



Technical Bulletin

Foam Products and the Environment

FATE OF FOAM IN THE ENVIRONMENT

Because of the potential for broad-scale release of fire fighting foams into the environment and the large volumes of surfactants used worldwide, the environmental fate of these products is an important consideration in choosing an agent, and in determining proper disposal and/or treatment of residue.

There are six areas of interest with regard to the environmental fate of Chemguard Foam products: aquatic toxicity, biodegradability, total organic carbon, fluorine content, nutrient loading and sewage treatment plant compatibility. All of these are of concern when the finished foam reaches natural or domestic water systems. Independent laboratories performed tests for these concerns.

AQUATIC TOXICITY

Aquatic toxicity is evaluated by using both vertebrates and invertebrates. The most common invertebrate species is *Daphnia magna* or water flea. Vertebrates commonly used are fundulus heteroclitus (a salt-water minnow as specified in MilF24385F); sheep head minnow (a fresh water minnow), fathead minnow (*Pimephales promelas*) or rainbow trout. Tests on these species give an indication of the broad range over which various fish populations can be affected. The results are expressed as LC/50 over a particular period of time (usually 48 or 96 hours) and are given in milligrams/liter (or ppm). LC/50 refers to the lethal concentration to kill 50% of a test population. The higher the value, the more tolerant an organism is to the test medium.

Properties for Chemguard 3% AFFF C303:

Pimephales promelas (96 hour)
LC/50 concentrate form = 233 ppm
LC/50 diluted (as used) form = 7767 ppm
Daphnia magna (48 hour)
LC/50 concentrate form = 1110 ppm
LC/50 diluted (as used) form = 37000 ppm

BIODEGRADABILITY

Biodegradability refers to the ability of microorganisms in the environment to consume a chemical and convert it to its most elemental form. It is determined by performing biological degradation tests (BOD) and chemical degradation tests (COD). The COD measures the amount of oxygen required to chemically oxidize a sample in water. The BOD measures the oxygen required to oxidize the sample biologically, using microorganisms. Biodegradability is then calculated by dividing the BOD, for a given period of time, by the COD and is expressed as a percentage over that period of time. Twenty-day tests are commonly done. Chemguard foam products vary from 50% to 95% biodegradable in 20 days.

SEWAGE TREATMENT PLANT COMPATIBILITY

Chemguard fire fighting foam products contain no constituents that are incompatible with wastewater treatment plants. Furthermore, they contain no constituent that requires reporting per SARA Title III, sec. 313. However, fire-fighting foam should never be discharged to any wastewater treatment plant without permission and recommendations from the plant as to what rate to discharge to the plant.

The major concern for fire fighting foams in wastewater treatment plants is the foam it creates. Although the microbes can tolerate concentrations of 100:1 (100 parts water to 1 part foam), the foam created by that high a concentration is often a problem. To limit the foaming, a dilution factor of 1000:1 would be more appropriate. Foam production can be decreased with the addition of an anti-foaming agent. Wastewater treatment plants can recommend appropriate agents.

NUTRIENT LOADING

Chemicals containing nitrogen or phosphorus, can add nutrients to an aquatic ecosystem. These added nutrients could cause an algae bloom, beginning a process called eutrophication. This

process eventually leads to oxygen depletion in the ecosystem. Chemguard foam contains no phosphates and only trace amounts of nitrogen. Therefore, nutrient loading problem is not an issue.

TOTAL ORGANIC CARBON

Total Organic Carbon (TOC) is not often considered in determining environmental fate, however, Chemguard feels it is necessary to examine. TOC is a measure of the mass of organic carbon in a sample, and gives us an idea of the total amount of material to be decomposed when it reaches the environment. Formulas that have a high biodegradability, but also a high TOC can represent a higher environmental impact than a formula with a lower biodegradability and low TOC. For Chemguard products, the TOC values vary greatly, since they are directly related to the amount of active ingredients contained, and active ingredients vary greatly depending upon the specific application for which a product is designed. In general, however, Chemguard's new line of AFFF products uses a unique combination of hydrocarbon and fluorocarbon surfactants, which provide higher strengths at lower activities than previously possible. This leads to a low TOC as compared to similar products.

Fluorinated surfactants decompose in the environment to a certain extent; however, these molecules will always leave behind a fluorinated carbon chain. The fluorinated surfactants used in all Chemguard AFFF formulations are telomer based, not based on Simon-cell chemistry (i.e. PFOS), and are therefore expected to be safer by 10-100 times.

Furthermore, Chemguard's new AFFF products are formulated with specifically designed hydrocarbon co-surfactants, which enhance the activity of the fluorinated surfactants. The ultimate effect is appropriate surface tension reduction with up to 40% less fluorine.

| <u>Agent</u> | <u>20 day BOD</u> | <u>COD</u> |
|------------------------|-----------------------|--------------|
| Chemguard 3% AFFF C303 | 79,800 mg/l | 210,000 mg/l |
| 3% fluoroprotien | 258,000 mg/l | 620,000 mg/l |
| 3% protein | 427,000 mg/l | 712,000 mg/l |
| Ultraguard 3% AR-AFFF | 200,000 mg/l | 283,000 mg/l |
| 3% AR-AFFF C-333 | 174,000 mg/l | 250,000 mg/l |
| 1%/3% AR-AFFF C133 | 326,000 mg/l | 402,000 mg/l |
| Johnson's Baby Shampoo | 358,000 mg/l | 610,000 mg/l |

| <u>Agent</u> | <u>Biodegradability BOD/COD</u> | <u>TOC</u> |
|------------------------|-------------------------------------|--------------|
| Chemguard 3% AFFF C303 | 38% | 33,600 mg/l |
| 3% fluoroprotien | 41% | 260,000 mg/l |
| 3% protein | 60% | 158,000 mg/l |
| Ultraguard 3% AR-AFFF | 71% | 8,200 mg/l |
| 3% AR-AFFF C-333 | 70% | 5,700 mg/l |
| 1%/3% AR-AFFF C133 | 81% | 12,100 mg/l |
| Johnson's Baby Shampoo | 59% | 14,000 mg/l |

FLUORINE CONTENT

Fluorine, in the form of fluorinated surfactants is an essential component of any AFFF concentrate. It provides surface tension reduction necessary to create the film formation, which makes AFFF the superior foam fire-fighting agent. Recently, there has been a heightened awareness of potential environmental impact associated with such chemicals, especially PFOS based fluorinated surfactants.