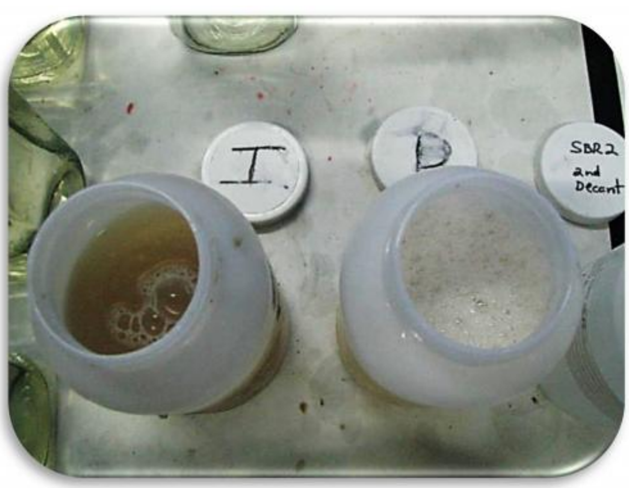
# Antifoam Applications - When To Use or Should You Use Them?

Foam is a gas (usually, air) dispersed in a liquid containing some impurity. In secondary treatment systems, bacterial activity is usually the main cause of foam, although mechanical action (cascading flow, pumps, violent agitation, etc.) and chemical contamination also can cause foam. Surfactants in the influent or in some polymer treatments can also cause foaming.

Excessive foam, especially in an aeration basin, can cause a variety of problems. A foam blanket on the aeration basin can interfere with oxygen uptake of the microorganisms and hinder BOD reduction. Foam can also cause the biological floc to float producing a sludge which will not settle in the final clarifier. Safety hazards and aesthetic problems occur when wind blows foam across parking lots or highways or neighboring locations. Foam can become an aesthetic problem when a thick blanket of foam floats down a stream from the plant outfall.

Antifoams control or eliminate foam in secondary treatment or final effluent areas of a waste treatment plant. Reducing foam by using antifoams in the past has been desirable for safety, health, and aesthetic reasons. Controlling the source of the foaming is usually a cheaper and better solution long term.
Industries often needing waste treatment antifoams include paper mills, refineries, municipalities, and petrochemical plants. Many industries use antifoams upstream in the process side.




Wastewater treatment antifoams are used to eliminate or control foam primarily in secondary treatment and final effluent areas in a waste treatment plant. Not all areas of secondary treatment are suited to the use of waste treatment antifoams. The common application areas are: 1) the activated sludge process, 2) aerated lagoons, and 3) the plant outfall.

Causes of foaming in the wastewater treatment plant can be Chemical, Biological or Mechanical.

**Chemical**: Chemical contamination includes chemical additives such as cleaners, organics in process effluents, and certain water characteristics such as excessive alkalinity. Surfactants in the influent or used on the process side can cause foaming. A simple jar shake-test can be performed to see if there are surfactants that are causing foaming. Take the influent in a jar, shake it up, if there is a stable foam similar to dish soap in your sink, than foaming due to chemicals are probably the cause. If you shake your jar, and no stable foam appears, your problem is due to young bugs, nutrient deficiency or a number of other conditions where bacteria can cause foam. Use your microscope to identify what the problem is with the biological portion. The bacteria will tell you the problem and cause based upon the species present. If you do not have the ability to use the microscope and identify causes and controls, contact us. We can easily help with that portion in our lab.

**Biological:**
Bacterial activity is usually the main cause of foam in secondary treatment systems. This includes the production of surface-active decomposition products and gaseous fermentation of organic materials.
Biological foam can be caused due to grease, septicity, low DO or just high BOD and very young sludge. Make sure you know what is causing the foaming, and it may be easier to change the cause than to use antifoams. Also antifoams do not work on every type of foam.

Foam due to Zooglea - High BOD & low nutrients Up & Right imageFoam due to Nocardia - oils and grease
Left down, Foam due to M. parvicella – grease Right down, Foam du to septicity & 0914.

Very young sludge at a winery, spilling out of equipment -Young sludge at meat packing plant - surfactants in DAF upstream causing some of the foaming also

Use the microscope and let the bacteria tell you what is going on. It is very easy to troubleshoot if you know what species are present, what they indicate and then usually you can troubleshoot, eliminate the problem and not even have to use antifoams.

**Mechanical:** Mechanical mixing can cause foaming, although usually this foam is not very stable and collapses on its own very quickly. Examples of mechanical action are cascading flow patterns, air leakage in pumps, and violent agitations such as those from surface aerators.

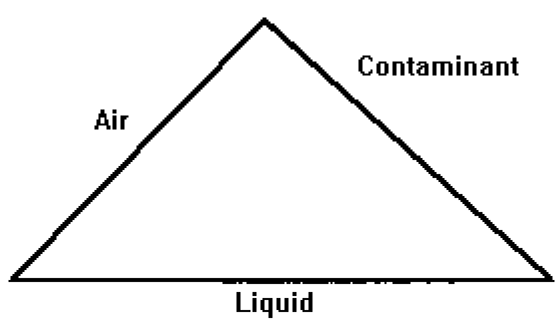
Additional things to consider about Antifoams.

## Mechanism of Antifoams

Foam is a gas dispersed in a liquid medium, the gas usually being air. Foam is created by either coalescence or a dispersion of the gas in the liquid. Pure liquids do not foam; therefore, gas in a liquid will not cause foam unless an impurity is present. This contaminant causes a stable protective film around each bubble.

Take away or weaken one of the legs of the triangle and the foam will collapse.

- Weakening the protective film
- Displacing the contaminant from the bubble surface
- Coalescing small bubbles into large weaker ones
- Allowing gas to escape




A waste treatment antifoam added to a foaming system will come into contact with the bubble by diffusion, thermal agitation, or random collision. If the film has already formed, the antifoam will break through the surface film and cause a weak spot, allowing the coalescence of small bubbles into larger, more easily broken ones. The antifoam will prevent foam by stepping the formation of a stable surfactant layer on the bubble wall.

**Composition of Antifoams: Some of the important properties to consider in selling an antifoam are:**

*Chemical and physical form* - Is the customer limited by feeding equipment to only one type of product? Do they require an oil-water or silicone based product? Can the antifoam be fed both neat and as an emulsion?

*pH range* - As the pH of the stream that's treated changes, the demand for antifoam will also change. Will antifoam work sufficiently at the extreme ends of the normal pH range that can be expected in the plant?

*Water based products* - Are usually more cost effective with less BOD contribution than oil or silicone based products. Because they are more miscible in water they are more active on entrained foam (below the water's surface). Freeze point can be a concern.

*Oil-based products* - Are generally less viscous as compared to water-based products. These products generally have a lower freeze point also. The price and/or cost performance of oil-based products are generally more volatile than water-based products. Dioxin precursors may be a concern with these products.

*Silicone based products* - These products are more expensive than other types of antifoams but are effective on almost all foaming problems. There are cases where a silicone based product will be very cost effective.

*Concentrated products* - *The* concentrated antifoams are the newest development in antifoam technology. These products are 100% active with no water or oil carrier, resulting in excellent cost effectiveness even though the product price is considerably higher. Concentrates must be diluted with water prior to application.

*Temperature* - Some antifoams are temperature sensitive; at the cloud point temperature, the actives begin to drop out. Be aware of the cloud point and expected temperatures at the drum or bulk tank site and in the product feed lines.

*Persistence* - This is a measure of how long a product will be effective. The less persistent a product is, the more feed points may be required to control the foam.

*Emulsion stability* - Some products are more stable in lower emulsion strengths than others.

*Flash Point* - Some products have a low flash point, which should be taken into consideration in relation to plant safety. When the flash point is below 100°F (38°C), Federal regulations will restrict indoor storage to about four drums per product.

*Antifoam/defoamer* - Does the product perform the task necessary to control foam? If the plant lets foam build up before treating, you need a defoamer. If the plant prevents foam from forming, you need an antifoam. Some products do both tasks well; others do one or the other. Each application should be evaluated on an individual basis. In practice, the terms antifoam and defoamer are used interchangeably.

*Miscellaneous additives*- Some defoamer agents contain particulate additives, such as silicone, hydrocarbons or other organic particles. The use of glycols or glycerols as foam-inhibiting agents is also known.

**What is the COD of your antifoam?**

We have seen cases where antifoams have had such a high COD, that they added 1100ppm per day to the BOD loading. One plant was a winery where no oils were to be found, yet antifoam was added to control foam due to young sludge and high BOD from the winery. Instead, the antifoam, although short term reduced the foam, long term, it caused the growth of filaments usually only found where high oils are present. The oils in this case were due to the antifoam. Remember, antifoams are organic, so sooner or later, they become food to the bacteria. Chose your antifoam carefully if you must use antifoams. The chemical composition as well as the amount of loading it can cause to your plant may not be worth the short term band-aid impact of reducing foam.

**Here is data off one antifoam MSDS sheet:**

Some defoamer agents contain particulate additives, such as silicone, hydrocarbons or other organic particles. The use of glycols or glycerols as foam-inhibiting agents is also common.

**BOD-382,000 ppm, COD-2,220,000pp,- probably the BOD was too high to really calculate if the BOD was this high, or it took longer than 5 days to degrade with such a small amount of bacteria in the test sample~**Do the math. Calculate how much antifoam at that high a COD it takes to make a difference in your plant based upon flow times loading!

**2. COMPOSITION/INFORMATION ON INGREDIENTS**

CHEMICAL DESCRIPTION: Hydrocarbon solvent, Polyglycol, Organic acid, Organic acid derivative.

HAZARDOUS INGREDIENTS:

| CAS NO. | EINECS NO. | CHEMICAL NAME | WT % | SYMBOL | R-PHRASES |
|---|---|---|---|---|---|
| 64742-46-7 | 2651482 | Petroleum destillate | 40-60 | Xn | 65 |
| 64742-47-8 | 2651498 | Aliphatic hydrocarbon | 15-25 | Xn | 65 |

**12. ECOLOGICAL INFORMATION**

PERSISTENCY AND DEGRADATION:
Biological Oxygen Demand ($BOD_5$) = 382000 ppm
Chemical Oxygen Demand (COD) = 2220000 ppm

MOBILITY AND BIOACCUMULATION POTENTIAL:
No data available

ECOTOXICOLOGICAL EFFECTS:
$LC_{50}$/96H/Pimephales promelus (Fathead Minnow)= 440 mg/l
NOEC/96H/Pimephales promelus (Fathead Minnow)= 220 mg/l
$LC_{50}$/96H/Oncorhynchus Mykiss (Rainbow Trout)= 310 mg/l
NOEC/96H/Oncorhynchus mykiss (Rainbow Trout) = < 78 mg/l
$EC_{50}$/48H/Daphnia magna (Water Flea) = 130 mg/l
NOEC/48H/Daphnia magna (Water Flea) = 16 mg/l

ADDITIONAL ECOLOGICAL DATA: AOX information: Product contains no organic halogens

**Here is another antifoam**

**COMPOSITION/INFORMATION ON INGREDIENTS**
CHEMICAL DESCRIPTION:
Water, Polyglycol.

11. TOXICOLOGICAL INFORMATION
Please refer to section 3 for hazards identification.
ACUTE TOXICITY DATA: The following results are for the active ingredients:
ACUTE LETHALITY VALUES:
EO/PO-Copolymer-Monobutylether:
Dermal (rabbit) LD50 = > 20 000 mg/kg
Oral (rat) LD50 = > 5000 mg/kg
Inhalation (rat) LC50 = ~ 0.1 mg/l / 4 h

12. ECOLOGICAL INFORMATION
PERSISTENCY AND DEGRADATION:
Biological Oxygen Demand (BOD 5): < 1 mg/l Chemical Oxygen Demand (COD): 8 mg/l

**So, while this has a lower BOD/COD it has toxic properties that may cause wet effluent toxicity issues.**

Hmm, guess you did not realize there were so many things to think about with an antifoam application! Ask your sales rep for the MSDS sheet, and the COD data as well. If he cannot provide it, run the test yourself. It may make a big difference.

## Testing of Antifoams

General Feed Rates:  Typically antifoams/defoamers are fed in the 5 to 50 ppm range for water and wastewater systems.  More or less antifoam may be needed depending on the contaminant loading.

Usually antifoams should be fed to the surface of the liquid, especially if solids concentration is high. The product is most efficient if system turbulence will help spread the antifoam to the desired areas. The feed point is critical to the success of any antifoam product. If fed too far ahead of the foaming condition, the product will be used up before it reaches the foam area. If fed too close to the foam, some of the product may be wasted because it does not disperse sufficiently to be completely effective. Most applications require the antifoam to be fed just ahead of the foaming problem. Since each application is unique, trial and error should be used to optimize the feed points.

**Impact on Dissolved Oxygen**-Antifoams are designed to remove the air or gas. If you are using a large amount of electricity to put oxygen into a system, then add chemicals to remove the oxygen, it almost defeats the purpose. Antifoams will definitely reduce the amount of oxygen available for the bacteria. If the main cause of foaming in your system is due to young sludge, and high growth, and you reduce the amount of oxygen available for the bacteria, you in effect, make it harder for them to get older. Antifoams will technically make it harder to digest an overload of organics and will take longer to recover.

**These 4 photos below show a plant with serious foaming.**
**The foam was almost up and over the edge in the top two.**
**After topical addition of antifoam, you can see it dropped the foam 8-10 inches instantly.**

**Alternatives to Antifoam -** Antifoams are not the only way to reduce foaming.
**Water:** Surface spray of water can physically knock the trapped air out of the system.

**Bioaugmentation:** Upstream control of loading, such as grease and oils where bioaugmentation can be used to degrade the grease prior to the basin.

Lift station filled with grease

Lift station after short use of bioaugmentation

**Chlorine or Peroxide:** Some plants use chlorine to spray on the foam and kill the filaments. Again, this is just a short term band-aid. If you do not make a process control, the filaments will return. Nocardia does not respond well to chlorination in the RAS, usually only spraying on the foam.

### Important Note: <u>If it is foaming due to Zooglea, you will make the foam worse.</u>

**Process Optimization:** That may include pre-screening, pH adjustment, nutrient addition, solids handling, and oxygen optimization.

What is causing your foam? Find out and in the long run, making changes to your plant will usually be more effective than antifoams.

Let us know if you need help with a plant audit to troubleshoot your plant, lab work to help identify what is going on in your system, or bioaugmentation to help control agents that might be causing foaming