fill with oil. Viton, PTFE or Kalrez elastomers are recommended. Mechanical shaft seal is recommended.

## CHLOROFORM

Other Names: Trichloromethane

Formula:  $CHCl_3$

Sp. Gr: 1.5

Viscosity: Water-thin

Remarks: Clear, colorless, heavy, volatile liquid; nonflammable; miscible with alcohol, ether, benzene, naphtha; slightly soluble in water, b.p. 61°C / 142°F, freezing point -63°C / -81°F; no flash point. Used in making fluorocarbon refrigerants and propellants, fluorocarbon plastics, dyes and drugs, anesthetics; also used as a general solvent, fumigant, and insecticide. Vapor is harmful. Liquid may be fatal if swallowed.

Pump Notes: Cast iron construction is satisfactory. Keep pump full of liquid at all times to prevent rapid oxidation or rusting. If pump is drained, fill with oil; any dilution or impurity can make this liquid corrosive. Viton elastomers are recommended. Mechanical shaft seal is recommended.

**CHLOROTHENE** - See [Trichloroethane](#)

## CHOCOLATE

Other Names: Bitter chocolate, sweet chocolate, milk chocolate, chocolate liquor, chocolate coating.

Viscosity: Varies widely from 2,000 cPs. to several thousand cPs. depending on type and process; also varies over normal temperature range of 38°C to 93°C / 100°F to 200°F. Chocolate viscosity is often expressed in degrees MacMichael. This is a standard viscosity unit of measure in the chocolate industry.

Remarks: Chocolate is made from cacao beans. The beans are roasted, ground up, and mixed with oils to get a semi-liquid which is the beginning point in the making of chocolate. Chocolate in the early stages of processing is known as bitter chocolate. Bitter chocolate to which sugar has been added is known as sweet chocolate (the sugar in sweet chocolate can carbonize to form abrasives in close running pump parts). Sweet chocolate to which milk has been added is known as milk chocolate. Chocolate that has been thinned down for spraying foods is known as chocolate liquor. Chocolate can be diluted with vegetable fats such as palm nut or coconut oils.

Pump Notes: Cast iron pumps are normally satisfactory but stainless steel may also be used. The handling of chocolate with positive displacement pumps can involve a number of challenges. Provide complete application details to individual manufacturers for recommendations.

## CHOLINE CHLORIDE

Formula:  $(\text{CH}_3)_3\text{N}(\text{C1})\text{CH}_2\text{OH}$

Viscosity: Water-thin

Remarks: White crystals with a salty, bitter taste and fishy odor. Soluble in water and alcohol; insoluble in ether, benzene and carbon disulfide; extremely hygroscopic. Used in medicine, nutrition, and as an animal feed supplement.

Pump Notes: Cast iron construction is satisfactory for concentrations up to 75%. Buna n elastomers are recommended. Mechanical shaft seal is recommended.

**CLAY COATINGS** - See [Paper Coatings](#)

## **COAL TAR**

Viscosity: Highly viscous or semi-solid at ambient temperatures. Normal pumping temperature ranges from 66°C to 260°C / 150°F to 500°F with viscosities ranging from 40 cPs. to several thousand cPs.

Remarks: A black, semi-solid material, heavier than water, obtained in the destructive distillation of coal. Sp. Gr. 1.2. Soluble in ether, benzene, carbon disulfide; slightly soluble in water. A major raw material for a variety of dyes, drugs and other organic chemicals. Coal tar or its fractions can also be used for waterproofing, paints, pipe coating, roofing, insulation, pesticides and in medicine.

Pump Notes: Cast iron construction is satisfactory. Pump jacketing features are recommended to keep the product liquid especially at start up.

## **COAL-TAR PITCH**

Viscosity: Solid at ambient temperatures; viscosity depends on the grade and handling temperature.

Remarks: A dark brown residue left after coal tar is redistilled. Coal tar pitch normally constitutes 50-65% of the usual grades of coal tar. Used as a binder for carbon electrodes, as a base for paints and as a plasticizer for elastomers and polymers, extenders, saturants and impregnants. Also used in impregnation of fiber pipe for electrical conduits and drainage, foundry core compounds, briquetting coal, paving and roofing.

Pump Notes: Cast iron construction is satisfactory. Pump jacketing features are recommended to keep the product liquid especially at start up. The product may contain abrasives that would require use of abrasion resistant parts in the pump.

## **COCOA BUTTER**

Other Names: Cacao butter, theobroma oil

Sp. Gr.: 0.86

Viscosity: Variable, depending on how it was put in solution and at what temperature it is being handled. Can range from a few hundred cPs. to several thousand cPs.

Remarks: Yellowish-white, brittle solid with chocolate-like taste and odor m.p. 35°C / 95°F.; insoluble in water; slightly soluble in alcohol; soluble in boiling alcohol. Used in making candies, pharmaceuticals, and soaps.

Pump Notes: Cast iron construction is usually satisfactory but stainless steel may be required. Pump jacketing may be required to keep the product liquid.

## **COCONUT OIL**

Other Names: Coconut palm oil, coconut oil; coconut butter

Sp. Gr.: 0.92

Viscosity: In the range of 22-110 cPs., depending on temperature.

Remarks: White, semi-solid lard-like fat; characteristic odor. Soluble in alcohol, ether and carbon disulfide, m.p. from 20-28°C / 68°F-82°F. Used in soaps; in foodstuffs; cosmetics; candles; emulsions; alkyd resins; lubricating greases; synthetic detergents; as a butter substitute and as a source of glycerin and fatty acids.

Pump Notes: Cast iron construction is usually satisfactory but stainless steel may be specified as well. Buna n elastomers are recommended.

## **COD-LIVER OIL**

Other Names: Morrhuia oil

Sp. Gr.: 0.92

Viscosity: Approximately 110 cPs.

Remarks: Pale yellow, liquid, non-drying oil; slightly fishy odor and taste. Soluble in ether, ethyl acetate and carbon disulfide. Used in medicine for its vitamin A and D content and in leather dressing.

Pump Notes: Cast iron construction is satisfactory but user needs may dictate stainless steel. Buna n elastomers are recommended.

**COLD FAT** - See [Fats](#)

## **CONTACT CEMENT**

Other Names: Rubber cement

Viscosity: Varies depending on the particular type of contact cement but is normally considered to be quite viscous

Remarks: Contact cement covers a wide range of materials; some may be emulsions sensitive to shearing; others may be flammable because of their vehicles; still others may be water solutions. Used for wide variety of adhesive-type applications.

Pump Notes: Cast iron or steel construction is satisfactory. Choice of elastomer depends on the particular grade of solvent used.

## **COOKING OILS, HOT**

Oils used for deep fat frying of foods.

Viscosity: Water-thin at normal operating temperatures of 150°C-204°C / 300°F-400°F

Remarks: Hot cooking oils are used primarily for deep fat frying of vegetables and meats. Some cooking oils or fats will become solid at room temperatures; some provision may be necessary to assure melted fat or oil in the pump.

Pump Notes: Cast iron construction is satisfactory. Viton elastomers are recommended due to temperature. . Some buildup on pump parts from residues in the oil may occur when continuously recirculating oils being used to fry certain kinds of meat.

**CORN OIL** - See [Vegetable Oil](#)

**CORN STARCH** - See [Starch](#)

## **CORN SYRUP**

Other Names: Glucose, starch syrup

Sp. Gr.: Varies, depending on amount of vapor removed, but normally 1.3 to 1.4

Viscosity: Varies, depending on amount of water vapor removed and temperature, but normally from 5,000 cPs. to 22,000 cPs.

Remarks: A thick, syrupy mixture of dextrose, maltose and dextrans with some water. Normally colorless; soluble in water and glycerin. Used in making candy, jelly, and other food products, alcoholic fermentations, pharmaceuticals, and in treating tobacco.

Pump Notes: Cast iron construction is usually satisfactory although stainless steel may also be specified. Buna n elastomers are satisfactory. Corn syrup may be handled at elevated temperature to reduce viscosity; pump jacketing features should be considered if this is the case. Mechanical seals may be used depending on liquid viscosity.



## **COTTONSEED OIL**

Viscosity: 44 to 110 cPs.

Sp. Gr.: 0.92

Remarks: Pale yellowish-brown to black-red, semi-drying oil. Odorless with a bland taste. Soluble in ether, benzene and carbon disulfide; solidifies around 32°C / 90°F. Used in medicine, soap stock, lubricants, glycerol, cosmetic creams; in food as an oleo or butter substitute, and in salad and cooking oils.

Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are satisfactory.

## **CREOSOTE**

Other Names: Creosote wood-tar; creosote coal-tar, often referred to as creosote. Creosote wood-tar and creosote coal-tar have similar pump application properties and will be combined herein.

Viscosity: Varies, depending on the source, but normally 22 cPs.-66 cPs.

Remarks: Oily liquid with distinctive odor; coal-tar creosote is poisonous. Sp. Gr. of the wood-tar creosote is 1.1. Creosote is used for wood preservatives and as a disinfectant.

Pump Notes: Cast iron construction is satisfactory. Viton elastomers are satisfactory. Mechanical seals may be used depending on the grade of creosote.

## **CRESOL**

Other Names: Methyl phenol, hydroxymethylbenzene, also similar to cresylic acid.

Commercial cresol is normally a mixture of the ortho, meta and /or para cresols.

Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{OH}$

Sp. Gr.: 1.04

Viscosity: 8 cPs. - 22 cPs.

Remarks: Meta is a yellowish liquid; others are crystals; all are soluble in alcohol and ether; all are hazardous, rapidly absorbed through the skin, and cause severe burns.

Pump Notes: Cast iron construction is satisfactory. Viton elastomers are satisfactory; use PTFE for meta.

**CRESYLIC ACID** - See [Cresol](#)

## **CRUDE OIL**

Viscosity: Varies, depending on oil field source. Can range from 8 cPs. to several thousand cPs.; some crudes have to be heated before they can be easily handled.

Remarks: All crude oils are complex mixtures of paraffin, naphthene and aromatic hydrocarbons with small amounts of aromatic hydrocarbons with small amounts of sulfur. The terms paraffin base crude, asphalt base crude and aromatic base crudes are used to indicate the most prevalent constituents of crudes from various fields. Crude oil is a flammable liquid varying in color from yellow to dark reddish-brown, has a peculiar heavy odor; specific gravity ranges from 0.78 to 0.97; crude is refined to give natural gas, gasoline, naphtha, kerosene, fuel oil, lubricating oil, paraffin wax, road oil, asphalt and coke. Crude oil and some of its fractions are major raw materials for many chemicals.

Pump Notes: Cast iron construction is satisfactory although some crude oils may require use of some stainless steel parts. Some crudes contain sand, salt water, and significant traces of sulfur. Any one of these conditions can determine preferred construction. Elastomer recommendation depends on the particular grade of crude and may range from buna n to PTFE.

## **DENATURED ALCOHOL**

Ethyl alcohol to which another substance has been added to make it unfit for human consumption, and also to prevent recovery of the alcohol from the mixture. The denaturants do not prevent use of the alcohol in the industry and the arts. Many chemicals have been used as denaturants including acetone, camphor, chloroform, ethyl acetate, gasoline, iodine, kerosene, phenol, pine oil, soaps, and wood alcohol.

Viscosity: Thin

Pump Notes: Cast iron construction is usually satisfactory. Elastomers used must be compatible with the denaturant.

## **DETERGENTS**

Other Names: Synthetic detergents, syndets

Sp. Gr.: 1.0 to 1.3

Viscosity: Varies widely over the range from 22 cPs. to 16,500 cPs., depending on make-up and temperature.

Detergents, as they are commonly thought of are materials which have a cleansing action like soap but are not derived directly from fats and oils. Synthetic detergents are surface active agents. There are three basic types, determined by how the ions are charged. Detergents may contain varying percentages of alkylaryl sulfonates, sulfates, fatty alcohols, fatty acids or amines.

Remarks: Detergents are used primarily as household cleaners. Also used in industry for textile scouring, bleaching, de-sizing, dyeing, printing and finishing, for metal cleaning and pickling, for cleaning and sterilizing food processing equipment, in cosmetics, processing leather, fire fighting making synthetic rubber.

Pump Notes: Pump construction varies with individual applications. Close work with user and supplier of product is necessary to arrive at good pump recommendation.

## **DIATOMACEOUS EARTH**

Other Names: Diatomite, kieselguhr, filter acid

Soft earthy rock composed of the siliceous skeletons of small aquatic plants called diatoms. Sold as a powder which is able to absorb 1.5 to 4.0 times its weight of water.

Remarks: Diatomaceous earth is used for filtration, clarifying and decolorizing, as a mineral filler, thermal insulation, as an absorbent, an abrasive and as a source of silica in chemical production.

Pump Notes: Diatomaceous Earth is always handled as a mixture with another liquid. Pump construction varies based on the liquid. Diatomaceous earth is mildly abrasive and a pump must be able to handle this.

**DICHLOROMETHANE** - See [Methylene Chloride](#)

**DIESEL FUEL** - See [Fuel Oil #1 & #2](#)

## DIETHANOLAMINE

Other Names: DEA

Formula:  $(\text{HOCH}_2\text{CH}_2)_2\text{NH}$

Sp. Gr.: 1.1

Viscosity: Normally in the 110 cPs. to 220 cPs.

Remarks: Colorless crystals or liquid, active base. m.p. 28°C / 82°F, b.p. 217°C / 423°F, flash point (open cup) 138°C / 280°F; soluble in water and alcohol, insoluble in ether. Used as a liquid detergent for emulsion paints, used in cutting oils, shampoos, cleaners and polishes, chemical intermediate for resins, plasticizers.

Pump Notes: Cast iron construction is usually satisfactory although other construction may be requested by the end user. PTFE or Kalrez elastomers are recommended.

## DIETHLENE GLYCOL

Other Names: DEG, dihydroxydiethyl ether

Formula:  $\text{CH}_2\text{OHCH}_2\text{OCH}_2\text{CH}_2\text{OH}$

Sp. Gr.: 1.1

Viscosity: Several hundred cPs.

Remarks: Clear, colorless, practically odorless, syrupy liquid; non-corrosive; hygroscopic. Miscible with water, ethyl alcohol, acetone, ethylene glycol, with a b.p. of 245°C / 443°F and a f.p. of -8°C / 18°F. It is used as a textile lubricant, a conditioner and softener for casin, gelatin, vulcanizing fibers, book-binding pastes, synthetic resins as a solvent for nitrocellulose, gums, resins, oils, organic compounds, for moistening and softening agent for cork compositions, glues, parchments, paper, tobacco, etc. It also can be used in cosmetics and as an anti-freeze to lower the freezing point of water.

Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended.

**DIISOCYANATE** - See [Toluene Diisocyanate](#)

## DIMETHYL FORMAMIDE

Other Names: DMF

Formula:  $\text{HCON}(\text{CH}_3)_2$

Sp. Gr.: 0.95

Viscosity: Thin

Remarks: A water-white liquid, non-corrosive with a b.p. of 153°C / 307°F and a m.p. of -61°C / -78°F; flash point (open cup) 67°C / 153°F. Miscible with water and most organic solvents. Used as a solvent for vinyl resins and acetylene, solvent for butadiene and some petroleum components, used in dyestuffs and pharmaceuticals.

Pump Notes: Cast iron construction is satisfactory. PTFE or Kalrez elastomers and standard mechanical shaft seals are recommended.

**DIMETHYLKETONE** - See [Acetone](#)

## DIOCTYL PHTHALATE

Other Names: Di(2-ethylhexyl) Phthalate, DOP

Formula:  $\text{C}_6\text{H}_4[\text{COOCH}_2\text{CH}(\text{C}_2\text{H}_5)\text{C}_4\text{H}_9]_2$

Sp. Gr.: 0.99

Viscosity: 66-88 cPs.

Remarks: Light colored, odorless liquid; pour point -46°C / -50°F; flash point 220°C / 425°F; vapor pressure nil; insoluble in water; miscible with mineral oil. Used as a plasticizer for many resins and synthetic rubbers, used as a barrier fluid in handling TDI and other foam liquids.

Pump Notes: Cast iron construction is satisfactory. PTFE and Kalrez are the best elastomers to use although Viton is fair. Mechanical shaft seal is recommended.

## DIVINYLBENZENE

Other Names: Alkane, detergent alkylate

Formula:  $\text{C}_6\text{H}_4(\text{CH}=\text{CH}_2)_2$

Sp. Gr.: 0.93

Viscosity: Thin

Remarks: Water-white liquid easily polymerized; b.p. 200°C / 390°F; used in drying oils, casting resins and polyesters. Liquid is highly reactive; once reaction started, may proceed with violence.

Pump Notes: Cast iron construction is satisfactory. PTFE or Kalrez elastomers and mechanical shaft seals are recommended.

## **DODECYLBENZENE**

Other Names: Alkane, detergent alkylate

Formula:  $C_{12}H_{25}C_6H_5$

Sp. Gr.: 0.86

Viscosity: 11 cPs. / 50 SSU

Remarks: Used in making synthetic detergents.

Pump Notes: Cast iron construction is satisfactory. PTFE or Kalrez elastomers and mechanical shaft seals are recommended.

**DOP** - See [Dioctyl Phthalate](#)

**DOWTHERM** - See [Heat Transfer Liquids](#)

## **EDIBLE OILS**

This group of oils may consist of vegetable, peanut, canola, corn, safflower, etc.

Pump Notes: Cast iron construction is satisfactory. Buna n elastomers and mechanical shaft seals are usually used.

**EMULSIFIER** - See [Emulsion](#)

## **EMULSION**

A substantially permanent mixture of two or more liquids which do not normally dissolve in each other, but which are held in suspension, one in the other. The suspension is usually stabilized by small amounts of additional substances known as emulsifiers. Typical emulsions are milk, Mayonnaise, liquid petroleum emulsions, asphalt emulsions, etc. Typical emulsifiers are egg yolk, casin, certain proteins, soap, bentonite.

Pump Notes: Construction varies based on the particular emulsion.

## **ENAMEL**

A type of oil-base paint containing binders that form a film on exposure to air. Enamel has an outstanding ability to level off brush marks and to form an especially smooth film. It is usually intended for use as top coats and contains relatively less pigment than paint formulations for priming or surfacing.

Viscosity: Ranges from 22 cPs. to 5,500 cPs., depending on make-up of the enamel.

Pump Notes: Cast iron construction is satisfactory. Elastomers may be Viton or PTFE depending on solvents used. Pump construction capable of handling mild abrasives should be considered.

## **EPOXY RESINS**

Epoxy resins are those materials resulting from the reaction of bisphenol-A and epichlorohydrin. They may be either viscous liquids or a clear, brittle solid. To the basic resin many different curing agents, diluents and modifiers can be added, as a result there is a wide range of properties.

Viscosity: Ranges from 1,200 to 22,000 cPs., depending on make-up of the resin and the temperature it is being handled. Normal temperature range for handling epoxies is ambient to 90°C / 200°F.

Remarks: Epoxy resins are used for surface coatings, as adhesives and for laminating to make tanks, pipe and some structural parts, some are cast to make plastic metal-forming tools and dyes; other grades are used for potting and encapsulation of electrical parts. Pumps should be slowed down in keeping with viscosity being handled.

Pump Notes: Cast iron construction is usually satisfactory. EPR or Neoprene elastomers are recommended. A sealless pump design may be used. Mechanical shaft seals and packing have also been used with success.

**ETHANOL** - See [Ethyl Alcohol](#)

## **ETHANOLAMINE**

Other Names: MEA, monoethanolamine, colamine

Formula: HOCH<sub>2</sub>CH<sub>2</sub>NH<sub>2</sub>

Viscosity: 100-200 cPs.

Sp. Gr.: 1.02

Remarks: Colorless, moderately viscous liquid. Ammonia-like odor. Strong base. Chemically active. Miscible with water; soluble in carbon tetrachloride and alcohol. b.p. 170°C / 340°F, freezing point 10°C / 50°F, vapor pressure 0.48 mm @ 20°C / 68°F, flash point (open cup) 93°C / 200°F. Used as a non-ionic detergent in dry cleaning, emulsion paints, polishes and agricultural sprays, used as a chemical intermediate, in pharmaceuticals and as a corrosion inhibitor.

Pump Notes: Cast iron construction is satisfactory. PTFE or Kalrez elastomers are recommended as are mechanical shaft seals.

## **ETHYL ACETATE**

Other Names: Acetic ether, acetic ester

Formula: CH<sub>3</sub>COOC<sub>2</sub>H<sub>5</sub>

Sp. Gr.: 0.89

Viscosity: Water-thin

Remarks: Colorless, fragrant, flammable liquid. Soluble in chloroform and alcohol, slightly soluble in water. b.p. 77°C / 170°F, vapor pressure 73 mm @ 20°C / 68°F, freezing point -84°C / -120°F, flash point 4°C / 40°F. Used as a lacquer and plastic solvent, as a general solvent, in flavoring and making perfumes, in pharmaceuticals. Ethyl acetate is flammable.

Pump Notes: Cast iron construction is satisfactory. PTFE or Kalrez elastomers are recommended as an mechanical shaft seals.

## **ETHYL ACRYLATE**

Formula: CH<sub>2</sub>:CHCOOC<sub>2</sub>H<sub>5</sub>

Sp. Gr.: 0.92

Viscosity: Thin

Remarks: Colorless liquid. b.p. 99°C / 210°F, m.p. -72°C / -97°F, flash point 10°C / 50°F. Readily polymerized. Used in making polymers, acrylic paints, as a chemical intermediate. Liquid is flammable and the vapor is harmful; may irritate skin and eyes.

Pump Notes: Cast iron construction is satisfactory. PTFE or Kalrez elastomers are recommended as is a mechanical shaft seal.



## ETHYL ALCOHOL

Other Names: Alcohol, grain alcohol, ethanol

Formula:  $C_2H_5OH$

Viscosity: Water thin

Sp. Gr.: 0.82

Remarks: Colorless, volatile liquid. b.p. 78°C / 172°F, freezing point -117°C / -178°F. Soluble in water, methyl alcohol and ether. Vapor pressure 43 mm @ 20°C / 68°F, flash point 14°C / 57°F. Used as a solvent and in the manufacture of dyes, synthetic drugs, synthetic rubber, detergents, cleaning solutions, cosmetics, pharmaceuticals and explosives. Used as an anti-freeze, as a beverage and a rocket fuel. Flammable liquid.

Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended as are mechanical shaft seals.

## ETHYL CHLORIDE

Other Names: Chloroethane

Formula:  $C_2H_5Cl$

Viscosity: Thin

Sp. Gr.: 0.92

Remarks: Colorless, highly flammable, volatile liquid. Miscible with most of the commonly used solvents, m.p. -140°C / -220°F, b.p. 12°C / 54°F, vapor pressure 1000 mm @ 20°C / 68°F, flash point (closed cup) -50°C / -58°F. Used as an anesthetic in medicine, in organic synthesis and as an alkylating agent; solvent for sulfur, fats, oils, resins and waxes. Used as an insecticide. Ethyl chloride is extremely flammable.

Pump Notes: Cast iron construction is usually satisfactory although the presence of water can cause rapid corrosion. PTFE or Kalrez elastomers are recommended and Viton has fair compatibility. Mechanical shaft seals recommended.

**ETHYLENE ALCOHOL** - See [Ethylene Glycol](#)

**ETHYLENE CHLORIDE** - See [Ethylene Dichloride](#)

## **ETHYLENE DICHLORIDE**

Other Names: Ethylene chloride, 1,2-dichloroethane

Formula:  $\text{C}_2\text{H}_4\text{Cl}_2$

Viscosity: Thin

Sp. Gr.: 1.25

Remarks: Colorless, oily liquid. Will not corrode metals. miscible with most solvents, slightly soluble in water. b.p.  $83^\circ\text{C} / 181^\circ\text{F}$ , freezing point  $35^\circ\text{C} / 95^\circ\text{F}$ , flash point  $21^\circ\text{C} / 70^\circ\text{F}$ . Used in making vinyl chloride; as a solvent for fats, oils, waxes, rubber, various resins, gums; used as a fumigant, in dry-cleaning solvents, in lacquers, paints, varnish and finish removers, as a metal degreaser, in soaps and in wetting or penetrating agents. Ethylene dichloride is flammable.

Pump Notes: Cast iron construction is satisfactory. Viton elastomers are recommended as is a mechanical shaft seal.

## **ETHYLENE GLYCOL**

Other Names: Ethylene alcohol, glycol

Formula:  $\text{C}_2\text{H}_6\text{O}_2$

Sp. Gr.: 1.1

Viscosity: 7 to 15 cPs. range; 50-50 mix by weight with water has viscosity of 8 cPs. at  $24^\circ\text{C} / 75^\circ\text{F}$

Remarks: Clear, colorless, syrupy liquid. Sweet taste. Hygroscopic. Lowers freezing point of water; soluble in water, alcohol and ether. b.p.  $197^\circ\text{C} / 387^\circ\text{F}$ , freezing point  $-13^\circ\text{C} / 9^\circ\text{F}$ , flash point  $116^\circ\text{C} / 241^\circ\text{F}$ . Used as an anti-freeze in automobiles, for brake fluid; used in making polyester fibers in films, as a dye solvent; used in lacquers, resins, printing inks, glue mixtures, as a solvent for waxes, resins and drugs.

Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended as is a mechanical shaft seal.

## **ETHYLENE OXIDE**

Formula: CH<sub>2</sub> CH<sub>2</sub>O

Sp. Gr.: 0.87

Viscosity: Water-thin

Remarks: Colorless liquid; soluble in most organic solvents and miscible with water in all proportions. Explosive limits of vapor in air 3 to 80%, b.p. 11°C / 52°F, flash point (open cup) below -20°C / -4°F. Basic material used in manufacturing several of the glycols, in making acrylonitrile, ethanolamines; used in making detergents; petroleum emulsifiers; also used as a rocket propellant. Ethylene oxide is extremely flammable; vapor is harmful and may cause burns. Spontaneous combustion may take place at or near ambient temperatures.

Pump Notes: Cast iron construction is satisfactory. PTFE or Kalrez elastomers are recommended. Due to the explosive nature of this product, double mechanical seals or a sealless design pump should be used.

## **FATS**

Other Names: Animal fat, cold fat, liquid fat, hot fat, lard, hashed fat and ground fat

Viscosity: For liquid fat, hot fat or melted lard, viscosity is water-thin. For hashed fat or ground fat, viscosity is very indefinite, but on the order of 22,000 cPs.

Remarks: Handling fats, both liquid and ground, is most often encountered in packing or food processing plants. Ground pork fat normally presents no problems, but beef fat is much more difficult to handle because of its "dry" nature.

Pump Notes: Cast iron construction is satisfactory. Buna n is satisfactory for ambient temperature applications; Viton may be required for high temperature applications. Use of a mechanical shaft seal depends on the product pumped. Cold fat applications generally required us of a packed pump.

## **FATTY ACID**

Other Names: Oleic acid, palmitic acid, stearic acid

Viscosity: Several hundred cPs., depending on the specific acid and temperature.

Normal temperature range is from ambient to 93°C / 200°F.

Remarks: Fatty acids are used in the making of soaps and synthetic detergents, lubricants, rubber products, cosmetics, waterproofing and as a nutrient. Sp. Gr. 0.84 (typical).

Pump Notes: Cast iron construction is generally acceptable although stainless steel may be required if slight corrosion on cast iron can not be tolerated. Viton, PTFE or Kalrez elastomers are recommended. Mechanical shaft seal is recommended.

**FILTER AID** - See [Diatomaceous Earth](#)

## **FISH OIL**

Viscosity: 20-70 cPs.

Sp. Gr.: 0.93

Remarks: Fish oils are a by-product of the cannery industry. Are used as nutrients, source of vitamins, in soaps and for leather dressing. Have a characteristic odor.

Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended as is a mechanical shaft seal.

## **FISH SOLUBLES**

"Fish Solubles" is residue from canning plants, consisting of fish scales, skin, small bones, other non-usable parts of the fish, non-cannable fish, along with sand or other materials the fish might have had in his stomach at the time of the catch. "Fish Solubles" is shipped as liquid sludge and then stored in closed tanks at the point of use for several years to allow fermentation to take place. The fermentation process increases the nutritive value of the solubles so they are more effective when added to animal feed. As they ferment they become increasingly acidic, making them more difficult to handle corrosion-wise as they age.

Viscosity: Normally in the 220-5,500 cPs.

Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are normally acceptable. This product may be abrasive; choice of sealing options and abrasion resistant pump options should be considered based on the product handled.

**FLUOROCARBONS** - See [Freons](#)

**FOAM** - See [Polyurethane Foams](#)

## FOOTS

Foots has several definitions, depending upon the industry under consideration. In the bean and seed processing (soy, cottonseed, etc.) It is the fibrous residue material after the beans have been processed and all of the oil completely removed; may include dirt and sand from the harvest fields. In the soap-making industry it is a mixture of soap, oil and impurities that precipitate out when natural fatty oils are refined by treatment with caustic soda. The make-up of "Foots" varies so widely in both industries that a pump recommendation is difficult to make. Some of the bean or seed Foots can build up within a pump, requiring that clean out or flush out features be considered. Foots, basically, are what is left after processing has been done in either industry and as a result, the pump recommendation should be based on each particular installation.

## FORMALDEHYDE

Other Names: Oxymethylene, formic aldehyde, methanal, formalin

Formula: HCHO

Sp. Gr.: 1.1 for 37% solution

Viscosity: 37% solution - water-thin

Remarks: Colorless gas; soluble in water, alcohol and ether; polymerizes easily. Is usually handled as an aqueous solution with or without methanol which acts as an inhibitor of the polymerization. Properties of 37% solution (also called formaldehyde or formalin): clear, colorless liquid; pH 3.0. Used in urea and melamine resins, in making phenolic resins, ethylene glycol, fertilizer, dyes and medicine. Also used in embalming fluids and as a preservative. Formaldehyde causes irritation of the skin, eyes, nose and throat. Proceed with caution when selecting a pump for handling formaldehyde.

Pump Notes: Cast iron construction may be used on an expendable basis. Percent concentration and end use of product may require other construction. PTFE and Kalrez are recommended elastomers with Viton<sup>®</sup> rated fair. A mechanical shaft seal is recommended.

**FORMALIN** - See [Formaldehyde](#)

## **FREONS**

Other Names: Fluorinated hydrocarbons, fluorocarbons

Formula: Depends on particular Freon

Sp. Gr.: 1.19-1.56

Viscosity: 0.2 to 0.4 cPs.

Remarks: Current use of Freons is limited mostly to refrigeration applications due to concerns of ozone depletion with Freons used as propellants or cleaning agents.

Pump Notes: Cast iron construction is satisfactory. Choice of elastomers depends on the particular Freon used. Mechanical shaft seals or sealless pump designs are recommended.

## **FRUIT JUICES**

Processing fruit juices presents some special problems because the acids contained in fruits are corrosive to many metals. There also can be corrosive action from some of the preservatives used.

Viscosity: Varies from thin to thick, depending on the stage in the process

Remarks: Processing of fruit juices may involve sanitary requirements, possible flushing cycles and handling of many additives and preservatives, as well as the fruit juices. Some viscosity may be involved, depending on the extent to which the juices have been concentrated.

Pump Notes: Pumps designed for sanitary service and constructed of stainless steel are normally required for this application.

## **FUEL OIL, #1, #2, #3, #4**

Viscosity: 8 to 88 cPs., depending on number and temperature

Sp. Gr.: 0.90

Remarks: Fuel oil is defined as any liquid petroleum product used for generation of heat or power, exclusive of liquids such as kerosene and lighter. #1 fuel oil is normally used in vaporizing type burners; #2 is used for domestic heating; #'s 3 and 4 are used in industrial furnaces.

Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are normally satisfactory but Viton $\diamond$  may also be required. Mechanical shaft seals are recommended.

## **FUEL OIL, #5 & #6**

Other Names: Bunker fuels, Bunker "C" Oil

Viscosity: Varies from 66-13,000 cPs. @ 21°C / 70°F. Normally handled at temperatures in the 120 to 150F range (50-1700 CPs.) for ease of handling.

Sp. Gr.: 0.90

Remarks: Fuel oil #5 and #6 are semi-solid or very viscous at room temperatures and must be preheated before being used. They are used as a fuel in many large commercial and public buildings as well as in large industrial plants and power plants. Occasional abrasives and/or sludge in these heavy oils can cause some pump or seal problems. Avoid the use of long suction lines with heavy fuel oils to prevent cavitation-type problems.

Pump Notes: Cast iron construction is satisfactory. Viton elastomers are usually acceptable with PTFE sometimes required depending on the particular liquid. Mechanical shaft seals are recommended.

## **FULLER'S EARTH**

A variety of clay-like material which has high natural adsorptive powers. It is used for decolorizing of oils and other liquids, for floor-sweeping compounds, cosmetics, rubber filler and as a filtering medium. It is slightly abrasive. Pumps handling liquids containing Fuller's earth should take the same precautions as recommended under diatomaceous earth, q.v.

## **FUMIGANT**

A broad term used almost synonymously with insecticide to mean those liquids, sprays or gases used to control harmful insects. These liquids can be highly corrosive, depending on concentration and liquid in which they are in solution. They are often highly toxic to plant and animal life.

A pump recommendation should be based on liquid supplier's suggestion, along with an understanding of user's procedure for pumping the liquid.

## **FURFURAL**

Other Names: Ant oil, artificial; furfuraldehyde

Formula:  $C_4H_3OCHO$

Viscosity: Thin

Sp. Gr.: 1.2

Remarks: Colorless liquid; soluble in alcohol, ether and benzene, m.p.  $-36^{\circ}C$  /  $-32^{\circ}F$ , b.p.  $162^{\circ}C$  /  $260^{\circ}F$ , flash point (open cup)  $65^{\circ}C$  /  $150^{\circ}F$ . Furfural is made from oat hulls, rice hulls or corn cobs. Used as a solvent in the refining of lubricating oils, solvent for nitrocellulose, cellulose acetate, used in the preparation of synthetic resins, as a weed killer and fungicide.

Pump Notes: Cast iron construction is satisfactory. PTFE or Kalrez elastomers are recommended as is a mechanical shaft seal.

## **GASOLINE**

Formula: Varies between  $C_6H_{14}$  and  $C_{10}H_{22}$

Sp. Gr.: 0.75

Viscosity: Thin

Remarks: Gasoline is a mixture of volatile hydrocarbons suitable for operation of internal combustion engines. It is also used as a solvent. It is dangerous because of its flammable nature.

Pump Notes: Cast iron construction is satisfactory. Buna n or Viton elastomers are recommended. Pay special attention to inlet conditions based vapor pressure of the particular grade.



## **GELATIN**

A protein obtained from collagen by boiling skin, ligaments, tendons, bones, etc. with water. It is similar to animal glue except that the raw materials are more carefully selected and cleaner. Type A gelatin is obtained from acid treated raw materials and type B from alkali treated raw materials.

Viscosity: Varies widely, depending on temperature and liquid used to put gelatin into solution. Normally handled in 49°C to 71°C / 120°F to 160°F range.

Remarks: Gelatin is a colorless, transparent, odorless, tasteless material available in sheets, flakes or powder. It swells up and absorbs five to ten times its weight of water; soluble in hot water, glycerol and acetic acid; insoluble in alcohol and other organic solvents. It is used in making photographic film, sizing, plastic compounds, textile and paper work, foods, rubber substitutes, adhesives, cements, capsules for medicinals, etc. Select pump for maximum viscosity that might be encountered; gelatin may set up in pump during down times; provision for heating should be considered along with consideration of oversize ports.

Pump Notes: Cast iron construction is satisfactory but may vary depending on the requirements of the end user. Buna n elastomers are generally acceptable but should be verified with the end user. Use of a mechanical shaft seal depends on viscosity of the particular product.

## **GENETRON**

Trade name for a line of fluorinated hydrocarbons made by Allied Chemical's General Chemical Division. They have numbers and properties similar to [Freons](#), q.v.

**GLUCOSE** - See [Corn Syrup](#)

**GLUE** - See [Adhesive](#)

## GLYCERIN

Other Names: Glycerol, glyceryl alcohol

Formula:  $C_3H_5(OH)_3$

Sp. Gr.: 1.3

Viscosity: Varies from 44 to 1,000 cPs. depending on temperature and concentration

Remarks: Clear, colorless, odorless, syrupy liquid; hygroscopic. m.p. 18°C / 64°F, b.p. 290°C / 554°F; soluble in water and alcohol; insoluble in ether; flash point 177°C / 350°F. Used in alkyd resins, cellophane, explosives, ester gums, pharmaceuticals, perfumery, cosmetics, foodstuffs, as a solvent, in printer's ink rolls, as an emulsifying agent, in anti-freeze, for paper coatings and finishes, for special soaps, lubricants and softeners and as a hydraulic fluid.

Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended as is a mechanical shaft seal.

**GLYCEROL** - See [Glycerin](#)

**GLYCOL** - See [Ethylene Glycol](#)

**GRAPE JUICE** - See [Fruit Juices](#)

## GREASE

Other Names: Lubricating grease, automotive grease, bearing grease, etc. For hot cooking grease see [Cooking Oils, Hot](#).

Viscosity: From 2,100 cPs. to several hundred thousand cPs. There are several different grades of greases running from an NLGI grade of 000 up through grade #6. NLGI is the National Lubricating Grease Institute. The smaller the grade number, the less viscous the grease. The viscosity of grease is often indicated by penetration number as determined by the distance a plumb bob of a known weight will sink into the surface of the grease during a given time period; thus, the higher the penetration number, the softer the grease, e.g., a number 1 grade grease has a penetration range from 310 to 340, while a number 4 grease has a penetration range of 175-205.

Remarks: Lubricating greases are generally mixtures of a mineral oil with one or more metallic soaps; the most common soaps are those of sodium, calcium, barium, aluminum, lead, lithium, potassium and zinc. The texture of grease may be smooth, buttery, ropy, fibrous, spongy or rubbery. Texture does not necessarily indicate the viscosity.

Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended. Shaft packing is normally used although a mechanical shaft seal may be used if viscosity permits. Grease is normally shear thinning so special attention must be paid to pump port sizing and motor sizing for correct horsepower.

## HEAT TRANSFER LIQUIDS

Heat transfer liquids are generally made from one of the following: mineral oil, diphenyls, modified terphenyls or polyalkylene glycols. Heat transfer liquid is also known by a variety of trade names such as Dowtherm, Mobiltherm, Therminol, Ucon, etc.

Other Names: Heat transfer oil, HTO

Sp. Gr.: Approximately 1.0 @ pumping temperature; varies with liquid and temperature

Viscosity: Less than 1 cPs. at pumping temperatures

Remarks: Heat transfer liquids are used instead of steam for transferring heat from a source to a point of use such as dies, presses, cooking vessels, processing equipment, etc. Many of them can operate at temperatures up to 315°C / 600°F.

Pump Notes: Cast iron construction is satisfactory. Viton elastomers are normally recommended due to heat but PTFE or Kalrez may also be needed. Mechanical shaft seals are recommended. Because of the low viscosity, pump capacity is sometimes less than nominal. To extend the service life, it is recommended that the pumps be run at rated speed or less and that the operating pressure in the system be kept as low as possible. Heat transfer liquid pumps are often critical to the success of an extensive operation, standby pumps should be considered.

## HEPTANE

Other Names: Dipropylmethane

Formula:  $\text{CH}_3(\text{CH}_2)_5\text{CH}_3$

Sp. Gr.: 0.68

Viscosity: Thin

Remarks: Volatile, colorless liquid; highly flammable; freezing point -90°C / -130°F, b.p. 98°C / 208°F, flash point -1°C / 30°F; soluble in alcohol, ether, chloroform; insoluble in water. Used as a standard for determining octane ratings, as an anesthetic, solvent, etc. Heptane is flammable.

Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended as is a mechanical shaft seal.

## HEXANE

Formula: C<sub>6</sub>H<sub>14</sub>

Sp. Gr.: 0.66

Viscosity: 0.4 cPs.

Remarks: Colorless, volatile liquid; highly flammable; b.p. 68°C / 154°F, flash point - 22°C / -9°F; soluble in alcohol, acetone and ether; insoluble in water. Used as a solvent, especially as an extraction solvent for vegetable oils, also as a paint diluent and as an alcohol denaturant. Hexane is highly flammable.

Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended as are mechanical shaft seals.

## HONEY

Other Names: Bees honey

Viscosity: 1,000-11,000 cPs. depending on how much moisture has been removed and on pumping temperature

Sp. Gr.: Approximately 1.2

Pump Notes: Pump construction depends on requirements of the end user. A pump suited for sanitary service may be specified.

## HOT MELT

Hot melt adhesives are those adhesives that do not contain solvents. They bond by being applied as a hot liquid and solidifying as they cool. Hot melts can produce a rapid bond because they bond as soon as the heat is removed. Hot melts normally are handled in the temperature range from 149 to 260°C / 300 to 500°F. See discussion on similar materials under [Adhesive](#).

Pump Notes: Pump construction varies from cast iron to stainless steel depending on the corrosive nature of individual adhesives. Elastomers also vary depending on individual adhesives and pumping temperature. Shaft sealing may be packing or special lip seals. Generally, adhesives are very viscous and the pump design must be capable of handling those viscosities. Adhesives may also contain abrasives and the pump design must be capable of handling particulate.

**HUMBLETHERM 500** - See [Heat Transfer Liquids](#)

## HYDRAULIC FLUIDS

Other Names: Fire resistant hydraulic fluids. Among the more common fire resistant hydraulic fluids are those made up of water and glycol with some thickeners and additives, phosphate esters and water in oil emulsions with additives.

Viscosity: Viscosities of the above liquids range from 22 to 110 cPs. at ambient temperatures

Pump Notes: Cast iron construction is satisfactory. Elastomers vary depending on the particular grade of hydraulic fluid. Hydraulic fluids are normally used at high differential pressures and a pump design capable of those pressures must be used.

## HYDRAULIC OILS - Also See [Hydraulic Fluids](#)

Viscosity: Normally in the 22 to 66 cPs. range at ambient temperatures

Remarks: There are many brands of hydraulic oils. They are all basically petroleum oils with various additives to enhance specific properties.

Pump Notes: Cast iron construction is satisfactory. Elastomers vary depending on the particular grade of hydraulic fluid. Hydraulic fluids are normally used at high differential pressures and a pump design capable of those pressures must be used.

## HYDROCARBONS

Hydrocarbons are compounds of carbon and hydrogen. Under ordinary conditions some of the hydrocarbons are gases, others are liquids, and still others are solids. Propane, gasoline, kerosene, lubricating oils, Vaseline and paraffin are all hydrocarbons. Other hydrocarbons serve as the raw material for dyes, medicines and other end products.

Paraffin Hydrocarbons - A mixture of some of the solid compounds of this series. Paraffin hydrocarbons satisfy the general formula  $C_nH_{2n+2}$ . The low carbon compounds of this series, such as methane, ethane, propane and butane, are gases under ordinary conditions. Compounds with 5 to 16 carbon atoms are liquids, and those materials that contain more than 16 carbon atoms are solid at ordinary conditions. Paraffin hydrocarbons are also known as saturated hydrocarbons.

Aromatic Hydrocarbons - Hydrocarbons characterized by a molecular structure with 6 carbon atom rings. The solvents benzene, toluene, xylene, naphthalene, etc., are all typical aromatic hydrocarbons. The compounds of this series are liquids under ordinary conditions.

Olefin Hydrocarbons - Stable organic liquids defined by a molecular structure containing at least one pair of double bonded carbon atoms. Ethylene and propylene are typical examples of olefin hydrocarbons.

Normal Hydrocarbons - These are compounds in which all of the carbon atoms of the molecule are in a single unbranched chain. Typical of this group is normal-hexane.

Branched Chain Hydrocarbons - A compound in which not all of the carbon atoms of the molecule are in a single chain. The simplest is isobutane.

**INK** - See [Printing Ink](#)

## **INSECTICIDES**

A broad term used almost synonymously with fumigants to mean those liquids, sprays or gases used to control harmful insects. These liquids can be highly corrosive, depending on concentration and liquid in the solution. Oftentimes they are highly toxic to plant and animal life.

Pump Notes: Specific recommendations are not possible as there is such a diversity in chemical make up of individual insecticides.

## **IRON OXIDE SLURRY**

Other Names: Ferrous oxide slurry

Viscosity: 22 to 1,648 cPs. depending on concentration, vehicle and additives

Remarks: Iron oxides are used in heavy-duty paint pigments such as used in railway finishes, marine paints and metal primers. They are also used for magnetic tape, polishing compounds, as pigment in rubber products and in grease paints.

Pump Notes: Cast iron construction is satisfactory. Elastomers depend on the solvents used in the slurry. Iron oxide is very abrasive which necessitates use of a pump suitable for abrasive liquid service.

## **ISOBUTANE**

Other Names: 2-methylpropane, trimethylmethane

Formula:  $(\text{CH}_3)_2\text{CHCH}_3$

Sp. Gr.: 0.56

Viscosity: 0.1 cPs.

Remarks: A colorless, stable gas that does not react with water and has no corrosive action on metals. It has a b.p. of  $-12^\circ\text{C}$  /  $-10^\circ\text{F}$  and a flash point  $-47^\circ\text{C}$  /  $-117^\circ\text{F}$ . It is used in organic synthesis, as a refrigerant, as a fuel and as an aerosol propellant.

Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended as is a mechanical shaft seal.

## ISOBUTYL ALCOHOL

Other Names: Isopropylcarbinol, isobutanol, 2-methyl-1-propanol

Formula:  $(\text{CH}_3)_2\text{CHCH}_2\text{OH}$

Sp. Gr.: 0.81.

Viscosity: Thin

Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended as is a mechanical shaft seal.

**ISOCYANATE** - See [Toluene Diisocyanate](#)

**ISOPROPANOL** - See [Isopropyl Alcohol](#)

## ISOPROPYL ACETATE

Formula:  $\text{CH}_3\text{COOCH}(\text{CH}_3)_2$

Sp. Gr.: 0.87

Viscosity: 0.5 cPs.

Remarks: Colorless, aromatic liquid. Stable, with a b.p. of 89°C / 192°F, and miscible with most of the common organic solvents. It is used as a solvent for nitrocellulose, fats, oils, waxes, gums, natural and synthetic resins, as well as in making artificial leather, dopes, films, lacquers, plastics and synthetic perfumes.

Pump Notes: Cast iron construction is satisfactory. PTFE or Kalrez elastomers are recommended as is a mechanical shaft seal.

## ISOPROPYL ALCOHOL

Other Names: IPA, dimethylcarbinol, isopropanol

Formula:  $(\text{CH}_3)_2\text{CHOH}$

Sp. Gr.: 0.80

Viscosity: Thin

Remarks: Colorless, clear, mobile liquid; flammable, b.p. 82°C / 180°F, vapor pressure 33 mm Hg at 20°C / 68°F, flash point 22°C / 72°F; soluble in water and ether. Used for making acetone; used as a solvent for oils, gums, resins; used as a deicing agent for liquid fuels; used in pharmaceuticals, perfumes, lacquers, as a preservative, antifreeze and rocket fuel. Isopropyl alcohol is flammable.

Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended as is a mechanical shaft seal.

## ISOTRON

Trade name for a line of fluorinated hydrocarbons made by Pennsalt Chemical Corporation. They have numbers and properties similar to [Freons](#), q.v.

## JET FUELS

Jet fuels are petroleum products similar to kerosene used in jet engines. The most common jet fuels now in use are:

JP-4 - Widely used fuel made up of approximately 65% gasoline and 35% light petroleum distillate.

JP-5 - A highly refined kerosene having a flash point of 60°C / 140°F. And a freezing point of -40°C / -40°F. Used by carrier based aircraft.

JP-6 - A higher kerosene cut than JP-4 with less impurities; used in advanced engines.

Commercial jets use ASTM type A, A-1, or B. A and A-1 are kerosene types. Type B is a gasoline-kerosene type similar to JP-4.

Viscosity: 1.5 to 6 cPs.

Pump Notes: Cast iron construction is satisfactory. Buna n or Viton ♦ are recommended depending on the particular grade.

**KETONE** - See specific Ketone such as [Methyl Ethyl Ketone \(MEK\)](#)

## LACQUER

A type of solvent-base paint that forms a film by evaporation of the solvent or by congealing from a molten state. The film-forming constituents consist of cellulose esters or ethers especially nitro-cellulose, often in combination with alkyd resins. Typical solvents used are ethyl alcohol, methyl isobutyl ketone, butyl acetate, toluene or xylene. Lacquer is used for coating metals and wood, especially furniture.

Viscosity: From 22 to 21,978 cPs. depending on make-up  
Sp. Gr.: 0.9 to 1.0

Pump Notes: Cast iron construction is satisfactory. PTFE or Kalrez ♦ elastomers are required. A mechanical seal or sealless design pump may be used depending on viscosity and characteristic of the lacquer.



## LACTIC ACID

Other Names: Milk acid  
Formula:  $\text{CH}_3\text{CHOHCOOH}$   
Sp. Gr.: 1.2  
Viscosity: 40 to 100 cPs.

Remarks: Colorless, odorless, hygroscopic, syrupy liquid. b.p. 122°C / 251°F, m.p. 18°C / 64°F; miscible with water, alcohol and glycerin. Used in foods and beverages, as a flavoring and preservative; also used in plastics and textiles.

Pump Notes: Stainless steel is required. PTFE or Kalrez elastomers are recommended.

## LANOLIN

Other Names: Wool fat, hydrous  
Viscosity: Widely variable, depending on amount of water

Remarks: A yellowish-white, ointment-like mass incorporating not less than 25% and not more than 30% water. Soluble in ether; insoluble in water; derived from the wool of sheep. Used as an ointment base, in cosmetics; leather dressing as a finishing and softening agent and in rosin soaps. May be mixed with other oils or fatty acids.

Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended. Shaft sealing depends on the viscosity of the product.

## LARD

Lard melts at from 38°C to 43°C / 100°F to 110°F. It has a very sharp demarcation between solid and liquid. For handling both solid and melted lard, see pump construction recommendations under [Fats](#).

Other Names: Hog fat, fat

## LATEX

LATEX - A milk-like fluid in which small globules or particles of natural or synthetic rubber or plastic are suspended in water.

Viscosity: Varies; generally in the range from 20 cPs. to 5,500 cPs.

Remarks: Latex is used in paints, in producing special papers, in adhesives, as a bonding agent in fibers and to make foam and sponge rubber.

Pump Notes: Construction varies and may range from cast iron to stainless steel. Elastomer recommendation varies as well. Latex is very shear sensitive; pump and shaft sealing selection are critical.

## **LEAD**

Chemical Symbol: Pb

Sp. Gr.: 11.3

Viscosity: Unknown, but relatively thin

Remarks: Lead melts at about 329°C / 625°F. It must be handled at this or somewhat higher temperatures. Molten lead is used in molding many of the end products made from lead, such as storage battery plates, bearings, pipes, etc. Remember to take into account the specific gravity of the lead when making pressure calculations.

Pump Notes: Cast iron construction is satisfactory. Pumps are usually submerged in molten lead to avoid sealing problems.

## **LECITHIN**

Viscosity: Varies widely over the range from 1,100 cPs. to 11,000 cPs. depending on make-up and temperature

Sp. Gr. : 1.0 to 1.2

Remarks: Lecithin is a mixture of acetone-insoluble phosphatides and triglycerides, fatty acids and carbohydrates. It is derived usually from soybean oil, but may be obtained from corn, other vegetable seeds and egg yolks. In the commercial form it is a light brown, viscous semi-liquid with a characteristic odor, is insoluble in acetone, partly soluble in water and soluble in chloroform and benzene. It is used as emulsifying, dispersing, wetting and penetrating agent; also in margarine, chocolate and candies, animal feeds, paints, printing ink, soaps and cosmetics, blending agent in oils and resins.

Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended. A mechanical shaft seal can be used depending on liquid viscosity.

**LEMON JUICE** - See [Fruit Juices](#)

## **LINSEED OIL**

Other Names: Flaxseed oil

Viscosity: Ranges from 200 to 1600 cPs. in its raw or refined state. Blown or boiled linseed oil may have viscosities of 11,000 cPs. or higher.

Sp. Gr.: 0.95

Remarks: Linseed oil is a golden-yellow or brown oil with bland taste; thickens and hardens on exposure to air; it is a typical drying oil used on paints. Soluble in ether, chloroform, carbon disulfide and turpentine. Used in making paints, varnishes, linoleum and oil cloth, printing inks, synthetic resins, caulking, soap and pharmaceuticals.

Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended. A mechanical shaft seal may be used depending on liquid viscosity.

## **LINSEED OIL, BLOWN**

Linseed oil which is bodied, i.e., its viscosity is increased by having air bubbled through it while heated to 125°C / 257°F. The resulting product dries to a harder film and is used largely in interior paints and enamels. Pump construction recommendations are the same as for linseed oil for the high viscosities.

## **LINSEED OIL, BOILED**

This term is a misnomer since the oil is not boiled. Small amounts of manganese, lead or cobalt are added to hot linseed oil. They serve to accelerate the drying of the oil. Pump construction recommendations are the same as for linseed oil for the high viscosities.

## **LIQUID FEED**

Other Names: Cattle feed solution, liquid cattle feed, liquid supplement; also known by such trade names as Morea, Beef Shake, Mol-Mix, CLS, etc.

Viscosity: Varies from 20 cPs. to several thousand at ambient temperatures. May go to 11,000 cPs. or more at sub-zero temperatures, depending on make-up of particular liquid feed.

Sp. Gr.: 1.1 to 1.3

Remarks: Liquid feed is normally made up of molasses, urea and a variety of additives such as trace minerals, vitamins, phosphorus, etc.

Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are generally acceptable. A mechanical shaft seal may be used depending on liquid viscosity.

## **LIQUID STICK**

Liquid stick is the product left after the water vapor is removed from the juices of cooked meats. It is primarily protein and is a highly viscous, sticky semi-liquid, difficult to pump. It is normally handled in a temperature range of 82°C / 180°F. Liquid stick is a by-product of packing plants.

**LIQUEFIED PETROLEUM GAS** - See [LP-Gas](#)

## **LP-GAS**

Other Names: Liquefied hydrocarbon gas, liquefied petroleum gas; propane is the best known LP-Gas

Formula Propane: C<sub>3</sub>H<sub>8</sub>

Sp. Gr. Propane: 0.51

Viscosity: .1 cPs.

Remarks: LP-Gas is a compressed or liquefied gas obtained as a by-product in petroleum refining or natural gasoline manufacture. Propane is a colorless gas, has no corrosive action on metals, boils at -42°C / -44°F. It is used primarily for a domestic fuel, an industrial fuel, motor fuel and in chemical synthesis.

Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended. A mechanical shaft seal is required due to the hazardous nature of this liquid.

**LUBRICATING GREASE** - See [Grease](#)

## **LUBRICATING OIL**

Other Names: Lube oil

Viscosity: Ranges widely, depending on the grade or number of oil

Sp. Gr.: 0.90

Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended. A mechanical shaft seal is normally used.

**LYE** - See [Sodium Hydroxide](#)

## **MAPP GAS**

Other Names: Methylacetylene Propadiene, stabilized

Sp. Gr.: 0.58 @ 16°C / 60°F

Vapor Pressure: 94 PSIG @ 21°C / 70°F

Viscosity: 0.1 to 0.2 cPs.

Remarks: MAPP Gas is an industrial fuel gas produced by Dow and distributed by Air Reduction Company. It is used as a replacement for acetylene, natural gas and propane in the metal cutting industry.

Pump Notes: Cast iron construction is satisfactory. Viton elastomers are recommended. A mechanical shaft seal is required due to the hazardous nature of this liquid.

## **MAYONNAISE**

Other Names: Salad dressing

Viscosity: Appears very viscous but is shear thinning.

Remarks: Mayonnaise is a thick sauce of egg yolk beaten up with additions of edible vegetable oil, vinegar, salt and water. At some stages in production mayonnaise may change state if sheared excessively.

Pump Notes: Stainless steel construction is satisfactory. Buna n elastomers are recommended. A designed for shear sensitive liquids must be used.

## **MEAT EMULSION**

Finely ground meat used for wieners, bologna, sausage, etc. Viscosity is very thick and extremely difficult to measure.

Pump Notes: Stainless steel construction is recommended due to sanitary requirements. Buna n elastomers are recommended. Meat emulsion is difficult to handle. Use a pump designed for this service.

## MELAMINE RESINS

Viscosity: 200 to 1000 cPs.

Melamine resins are made from melamine and formaldehyde. They are widely used as molding compounds with cellulose, wood-flour or mineral powders as fillers; they may incorporate coloring materials. Also used for laminating, boil proof adhesives, for increasing wet strength of paper, and for textile treatment to achieve crease and wrinkle resistance. By varying percentages of the main constituents, and by the use of additives, resins with many different properties can be made. Butylated melamine resins and melamine-acrylic resins are examples of these variations. Melamine resins have high retention of color and luster at high temperatures and have fast curing rates at relatively low temperatures.

Pump Notes: Cast iron construction is satisfactory. PTFE or Kalrez<sup>®</sup> elastomers are recommended. Consider use of a mechanical shaft seal or sealless design pump.

## MERCAPTANS

Viscosity: Thin

A group of organic compounds similar to alcohol but having some of the oxygen replaced by sulfur. There are several kinds of mercaptans such as ethyl, lauryl, etc. They have a strong, disagreeable odor; are frequently used for the "stench" in LP-Gas or natural gas.

Pump Notes: Cast iron construction is satisfactory. PTFE or Kalrez elastomers are recommended. A mechanical shaft seal or sealless pump design should be used as Mercaptan is frequently used in hazardous areas.

## METHANOL

Other Names: Methyl alcohol, wood alcohol

Formula: CH<sub>3</sub>OH

Sp. Gr.: 0.97

Viscosity: Thin

Remarks: Clear, colorless, volatile, flammable liquid; poisonous. Soluble in water, alcohol and ether, m.p. 98°C / 208°F, flash point (open cup) 16°C / 60°F. Used in the production of formaldehyde, as an automobile antifreeze, as a general solvent, as a denaturant for ethyl alcohol, rocket fuel. Methanol is flammable and the vapor is harmful. May be fatal or cause blindness if swallowed; cannot be made non-poisonous.

Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended as is a mechanical shaft seal.

**METHYL ALCOHOL** - See [Methanol](#)

**METHYLBENZENE** - See [Toluene](#)

### **METHYL CHLORIDE**

Other Names: Chloromethane

Formula: CH<sub>3</sub>Cl

Sp. Gr.: 0.92

Viscosity: Thin

Remarks: Colorless, non-corrosive, liquefiable gas, non-irritant but poisonous; b.p. - 24°C / -11°F, m.p. -98°C / -144°F, flash point below 0°C / 32°F. Soluble in alcohol, benzene and carbontetrachloride. Used in making silicones, as a refrigerant, in medicine, as a fluid in thermometers, as a low temperature solvent, as a propellant in high pressure aerosols and as a pesticide. Flammable liquid. Vapor harmful. Corrosive in presence of water.

Pump Notes: Cast iron construction is satisfactory. Do not use a pump with any aluminum parts. PTFE or Kalrez elastomers are recommended as is a mechanical shaft seal.

### **METHYLENE CHLORIDE**

Other Names: Chloromethane

Formula: CH<sub>2</sub>Cl<sub>2</sub>

Sp. Gr.: 1.3

Viscosity: .4 cPs.

Remarks: Colorless, volatile liquid. Poisonous when inhaled. Soluble in alcohol and ether, m.p. -97°C / -142°F, b.p. 40°C / 104°F. Used as a component of paint removers, as a fumigant, solvent for alkoids, crude rubbers, oils, resins, waxes; in textile and leather coatings, refrigeration, local anesthetic, for the extraction of oils, fats, perfumes, flavors and drugs, as a propellant for aerosol and a blowing agent in foam. Avoid prolonged or repeated contact with skin or breathing of vapor. Corrosive in presence of water.

Pump Notes: Cast iron construction is satisfactory. Do not use a pump with any aluminum parts. PTFE or Kalrez elastomers are recommended as is a mechanical shaft seal.

## **METHYL ETHYL KETONE**

Other Names: Ethyl methyl ketone, 2-butanone, MEK

Formula:  $\text{CH}_3\text{COC}_2\text{H}_5$

Sp. Gr.: 0.82

Vapor Pressure: Approximately 90mm Hg. absolute at 21°C / 70°F

Viscosity: 0.4 cPs. / 2.22 SSU

Remarks: Colorless liquid; acetone-like odor; flammable. b.p. 80°C / 176°F, m.p. - 86°C / -122°F, flash point -4°C / 24°F. Soluble in water, alcohol and ether. Miscible with oil. Used in lacquers, dewaxing of lubricating oils, paint removers, in adhesives, dopes, manufacture of smokeless powder, in cleaning fluids and printing. Flammable.

Pump Notes: Cast iron construction is satisfactory. PTFE or Kalrez  $\diamond$  elastomers are recommended as is a mechanical shaft seal.

## **MINERAL OIL** - Also see [Lubricating Oils](#)

Any liquid product of petroleum within the viscosity range of liquids commonly called oils. Mineral oil is also the official title for a grade of petrolatum, q.v.

Viscosity: From 20 to 1000 cPs.

Sp. Gr.: 0.8 to 0.9

Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended as is a mechanical shaft seal.

## **MINERAL SPIRITS** - See [Naphtha, Painter's](#)

## **MOBILTHERM** - See [Heat Transfer Liquids](#)



## **MOLASSES**

Other Names: Beet molasses, cane molasses

Viscosity: From a few hundred cPs. 22,000 cPs.

Remarks: In the raw cane sugar industry in the United States, molasses is defined as the syrupy mother liquor which is left after the sucrose has been removed from the cane juice by concentration. If only one crop of crystals had been removed, the mother liquor is called FIRST MOLASSES. If the second crop has been removed after concentration, the product is termed SECOND MOLASSES and so on. The final mother liquor from which no more cane sugar can be extracted is called Final Molasses, Black Strap Molasses. Molasses is used as an animal feed, in food for human consumption, as a raw material for Butanol and acetone; it is also mixed with urea to make an animal feed called "liquid feed." Viscosity of liquid feed is generally quite low with respect to most grades of molasses.

Pump Notes: Cast iron construction is satisfactory but stainless steel may also be specified because of sanitary reasons. Buna n elastomers are usually recommended. Pumps are normally furnished with shaft packing.

**MONOETHANOLAMINE** - See [Ethanolamine](#)

## **MONOMER**

A compound usually containing carbon and of simple structure which is capable of conversion to polymers, synthetic resins or elastomers by combination with itself or similar molecules or compounds. Styrene is the monomer from which polystyrene resins are produced; vinyl chloride and vinyl acetate are the monomers from which "Vinylite" resins are obtained. Styrene and butadiene are the monomers from which SBR synthetic rubber is obtained.

Pump Notes: Since monomer is a general term, there is no construction that generally applies.

## **MORPHOLINE**

Formula:  $C_4H_8ONH$

Sp. Gr.: 1.0

Viscosity: 4 cPs.

Remarks: Colorless, mobile, hygroscopic liquid. A mild base. Miscible with water. Soluble in alcohol and ether, b.p. 129°C / 264°F, m.p. -5°C / 23°F, vapor pressure 6.6 mm @ 20°C / 68°F, flash point (open cup) 38°C / 100°F. Used as a solvent for dyes, resins and waxes, as an emulsifying agent, to make water resistant adhesives and polishes and as a corrosion inhibitor.

Pump Notes: Cast iron construction is satisfactory. PTFE or Kalrez elastomers are recommended as is a mechanical shaft seal.

## **MUSTARD**

Viscosity: Depends on the mix. Estimated 5,500 cPs.

Remarks: Mustard is the yellow powder of the mustard seed mixed with a liquid for use as a condiment.

Pump Notes: Stainless steel construction is satisfactory. Buna n elastomers are recommended.

## **NAPHTHA**

The term is usually applied to a narrow-boiling-range fraction of petroleum with volatility somewhere between that of gasoline and kerosene. There are many different types, some of which are listed below.

### **PETROLEUM NAPHTHA**

A general term applied to refined or partially refined petroleum products and liquid products of natural gas which are distilled off in the temperature range of 177-238°C / 350-460°F.

### **PAINTER'S NAPHTHA**

Also called naphtha, V.M. & P. - varnish makers' & painters', varnish makers' naphtha, petroleum spirits, petroleum thinner, mineral spirits, turpentine substitute, mineral thinner, mineral turpentine. Any of a number of narrow-boiling-range fractions of petroleum with boiling points of about 93-204°C / 200-400°F according to the specific use.

### **SOLVENT NAPHTHA**

A term applied to aromatic solvents derived from coal tar. Information below applies to all naphthas listed.

Viscosity: Water thin

Remarks: Naphthas are used primarily as solvents for a variety of applications such as thinning paints and varnishes, as a source for certain petro chemicals.

Pump Notes: Cast iron construction is satisfactory. Viton elastomers are recommended as is a mechanical shaft seal.

## **NAPHTHALENE**

Other Names: Tar camphor

Formula: C<sub>10</sub>H<sub>8</sub>

Sp. Gr.: 1.14

Viscosity: 0.8 cPs.

Remarks: White crystalline, volatile flakes; strong coal-tar odor; soluble in benzene; m.p. 80°C., b.p. 218°C., flash point 176°F. Used as a moth repellent, fungicide, cutting fluid, lubricant in synthetic resins, as a preservative, solvent and for textile chemicals. May be some tendency for crystals to form.

Pump Notes: Cast iron construction is satisfactory. Viton elastomers are recommended. A mechanical shaft seal may be used but should include proper circulation for any crystals formed.

**OIL** - See specific oil, such as [Lubricating Oil](#), [Fuel Oil](#), etc.

**OLEIC ACID** - See [Fatty Acid](#)

**OLIVE OIL** - See [Vegetable Oil](#)

**ORANGE JUICE** - See [Fruit Juice](#)

**ORGANIC SOLVENTS** - See [Solvents](#)

**ORTHOPHOSPHORIC ACID** - See [Phosphoric Acid](#)

## **PAINT**

Other Names: Many names are used to describe various types of paints or liquids used in various stages of the making of paints, e.g., primer, abrasive paint, hot bituminous paint, latex paint, water soluble, non-abrasive, Flocoat, paint paste, paint base, alkyd base, epoxy paint, acrylic paint, etc., etc.

Paint is a liquid mixture which can be applied to surfaces to form a dry, thin, protective or decorative film. Paint is composed of a solid (pigment) and a liquid vehicle. The vehicle consists of a binder which forms a film and usually a volatile solvent to improve the ease of application. Paints may be either water-base or oil-base. Oil-base paints have as the thinner organic liquids such as turpentine, naphtha, benzene, acetone or an alcohol.

Some paint binders form film by oxidation or polymerization. Examples of these are drying oils and phenolic or melamine resins. Other binders form films by evaporation of the thinner. Still other binders form a film when particles coagulate from a latex or dispersion of synthetic rubbers.

Paints also contain small amounts of plasticizers, driers, extenders, emulsifiers, stabilizers, etc.

Viscosity: Varies from 20 cPs. to 5,500 cPs. normally, with some of the paste-like materials going much higher

Remarks: Paints are used, in addition to the normally accepted applications of protective and decorative coatings, for such things as imparting resistance to corrosion, fire or mildew and fungus growth, providing electrical insulation, reduction of frictional resistance, etc.

Pumps are used for handling paints and their constituents at all stages of production. Pumps are used in feeding liquid to and taking it from sand grinders in preparation of the pigments, in the mixing and blending of the various paints when they are being compounded, for circulating, transferring and delivering directly to the point of application, such as a spray head or a striper.

Some paints are shear sensitive; the latex and emulsion type should be handled cautiously, particularly if they are recirculated. Many pumping systems are flushed when colors are changed or at the end of a run, so provision should be made for handling a thin solvent as well as for the paint itself.

Pump Notes: Cast iron construction is usually satisfactory but stainless steel may be required depending on the paint handled. Elastomer recommendations depend on the solvent used. Many paints or paint constituents are abrasive and must be handled with a pump designed to handle abrasives.

**PALMITIC ACID** - See [Fatty Acid](#)

## **PAPER COATING**

Paper coating is basically a starch slurry with a high percentage (up to 70%) of finely ground clay mixed in. Some paper coatings may also include small amounts of other materials such as titanium dioxide (extremely abrasive), methyl ethyl ketone, latex, toluene and alcohol.

Viscosity: In the 20,000 cPs. range as measured on normal viscosity testing equipment. Liquid is shear thinning. The estimated viscosity as it passes through the pump is in the range of 2,000 cPs. Use of 2,000 cPs. for determining capacity and horsepower gives reasonable results.

Sp. Gr.: Varies from 1.3 to 1.7

Remarks: Paper coating provides the "slick" surface to paper stock used for magazines. Coating is normally applied by blade coaters.

Pump Notes: Stainless steel construction is frequently used to maintain product color and purity. Buna n elastomers are recommended. Paper coating is abrasive and a mechanical shaft seal and pump design must be selected that are suitable for handling abrasives

## **PARAFFIN**

Other Names: Paraffin wax, paraffin hydrocarbon

Viscosity: Solid at ambient temperatures, almost water-thin when melted (melts above 1200F)

Remarks: White, translucent, waxy, tasteless, odorless solid. Soluble in benzene, warm alcohol, chloroform and olive oil. Insoluble in water and acids. m.p. in the range of 49°C to 65°C / 120°F to 150°F. Used in the manufacture of candles, wax paper, waterproofing wood, impregnating matches, as a lubricant, for preserving eggs, in making crayons, in ointments, preservative coating for food products, phonograph records, floor polishes, cosmetics and in packing tobacco products.

Pump Notes: Cast iron construction is satisfactory. Buna n or Viton elastomers are recommended depending on temperature. A mechanical shaft seal may be used.

**PASTE** - See [Adhesive](#)

## PEANUT BUTTER

Viscosity: Ranges from 2,000 to 22,000 cPs., varying as make-up and temperature.  
Normal pumping temperature is from 32°C to 82°C / 90°F to 180°F.  
Sp. Gr.: 1.1 to 1.2

Remarks: Peanut butter is made by mixing ground up peanuts with various additives and fillers. From the mixer peanut butter is pumped through a deaerator and/or a heat exchanger to remove entrained air and to drop the temperature prior to being pumped to the jar filling machines.

Pump Notes: Cast iron construction is satisfactory but stainless steel may be used because of sanitary requirements. Buna n elastomers are recommended.

**PEANUT OIL** - See [Vegetable Oil](#)

## PENTACHLOROPHENOL

Other Names: PCP  
Formula:  $C_6Cl_5OH$   
Sp. Gr.: 2.0  
Viscosity: Thin. Depends on the liquid in which it is in solution.

Remarks: White powder or crystals; soluble in alcohol, acetone, pine oil, benzene. Used as a fungicide, bactericide, herbicide and as a wood preservative. Dust is harmful. Solutions can cause skin irritation.

Pump Notes: Cast iron construction is satisfactory. PTFE or Kalrez elastomers are recommended as is a mechanical shaft seal.

## PENTANE

Other Names: n-Pentane, amyl hydride  
Formula:  $CH_3(CH_2)_3$   
Sp. Gr.: 0.63.  
Viscosity: Thin.

Remarks: A colorless, mobile, flammable liquid; freezing point -130°C / -202°F, b.p. 36°C / 97°F. Soluble in hydrocarbons, oils and ether; flash point -49°C / -57°F. It is one of the fractions of petroleum; is used as an anesthetic, for low temperature thermometers, as a solvent in extraction processes, as a general solvent, as a blowing agent in plastics and as a pesticide. Pentane is flammable.

Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended as is a mechanical shaft seal.

## PERCHLOROETHYLENE

Other Names: "per", tetrachloroethylene, perk

Formula:  $\text{Cl}_2\text{C}=\text{CCl}_2$

Sp. Gr.: 1.6

Viscosity: Thin

Remarks: Colorless liquid, nonflammable, nonexplosive, extremely stable. b.p. 121°C / 250°F, flash point none, miscible with alcohol, ether and oils in all proportions. Used as a dry cleaning solvent, vapor degreasing solvent, drying agent for metals and certain other solids, solvent for rubber, waxes, tar, paraffins, gum. May be corrosive in presence of water.

Pump Notes: Cast iron construction is satisfactory. Viton elastomers are recommended as is a mechanical shaft seal.

**PERCHLOROMETHANE** - See [Carbon Tetrachloride](#)

## PETROLATUM

Other Names: White mineral oil, paraffin oil-white, Vaseline

Sp. Gr.: 0.85

Viscosity: Grease-like at room temperatures, turns to liquid at 38°C / 100°F; has a viscosity of 22 cPs. at its melting point

Remarks: Soluble in ether, carbon disulfide, benzene. Derived by distillation of one of the high boiling point petroleum fractions. Used in medicine, cosmetics, dispersants, diluents, plastics manufacture, as a binder in foods, as a defoaming agent, lubricant, as a release agent and as a protective coating.

Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended as is a mechanical shaft seal.

## PHENOL

Other Names: Carboic acid, phenylic acid, benzophenol, hydrobenzene

Formula:  $C_6H_5OH$

Sp. Gr.: 1.07

Viscosity: Phenol melts at 43°C / 110°F. It is thin in the molten state.

Remarks: White, crystalline mass; absorbs water from the air and liquefies, distinctive odor. Poisonous. m.p. 43°C / 110°F, b.p. 182°C / 360°F, flash point 83°C / 182°F. Soluble in alcohol, water, ether, chloroform, glycerol, carbon disulfide, petrolatum. Used in making phenolic resins, epoxy resins (bisphenol-A), in weed killers, as a solvent for lubricating oils, for making a number of acids and pharmaceuticals. Hazardous liquid; rapidly absorbed through the skin, causing severe burns.

Pump Notes: Cast iron construction is generally satisfactory but stainless steel may also be requested. Viton elastomers are recommended as is a mechanical shaft seal.

**PHENOL-FORMALDEHYDE RESINS** - See [Resins](#)

## PHOSPHORIC ACID

Other Names: Ortho phosphoric acid, phosphoric anhydride. Phosphorus pentoxide, formula  $P_2O_5$ , absorbs moisture to form phosphoric acid  $H_3PO_4$ .

Viscosity: At ambient temperatures, viscosity varies from thin at the 50 and 75% strengths to a syrupy liquid at the 85% strength, to crystals at 100% phosphoric acid.

Sp. Gr.: Solid - 1.8

Remarks: Phosphoric acid is a clear, colorless, odorless, sparkling liquid, or a transparent, crystalline solid, depending on the concentration and the temperature. The percent concentration of acid is frequently given as a percentage of  $P_2O_5$ , e.g., 75% phosphoric acid contains 54%  $P_2O_5$ , 58% phosphoric acid contains 42%  $P_2O_5$ . Phosphoric acid is used in making fertilizers, soaps and detergents, in pickling and rust-proofing of metals, in pharmaceuticals, sugar refining, water treatment, animal feeds, waxes and polishes and in foods. CAUTION! Phosphoric acid causes skin irritation. Some phosphoric acids contain impurities which can affect corrosive and abrasive nature of the acid.

Pump Notes: Stainless steel construction is satisfactory. PTFE or Kalrez elastomers are recommended as is a mechanical shaft seal.



## **PHTHALIC ANHYDRIDE**

Formula:  $C_6H_4(CO)_2O$

Sp. Gr.: 1.5

Viscosity: Thin

Remarks: White, crystalline needles; soluble in alcohol; melts at 127°C / 260°F. Used in making alkyd resins, plasticizers, hardener for resins, used in making chlorinated products, insecticides and diethyl and dimethyl phthalate. Phthalic anhydride sets up to a brittle solid when it comes in contact with moisture.

Pump Notes: Cast iron construction is usually satisfactory but other construction may be requested. PTFE or Kalrez elastomers are recommended as is a mechanical shaft seal.

## **PITCH**

Other Names: Coal-tar pitch, hot pitch, tar pitch, roof pitch. Pitch is a thick, dark-colored bituminous substance obtained either as the result of industrial destructive distillation, or as deposits in the earth. Pitch is usually insoluble in water, miscible with carbon disulfide and benzene; has a "tarry" odor. Pitch can be divided into several groups:

- (1) Natural deposits - such as asphalt.
- (2) Residues from the distillation of mineral oils.
- (3) Residues from the distillation of tars. Typical of this group are coal tar pitch, wood tar pitch, pine tar pitch.
- (4) Residues from the distillation of fusible organic substances. Fatty acid pitch is typical of this group.

Viscosity: Ranging from 22 to 1,100 cPs., depending on particular type of pitch and temperature at which it is being handled. Typical operating temperature range for handling pitch is 204 to 260°C / 400 to 500°F.

Pump Notes: Cast iron construction is satisfactory. Viton elastomers are usually required because of temperature. Mechanical shaft seals suited for this service may be used.

## **PLASTICIZERS**

Plasticizers are materials that are added to a plastic to facilitate compounding and to improve flexibility and other properties of the finished product. Among the important plasticizers are nonvolatile organic liquids or low-melting solids. Typical of the plasticizers are phthalate and aryl phosphate esters; polyol alcohols are also common plasticizers.

Viscosity: Varies widely with the particular plasticizer and the pumping temperature.

Remarks: Plasticizers are especially important in the making of rubber, vinyl and cellulosic resins.

Pump Notes: For specifics on the particular plasticizer being handled, check with the user or supplier for information.

## **PLASTISOL**

Plastisol is a liquid dispersion of finely divided resin in a plasticizer, q.v.. Polyvinyl chloride resin dispersed in a plasticizer is a typical plastisol. It is usually 100% solid with no volatiles; when volatile content exceeds 5% of the total weight, it is called an organosol. When the plastisol is heated, the plasticizer solvates the resin particles and the mass gels. With continued application of heat, the mass fuses to become a conventional thermoplastic material.

Remarks: Plastisols are useful for molding, casting films or coating. They are often used without volatile or high processing temperatures. Some plastisols or organosols may be heat or shear-sensitive.

Pump Notes: Check with supplier of material for liquid characteristics before making a pump recommendation.

**POLYESTER RESIN** - See [Resins](#)

## **POLYETHYLENE GLYCOL**

Other Names: PEG, polyoxyethylene, polyglycol or polyether glycol. Polyethylene glycol is the name for polymers of ethylene glycol having a wide range of molecular weights. Properties vary with molecular weight.

Viscosity: varies widely, depending on the particular glycol. Generally in the range of 22 to 220 cPs., with variations beyond this possible.

Remarks: Clear, colorless, odorless, viscous liquids or waxy solids. Soluble or miscible with water and organic solvents. Used in making plasticizers, softeners, lubricants, as a base for cosmetics and pharmaceuticals. Polyethylene glycol is often identified by a number such as 400 following the name. The number following the name indicates average molecular weight. The numbers 400 and less indicate a liquid; those with higher numbers generally indicate a solid at room temperature.

Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended as is a mechanical shaft seal.

## **POLYMER**

A substance composed of giant molecules that have been formed by the union of a number of simple molecules with one another. The number that unite to form a polymer molecule varies from two to hundreds or thousands. The simple molecules that undergo such a change are known as monomers, and their union is called polymerization. The monomer molecules may be all alike, or there may be two or more varieties of monomer involved in the formation of a single polymer. Ethylene molecules can be united with themselves to form polyethylene resin which is a monopolymer. SBR synthetic rubber is a copolymer, since two different kinds of monomer (styrene and butadiene) are required. A polymer formed from three monomers is a terpolymer. The most important polymers in order of volume used are polyethylene, polyvinyl and polystyrene.

Viscosity: From the above discussion it is obvious that there can be a wide range of properties of a polymer. Records show that a viscosity range of 220 to 22,000 cPs. would cover most polymers pumped. Sp. Gr. is a function of the particular polymer.

Remarks: In addition to the many chemical names for polymers, there are many trade names used by manufacturers to identify their specific polymers.

Pump Notes: Cast iron construction is usually satisfactory but stainless steel may also be required. Elastomer recommendation depends on the particular polymer.

## **POLYOL**

Other Names: Polyalcohol. Alcohols having many hydroxyl radicals are called polyols.

Viscosity: Varies widely, depending on the specific polyol. Generally in the range from 550 cPs. to 33,000 cPs.

Remarks: Many companies market polyols under their own trade names.

Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are usually acceptable. A mechanical shaft seal may be used as well as a sealless design pump.

**POLYPHOSPHORIC ACID** - See [Phosphoric Acid](#)

**POLYPROPYLENE GLYCOL** - Similar to [Polyethylene Glycol](#), q.v.

## **POLYURETHANE FOAM**

To make polyurethane foam, a polyether such as polypropylene glycol is treated with a diisocyanate in the presence of water and a catalyst (amines, tin soaps, organic tin compounds), as well as fillers, dispersing and emulsifying agents, etc. Simultaneously with the polymer-forming reactions the water reacts with the isocyanate group to cause cross linking and curing, and also produces carbon dioxide which causes foaming. In some foams, a volatile material such as Freon is incorporated to serve as a blowing agent. Foam is normally made by one of two basic methods, the prepolymer system or the one-shot system.

The prepolymer system brings two streams together at the foaming head. Component A is a mixture of a polyol, catalyst, surfactant and blowing agent, while component B is a polyol isocyanate mixture. Both components are quite viscous.

The one-shot system brings all components together at the spray head through independent lines from separate supplies. This system requires more equipment and precise metering, but once controls are established the uniformity of the foam is much better than with the prepolymer system.

Viscosity: Varies widely from thin for the blowing agents, catalyst and amines to the order of 5,000 for the polyols or resins.

Remarks: Flexible foams, made with resins having triols as a basic material, have high strength, good heat insulating properties, and resistance to water, oil, solvents and abrasion. The rigid foams made from polyether containing compounds such as sorbitol, or sucrose, add strength and rigidity to metal framework at little increase in weight. Foams are used in insulating tresses and upholstery, interlining for clothing and sleeping bags, for soundproofing walls, as an insulation against heat loss, in life preservers, fish net floats, foam rubber applications, packaging and many other areas of use.

Pump Notes: Cast iron construction is normally satisfactory. Elastomer selection varies based on the particular grade of material. A sealless design pump is the pump of choice due to crystallization tendencies of the products pumped.

## **POLYVINYL ACETATE**

Other Names: PVAc

Viscosity: Ranges from 1,100 to 11,000 cPs.

Sp. Gr.: 1.2

Remarks: Colorless, odorless, tasteless, non-toxic, transparent, thermoplastic solid. Insoluble in water, oils and fats. Soluble in alcohols, esters, benzene and ketones. Used in latex water paints, in hot melt and other types of adhesives, for coating and finishing fabrics, as a component of lacquers, inks and in caulking compounds and chewing gum.

Pump Notes: Cast iron construction may be satisfactory but stainless steel may also be required. EPR elastomers are generally acceptable. Attention needs to be given to speed and sealing methods with this liquid.

## **POLYVINYL ALCOHOL (PVA)**

A water soluble synthetic resin made by hydrolysis of polyvinyl acetate.

Viscosity: Variable, depending on the degree of hydrolysis; ranges from 400 to 40,000 cPs.

Sp. Gr.: 1.2 to 1.3

Remarks: A base material for water-resistant laminating adhesives. Used in adhesives, in binders for leather, cloth and paper, in grease proof paper, as a paper size, as an emulsifying agent, as an emulsion stabilizer and thickener, for temporary protective coatings.

Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are generally acceptable. A mechanical shaft seal may be used depending on viscosity.

**POTASSIUM HYDROXIDE** - See [Sodium Hydroxide](#)

## PRINTING INK

A mixture of finely divided pigment such as carbon black suspended in a drying oil such as linseed oil. Synthetic resins are frequently used plus cobalt, manganese and lead soaps are often added to achieve rapid drying by oxidation and polymerization. Mineral oils are also used in certain inks. Some types of ink dry by evaporation of a volatile solvent rather than by oxidation of a drying oil. For colored inks, pigments such as chrome yellows or lithol reds are used.

Viscosity: Varies from a few hundred cPs. to 40,000 cPs., depending on the type of ink and temperature

Remarks: Some inks such as carbon paper inks contain wax; these inks and certain other types are often handled at temperatures in the range of 82 to 93°C / 180 to 200°F. Steam jacketed features may be required for handling these inks. Certain inks, depending on the solvent, may be considered flammable.

Pump Notes: Cast iron construction is generally acceptable. Elastomers depend on the solvent used. A mechanical seal suitable for thick and or abrasive type liquids should be used.

**PROPANE** - See [LP-Gas](#)

## PROPYLENE GLYCOL

Other Names: Methylethylene glycol, methyl glycol

Formula:  $\text{CH}_3\text{CHOHCH}_2\text{OH}$

Sp. Gr.: 1.04

Viscosity: From 10 to 100 cPs.

Remarks: Colorless, viscous, stable, hygroscopic liquid. Miscible with water, alcohols and many organic solvents. b.p. 187°C / 369°F, vapor pressure 0.07 mm @ 20°C / 68°F, flash point (open cup) 107°C / 225°F. Used in making polyester resins, anti-freeze solutions; used as a solvent for fats, oils, waxes, resins, perfumes. Serves as a hygroscopic agent; lubricant in refrigeration machines, plasticizer, cosmetics, solvent in foods, as a wetting agent, an emulsifier and as an animal feed additive.

Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended as is a mechanical shaft seal.

**PVA** - See [Polyvinyl Alcohol](#)

**PVAc** - See [Polyvinyl Acetate](#)

**REFRIGERANTS** - See [Anhydrous Ammonia](#) and [Freons](#)

## RESINS

Resin is an organic, semi-solid or solid material produced by union (through polymerization or condensation) of a large number of molecules of one or two relatively simple compounds. Properties vary widely with the raw materials, their proportions and the conditions of formulation of the resin. Resins are broadly classified as thermoplastic or thermosetting according as they soften or harden with the application of heat.

Listed below are some of the synthetic resins classed by their derivation:

1. Modification of natural polymers, e.g., chlorinated rubber, cellulose acetate, casein and ester gums.
2. Resins formed by polymerization (union of small molecules without formation of water or some other simple molecule as a by-product), e.g., acrylate resins, polystyrene, vinylidene resins, etc.
3. Resins derived by condensation (union of small molecules with the formation of water or some other simple molecule as a by-product), e.g. alkyd resins, q.v., epoxy resins, q.v., phenolic resins, polyurethane resins, urea-formaldehyde resins, q.v., etc.

Viscosity: Varies from a few hundred cPs. to several thousand cPs. depending on particular resin

Remarks: Additives such as solvents, blowing agents, abrasive solids, etc. are often mixed with various resins to provide an almost endless variation to the end product. Resins have a broad range of application for such things as paints, protective coatings "plastic" parts, potting materials, hot melts, foam, adhesives, etc. See specific resins by name for additional uses.

Pump Notes: Construction recommendation depends on the individual resin. Additives can affect pump recommendation. Some resins are shear and/or heat sensitive; reduced speeds, cooling jackets, etc., may be helpful.

**ROOFING TAR** - See [Tar](#)

## **ROSIN**

Other Names: Gum rosin, colophony, pine resin, wood rosin

Viscosity: Varies from a few hundred cPs. to 20,000 cPs. depending on temperature and/or solvent. Rosins without solvents are often handled in the 204 to 260°C / 400 to 500°F. temperature range.

Sp. Gr.: 1.1

Remarks: Rosin occurs as angular, translucent, amber-colored fragments. M.p. in the 93 to 149°C / 200 to 300°F range; insoluble in water; soluble in alcohol, benzene, ether and oils. It is obtained from pine trees by distillation process. Rosin is used in making linoleum, in making soldering compounds, core oils, insulating compounds, molding compounds, sealing waxes, medicines, in paper sizing, printing inks and varnishes. Rosin is combustible; gives off flammable vapors when heated.

Pump Notes: Cast iron construction is usually satisfactory although stainless steel may also be requested. Elastomer and shaft sealing recommendation depends on the particular rosin and temperature.

## **RUBBER CEMENT**

Viscosity: Varies widely, depending on particular cement. Can range from 150 to 22,000 cPs. and higher.

Sp. Gr.: 0.6 to 0.9

Remarks: Rubber cement is normally a solution of rubber and a hydrocarbon solvent. Used as a binder to hold materials in position until sewing or clamping is accomplished, as permanent bonds, as vulcanizing seals, in shoe manufacture, as a sound deadener, as an adhesive for paper and for repairing.

Pump Notes: Cast iron construction is usually satisfactory. Elastomer recommendation depends on the solvent used in the cement. Mechanical shaft seals have been used successfully on this product.

**SALAD DRESSING** - See [Mayonnaise](#)

**SAUSAGE STUFFING** - See [Meat Emulsion](#)

**SILICATE** - See [Sodium Silicate](#)

**SHORTENING** - Similar to [Vegetable Oil](#), q.v.



## **SHELLAC**

Shellac is a resin secreted by an insect from the far east. After processing the resin becomes shellac as we know it.

Other Names: Lac, garnet lac, gum lac or stick lac

Viscosity: 22 cPs. to several thousand, depending on how much it has been reduced

Remarks: Insoluble in water, soluble in alcohol. Used in paints, stains, varnishes, as a general binder and for making sealing wax.

Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are usually acceptable.

**SILICATE OF SODA** - See [Sodium Silicate](#)

## **SILICONE FLUIDS**

Viscosity: Commercially available in a range of viscosities from 1 cPs. to several thousand cPs.

Remarks: Silicone fluids are characterized by heat stability, water repellency, good dielectric properties and incompatibility with many organic polymers which makes them effective release agents. Some silicones tend to have low surface tension which means they have little lubricating ability.

Pump Notes: Cast iron construction is satisfactory. Viton ♦ elastomers are recommended. A mechanical shaft seal or sealless design pump may be used.

## **SOAP**

Other Names: Kettle soap, soap stock, soap skimmings, liquid soap; soap as discussed here is from natural oils and fatty oils as differing from black liquor soap that is a by-product of the paper pulp processing.

Ordinary soap is a mixture of sodium salts of various fatty acids of natural oils and fats. It is made by heating the oils with caustic soda, salting out the soluble soap formed and drawing off the dilute glycerol produced. Common soap is largely a mixture of the sodium salts of palmitic, stearic and oleic acids. Rosin soaps as used for laundry purposes are made by adding a soap made from rosin or rosin itself to an ordinary soap. Castile soaps are made from olive oil. Transparent soaps are made from decolorized fats with the addition of glycerol or sugar. Liquid soap is usually a potash soap dissolved in water.

Viscosity: Varies from 40cps to 40,000 cPs. SSU and up depending on type of soap and stage in process. Soap is normally handled anywhere between ambient temperatures and 93°C / 200°F.

Sp. Gr.: 0.9 to 1.0

Pump Notes: Cast iron or stainless steel construction is needed depending on the particular soap. PTFE or Kalrez elastomers are usually recommended. Mechanical seals may be used but PTFE packing is also frequently used.

**SOAP SKIMMINGS** - See [Black Liquor Soap](#)

## **SODIUM CHLORIDE BRINES**

Other Names: Table salt, sea salt, common salt, rock salt. Brine is made when the salt is put into solution in water.

Formula: NaCl

Sp. Gr.: 1.1 to 1.2

Viscosity: Brines being solutions in water are normally almost as thin as water

Remarks: Sodium chloride brine is used for refrigeration purposes in food preservation.

Pump Notes: Cast iron construction is usually acceptable. Avoid use of dissimilar metals in pump construction due to electrolytic action of the salt. Buna n elastomers are recommended as is a mechanical seal.

## **SODIUM HYDROXIDE**

Other Names: Caustic, caustic soda, lye, sodium hydroxide, aqueous

Formula: NaOH

Sp. Gr.: 1.1 for 10% concentration, 1.4 for 50% concentration

Viscosity: From water-thin to 40 cPs. depending on concentration and temperature

Remarks: Sodium hydroxide is a white, crystalline hygroscopic solid. It is soluble in water, alcohol and glycerol. It is used in the manufacture of other chemicals, rayon and film, petroleum refining, pulp and paper, making of aluminum, refining vegetable oil, in detergents, soaps, textile processing, in reclaiming rubber and as an alkali in foods. Causes severe burns to skin and eyes.

Pump Notes: Concentrations up to 50% can usually be handled with cast iron construction. Elastomer recommendation depends on concentration and ranges from buna n to PTFE or Kalrez.

**SODIUM METASILICATE** - Similar to [Sodium Silicate](#).

## **SODIUM SILICATE**

Other Names: Soluble glass, silicate of soda, liquid glass, water glass; similar to sodium metasilicate

Formula:  $\text{Na}_2\text{O} \cdot 3.75 \text{SiO}_2$  to  $2\text{Na}_2\text{O} \cdot \text{SiO}_2$  with various proportions of water

Viscosity: Varies widely over a range. Normal range is from 100 cPs. to 5,500 cPs.

Normally handled at room temperature.

Sp. Gr.: 1.4 to 1.5

Remarks: White powder or clear liquid with widely varying viscosity. Freezing point is slightly lower than that of water. Made by melting sand and soda ash. Used as a catalyst. Also used in making soaps and detergents, adhesives, pigments, water treatment, bleaching and sizing of textiles and paper pulp, as a binder for foundry cores and molds and in waterproofing mortars and cements. Sodium silicate is irritating to the eyes and skin.

Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended. A mechanical shaft seal may be used if suitable for the viscosity and potential abrasion but packing is also frequently used.

**SOLDER** - See construction recommendations under [Lead](#)

## **SOLVENTS**

A solvent normally means the liquid used to dissolve a solid or put it into solution. The term is used widely in the paint industry, metal cleaning, degreasing, plastics, etc. Alcohol, naphtha, toluene, ketones are all typical solvents. Many solvents are listed by name in this Liquid List.

Viscosity: Almost all solvents are water-thin

## **SOYBEAN OIL**

Other Names: Soya bean oil, Chinese bean oil, soy oil

Viscosity: From 10 cPs. to several hundred cPs. depending on stage of process and temperature

Remarks: Pale, yellow oil; soluble in alcohol, ether, chloroform and carbon disulfide; m.p. approximately 25°C / 77°F. The oil is obtained from soybeans that are crushed, heated with steam and pressed, or by solvent extraction. Soybean oil is used in making soaps, as a food, in making inks, as a substitute for linseed oil in paints and varnishes, as a cattle feed, a butter substitute, in salad dressings, in resins, linoleum and in the manufacture of glue.

Soybean foots are sometimes encountered in soybean oil processing. See [Foods](#).

Soybean gums are also sometimes handled as a by-product of soybean oil processing. These gums can have viscosities upwards of 20,000 cPs.

Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended as is a mechanical shaft seal.

## STARCH

Other Names: Hot starch, cooked starch, raw starch, starch slurry. For recommendations on clay and starch mixtures in the paper industry see [Paper Coatings](#).

Formula:  $(C_6H_{10}O_5)_X$

Sp. Gr.: 1.5

Viscosity: Varies from a few cPs. to at least 20,000 cPs., depending on type of starch, amount of liquid in the slurry, temperature, etc.

Remarks: Starch is a white, tasteless powder; insoluble in cold water, forms a jelly with hot water. It is derived from corn, arrowroot or potatoes. It is used for making adhesives, for the sizing and finishing of textiles, in foods, in sizing paper, in making explosives, in medicines, face powders, cosmetics, bookbinding, making glucose, malt sugar, caramel and in cattle feeds.

Pump Notes: Construction varies from cast iron to stainless steel. Buna n elastomers are normally acceptable. Starches are generally shear sensitive liquids; the pump design must be capable of handling that type of liquid.

**STEARIC ACID** - Melts at 71°C / 160°F, viscosity 30 cPs. at 82°C / 180°F. See [Fatty Acid](#) for additional information.

**STICK** - See [Liquid Stick](#)

**STODDARD SOLVENT** - See [Solvents](#)

## STYRENE

Other Names: Styrene monomer, vinyl benzene, phenylethylene

Formula:  $C_6H_5CH:CH_2$

Sp. Gr.: 0.90

Viscosity: Styrene monomer - thin. If polymerization has taken place, or if the styrene has been mixed with other liquids, viscosity may range up to 100,000 cPs.

Remarks: Styrene is a colorless, oily-like liquid, aromatic odor; freezing point -31°C / -24°F, -b.p. 145°C / 293°F, flash point (open cup) 38°C / 100°F. Insoluble in water, soluble in alcohol and ether; readily polymerizes when heated or exposed to light, becoming increasingly viscous until a clear solid is produced. Inhibitors are mixed with the styrene during shipment to prevent polymerization. Used for making polystyrene plastics, making SBR and ABS resins, and in making protective coatings.

Pump Notes: Cast iron construction is normally satisfactory. Elastomers vary from Viton to PTFE or Kalrez. A mechanical shaft seal is frequently used.

**SUCROSE - TECHNICAL NAME FOR SUGAR** - See [Sugar Syrup](#)

## **SUGAR SYRUP**

Other Names: Liquid sugar, sugar, beet sugar, cane sugar, sucrose

Formula:  $C_{12}H_{22}O_{11}$

Sp. Gr.: 1.1 to 1.5

Viscosity: Varies widely depending on specific gravity and temperature, e.g., 21°C / 70°F., 68 Brix syrup has a viscosity of approximately 240 cPs. while 21°C / 70°F. 76 Brix sugar has a viscosity of 1,300.

Remarks: The term sugar syrup or syrup is a very broad one and is applied very generally to a number of sweet tasting carbohydrates. Sugar syrups are used in food, for sweetening, in candy, preserves and jams, in making soap, pharmaceuticals, carmel, as a chemical intermediate for detergents, as an emulsifying agent in such things as plasticizers, resins, explosives, glues and insecticides.

Pump Notes: Construction varies from cast iron to stainless steel depending on user needs. Buna n elastomers are recommended. Mechanical shaft seals are frequently used.

## **SULFONIC ACID**

Sulfonic acid is a very general term which often is applied to a liquid which has been sulfonated, i.e., a liquid which has been joined together with the  $SO_2OH$  group. This process is called sulfonation. An example of this is the conversion of benzene ( $C_6H_6$ ) into benzene sulfonic acid ( $C_6H_5HSO_3$ ). Common sulfonating agents are concentrated sulfuric acid, fuming sulfuric acid, sulfur trioxide and other sulfur-containing liquids. Generally sulfonic acid will be rather active corrosion-wise.

Pump Notes: Construction varies from cast iron to stainless steel depending on the liquid. PTFE or Kalrez are elastomers are normally used.

## **SULFUR**

Other Names: Brimstone, flours of sulfur, molten sulfur

Formula: S

Sp. Gr.: 1.8

Viscosity: In the suggested handling range of 121°C / 250°F to 154°C / 310°F, viscosity varies from 9 cPs. to 6 cPs. Above 154°C / 310°F, the viscosity increases rapidly as the temperature increases until at 188°C / 370°F it is almost solid.

Remarks: Sulfur is mined as the pure element in areas of Texas, Louisiana and Sicily. It is also found combined in many ores, petroleum and natural gas. It is used in making sulfuric acid, in the pulp and paper industry, in making carbon disulfide and other chemicals and dyes, for vulcanizing rubber and in medicines. Some sulfur contains abrasive impurities; sulfur should be considered a non-lubricating liquid.

Pump Notes: Cast iron construction is satisfactory. Viton elastomers are acceptable. Special attention must be paid to shaft sealing because of the liquid properties.

## **SULFURIC ACID, CONCENTRATED**

Other Names: Hydrogen sulfate, oil of vitriol, battery acid, 660 Baume sulfuric acid (93.2%), 98% sulfuric acid

Formula: H<sub>2</sub>SO<sub>4</sub>

Sp. Gr.: 1.84

Viscosity: Less than 160 cPs.

Remarks: Sulfuric acid is one of the most important of the heavy chemicals. It is strongly corrosive, dense, oily, colorless to dark brown depending on purity. It is miscible with water in all proportions, but great caution is necessary in mixing due to evolution of much heat that may cause explosive spattering. It is very reactive, dissolves most metals; concentrated acid oxidizes, dehydrates, or sulfonates most organic compounds, often causing charring. Used in making fertilizers, as a source of many chemicals, in petroleum refining, in making paints and pigments, in production of iron and steel, in the manufacture of rayon and cellulose film, in making industrial explosives. Some of the high concentrations are prone to "salt out," which can cause the pump to bind up in the bushing areas. Applicants for handling sludge or spent sulfuric acid should be reviewed with user.

Pump Notes: Because of the corrosive characteristics of this liquid consult the pump manufacturer for specific recommendations.

**SUPERPHOSPHORIC ACID** - See [Phosphoric Acid](#)

**SYRUP** - See [Sugar Syrup](#)

## TALL OIL

Other Names: Tallol, liquid rosin

Viscosity: Varies widely, depending on source of tall oil and stage in process. Can vary from 220 to 560 cPs. Generally handled in the temperature range from ambient to 93°C / 200°F.

Remarks: Tall oil is the oily mixture of rosin acids, fatty acids and other materials obtained by acid treatment of the alkaline liquors from the digesting of pine wood. The spent black liquor from the pulping process is concentrated until the sodium salts of the various acids separate out and are skimmed off. These soaps are acidified by sulfuric acid to obtain the crude tall oil. Used in drying oils, alkyd resins, linoleum, soaps, cutting oils, emulsifiers, flotation agents, lubricants and greases, and in making rubber. Suggest checking with user or supplier of material to make sure materials of construction recommended for the pump are in keeping with materials in the rest of the system.

Pump Notes: Cast iron construction is satisfactory. Elastomer recommendation varies with specific product.

**TALLOW** - See [Fats](#)

## TAR

Tar is a dark-colored bituminous substance, liquid or semi-liquid at ambient temperatures, obtained by the destructive distillation of coal, wood, peat, or other carbonaceous or vegetable materials. On further distillation, it forms a pitch. The composition and origin of tar varies widely.

Other Names: Roofing tar; often called, although perhaps incorrectly, asphalt, or pitch

Viscosity: Solid or semi-solid at room temperatures; 100 cPs. to 500 cPs. at normal pumping temperature range of 204°C / 400°F to 315°C / 600°F

Remarks: Tar is often a residue remaining after the processing of basic materials; as a result, it frequently contains a variety of materials and liquids which makes one single pump construction recommendation impractical. Tar is used oftentimes for such things as coating roofs, coating cast iron pipe or gas transmission lines, etc.

Pump Notes: Cast iron construction is satisfactory. Viton elastomers are normally recommended due to temperature. A mechanical shaft seal can be used but packing or submerging the pump in the liquid are more common sealing solutions.

**TDI** - See [Toluene Diisocyanate](#)

**TETRACHLOROETHYLENE** - See [Perchloroethylene](#)



## TETRAHYDROFURAN

Other Names: THF

Formula: C<sub>4</sub>H<sub>8</sub>O

Sp. Gr.: 0.89

Viscosity: Thin

Remarks: Water-white liquid. Freezing point -65°C / -85°F, b.p. 66°C / 87°F, flash point (open cup) -15°C / 5°F, soluble in water and organic solvents. Used as a solvent for natural and synthetic resins. Used in coating solutions, protective coatings, adhesives and printing inks.

Pump Notes: Cast iron construction is satisfactory. PTFE or Kalrez elastomers are recommended as is a mechanical shaft seal.

**THERMINOL** - See [Heat Transfer Liquids](#)

## TITANIUM DIOXIDE

Handled as a slurry. It is extremely abrasive.

Formula: TiO<sub>2</sub>

Sp. Gr.: 3.8

Viscosity: Varies, depending on the type of slurry being handled from 22 to 2,200 cPs.

Remarks: Titanium dioxide is used as a paint pigment, in paper coating, making floor coverings; also in printing inks.

Pump Notes: Cast iron construction is satisfactory. Elastomer recommendation depends on the solvent used. The pump design needs to be capable of handling abrasives.

## TOLUENE

Other Names: Toluol, methylbenzene, phenylmethane

Formula:  $\text{CH}_3\text{C}_6\text{H}_5$

Sp. Gr.: 0.87

Vapor Pressure: Approximately 30mm Hg. absolute at 70°F

Viscosity: Thin. 1 cPs.

Remarks: Colorless, flammable liquid. B.p. 111°C / 232°F, flash point 4°C / 40°F. Soluble in alcohol, benzene and ether; insoluble in water. Used in blending aviation gasoline, as a raw material for benzene phenol, as a solvent for paints, coatings, gums, resins and rubber cement. Used for making chemicals, in medicines, dyes, perfumes and as a source of toluene diisocyanates used in polyurethane resins. Flammable; vapor is harmful.

Pump Notes: Cast iron construction is satisfactory. Viton♦ elastomers are usually acceptable. A mechanical shaft seal or sealless pump design may be used.

## TOLUENE DIISOCYANATE

Other Names: TDI, toluene-2,4-isocyanate; commercial grades are often mixtures of the 2,4- isomer and the 2,6- isomer

Formula:  $\text{CH}_3\text{C}_6\text{H}_3(\text{NCO})_2$

Sp. Gr.: 1.2

Viscosity: Variable depending on mixture of isomers but normally in the range of 7 to 165 cPs.

Remarks: Water-white to pale yellow liquid with a sharp, pungent odor; b.p. 250°C / 418°F, flash point 132°C / 270°F, m.p. (pure) 20°C / 68°F, vapor pressure 0.01 mm @ 20°C / 68°F; soluble in ether, acetone and other organic solvents. Used in making polyurethane foams q.v., elastomers and resins. Irritating to eyes and nose; causes burns.

Pump Notes: Cast iron construction is usually acceptable. Viton♦, PTFE or Kalrez elastomers are recommended. TDI is normally handled with a sealless design pump.

**TOLUOL** - See [Toluene](#)

## **TRANSFORMER OIL**

Any refined petroleum oil suitable for use in surrounding the coils of transformers to provide electrical insulating and to conduct heat.

Viscosity: 10 to 22 cPs.

Remarks: Transformer oil is highly refined to keep oxidation, moisture, acid, soap, salts and suspended matter to a minimum. Some applications may involve a high vacuum if equipment is being used to remove vapor from the transformer oil.

Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended as is a mechanical shaft seal.

## **TRICHLOROETHANE**

Other Names: 1,1, 1-trichloroethane; methyl chloroform

Formula:  $\text{CH}_3\text{CCl}_3$

Viscosity: Thin

Remarks: Colorless liquid. b.p. 75°C / 167°F; insoluble in water, soluble in alcohol and ether. Used in medicine; as a pesticide; as a general solvent for fats, oils, waxes, resins, and cutting oil compounds; as a coolant and lubricant.

Pump Notes: Cast iron construction is satisfactory. PTFE, Kalrez or Viton elastomers provide acceptable results.

## **TRIETHYLENE GLYCOL**

Other Names: TEG

Formula:  $\text{HO}(\text{C}_2\text{H}_4\text{O})_3\text{H}$

Sp. Gr.: 1.12

Viscosity: 25 to 65 cPs.

Remarks: Colorless, hygroscopic, odorless liquid. Soluble in water. Used as a solvent for nitrocellulose, for various gums and resins, in making lacquers and as a textile conditioner.

Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended as is a mechanical shaft seal.

## TRICHLOROETHYLENE

Formula:  $\text{CHCl}_2\text{CCl}_2$

Sp. Gr.: 1.46

Viscosity: Thin

Remarks: Stable, low-boiling, colorless, heavy, mobile, toxic liquid. Nonflammable, nonexplosive, noncombustible. Will not attack common metals in presence of moisture. b.p.  $87^\circ\text{C} / 189^\circ\text{F}$ , m.p.  $-73^\circ\text{C} / -99^\circ\text{F}$ , flash point (open cup) none up to boiling point. Miscible with common organic solvents, insoluble in water. Used in metal degreasing, solvent for oils, fats and waxes, dry cleaning, as a refrigerant, heat exchange liquid, as a fumigant, and for cleaning and drying small intricate parts. Vapor is harmful.

Pump Notes: Cast iron construction is satisfactory. Viton elastomers are recommended as is a mechanical shaft seal.

## TRIETHANOLAMINE

Other Names: TEA

Formula:  $(\text{HOCH}_2\text{CH}_2)_3\text{N}$

Sp. Gr.: 1.13

Viscosity: 110 to 440 cPs.

Remarks: Colorless, viscous, hygroscopic liquid. m.p.  $21^\circ\text{C} / 70^\circ\text{F}$ ; miscible with water, alcohol; soluble in chloroform. Used in cosmetics, detergents, oil emulsions, as a corrosion inhibitor, plasticizer, and insecticide.

Pump Notes: Cast iron construction is satisfactory. PTFE or Kalrez elastomers are recommended as is a mechanical shaft seal.

## TURPENTINE

Other Names: Spirits of turpentine, turps, oil of turpentine

Formula:  $\text{C}_{10}\text{H}_{16}$

Sp. Gr.: 0.87

Viscosity: Thin

Remarks: Turpentine is a volatile oil obtained by distilling the oleo resin contained in the wood of certain pine trees. It is a colorless, mobile liquid, lighter than water. Flash point (closed cup)  $32-46^\circ\text{C} / 90-115^\circ\text{F}$ . Used in medicine, as a general solvent, as a thinner for paints, varnishes, lacquers and as a rubber solvent and reclaiming agent.

Pump Notes: Cast iron construction is satisfactory. Viton elastomers are recommended as is a mechanical shaft seal.

**UCON** - See [Heat Transfer Liquids](#)

**UREA FORMALDEHYDE RESIN** - See [Resin](#)

**URETHANE FOAM** - See [Polyurethane Foam](#)

## **VARNISH**

An unpigmented, oil-base paint composed of a solvent and one of two types of binders. One type of binder is made up of drying oils alone or in combination with resins which form a film by oxidation or polymerization. The second type of binder is that which forms a film by evaporation of the solvent; typical of this type is shellac or alkyd and phenolic resin varnishes.

Viscosity: Varies from several cPs. to several thousand cPs. depending on type, proportions and temperature

Remarks: Varnish is used primarily for a protective coating, particularly of such items as furniture, woodwork and the like.

Pump Notes: Cast iron construction is satisfactory. Elastomer recommendation depends on the solvent used. A mechanical shaft seal or sealless design pump may be used.

## **VEGETABLE OIL**

Other Names: Shortening edible oil; also may be identified by specific name such as corn oil, or cottonseed oil, etc.

Viscosity: Varies from 11 cPs. to 110 cPs., depending on specific oil and temperature

Sp. Gr.: 0.9 to 1.0

Remarks: Vegetable oils are an important class of oils obtained from plants and used industrially as drying oils, for lubricants, in cutting oils, for dressing leather and many other purposes. The edible oils are used in such things as salad oils, shortenings, margarine, etc.

Pump Notes: Cast iron construction is satisfactory. Buna n elastomers are recommended as is a mechanical shaft seal.

## VINYL ACETATE

Formula:  $\text{CH}_3\text{COOCH}=\text{CH}_2$

Sp. Gr.: 0.93

Viscosity: Thin

Remarks: Colorless liquid, stabilized with inhibitors. B.p. 73°C / 163°F, flash point (open cup) -1°C / 30°F. Soluble in most organic solvents. Insoluble in water. Used in making polyvinyl acetate, polyvinyl alcohol and polyvinyl chloride-acetate resins. These materials are used particularly in latex paints, adhesives and textile finishing. Vinyl acetate is extremely flammable.

Pump Notes: Cast iron construction is satisfactory although other construction may be requested by the end user. PTFE or Kalrez<sup>®</sup> elastomers are recommended as is a mechanical shaft seal.

## VINYL CHLORIDE

Other Names: VC, chloroethene, chloroethylene

Formula:  $\text{CH}_2=\text{CHCl}$

Sp. Gr.: 0.91

Viscosity: Thin

Remarks: The most important of the vinyl monomers. It is an easily liquefied gas. B.p. -14°C / 7°F, vapor pressure 3.45 BAR / 50 PSI at 20°C / 68°F, flash point -78°C / -108°F; slightly soluble in water, soluble in alcohol and ether. Used mainly for making polyvinyl chloride and copolymers. Extremely flammable liquid.

Pump Notes: EPA/OSHA regulations call for special construction. Consult with individual pump manufacturer.

## VISCOSE

Other Names: Sometimes referred to as rayon viscose by converting cellulose to the soluble xanthate, which can be spun into fibers and then reconverted to cellulose by treatment with acid. Wood pulp is steeped in caustic soda and then shredded and aged. It is then treated with carbon disulfide of cellulose xanthate. After filtration and deaeration, the remaining solution is known as viscose.

Viscosity: Ranges from 5,500 cPs. to 55,000 cPs. with the most normal range being 5,500 cPs. to 11,000 cPs.

Remarks: Much of the viscose ends up as cellophane or rayon fibers.

Pump Notes: Cast iron construction is satisfactory. Pumps are normally supplied with shaft packing.

**WATER GLASS** - See [Sodium Silicate](#)

## **WATER**

Also further identified by such terms as deionized, demineralized, soft, tap, hard, salt, mine, sea, distilled, hot, bilge, fresh, etc.

Formula: H<sub>2</sub>O

Sp. Gr.: 1.0

Viscosity: 1 cPs.

Remarks: Water is the most readily available liquid and one of the most difficult to handle, primarily because of its lack of lubrication, corrosive and erosive nature. Adding a small amount of soluble oil or glycol to water changes its properties very materially and makes it much more suitable for handling in a positive displacement pump.

Pump Notes: Construction varies from cast iron to stainless steel. Elastomer recommendation depends on the particular service. Not all pump manufacturers recommends pumps for handling water; check with individual suppliers.

## **WAX**

Waxes are unctuous, fusible, variably viscous to solid substances having a characteristic waxy luster. They are insoluble in water but soluble in most organic solvents. Waxes have a relatively sharp melting point. They have several different origins such as animal wax, e.g., beeswax; vegetable wax, e.g., carnauba, bayberry, etc.; mineral wax, e.g., paraffin and petroleum waxes, etc.; synthetic waxes, e.g., polyethylene glycols, etc.

Other Names: Liquid wax, molten wax, beeswax, paraffin

Viscosity: From water-thin to several thousand cPs. depending on origin and temperature. Many waxes are handled in the temperature range of 93°C / 200°F to 121°C / 250°F.

Sp. Gr.: From 0.80 to 1.0 range

Remarks: Waxes are used as protective coatings for furniture, floors, automobiles and machine tools, in the food preserving process, making paper and the packaging industry, printing inks, cosmetics, candles, waterproofing and in lubricant manufacture.

Pump Notes: Cast iron construction is usually acceptable. Shaft packing is normally supplied. Abrasion resistant materials may be required due to fillers.

## **WHEY**

Other Names: Milk serum

Viscosity: Thin

Remarks: Whey is the liquid remaining after the fat and the casein have been removed from milk. It is essentially a 5% water solution of lactose.

Pump Notes: Stainless steel construction is normally required. Buna n elastomers are recommended as is a mechanical shaft seal. This liquid is normally handled with a pump designed for sanitary service.

**WOOD ALCOHOL** - See [Methanol](#)

## **XYLENE**

Other Names: Xylol, dimethylbenzene

Formula:  $C_6H_4(CH_3)_2$

Vapor Pressure: Nil at 21°C / 70°F

Viscosity: Thin

Remarks: Clear, toxic, flammable, soluble in alcohol and ether and insoluble in water. Flash point 23°C / 73°F. Used in aviation gasoline, in protective coatings, as a solvent for alkyd resins, lacquers, enamels and rubber cements.

Pump Notes: Cast iron construction is satisfactory. Viton elastomers are recommended as is a mechanical shaft seal.

## **YEAST**

Other Names: Barm. Information given below also applies to terms such as spent yeast and yeast slurry.

Viscosity: Viscosity varies from slightly more than the viscosity of water to that of heavy cream, depending on the type of yeast and its use.

Remarks: Yeast is a yellowish-white liquid. It is used for the fermentation of sugars, molasses and cereal grains for alcohol brewing, medicine and making bread. Yeast is an important source of Vitamin B complex.

Pump Notes: Stainless steel construction is normally required. Buna n elastomers are recommended as is a mechanical shaft seal. This liquid is usually handled with a pump designed for sanitary service.



## **ZINC OXIDE**

Other Names: Zinc oxide coating, zinc oxide slurry  
Viscosity: 44 to 220 cPs.

Remarks: Used as a filler and accelerator-activator in rubber and plastics, as a pigment in paints, in medicines and cosmetics. Zinc oxide is abrasive.

Pump Notes: Cast iron construction is satisfactory. Viton elastomers are usually acceptable. A pump designed for abrasive service must be used.

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