Product Safety Assessment

**DOW™ Nonylphenol Ethoxylate Surfactants**


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Names

- CAS No. 127087-87-0
- Nonylphenol ethoxylate
- Alkylaryl polyether alcohols
- Poly(oxy-1,2-ethanediyl)
- Polyethoxylate
- Polyoxyethylene nonylphenol
- Nonoxynol
- NPE
- Alcohol ethoxylates
- Nonylphenoxypolyethoxyethanol
- Nonylphenyl polyethylene glycol
- Nonylphenol polyoxyethylene ether NP surfactants
- α-(4-Nonylphenyl)-ω-hydroxy-, branched
- Polyethylene glycol nonyl phenyl ether
- Polyoxyethylene nonyl phenyl ether
- DOW™ nonylphenol ethoxylate surfactants
- TERGITOL™ NP nonionic surfactants
- TRITON™ N-57 nonionic surfactant

Product Overview

- Nonylphenol ethoxylates (NPEs) are nonionic surfactants and are a category of alkylphenol ethoxylates. NPE-based surfactants sold by The Dow Chemical Company (“Dow”) and affiliated companies of Dow are used in industrial cleaning products, processes, agricultural formulations and paints. Dow sells NPE-based surfactants under trade names that include but are not limited to TERGITOL™ NP nonionic surfactants or the product name TRITON™ N-57 nonionic surfactant. The TERGITOL NP product family has various molecular weights and properties. The properties of a particular NPE depend upon the number of ethoxylate groups that are attached (the number of ether linkages along the chain), which can vary from just a few up to about one hundred. For further details, see Product Description, Product Uses, and Manufacture of Product.
- Occupational and consumer exposure is possible because NPE is used in industrial cleaning products, agricultural formulations, paints and other formulated products. For further details, see Exposure Potential.
- The results of numerous mammalian toxicity studies conducted on nonylphenol (NP) and nonylphenol ethoxylates (NPE), along with an understanding of their occupational and consumer use practices, support the conclusion that human safety should not be a concern for these compounds. Trace levels of alkylphenol ethoxylates (APEs) like the NPEs found in recent household monitoring studies do not represent a toxicological concern and are...
significantly below concentrations considered to be safe. Certain alkylphenol (AP) and low-mole (lower molecular weight) alkylphenol ethoxylate compounds have shown weak estrogen-like activity in cell cultures and laboratory animals. High-mole (higher molecular weight) APEs have not exhibited estrogen-like activity in the same tests. More information may be found on a statement issued by the APE Research Council entitled, "Commercial Nonylphenol Ethoxylates Are Not Estrogenic." Because the properties of individual TERGITOL™ NP surfactants vary, consult the specific Safety Data Sheet for the material of interest, or see Health Information.

- NPEs are inherently biodegradable and can be effectively removed in well functioning sewage treatment plants. They are unlikely to bioaccumulate in the food chain, and range from moderately toxic to toxic to fish and aquatic organisms on an acute basis. For further details, see Environmental Information.
- Nonylphenol ethoxylates are normally nonreactive, but prolonged, excessive heat may cause some products to decompose. Avoid contact with strong bases, strong acids, strong oxidizing agents, and materials that react with hydroxyl compounds. For further details, see Physical Hazard Information.

Manufacture of Product

- Capacity – Global consumption of alcohol ethoxylates in 2009 was estimated to be 612,000 metric tons (1.35 billion pounds). Dow sells alkylphenol ethoxylates globally and has a U.S. production site in Hahnville, Louisiana.
- Process – Nonylphenol ethoxylates are produced by reacting nonylphenol and ethylene oxide with potassium hydroxide as a catalyst. The ratio of ethylene oxide to nonylphenol determines the molecular weight of the product or the length of the molecule produced. Sometimes water is added to the product to simplify handling.

\[
\text{R-} \overset{\text{OH}}{\text{O}} \text{R(OC}_2\text{H}_4\text{O)nOH} \quad \text{[KOH]} \quad \text{R-} \overset{\text{OCH}_2\text{CH}_2\text{OH}}{\text{Nonylphenol ethoxylate, where n varies by product}}
\]

Product Description

Dow sells NPE-based surfactants under trade names that include but are not limited to TERGITOL™ NP nonionic surfactants and the product name TRITON™ N-57 nonionic surfactant.

**TERGITOL NP Surfactants**

TERGITOL NP surfactants can be either solids or liquids depending on their molecular weight and the use temperature. The solids are white to yellow in color, and the liquids are clear to slightly cloudy. Lower molecular weight nonylphenol ethoxylates products tend to be liquids and higher molecular weight products tend to be solids, unless diluted with water.

Because TERGITOL NP surfactants vary in molecular weight (and the number of ether linkages along the chain), the products have different solubilities. TERGITOL NP-4 and NP-6 surfactants are oil soluble, and can solubilize kerosene and aliphatic hydrocarbons. TERGITOL NP-7 through NP-15 surfactants are miscible with chlorinated and aromatic solvents and soluble in water. TERGITOL NP-30 through NP-70 surfactants are highly water soluble. Some products may form gels in certain solvents or under certain conditions.
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TRITON™ N-57 Surfactants
TRITON N-57 is a colorless liquid and is not diluted with water.

Product Uses
Nonylphenol ethoxylates are primarily used in industrial applications. Use of nonylphenol ethoxylates in household and consumer applications is declining.

The market applications for these products fall into the four basic categories listed below:

- **Industrial** – agriculture, leather processing, metal working, oil field, pulp and paper, textile processing, water treatment
- **Emulsions and coatings** – paints and coatings, emulsion polymerization, adhesives
- **Industrial and institutional cleaning** – hard-surface cleaners, circuit-board cleaners, industrial laundry/dry-cleaning detergents, metal cleaning, food and dairy
- **Household cleaning** – detergents, laundry prewash, hard-surface cleaners, air fresheners

Exposure Potential
Nonylphenol ethoxylates are used in the production of industrial, agricultural, institutional, and a limited number of consumer products. Based on the uses for these products, the public could be exposed through:

- **Workplace exposure** – Exposure can occur either in a facility that manufactures nonylphenol ethoxylates or in the various formulating facilities that use these products. Those working with these products could be exposed during maintenance, sampling, testing, or other procedures. Each manufacturing or formulating facility should have a thorough training program for employees and appropriate policies, work processes, ventilation, and safety equipment in place to limit exposure. See Health Information.
- **Consumer exposure to products containing nonylphenol ethoxylates** – Dow does not sell nonylphenol ethoxylates for direct consumer use, but they can be used as a component of agricultural chemicals, degreasers, paints, and certain household cleaning products and detergents, etc. Therefore, there is a potential for consumers to come into contact with products containing small amounts of these materials. Always read the product information before use and follow the label/use instructions. See Health Information.
- **Environmental releases** – Most uses of NPEs result in their release to industrial or publicly-owned waste water treatment plants, where they have been show to be highly treatable, though trace levels of low mole NPEs (i.e., NPE1 and NPE2) and NP can be released to the environment after treatment. Some uses of NPE (e.g. in formulated agricultural products) can result in the release of nonylphenol ethoxylates directly to the environment during use. Nonylphenol ethoxylates are soluble in water. Nonylphenol ethoxylates are inherently biodegradable and they continue to degrade in aquatic and terrestrial environments. In the event of a spill, the focus is on containing the spill to prevent contamination of soil and surface or ground water. Use inert materials (e.g., sand, soil) to contain spills. To avoid gelling and foaming problems, do not use water to flush away spills. Water that is contaminated with nonylphenol ethoxylates should be sent to a wastewater-treatment facility to reduce residues to concentrations that pose no harm to the environment. In sufficient concentrations, nonylphenol ethoxylates can be toxic to aquatic organisms and animals. See Environmental, Health, and Physical Hazard Information.
- **Large release** – Industrial spills or releases are infrequent and generally contained. If a large spill does occur, the material should be captured, collected, and reprocessed or disposed of according to applicable governmental requirements. Emergency personnel should wear proper protective equipment, including positive-pressure, self-contained breathing apparatus
(SCBA), and follow emergency procedures carefully. When relevant in scale or risk, the community should be notified of the hazards associated with the specific release event. See Environmental, Health, and Physical Hazard Information.

- **In case of fire** – Isolate the fire and keep people away. Use water fog, dry-chemical or carbon-dioxide extinguishers, or foam to fight the fire. Do not direct a solid stream of water or foam into hot, burning pools as this may cause frothing and increase fire intensity. Firefighters should wear positive-pressure, self-contained breathing apparatus and protective firefighting equipment. Avoid accumulation of water. Combustion of nonylphenol ethoxylates can produce carbon monoxide (highly toxic) and carbon dioxide (an asphyxiant at sufficient concentrations). See Environmental, Health, and Physical Hazard Information.

For more information, see the relevant Safety Data Sheet.

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**Health Information**

Health information for nonylphenol ethoxylate products is summarized on the relevant Safety Data Sheets. It is important to note that health risks associated with individual products may vary based on their formulation or intended use. The Safety Data Sheet is the preferred source for specific health information. These materials may also contain minor components or additives that have additional health risks. An overview of health information for nonylphenol ethoxylate products appears below.

Numerous studies show that under normal conditions of use, exposure to alkylphenols or alkylphenol ethoxylates does not pose a significant risk to human health. Trace levels of alkylphenol ethoxylates (APEs) like the NPEs found in recent biomonitoring studies do not represent a toxicological concern and are significantly below concentrations considered to be safe. Certain alkylphenol (AP) compounds have shown weak estrogen-like activity in cell cultures and laboratory animals. Some screening level tests have shown that some low-mole (lower molecular weight) alkylphenol ethoxylates bind weakly to the estrogen receptor in cell cultures, but high-mole (higher molecular weight) APEs have not.

Scientists determine whether a compound is estrogenic by testing the substance in a system that is known to respond to estrogen in a specific way. Since the uterus is highly responsive to estrogenic compounds, a uterotrophic assay is often used. Several uterotrophic studies in rats – and more recently, a study in fish – showed no estrogen-like activity up to maximum tolerable doses of commercial products TERGITOL™ NP-4 and TERGITOL NP-9.

The toxicological properties of NPEs and TERGITOL NP surfactants vary with molecular weight. TERGITOL NP-4 through NP-15 surfactants are more irritating than higher molecular weight TERGITOL NP-30 through NP-70 surfactants.

**TERGITOL NP-4 through NP-15 Surfactant**

- **Eye contact** – Contact may cause severe irritation or corneal injury.

- **Skin contact** – Prolonged contact may result in slight irritation with local redness. Prolonged or widespread skin contact is unlikely to result in absorption of harmful amounts. These surfactants are not skin sensitizers.

- **Ingestion** – These products have low toxicity. Small amounts swallowed incidental to normal handling operations are not likely to cause injury. In two-year feeding studies, animals that were fed up to 200 mg/kg/day of TERGITOL NP-9 – the equivalent of eating 14 grams (0.5 ounces) for
a 68-kg (150-pound) adult each day for 2 years – showed no significant affects, i.e. was not
carcinogenic. TERGITOL™ NP-4 was also not carcinogenic in a two-year study.

**Inhalation** – Prolonged excessive exposure may cause serious adverse effects, even death. Vapor or mist may cause irritation of the upper respiratory tract. Some deaths have occurred in animals exposed to high aerosol concentrations of these surfactants for 4 hours. It is likely that these deaths were caused by suffocation because there was no evidence in the lungs to support chemical toxicity.

**Other** – These surfactants show no evidence of being genotoxic or mutagenic or causing birth defects. Minor skeletal alterations have been reported at dose levels that are toxic to the mother.

**TERGITOL NP-30 through NP-70 Surfactants**

**Eye contact** – Contact can cause slight, temporary irritation. Corneal injury is unlikely.

**Skin contact** – Prolonged contact might cause slight irritation with local redness, especially for the lower molecular weight products. Even prolonged contact is unlikely to result in absorption of harmful amounts.

**Ingestion** – These products have low toxicity. Small amounts swallowed incidental to normal handling operations are not likely to cause injury. Aspiration may cause lung damage.

**Inhalation** – Vapor is unlikely at room temperature because of the physical properties. No adverse effects are anticipated from inhalation.

**Other** – These surfactants show no evidence of being genotoxic, mutagenic, or causing birth defects.

For more information, see the relevant Safety Data Sheet.

**Environmental Information**

Nonylphenol ethoxylates are extensively biodegraded in laboratory screening tests, but do not meet the stringent criteria for classification as "readily biodegradable." These substances are inherently biodegradable to carbon dioxide and water, and numerous studies have shown that under conditions where sufficient oxygen, nutrients, and microorganism concentrations occur, such as in soils, surface waters, and well-functioning sewage treatment plants, the substances are extensively biodegraded. Treatment efficiencies vary, although most facilities typically remove between 80 and 90% (through a combination of biodegradation and adsorption). Small amounts of various metabolites have been detected in effluents from sewage treatment plants, including low molecular weight nonylphenol ethoxylates, ether carboxylates and nonylphenol. Nonylphenol is a minor metabolite in aerated systems, although higher levels can be formed during anaerobic treatment of sewage biosolids (sludges).

Nonylphenol and nonylphenol ethoxylates are not expected to bioaccumulate in the food chain since they are metabolized and excreted by fish. This conclusion is supported by an assessment performed by Environment Canada of all commercially relevant alkylphenols and their ethoxylates which stated that none of the substances met the criteria for persistence or bioaccumulation. Further, nonylphenol is listed in the European Chemical Substances Information System (ESIS) as not fulfilling PBT and vPvB criteria.

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Nonylphenol ethoxylates vary in their toxicity, ranging from moderately toxic to toxic to fish and aquatic organisms on an acute basis. The toxicity of nonylphenol ethoxylates increases as the length of the ethoxylate chain (molecular weight) decreases. Alkylphenols and their ethoxylates like nonylphenol and nonylphenol ethoxylates have been the subject of considerable regulatory attention due to concerns about their aquatic toxicity and weak endocrine activity. The U.S. Environmental Protection Agency (EPA) has finalized Water Quality Criteria (WQC) for nonylphenol pursuant to Section 304(a)(1) of the Clean Water Act. In the U.S. EPA WQC document concluded that although nonylphenol has endocrine activity, the ability of nonylphenol to induce estrogenic effects has seldom been reported at concentrations below the freshwater Final Chronic Value of 6.6 ug/L.

Risk assessments for alkylphenols and their ethoxylates have been conducted by regulatory authorities around the world (U.S. EPA, 1996; EC and HC, 2001; EC 2002; UKEA 2005). In some countries, risk management strategies have been implemented that include the elimination of certain applications or voluntary reductions in their use due to concerns about aquatic toxicity risks. For further detail, visit the relevant sites listed in Additional Information.

Physical Hazard Information
Nonylphenol ethoxylates are normally nonreactive, but prolonged, excessive heat may cause some products to decompose. Avoid contact with strong bases, strong acids, strong oxidizing agents, and materials that react with hydroxyl compounds.

For more information, see the relevant Safety Data Sheet.

Regulatory Information
Governmental requirements may exist that govern the manufacture, sale, transportation, use, and/or disposal of nonylphenol ethoxylates. These requirements may vary by city, state, country, or geographic region. Additional information may be found by consulting the relevant Safety Data Sheet or Contact Us.

Additional Information
- Safety Data Sheet (www.dow.com/webapps/msds/msdssearch.aspx)
- Alkylphenol Ethoxylates Research Council (www.aperc.org/)
- European Council for Alkylphenols and Derivatives (www.cepad.eu/index.asp)
- European Surfactant Trade Association (www.cefic.org/cesio)
• European Commission, European Union Risk Assessment Report: 4-Nonylphenol ( Branched) and Nonylphenol, 2002
• United Kingdom Environment Agency, Environmental Risk Evaluation Report: 4-tert-Octylphenol, 2005

For more business information about TERGITOL™ NP surfactants, visit the Dow Surfactant web site at www.dowsurfactants.com/.

References

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NOTICES:

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