



Nonylphenol and its Ethoxylates

This fact sheet describes the Canadian Water Quality Guidelines for nonylphenol and nonylphenol ethoxylates to protect freshwater and marine life. It is part of the series *Guidelines at a Glance*, which summarizes information on toxic substances and other parameters for which there are Canadian Environmental Quality Guidelines.

The National Guidelines and Standards Office of Environment Canada coordinates the development of Canadian Environmental Quality Guidelines in cooperation with the Canadian Council of Ministers of the Environment (CCME).

Where do nonylphenol and nonylphenol ethoxylates come from?

Nonylphenol ethoxylates (NPEs) are a group of synthetic chemicals produced for their surfactant properties; that is, their ability to make liquids spread out on flat surfaces rather than collecting in droplets, and their ability to bind non-mixable substances such as oil and water. NPEs are made from nonylphenol (NP), also a synthetic chemical, by adding as many as one hundred ethoxylate groups. Ethoxylate groups are made of carbon, hydrogen, and oxygen. Most of the commonly used NPEs have six to twelve ethoxylate groups. NPEs are used in a wide variety of residential and commercial cleaning products, including detergents, shampoos, and surface cleaners. They are also used in pesticides and spermicides. Industry uses NPEs as detergents, emulsifiers, wetting agents, and dispersing agents in textile processing. Other industrial uses are in paint and protective coatings, the manufacturing of plastics, pulp and paper production, oil extraction and petroleum production, metal processing, leather manufacturing, and building and construction.

Many of the NPEs in use today are found in cleaners, detergents, and shampoos which subsequently are washed down household drains to municipal wastewater treatment plants. Some NPEs are degraded in the treatment plants, some end up in sludge, and some are released to surface waters. Some industries using NPEs may also discharge effluents containing these chemicals directly into the aquatic environment.

What happens to nonylphenol and nonylphenol ethoxylates released into the environment?

NP and NPEs in the environment and in wastewater treatment plants are broken down (biodegraded) by bacteria and other microorganisms. Initially NPEs are rapidly biodegraded into intermediate breakdown products which include NP itself. Eventually these intermediates are completely biodegraded to carbon dioxide, water, and inorganic salts, but this process occurs over several weeks. The intermediate breakdown products therefore remain in the environment longer than the parent NPEs.

When released to surface waters, NP and NPEs may also cling to particles and concentrate in the sediments at the bottom of waterbodies. In the upper layers of the water, NP and NPEs may be broken down through exposure to sunlight (photolysis). Aquatic plants, invertebrates, and fish can take up NP and NPEs from the water.

What effects can nonylphenol and nonylphenol ethoxylates have on fish and other forms of aquatic life?

Algae and aquatic plants may have reduced growth when exposed to NP and NPEs. Exposed aquatic invertebrates and fish may be smaller, slower to mature, and may have lower reproductive success. At very high concentrations, invertebrates and fish may die. NP and some NPEs can also disrupt the hormone-regulating systems of aquatic animals. For example, they can cause male fish to produce chemicals in their bodies that are normally only produced by female fish as they form eggs. NP and



NPEs can also cause invertebrates and fish to form both male and female reproductive organs, and they can affect the ratio of males to females within a population. These changes have the potential to alter normal breeding activity in the affected species.

What levels of nonylphenol and nonylphenol ethoxylates are safe for plants and animals that live in Canadian waters?

As NP and NPEs typically occur together in the environment, their combined effects should be considered. NP is about 2 to 200 times more potent than NPEs, depending on the number of ethoxylate groups on the NPEs. The toxicity of a mixture of NP and NPEs can be expressed by converting the concentrations of each NPE to an equivalent potency of NP. Each converted potency is called a nonylphenol toxic equivalent (TEQ).

The Canadian Water Quality Guideline (CWQG) to protect freshwater life is 1.0 microgram of nonylphenol TEQs per litre of water. This freshwater guideline is based on a large number of scientific studies that examined the impacts of NP and NPEs on the plants and animals that live in our lakes and rivers.

The CWQG to protect marine life is 0.7 micrograms of nonylphenol TEQs per litre of water. This marine guideline is based on a large number of scientific studies that examined the impacts of NP and NPEs on the plants and animals that live in our estuaries and along our coasts.

If the level of nonylphenol toxic equivalents measured in a lake, river, estuary, or ocean is less than the corresponding guideline, one would not expect to see adverse health effects in even the most sensitive species. In places where the CWQGs for NP and NPEs are exceeded, adverse effects will not necessarily occur. Whether effects will occur depends on the amount by which the guideline levels are exceeded and on the kinds of plants and animals that live there. Further investigation at a particular site is needed to determine whether or not there is a negative impact.

How do levels of nonylphenol and nonylphenol ethoxylates in Canadian waters compare to the guidelines?

In many Canadian lakes and rivers, concentrations of NP are less than 1.0 microgram per litre of water and concentrations of individual NPEs are less than 10 micrograms per litre of water. When converted to nonylphenol TEQs, concentrations that exceed the freshwater guideline typically only occur in waters near industrialized areas or immediately downstream from municipal wastewater discharges. Data have not been collected for lakes or rivers in Alberta, Manitoba, New Brunswick, Newfoundland, Saskatchewan or the territories. There is no information on the levels of NP and NPEs in Canadian marine waters, so it is unknown whether the marine guideline is likely to be exceeded.

How can CWQGs be used to make a difference?

In general, Canadian Water Quality Guidelines can be used by Canadian federal, provincial and territorial governments on a voluntary basis to set local guidelines, discharge limits for industry, and clean-up targets. CWQGs are most commonly used in environmental assessments as benchmarks or yardsticks to which measured levels are compared. Anyone can use the guidelines to determine if the level of nonylphenol toxic equivalents measured in a sample of water has the potential to cause adverse environmental effects.

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