



Nonylphenol and its Ethoxylates

This fact sheet describes the Canadian Soil Quality Guidelines for nonylphenol and nonylphenol ethoxylates to protect environmental health. 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. Releases to soil may occur through spraying of pesticides, application of industrial and municipal sewage sludge to agricultural soils, disposal of sludge in landfills, or irrigation of soils with NPE-contaminated water.

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.

NP and NPEs have a tendency to cling to soil particles, but they may also move down through the soil into groundwater. NP and NPEs in the soil can be taken up by plants and invertebrates.

What effects can nonylphenol and nonylphenol ethoxylates have on terrestrial forms of life?

The presence of NP and NPEs in soil can affect the normal processes of soil microorganisms, thereby affecting nutrient cycling. The growth of terrestrial plants exposed to NP and NPEs may be reduced, and invertebrates living in the soil may be smaller or have lower reproductive success. At very high concentrations, soil invertebrates may die. The growth of terrestrial mammals may also be reduced through exposure to NP and NPEs. NP and some NPEs can also disrupt the hormone-regulating systems of animals. For example, in experiments with rats, NP and some NPEs disrupted estrous cycles, reduced sperm counts, and affected the size of reproductive organs.



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

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 Soil Quality Guideline (CSoQG) to protect environmental health on agricultural and residential/park lands is 5.7 milligrams of nonylphenol TEQs per kilogram of soil. The CSoQG to protect environmental health on commercial and industrial lands is 14 milligrams of nonylphenol TEQs per kilogram of soil. Soil concentrations less than 21 milligrams per kilogram would not be expected to result in contamination of groundwater. These guidelines are based on a number of scientific studies that examined the impacts of NP and NPEs on the plants and animals that live in or on our soils.

If the level of nonylphenol toxic equivalents measured in soil is less than the corresponding guideline, one would not expect to see adverse health effects in the plants and animals that live there. In places where the CSoQGs 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, the kinds of plants and animals that live there, and the soil characteristics (e.g., organic carbon content and pH). 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 soils compare to the guidelines?

Very little information is available on the concentration of NP and NPEs in Canadian soils. One study, which examined a field that had received municipal sewage sludge applications, measured 2.7 milligrams of NP per kilogram of soil. Only trace amounts of other NPEs were measured. In this particular case, when converted to nonylphenol TEQs, the CSoQGs were not exceeded.

How can CSoQGs be used to make a difference?

In general, Canadian Soil Quality Guidelines can be used by Canadian federal, provincial, and territorial governments on a voluntary basis to set local guidelines and clean-up targets. CSoQGs 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 soil sample has the potential to cause adverse environmental effects.

For more information, contact us at:

National Guidelines and Standards Office
Environment Canada
Ottawa ON K1A 0H3

T: (819) 953-1550 F: (819) 956-5602
E-mail: ceqg-rcqe@ec.gc.ca
website: www.ec.gc.ca/ceqg-rcqe/

