



## **Technical Brief**

# **Nonylphenol & Nonylphenol Ethoxylates**

### **General Concern to the Dairy Industry**

- Infant formula manufacturers in Europe have recently voiced concerns over residual levels in U.S. milk
- These materials are banned by the EU due to contamination of water supplies
- Nonylphenol and nonylphenol ethoxylates have been shown to bind to estrogens if consumed by humans; one study found residuals in human breast milk after consumption of contaminated fish in Italy
- The surfactants may be included in rinse agents in the U.S. for processing equipment (surfaces, membranes, etc.)
- May also be found in teat dips and other chemicals used in dairy operations

### **Background on NP and NPEs**

NPEs are surfactants, a functional class of chemicals that provide increased surface activity and reduce the surface tension of water, allowing easier spreading, wetting, and better mixing of liquids. Surfactants are classified into one of four categories based on their ionic properties in water: anionic (negative charge), non-ionic (no charge), cationic (positive charge), and amphoteric (both positive and negative charges). NPEs are nonionic surfactants that are part of the broader category of surfactants known as alkylphenol ethoxylates (APEs). NPEs are considered workhorse surfactants given their cost-effectiveness and high performance in multiple applications. The primary use of NP is as a raw material in the synthesis of NPEs. NPEs are manufactured by reacting NP with ethylene oxide (EO) under basic conditions, with the molar ratio of NP to EO determining the degree of ethoxylation. NPE surfactants are referred to by their degree of ethoxylation; commercially available NPEs range from four moles of ethoxylates (NPE4) to 80 moles of ethoxylates (NPE80). NPEs with nine moles of ethoxylates (NPE9) are by far the most commonly manufactured NPE. While some CAS numbers specific to certain levels of ethoxylates exist, all degrees of ethoxylation may be manufactured under the CAS numbers for poly-ethoxylates (CAS 127087-87-0), as long as they are synthesized via polymerization reaction between NP and EO.

NPEs degrade to more toxic chemicals, including NP, which often partitions to sediment and accumulates. The use of products containing NPE can result in the release of NP and other degradates to the environment, potentially exposing aquatic life to these compounds. NP is lethal to fish and other aquatic organisms at low concentrations (lower than for the parent NPE) in both acute and chronic fish studies. In addition,

effects on growth and reproduction have been documented. The EPA recommended Aquatic Life Ambient Water Quality Criteria (AWQC) concentrations for NP are in the low parts per billion, based on this aquatic toxicity information. The EPA AWQC and its scientific basis are consistent with similar findings and regulatory actions taken by governments in Europe, Canada and Japan.

NP and NPEs are produced in large volumes, with uses that lead to widespread release to the aquatic environment. NPEs represent approximately 80% to 85% of the volume of alkylphenol ethoxylates. U.S. and Canadian consumption of NPEs has been estimated between 300 and 400 million pounds per year.

Source: (EPA 2010)

## **EU Directive – Restricting Use of Nonylphenol Ethoxylate & Nonylphenol Products**

### **Background**

An EU risk assessment was made under the Existing Substances Regulation 93/793/EEC because of the large quantity of nonylphenol (NP) manufactured and used, as well as its toxicity to aquatic organisms and concerns about its biodegradability. The nonylphenol ethoxylated (NPE) products were also assessed as they are the main pathway of nonylphenol into the environment. For NP the risk assessment showed that the main concern is the high aquatic toxicity and that it did not break down readily in ecosystems. No adverse human exposure risks during use were identified. The environmental risk assessment indicated the need to reduce the risks associated with the production, formulation into products and end-uses of NPE and NP. It is estimated that the proposed restrictions will decrease emissions to the aquatic environment by about 80%.

### **EU Directive**

The EU passed in July 2003 the directive 2003/53/EC, which restricts the marketing and use in Europe of products and product formulations that contain more than 0.1% of NPE or NP. This applies to many industries, including the textile and leather industries, except in the case of closed application systems where no release into waste waters occurs. From January 2005 this EU Directive came into force.

### **EPA Alternatives Assessment**

May 2012, the EPA released a document entitled “DfE Alternatives Assessment for Nonylphenol Ethoxylates” as part of their “Design for the Environment” Program. The document lists a series of alternative chemical surfactants having significantly lower or completely non-toxic degradation products. The full document can be accessed on EPA’s website (EPA.gov) for more information.

## **Commonly Used Nonylphenol/Nonylphenol Ethoxylate-based Surfactants Use in Food & Dairy Applications in the U.S.**

DOW TERGITOL NP Line

DOW TRITON N-57

## **Alternatives to Nonylphenol Ethoxylate Surfactants**

DOW ECOSURF LF Surfactants (Biodegradable)