Contents :

I - Antifoaming Agents

I – Introduction :

List of Important Material Wish Uses As Antifoaming Agents :

** Alkyl poly acrylates*
** Castor Oil*
** Fatty Acids ,*
** Fatty Acids Esters ,*
** Fatty Acids Sulfate ,*
** Fatty Alcohol ,*
** Fatty Alcohol Esters ,*
** Fatty Alcohol Sulfate ,*
** Foot Olive Oil*
** Mono & Di Glyceride*
** Paraffin Oil ,*
** Paraffin Wax ,*
** Poly Propylene Glycol ,*
** Silicones Oil ,*
** Vegetable & Animal Fats ,*
** Vegetable & Animal Fats Sulfate ,*
** Vegetable & Animal Oil ,*
** Vegetable & Animal Oil Sulfate ,*
** Vegetable & Animal Wax ,*
** Vegetable & Animal Wax Sulfate ,*

What is the Foam ?

Soap foam bubbles

Contents

1 - Introduction :

A **foam** is a substance that is formed by trapping pockets of gas in a liquid or solid. A bath sponge and the head on a glass of beer are examples of foams. In most foams, the volume of gas is large, with thin films of liquid or solid separating the regions of gas.

An important division of solid foams is into closed-cell foams and open-cell foams. In a closed-cell foam, the gas forms discrete pockets, each completely surrounded by the solid material. In an open-cell foam, the gas pockets connect with each other. A bath sponge is an example of an open-cell foam: water can easily flow through the entire structure, displacing the air. A camping mat is an example of a closed-cell foam: the gas pockets are sealed from each other, and so the mat cannot soak up water.

Foams are examples of dispersed media. In general, gas is present in large amount so it will be divided in gas bubbles of many different sizes (the material is poly disperse) separated by liquid regions which may form films, thinner and thinner when the liquid phase is drained out of the system films. When the principal scale is small, i.e. for a very fine foam, this dispersed medium can be considered as a type of colloid.

2 - Structure of foams

Cappuccinos are topped with a layer of steamed-milk foam.

A foam is in many cases a multi scale system.

One scale is the bubble one: real-life foams are typically disordered and have a variety of bubble sizes. At larger sizes, the study of idealized foams is closely linked to the mathematical problems of minimal surfaces and three-dimensional tessellations, also called honeycombs. The Weaire - Phelan structure is believed to be the best possible (optimal) unit cell of a perfectly ordered foam , while Plateau's laws describe how soap-films form structures in foams.

At lower scale than the bubble one, is the thickness of the film for dry enough foams, which can be considered as a network of interconnected films called lamellae. Ideally, the lamellae are connected by three and radiate 120° outward from the connection points, known as Plateau borders. An even lower scale is the one of the liquid-air interface at the surface of the film. Most of the time this interface is stabilized by a layer of amphiphilic structure, often made of surfactants, particles (Pickering emulsion), or more complex associations.

3 - Foaming and foam stability

Several conditions are needed to produce foam: there must be mechanical work, surface active components (surfactants) that reduce the surface tension, and the formation of foam faster than its breakdown. To create foam, work (W) is needed to increase the surface area (ΔA):

$$W = \gamma \Delta A$$

where γ is the surface tension.

Stabilization of foam is caused by van der Waals forces between the molecules in the foam, electrical double layers created by dipolar surfactants, and the Marangoni effect, which acts as a restoring force to the lamellas.

Several destabilizing effects can break foam down :

(i) Gravitation causes drainage of liquid to the foam base,

(ii) Osmotic pressure causes drainage from the lamellas to the Plateau borders due to internal concentration differences in the foam, while

(iii) Laplace pressure causes diffusion of gas from small to large bubbles due to pressure difference. Films can break under disjoining pressure, These effects can lead to rearrangement of the foam structure at scales larger than the bubbles, which may be individual (T1 process) or collective (even of the "avalanche" type).

4 - Experiments and characterizations

Being a multi scale system involving many phenomena, and a versatile medium, foam can be studied using many different techniques. Considering the different scales, experimental techniques are diffraction ones, mainly light scattering techniques (DWS, see below, static and dynamic light scattering, X rays and neutron scattering) at submicronic scales, or microscopic ones. Considering the system as continuous, its *bulk* properties can be characterized by light transmittance but also conductimetry. The correlation between structure and bulk is evidenced more accurately by acoustics in particular. The organization between bubbles has been studied numerically using sequential attempts of evolution of the minimum surface energy either at random (Pott's model) or deterministic way (surface evolver). The evolution with time, i.e. the dynamics, can be simulated using these models, but also the *bubble model* (Durian) which considers the motion of individual bubbles.

Among possible examples, low scale observations of the structure done using reflectivity by the films between bubbles, of radiation, ponctual using laser or X rays beams, or more global using neutron scattering.

A typical light scattering (or diffusion) optical technique is multiple light scattering coupled with vertical scanning is the most widely used technique to monitor the dispersion state of a product, hence identifying and quantifying destabilization phenomena.[2][3][4][5] It works on any concentrated dispersions without dilution, including foams. When light is sent through the sample, it is backscattered by the bubbles. The backscattering intensity is directly proportional to the size and volume fraction of the dispersed phase. Therefore, local changes in concentration (drainage, syneresis) and global changes in size (ripening, coalescence) are detected and monitored.

5 - Applications

5 – 1 - Liquid foams

Liquid foams can be used in fire retardant foam, such as those that are used in extinguishing fires, especially oil fires.

In some ways, leavened bread is a foam, as the yeast causes the bread to rise by producing tiny bubbles of gas in the dough. Ideally, the dough is a closed-cell foam, in which the gas pockets do not connect with each other. Cutting the dough releases the gas in the bubbles that are cut, but the gas in the rest of the dough cannot escape. However, If the dough is allowed to rise too far, it becomes an open-cell foam, in which the gas pockets are connected. Now, if dough is cut or the surface otherwise broken, a large volume of gas can escape, and the dough collapses. The open structure of an over-risen dough is easy to observe: instead of consisting of discrete gas bubbles, the dough consists of a gas space filled with threads of the flour/water paste.

The unique property of gas-liquid foams having very high specific surface area are exploited in the chemical processes of froth flotation and foam fractionation.

5 – 2 - Solid foams

Solid foams form an important class of lightweight cellular engineering materials. These foams can be classified into two types based on their pore structure: open-cell-structured foams (also known as reticulated foams) and closed-cell foams.

Open-cell-structured foams contain pores that are connected to each other and form an interconnected network that is relatively soft. Open-cell foams will fill with whatever they are surrounded with. If filled with air, a relatively good insulator is the result, but, if the open cells fill with water, insulation properties would be reduced. Foam rubber is a type of open-cell foam.

Closed-cell foams do not have interconnected pores. The closed-cell foams normally have higher compressive strength due to their structures. However, closed-cell foams are also in general denser, require more material, and as a consequence are more expensive to produce. The closed cells can be filled with a specialized gas to provide improved insulation. The closed-cell structure foams have higher dimensional stability, low moisture absorption coefficients, and higher strength compared to open-cell-structured foams. All types of foam are widely used as core material in sandwich-structured composite materials.

From the early 20th century, various types of specially manufactured solid foams came into use. The low density of these foams made them excellent as thermal insulators and flotation devices, and their lightness and compressibility made them ideal as packing materials and stuffings.

5 – 3 - Syntactic foam

A special class of closed-cell foams is known as syntactic foam, which contains hollow particles embedded in a matrix material. The spheres can be made from several materials, including glass, ceramic, and polymers. The advantage of syntactic foams is that they have a very high strength-to-weight ratio, making them ideal materials for many applications, including deep-sea and space applications. One particular syntactic foam employs shape memory polymer as its matrix, enabling the foam to take on the characteristics of shape memory resins and composite materials; i.e., it has the ability to be reshaped repeatedly when heated above a certain temperature and cooled. Shape memory foams have many possible applications, such as dynamic structural support, flexible foam core, and expandable foam fill.

5 – 4 - Integral skin foam

Integral skin foam, also known as *self-skin foam*, is a type of foam with a high-density skin and a low-density core. They can be formed in an *open-mold process* or a *closed-mold process*. In the open-mold process, two reactive components are mixed and poured into an open mold. The mold is then closed and the mixture is allowed to expand and cure. Examples of items produced using this process include arm rests, baby seats, shoe soles, and mattresses. The closed-mold process, more commonly known as *reaction injection molding* (RIM), injects the mixed components into a closed mold under high pressures.

6 - De foaming

Foam, in this case meaning "bubbly liquid", is also produced as an often-unwanted by-product in the manufacture of various substances. For example, foam is a serious problem in the chemical industry, especially for biochemical processes. Many biological substances, for example proteins, easily create foam on agitation and/or aeration. Foam is a problem because it alters the liquid flow and blocks oxygen transfer from air (thereby preventing microbial respiration in aerobic fermentation processes). For this reason, anti-foaming agents, like silicone oils, are added to prevent these problems. Chemical methods of foam control are not always desired with respect to the problems (i.e., contamination, reduction of mass transfer) they may cause especially in food and pharmaceutical industries, where the product quality is of great importance. In order to prevent foam formation, in such cases mechanical methods are mostly dominant over chemical ones.

What is the Defoamer

Dosage of defoamer

Contents

1 - Introduction

A **defoamer** or an **anti-foaming agent** is a chemical additive that reduces and hinders the formation of foam in industrial process liquids. The terms anti-foam agent and defoamer are often used interchangeably.

In industrial processes, foams pose serious problems. They cause defects on surface coatings. They prevent the efficient filling of containers. A variety of chemical formulas are available to prevent formation of foams.

2 - Properties

Generally a defoamer is insoluble in the foaming medium and has surface active properties. An essential feature of a defoamer product is a low viscosity and a facility to spread rapidly on foamy surfaces. It has affinity to the air-liquid surface where it destabilizes the foam lamellas. This causes rupture of the air bubbles and breakdown of surface foam. Entrained air bubbles are agglomerated, and the larger bubbles rise to the surface of the bulk liquid more quickly.

3 - History

The first defoamers were aimed at breaking down visible foam at the surface. Kerosene, fuel oil and other light oil products were used to break down foam. Other vegetable oils also found some use. Fatty alcohols (C7 - C22) were effective but expensive antifoams. They were added to oil products to boost the efficiency. Milk and cream were forbears for modern day emulsion type defoamers.

During the 1950s experiments with silicone based defoamers started. These were based on poly dimethyl siloxane (silicone oil) dispersed in water or light oil. Silicone oils worked well, but caused surface disturbances in many applications like paints and papermaking. In 1963 the first antifoams with hydrophobic particles (hydrophobic silica) in light oil were patented. In the early 1970s, hydrophobic waxes like ethylene bis stearamide dispersed in oils developed. These types of defoamers were very efficient, but the oil crisis of 1973 made these too expensive and resulted in a push for reduction of the oil content. The solution was adding water. So water extended (water in oil emulsion) and water based (oil in water emulsion) defoamers appeared.

The development of silicone based defoamers has continued, using different emulsifiers and modified silicone oils. In the early 1990s, silicone emulsion defoamers that caused less surface disturbances were used in the wood pulping industry with great success. These caused better washing, reduced biological oxygen demand (BOD) in effluent and reduced deposits.

4 - Classification

4 – 1 - Oil based defoamers

Oil based defoamers have an oil carrier. The oil might be mineral oil, vegetable oil, white oil or any other oil that is insoluble in the foaming medium, except silicone oil. An oil based defoamer also contains a wax and/or hydrophobic silica to boost the performance. Typical waxes are ethylene bis stearamide (EBS), paraffin waxes, ester waxes and fatty alcohol waxes. These products might also have surfactants to improve emulsification and spreading in the foaming medium.

These are heavy duty defoamers and are normally best at knocking down surface foam.

4 – 2 - Powder defoamers

Powder defoamers are in principle oil based defoamers on a particulate carrier like silica. These are added to powdered products like cement, plaster and detergents.

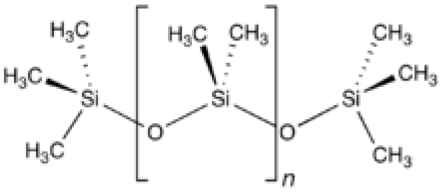
4 – 3 - Water based defoamers

Water based defoamers are different types of oils and waxes dispersed in a water base. The oils are often white oils or vegetable oils and the waxes are long chain fatty alcohol, fatty acid soaps or esters. These are normally best as deaerators, which means they are best at releasing entrained air.

4 – 4 - Silicone based defoamers

Silicone-based defoamers are polymers with silicon backbones. These might be delivered as an oil or a water based emulsion. The silicone compound consists of an hydrophobic silica dispersed in a silicone oil. Emulsifiers are added to ensure that the silicone spreads fast and well in the foaming medium. The silicone compound might also contain silicone glycols and other modified silicone fluids.

These are also heavy duty defoamers and are good at both knocking down surface foam and releasing entrained air.



Poly dimethyl siloxane is a widely used antifoaming agent.

Silicone based defoamers are also suitable in non-aqueous foaming systems like crude oil and oil refining. For very demanding applications fluoro silicones may be suitable.

4 – 5 - EO / PO based defoamers

EO / PO based defoamers contain polyethylene glycol and polypropylene glycol copolymers. They are delivered as oils, water solutions, or water based emulsions. EO / PO copolymers normally have good dispersing properties and are often well suited when deposit problems are an issue.

4 – 1 - Alkyl poly acrylates

Alkyl poly acrylates are suitable for use as defoamers in non-aqueous systems where air release is more important than the breakdown of surface foam. These defoamers are often delivered in a solvent carrier like petroleum distillates.

5 - Industrial problems

The most noticeable form of foam is foam floating on the stock surface. It is easy to monitor and relatively easy to handle. Surface foam may cause problems with liquid levels and give overflow. This might reduce the process speed and availability of process equipment.

5 – 1 - Mechanical problem factors

Mechanical factors that may generate foam and entrapped air:

Leaky seals on pumps

High pressure pumps

Poor system design (tank, pump inlet, outlet and manifold design)

Pressure release

The main classes of air that are of concern to the mechanical systems are

Dissolved air behaves as part of the fluid phase, except that it can come out of solution as small bubbles (entrained air)

Entrained air consists of bubbles that are small enough to collect on top of a fluid

Bubbles that have sufficient buoyancy to rise to the surface and are described as foam

5 – 2 - Foam in process and coolant liquids

Foam, entrained and dissolved air that are present in coolants and processing liquids, may cause various kinds of problems, including :

Reduction of pump efficiency (cavitation)

Reduced capacity of pumps and storage tanks

Bacterial growth

Dirt flotation / Deposit formation

Reduced effectiveness of the fluid solution(s)

Eventual downtime to clean tanks

Drainage problems in sieves and filters

Formation problems (i.e. in a paper mill it may cause the fibers to form an inhomogeneous sheet)

Cost of replenishing the liquid

Cost of entire material rejection due to imperfections

6 - Test methods

There are several ways to test defoamers.

The easiest is looking at the surface foam. All that is needed is a system for generating foam. This might be done with a round pumping system with a nozzle and a cylinder or an air injection system into a cylinder. The cylinder is fitted with a scale to measure the foam height. This equipment may have a heater to control the temperature.

Entrained air can be tested with a similar equipment that have a density meter that can record changes of the liquor density over time.

Drainage can be tested with a filter system for measuring the time to drain a liquid through the filter. The filter might be pressurized or have a vacuum.

7 - Applications

7 – 1 - Detergents

Anti-foams are added in certain types of detergents to reduce foaming that might decrease the action of the detergent. For example dishwasher detergents have to be low foaming for the dishwasher to work properly.

7 – 2 - Food

When used as an ingredient in food, antifoaming agents are intended to curb effusion or effervescence in preparation or serving. The agents are included in a variety of foods such as chicken nuggets in the form of poly dimethyl siloxane (a type of silicone).

Silicone oil is also added to cooking oil to prevent foaming in deep - frying.

7 – 3 - Industrial use

Defoamers are used in many industrial processes and products: wood pulp, paper, paint, industrial wastewater treatment, food processing, oil drilling, machine tool industry, oils cutting tools, hydraulics, etc.

7 – 4 - Pharmaceuticals

Antifoaming agents are also sold commercially to relieve bloating. A familiar example is the drug Simethicone , which is the active ingredient in drugs such as Maalox, Mylanta, and Gas-X.

Poly Propylene Glycol

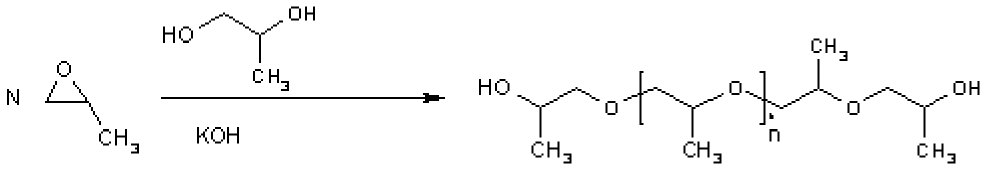
Contents

1 - Introduction

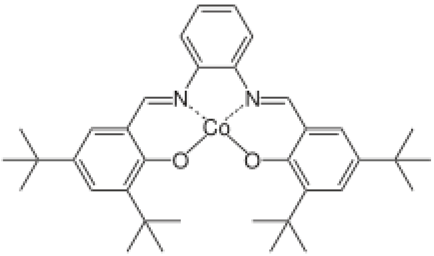
Polypropylene glycol or **polypropylene oxide** is the polymer of propylene glycol. Chemically it is a polyether. The term polypropylene glycol or **PPG** is reserved for low to medium range molar mass polymer when the nature of the end-group, which is usually a hydroxyl group, still matters. The term "oxide" is used for high molar mass polymer when end-groups no longer affect polymer properties. In 2003, 60 % of the annual production of propylene oxide of 6.6×10^6 tones was converted into the polymer.

2 - Polymerization

Polypropylene glycol is produced by ring-opening polymerization of propylene oxide. The initiator is an alcohol and the catalyst a base, usually potassium hydroxide. When the initiator is ethylene glycol or water the polymer is linear. With a multifunctional initiator like glycerine, penta erythritol or sorbitol the polymer branches out.



Conventional polymerization of propylene oxide results in an atactic polymer. The isotactic polymer can be produced from optically active propylene oxide, but at a high cost. A salen cobalt catalyst has recently been reported to provide isotactic polymerization of the racemic propylene oxide .



Cobalt catalyst for isotactic polypropylene oxide

3 - Properties

PPG has many properties in common with polyethylene glycol. The polymer is a liquid at room temperature. Solubility in water decreases rapidly with increasing molar mass. Secondary hydroxyl groups in PPG are less reactive than primary hydroxyl groups in polyethylene glycol. PPG is less toxic than PEG, so biotechnologicals are now produced in PPG.

Combustible and in the form of vapour explosive when exposed to heat or flame. When heated to decomposition it produces acrid and irritating fumes .

The toxicity of polypropylene glycol is mainly due to the parent compound and not to its metabolites. Polypropylene glycol has an irritatant effect on direct contact with eyes, mucous membranes and possibly after prolonged contact with skin.

Propylene glycol causes CNS depression similar to that caused by ethanol but it is only one-third as potent. Cardiotoxic effects include arrhythmias and cardiac arrest. Renal and hepatic damage has been reported .

4 - Uses

PPG is used in many formulations for polyurethanes. It is used as a rheology modifier.

PPG is used as a surfactant, wetting agent, dispersant in leather finishing.

PPG is also employed as a tuning reference in mass spectrometry.

PPG is used as a primary ingredient in the manufacture of paintballs.

PPG is used to administer the drug Melarsoprol in patients suffering from second stage trypanosomiasis since the drug is insoluble in water. This mixture must be injected intravenously. [1]

What is Turkey Red Oil ?

Contents

1 - Introduction

Turkey Red Oil is also known as Sulfated Castor Oil. It is the only oil that will completely disperse in water. The oil is expressed from the seed. Sulfated castor oil is created by adding sulfuric acid to castor oil, and is considered the first synthetic detergent. Turkey Red Oil has a distinct and heavy scent. It is a surfactant and therefore makes a wonderful base for a bath oil as it mixes well with water, producing a milk bath.

2 - Uses

Used in Textile industries, Sugar industry, as a defoaming agent , as an Emulsifier. In cosmetics it is used as humectants and as an Emulsifier for Oil Bath.

3 - Specifications

Appearance	Amber coloured Viscous liquid.
Melting point	< 0°C
Boiling Point	> 150°C
Solubility	Miscible in Water, gives a clear solution.
Specific Gravity	1.015 for **50 %** and 1.03 for **70%** 20°C
Sulphonation degree	Minimum 4.0

4 - Various Applications

Turkey Red oil is used in agriculture as organic manure, in textiles as surfactants and wetting agents, in paper industry for defoaming, in cosmetics as emulsifiers, in pharmaceuticals as undecylenate, in paints inks and as lubricants.

For e.g. it is used to emulsify essential oils so that they will dissolve in other water-based products, or for superfatting liquid soap if you want the soap to remain transparent. This means that the oil will combine with the water in the tub, and not leave those little oil bubbles floating on the top of the water. It is of medium viscosity and is usually used in bath oil recipes along with fragrance or essential oils, or in shampoos. This oil also has great moisturizing abilities.

5 - Various Grades

Various grades of TRO are available for different applications. Our TRO is made as per International Process and Standards.

5 -1 - TRO – Phenyl Grade.

Used in manufacture of Black Phenyl and White Phenyl. Phenyl manufacturers generally face problems of layer separation while manufacturing white phenyl. Using our Phenyl Grade TRO this problem is eliminated. Also quantity of TRO to Pine Oil decreases from 1:3 to 0.8:3 resulting in substantial savings

5 - 2 - TRO – Textile Grade.

Used in the process of Dyeing. Textile dyers generally face problems of oil floating on water during dyeing process, this results in the cloth getting contaminated with oil. Using our Textile Grade TRO this is totally eliminated.

5 - 3 - TRO – Leather Grade.

Used in production of Leather Boards.

5 - 4 - TRO – Metal Cutting Grade

Used in manufacture of Metal Cutting Oil.

5 - 5 - TRO – Distillery Grade

This grade is used in Sugar Industry and Distillery as a De-foaming agent.

struktol®

Schill+Seilacher

Foam Formation During Beet Sugar Processing

Sugar beets have a dry mass content of about 22 to 26 percent when being harvested. The dry mass contains organic parts and ashes, like oxides, sulfates, alkali and earth alkali metals. The organic content can be divided into non-sugar and sugar substances. As non sugar substances we mainly find nitrogen containing chemical compounds (for example amino acids and proteins). The most important sugar in the beet is saccharose – other sugars like fructose and galactose can only be found in small quantities. The sugar content of the beet depends on many different factors like climate, soil conditions, fertilization, varying in a range between 16 and 19 percent.

During beet processing foam occurs due to foam active substances (proteins, sugar and degradation products), which are eluted during the transport in water, mash and during the cossettes extraction. During this process a protein foam is generated, which is stabilized by sugar.

An additional application of antifoaming agents in sugar processing is at the boiling station. In this case degassing is more important than defoaming as the consequences of in-process air can lead fo instable process conditions (boiling delay, negative influence on colour, etc.) as well as higher energy consumption. By the use of Struktol antifoam products both negative effects can be counteracted.

The foaming mainly depends on the process conditions and the beet quality (impurity of beet, frost etc.). Different diffusion techniques (BMA, RT, DeSmet etc.) lead to foaming in different stages of the process. As a result, the foam occurs at different points throughout the process.

Besides the contents of the sugar beet process conditions and process temperatures mainly influence the foam generation. Also the dimension of the water circulation has a major impact. The higher the concentration of foam active substances in the circulation, the higher the level of foam.

Foam Prevention & Foam Destruction By Sutable STRUKTOL Antifoam Products :

Struktol antifoam products are adapted exactly to the requirements of the different stages in sugar production. Often each part of process needs an individual antifoam formulation.

The dosage of antifoam products is carried out in order to achieve not only destruction of already existing foam, but also prevention of foam generation.

For a smooth factory process the prevention of foaming is recommendable. The best possible dosage point and quantity depend on the corresponding process. Usually the dosage is carried out in advance in order to achieve maximum performance at the foaming point. The necessary dosage quantities vary and depend on different factors. They have to be found out by production trials.

Exact dosage quantities and best suitable dosage points have to be found out during trials at the corresponding sugar factory. Different pH-values do not have major impact on the effectiveness of the antifoam products. Both in acidic or alkaline areas the Struktol antifoam products show a good performance.

PRPDUCTS

Struktol® SB 2031 N
Struktol® SB 2032
Struktol® SB 2036
Struktol® SB 2076
Struktol® SB 2080
Struktol® SB 2121
Struktol® SB 2181 A
Struktol® SB 2339
Struktol® SB 2433
Struktol® SB 401
Struktol® SB 404
Struktol® SB 543