



Toxics Link
for a toxics-free world

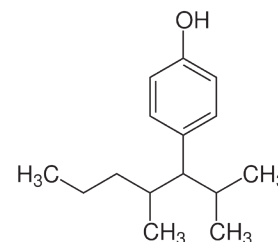
NONYLPHENOL (NP)

INTRODUCTION

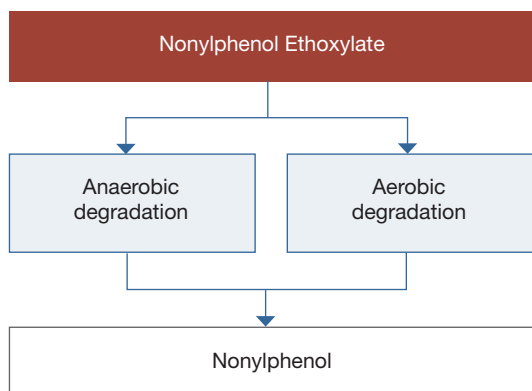
- Discovered in 1940, Nonylphenol (NP) - is a nine carbon chain belonging to the Alkylphenols group.
- There are various isomers of Nonylphenol, however, 4-nonylphenol is the most widely produced and marketed Nonylphenol¹.
- Nonylphenols are produced through industrial process however they also get leached into the environment from the degradation of alkylphenol ethoxylates (eg. Nonylphenol Ethoxylates) which is a very widely used chemical.
- **United Nations Environment Programme** (UNEP, 2003) has identified NP as a chemical of global concern in its region-based Assessment of Persistent Toxic Substances.

NONYLPHENOL ETHOXYLATES (NPES)

NPES are hydrophilic (“water-attracting”) at one end of the molecule and hydrophobic (“water-avoiding”) at the opposite end. The hydrophilic “head” attracts water and the hydrophobic “tail” attracts poorly soluble substances, such as oils and greases. This ability to simultaneously attract water and hydrophobic substances makes NPES an ideal surfactant and a majorly produced compound.



- Currently, various market players such as AkzoNobel N.V. (Netherlands), Clariant AG (Switzerland), The DOW Chemical Company (U.S.), Hunstman (U.S.), Stepan Company (U.S.), India Glycols (India), SABIC (Saudi Arabia), PJSC Nizhnekamskneftekhim (Russia), Solvay (Belgium), and PCC Exol SA (Poland) dominate the global NPES market².



In sewage sludge and sediments

Half-lives (t/2) for NP in aerobic degradation ranged from 1.1 to 99.0 days

Half-lives (t/2) for NP in anaerobic degradation it ranges from 23.9 to 69.3 days

APPLICATIONS OF NONYLPHENOLS AND NONYLPHENOL ETHOXYLATE

Nonylphenols

- Surfactant in detergents
- Antioxidants
- Lubricating oil additives
- Laundry
- Dish detergents,
- Emulsifiers,
- Solubilizers, etc
- Production of NPES

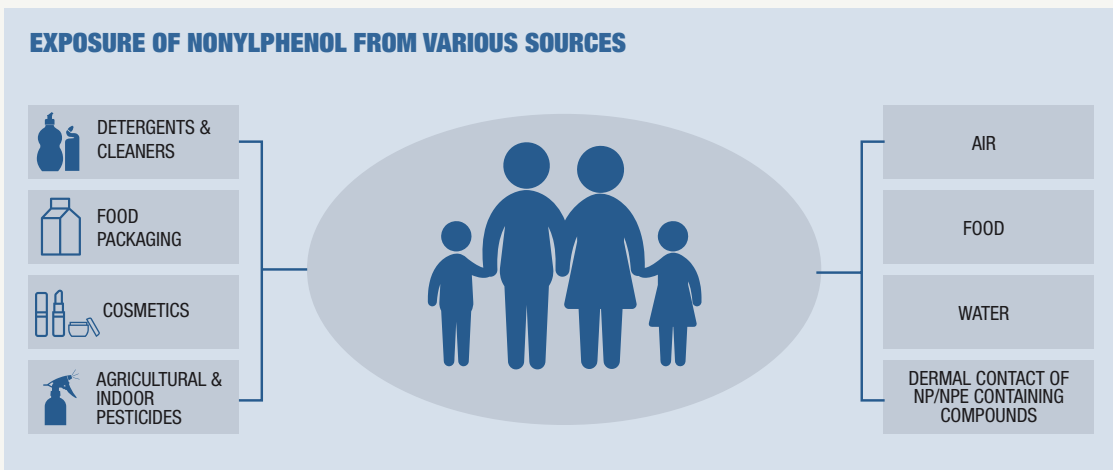
Nonylphenol Ethoxylates

- Detergents
- Paints
- Pesticides
- Personal care products
- Plastics, etc.



¹ EPA. 2010. Nonylphenol (NP) and Nonylphenol Ethoxylates (NPES) Action Plan. February, 2014.

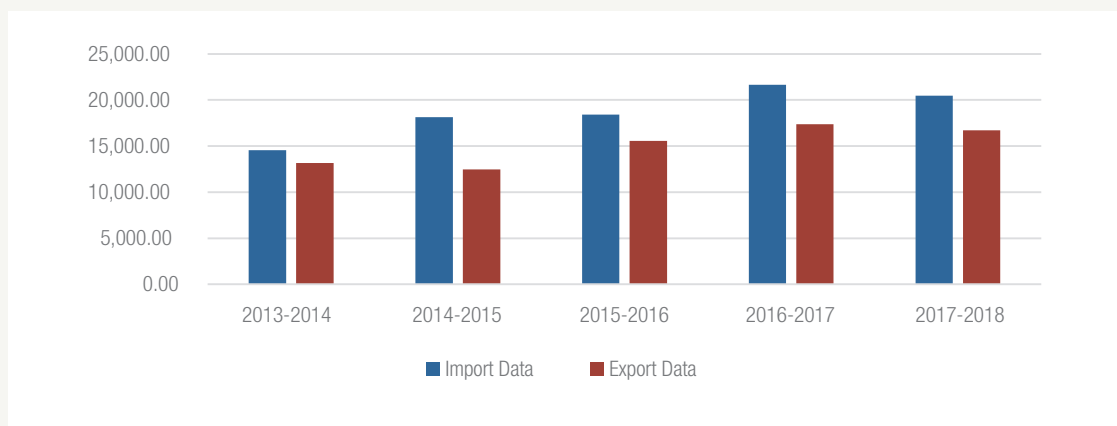
² <https://www.marketsandmarkets.com/PressReleases/nonylphenol-ethoxylate.asp>



IMPACTS ON HUMAN HEALTH AND ANIMALS³

- Endocrine Disruptor – poses potential harm to immune and reproductive system
- A potential neurotoxin
- Highly irritating and corrosive to the skin and eye
- Can cause reproductive disorders
- Learning disabilities
- Endocrine disruptor - due to its ability to mimic estrogen and in turn disrupt the natural balance of hormones in affected organisms.
- NP at high doses has been linked to breast cancer in mice
- Significant reduction in animal population
- Nonylphenol can cause endocrine disruption in fish by interacting with estrogens and androgen receptors

Fig.: Import and Export Values (In Rs. Lac) for last 5 years



EXPORT AND IMPORT OF NONYLPHENOL ETHOXYLATES IN INDIA⁴

Import/Export	Import Value (In Rs. Lac)				
	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018 (Apr-Feb)
Import Data	14,552.96	18,120.74	18,416.20	21,641.36	20,479.23
Export Data	13,176.17	12,465.27	15,543.46	17,382.25	16,707.21

³ https://www.unitedlabsinc.com/usa/content/about_us/npe_free.asp

⁴ <http://commerce-app.gov.in/eidb/default.asp>

RESEARCH STUDIES ON NONYLPHENOL IN INDIA

Year	Authors	Institute	Findings
2016	K.P. Asifa, and K.C. Chitra ⁵	Endocrinology and Toxicology Laboratory, Department of Zoology, University of Calicut, Malappuram District, Kerala	Alterations in the antioxidant defence system were observed after acute exposure to Nonylphenol.
2014	Krishna Kumar Selvaraj et al ⁶	Department of Environmental Biotechnology, School of Environmental Sciences, Bharathidasan University, Tiruchirappalli, Tamil Nadu	Varied concentrations of Nonylphenol were observed in three rivers viz. Kaveri, Vellar and Tamiraparani.
2004	K. C. Chitra and P. P. Mathur ⁷	School of Life Sciences, Pondicherry University, Pondicherry	Nonylphenol induced oxidative stress in the testis of rats could be reversed by the administration of vitamin E
2015	Madhu Sharma and Pooja Chadha ⁸	Department of Zoology, Guru Nanak Dev University Amritsar, Punjab	4-nonylphenol caused haemotoxicity in fish.

GLOBAL RESTRICTIONS ON USE OF NONYLPHENOL

- The EU passed a directive 2003/53/EC in 2003 in Europe, restricting the marketing and use of products and product formulations that contain more than 0.1% of NPE or NP⁹. Further in 2016, it restricted NPE concentration to 0.01 % in textile articles entering the market after 2021¹⁰.
- EPA** had proposed nonylphenols (NP) and nonylphenol ethoxylates (NPE) in its **Significantly New Use Rule (SNUR)**. It has also been included in Contaminant Candidate List 4 (CCL 4) of EPA in 2016 and it may lead to a future regulation under the Safe Drinking Water Act (SDWA).
- The **European water framework directive (WFD)** (EC, 2008) has listed NP as a priority pollutant and has prohibited its use >0.1% of mass in various commodities.

5 K.P. Asifa, K.C. Chitra., Alteration in hepatic antioxidant defense system induced by nonylphenol in cichlid fish, *Etiopius maculatus* (Bloch, 1795), *The Journal of Zoology Studies*, Vol. 3 No. 4 2016 : <http://www.journalofzoology.com/volume3/v3i4/pdf/5.1.pdf>

6 Please put this as a footnote: https://www.researchgate.net/profile/Krishna_Kumar_Selvaraj/publication/258252060_GC-MS_determination_of_bisphenol_A_and_alkylphenol_ethoxylates_in_river_water_from_India_and_their_ecotoxicological_risk_assessment/links/5a153b89aca27273c9eb2386/GC-MS-determination-of-bisphenol-A-and-alkylphenol-ethoxylates-in-river-water-from-India-and-their-ecotoxicological-risk-assessment.pdf

7 [http://nopr.niscair.res.in/bitstream/123456789/23367/1/IJEB%2042\(2\)%20220-223.pdf](http://nopr.niscair.res.in/bitstream/123456789/23367/1/IJEB%2042(2)%20220-223.pdf)

8 Sharma Madhu, Chadha Pooja. Acute Toxicity of 4-nonylphenol on Haematological profile of Fresh water Fish *Channa punctatus*. *Res. J. Recent Sci.*, Volume 4, Issue (ISC-2014), Pages 25-31, (2015) : <http://www.isca.in/rjrs/archive/v4/isc-2014/5.ISCA-ISC-2014-Oral-2AVFS-03.php>

9 <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:178:0024:0027:en:PDF>

10 <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R0026&from=EN>

- Many leading companies such as Procter & Gamble, Unilever and Walmart have phased out the use of nonylphenol ethoxylates^{11,12,13}.

REGULATIONS IN INDIA

- IS 4707 (Part 2):2009 by Bureau of Indian Standards have prohibited the use of Nonylphenol in cosmetics.
- There are no specific standards for nonylphenol or nonylphenol ethoxylates for water and wastewater, but standards for phenolic compounds are listed in the standards for drinking water.
- General Parameters Concerning Substances Undesirable in Excessive Amounts –as per IS 10500 : 2012

Parameter	Requirement (Acceptable limit)	Permissible limit in the absence of alternative source
Phenolic compounds (as C6 H5 OH) mg/l, Max	0.001	0.002

- General standards for discharge of environmental pollutants Part-A: Effluents – as per The Environment (Protection) Rules, 1986

Parameter	Inland surface water	Public Sewers	Land for irrigation	Marine coastal areas
Phenolic compounds (as C6 H5 OH) mg/l, Max	1.0	5.0	--	5.0

11 See Use of Nonylphenol and Nonylphenol Ethoxylates in P&G Products at www.pgperspectives.com/en_UWproductingredient/nonylphenol~onlyphenolethoxylatesen.html

12 See Frequently Asked Questions: "Do you use nonylphenol ethoxylates (NPEs) as surfactants?" at www.unilever.com/ourvalues/environmentandsociale/ensocialreport-consumers/chemicalsinproducts/FAOs.asp

13 See Wal-Mart Stores, Inc. Launches Innovative Program to Inspire Use of Preferred Substances in Chemical Intensive Products at www.walmartfacts.com/articles/4556.aspx.

ALTERNATIVES

NPEs being one of the APEs (Alkylphenol Ethoxylates) can be easily substituted by using other APEs. Some of the alternatives are:

- Glycerol (glycerin), glucosides, or other sugars, either as monosaccharides (e.g. sorbitol) or disaccharides (e.g. sucrose)
- Other Alkylphenol Ethoxylates (such as alcohol ethoxylates, both linear and branched, and glucose-based carbohydrate derivatives such as alkylpolyglucoside, glucamides, and glucamine oxides.)
- NPE can also be replaced with a surfactant blend of alternative non-ionics or a blend that include anionic or amphoteric surfactants.
- In May 2012, EPA1 released the following alternatives to Nonylphenol
- Sodium lauryl sulphate; C9-11 Alcohols; ethoxylated (6 EO); C12-15 Alcohols, ethoxylated (9EO); Oxirane methyl-, polymer with oxirane mono (2-ethylhexyl ether) Ecosurf; EH-9 D-Glucopyranose, oligomeric, decyl octyl glycosides; Benzenesulfonic acid, C10-13-alkyl derivs., sodium salt; Polyoxy(1,2-ethanediyl), alpha-sulfo-omegadodecyloxy-, sodium salt; Sorbitan monostearate

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4. http://www.chem.unep.ch/pts/gr/Global_Report.pdf
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23. See Use of Nonylphenol and Nonylphenol Ethoxylates in P&G Products at www.pgperspectives.com/en/UWproductingredient/nonylphenol~nonylphenolethoxylatesen.html
24. See Frequently Asked Questions: "Do you use nonylphenol ethoxylates (NPEs) as surfactants?" at www.unilever.com/ourvalues/environmentandsoc/envsocialrepol~consumers/chemicalsinproducts/FAOs.asp
25. See Wal-Mart Stores, Inc. Launches Innovative Program to Inspire Use of Preferred Substances in Chemical Intensive Products at www.walmartfacts.com/articles/4556.aspx.

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