

NONYLPHENOL AND ENDOCRINE EFFECTS:

RISKS NOT SUBSTANTIATED

It has been hypothesized that nonylphenol and its derivatives, some of which are used extensively in industry as surfactants, could pose a risk to the human endocrine system. In fact the research evidence does not back up these assertions. Commercial nonylphenol ethoxylates, the derivatives most widely used, exhibit no endocrine activity. The EU risk assessment of nonylphenol concludes that the weak oestrogen-like character of this substance does not merit its classification as a reproductive toxin, and that there is no concern for consumer health.

The endocrine hypothesis

Results from some wildlife studies and laboratory experiments have led to the suggestion that certain synthetic chemicals in the environment - including the group of industrial chemicals known as alkylphenols - exhibit characteristics similar to the naturally occurring human hormones known as oestrogens. It is alleged that these substances, once in the body, could alter the normal functions controlled by the endocrine system. Such "oestrogen mimics" have been postulated to be related to a number of adverse effects on human health.

There is a great deal of scientific debate surrounding the endocrine hypothesis, including the potential relationship to a number of reproductive disorders. Governments and industry groups world-wide are funding wide-ranging research programmes to determine whether human reproductive problems are really on the increase, and if so, what the causes might be.

While there is no available scientific evidence to indicate that exposure to nonylphenol poses a risk to the human endocrine system, alkylphenol and derivative suppliers, both in the Europe and the U.S.A., appreciate the concern that this issue has raised, and continue supporting research to determine if such concern is justified.

The evidence to date

Nonylphenol and other alkylphenols have been used for more than 40 years without evidence of adverse human health effects. Nonylphenol is used almost exclusively to make other derivatives, of which the nonylphenol ethoxylates are the most commercially important because of their excellent surfactant properties. Commercial nonylphenol ethoxylates do not exhibit endocrine activity, Therefore their widespread use would not be expected to cause any harm to human health, nor is there any evidence for such effects.

Nonylphenol itself exhibits very weak hormone-like characteristics in laboratory experiments. As the draft EU risk assessment report states "nonylphenol has oestrogenic activity of a potency that is between 3 and 6 orders of magnitude less than that of oestradiol [the human female hormone]" (1). Naturally occurring phyto-oestrogens are even more potent than nonylphenol in laboratory tests. Significant quantities of such phyto-oestrogens contained in grains, fruits and vegetables are part of our daily diet.

For consumer health, the overall conclusion of the EU risk assessment report is that there is no concern. While observations of weak oestrogenic activity (at doses far above any possible human exposure) do "raise concern for reproductive toxicity", the report does not recommend to classify nonylphenol as a reproductive toxin (4).

Further, recent work shows that nonylphenol is rapidly metabolised and excreted in mammals (2). This is supported by studies on the closely related alkylphenol, octylphenol (3). Hence bio-accumulation in animals leading to bio-magnification and harmful exposure to humans is highly unlikely.

For the aquatic environment, the environmental section of the EU risk assessment report (5) indicates that because oestrogen-like effects only start to occur at around 10-20 microgrammes per litre "the calculated PNEC (predicted no-effect concentration) should be protective for oestrogenic effects in fish as well". Generally levels of nonylphenol in surface waters are less than 1 microgramme per litre. The only causal link between fish feminisation and oestrogens in the environment that has been demonstrated to date comes from research by the U.K. Environment Agency that concluded that the likely cause of such oestrogenic response in fish was the presence of human and contraceptive oestrogens in treated domestic sewage effluents, not residues of industrial chemicals or plant oestrogens (6).

Conclusions

It is clear from the evidence at hand that the very weak oestrogen-like properties that nonylphenol exhibits in laboratory experiments cannot be linked to any adverse effects in humans, or in wildlife at levels below thresholds for toxic effects. As a recent publication (7) by the German Ministry of Environment concludes: *"Current findings suggest the absence of human health risk from chemicals due to their inherent oestrogenic activity rather than the reverse.....this is because both the potency and the quantity of the substances encountered are lower than those of endogenous oestrogens by several orders of magnitude. However, under certain circumstances, e.g. very high local concentrations as a consequence of industrial accidents or discharges of chemicals into waters, these substances may of course have an impact on the environment."* This is a view we and the European chemical industry fully support.

References

1. Risk Assessment of 4-nonylphenol (branched) and nonylphenol, Human Health Effects, draft of August 1999, section 4.1.2.9.1
2. Fennel and Macneela, "Disposition and metabolism of p-nonylphenol in male and female rats", *Toxicologist*, **36**, 142, 1997; Knaak, Eldridge and Sullivan, "Excretion of certain polyethylene glycol ether adducts of nonylphenol by the rat", *Toxicol. Appl. Pharmacol.*, **9**, 331, 1966
3. Certa, Fedtke, Wiegand, Mueller, and Bolt, "Toxicokinetics of p-tert-octylphenol in male Wistar rats", *Arch. Toxicol.*, **71**, 112-122, 1998
4. Reference (1), sections 4.1.2.9.4 and 4.1.3.2.3
5. Risk Assessment of 4-nonylphenol (branched) and nonylphenol, Environmental Section, draft of September 1998, section 3.2.1.1.7
6. Desbrow, Routledge, Brighty, Sumpter and Waldock, "Identification of oestrogenic chemicals in STW effluent, 1. Chemical fractionation and in vitro biological screening", *Environ. Sci. Technol.*, **32**, 1549-1558, 1998; Routledge, Sheahan, Desbrow, Brighty, Waldock and Sumpter, "Identification of oestrogenic chemicals in STW effluent, 2. In-vivo responses in trout and roach", *ibid.*, **32**, 1559-1565, 1998
7. Basler and Lebsanft, *Environ. Sci. & Pollut. Res.*, **6**(1), 44-48, 1999