LUBE-TECH

No.47

HEALTH AND SAFETY IN THE WORKPLACE: RISK ASSESSMENT.

Background

EU Council Framework Directive **89/391/EEC** introduced measures to encourage improvements in the safety and health of workers at work. A number of linked Directives followed and each covered specific areas, such as, 89/654 (Workplaces), 89/655 (Work Equipment), 89/656 (Personal Protective Equipment), 90/269 (Manual Handling of Loads) and 90/270 (Display Screen Equipment).

Each Member State was subsequently required to implement changes to its national laws and practices to ensure compliance.

Framework Directive 89/391/EEC includes the following key provisions: -

Employers are obliged:

- *to ensure the safety and health of workers in every aspect related to the work, primarily on the basis of the specified general principles of prevention, without involving the workers in any financial cost;*
- *to evaluate the occupational risks, inter alia in the choice of work equipment and the fitting-out of workplaces, and to make provision for adequate protective and preventive services;*
- *to keep a list of, and draw up reports on, occupational accidents;*
- *to take the necessary measures for first aid, fire-fighting, evacuation of workers and action required in the event of serious and imminent danger;*
- *to inform and consult workers and allow them to take part in discussions on all questions relating to safety and health at work;*
- *to ensure that each worker receives adequate safety and health training throughout the period of employment.*

Workers are obliged:

- *to make correct use of machinery, other means of production, personal protective equipment and safety devices;*
- *to give warning of any work situation presenting a serious and immediate danger and of any shortcomings in the protection arrangements;*
- *to co-operate in fulfilling any requirements imposed for the protection of health and safety and in enabling the employer to ensure that the working environment and working conditions are safe and pose no risks.*

The health of workers is monitored through the application of measures introduced in accordance with national laws and practices.

Particularly sensitive risk groups must be protected against the dangers which specifically affect them.

Outside the EU in most industrialised countries workers are also protected by Duty of Care provisions. Duty of Care may be considered a formalisation of the implicit responsibilities held by an individual towards another individual within society. In most countries, it is not a requirement that a duty of care be defined by law, but it will often evolve through the jurisprudence of common law.

Risk Assessment

One well tried technique often used to help companies comply with the various national H&S requirements is a called Risk Assessment and it plays an essential role to help companies and their workforce stay safe. In the UK, it is a statuary requirement to assess the risks in your workplace and in many other counties. The following guidance has been written for use in the UK, but these guidance rules can be adapted for use in most other countries.

What is Risk Assessment?

A risk assessment is nothing more than a careful examination of what, in your work, could cause harm to people, so that you can weigh up whether you have taken enough precautions or should do more to prevent harm. The aim is to make sure that no one gets hurt or becomes ill. Accidents and ill health can ruin lives and affect your business too if output is lost, machinery is damaged, insurance costs increase, or you have to go to court.

The important things you need to decide are whether a HAZARD IS SIGNIFICANT and whether you have it covered by satisfactory precautions, so that the RISK IS SMALL. You need to check this when you assess the risks. For instance, electricity can kill, but the risk of it doing so in an office environment is remote, provided that 'live' components are insulated and metal casings properly earthed.

Hazard and Risk - don't let words put you off!

Hazard means anything that can cause harm (e.g. chemicals, electricity, working from ladders, etc)

Risk is the chance, high or low, that somebody will be harmed by the hazard.

There are Five Steps to RISK ASSESSMENT

How to assess the risks in your workplace

STEP 1: Look for the hazards
STEP 2: Decide who might be harmed and how
STEP 3: Evaluate the risks and decide whether the existing precautions are adequate or whether more should be done
STEP 4: Record your findings
STEP 5: Review your assessment and revise it if necessary

Don't be overcomplicated. In most firms in the commercial, service and light industrial sectors, the hazards are few and simple. Checking them is common sense, but necessary. You probably already know whether, for example, you have machinery that could cause harm, or if there is an awkward entrance or stair where someone could be hurt. If so, check that you have taken what reasonable precautions you can to avoid injury.

The following rules may be different in some counties; if you are a small firm and you are confident you understand what's involved, you can do the assessment yourself (you don't have to be a health and safety expert!). If you are a larger firm, you could ask a responsible employee, safety representative or safety officer to help you. If you are not confident, get help from a competent source. But remember - where the law requires it, you are responsible for seeing it is adequately done.

STEP 1: Look for the hazards

If you are doing the assessment yourself, walk around your workplace and look afresh at what could reasonably be expected to cause harm. Ignore the trivial and concentrate on significant hazards which could result in serious harm or affect several people.

Ask your employees or their representatives what they think. They may have noticed things which are not immediately obvious. Manufacturers' instructions or data sheets can also help you spot hazards and put risks in their true perspective and so can a company's accident and ill-health records.

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STEP 2: Decide who might be harmed, and how

Don't forget: -

- young workers, trainees, new and expectant mothers, etc who may be at particular risk
- cleaners, visitors, contractors,
- maintenance workers, etc who may not be in the workplace all the time
- members of the public, or people you share your workplace with, if there is a chance they could be hurt by your activities.

STEP 3: Evaluate the risks and decide whether existing precautions are adequate or more should be done

Consider how likely it is that each hazard could cause harm. This will determine whether or not you need to do more to reduce the risk. Even after all precautions have been taken, some risk usually remains. What you have to decide for each significant hazard is whether this remaining risk is high, medium or low.

First, ask yourself whether you have done all the things that the law says you have got to do. For example, there are legal requirements on prevention of access to dangerous parts of machinery. Then ask yourself whether generally accepted industry standards are in place. But don't stop there think for yourself, because the law also says that you must do what is reasonably practicable to keep your workplace safe. Your real aim is to make all risks small, by adding to your precautions as necessary.

If you find that something needs to be done, draw up an 'action list' and give priority to any remaining risks which are high and/or those which could affect most people. In taking action ask yourself: -

a) can I get rid of the hazard altogether?

b) if not, how can I control the risks so that harm is unlikely?

In controlling risks apply the principles below, if possible in the following order: -

- try a less risky option
- prevent access to the hazard e.g. by guarding machinery and plant
- organise work to reduce exposure
- to the hazard
- issue personal protective equipment
- provide welfare facilities e.g. washing facilities for removal of contamination and first aid

Improving health and safety need not cost a lot. For instance, placing a mirror on a dangerous blind corner to help prevent vehicle accidents, or putting some non-slip material on slippery steps, are inexpensive precautions considering the risks. And, failure to take simple precautions can cost you a lot more if an accident does happen.

But, what if the work you do tends to vary a lot or you or your employees move from one site to another? Identify the hazards you can reasonably expect and assess the risks from them. After that, if you spot any additional hazards when you get to a site, get information from others on site, and take what action seems necessary.

But what if you share a workplace? Tell the other employers and self-employed people there about any risks your work could cause them, and what precautions you are taking. Also, think about the risks to your own workforce from those who share your workplace.

STEP 4: Record your findings

In the UK, if you have fewer than five employees you are not required to write anything down, though it is useful to keep a written record of what you have done. But, if you employ five or more people you must record the significant findings of your assessment. This means writing down the significant hazards and conclusions. Examples might be 'Electrical installations: insulation and earthing checked and found sound' or 'Fume from welding: local exhaust ventilation provided and regularly checked'.

But, what if you have already assessed some of the risks?

If, for example, you use hazardous chemicals and you have already assessed the risks to health and the precautions you need to take in the UK, under the Control of Substances Hazardous to Health Regulations (COSHH), you can consider them 'checked' and move on. In other countries the rules may be different, find out how to comply.

You must also tell your employees about your findings.
Risk assessments must be suitable and sufficient, not necessarily 'Perfect'!

You need to be able to show that: -

- a proper check was made
- you asked who might be affected.
- you dealt with all the obvious significant hazards, taking into account the number of people who could be involved, the precautions are reasonable and the remaining risk is low.

Keep the written record for future reference or use; it can help you if an inspector asks what precautions you have taken, or if you become involved in any action for civil liability. It can also remind you to keep an eye on particular hazards and precautions. And it helps to show that you have done what the law requires.

To make things simpler, you can refer to other documents, such as manuals, the arrangements in your health and safety policy statement, company rules, manufacturers' instructions, your health and safety procedures and your arrangements for general fire safety. These may already list hazards and precautions. You don't need to repeat all that, and it is up to you whether you combine all the documents, or keep them separately.

STEP 5: Review your assessment and revise it if necessary

Sooner or later you will bring in new machines, substances and procedures which could lead to new hazards. If there is any significant change, add to the assessment to take account of the new hazard. Don't amend your assessment for every trivial change, or still more, for each new job, but if a new job introduces significant new hazards of its own, you will want to consider them in their own right and do whatever you need to keep the risks down. In any case, it is good practice to review your assessment from time to time to make sure that the precautions are still working effectively.

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Part one of a two-part series.

NONYLPHENOL ETHOXYLATES (NPEO)

ecological and toxicological properties and consequences of the eu risk reduction strategy for technical applications

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Nonylphenol ethoxylates (NPEO) are non-ionic surfactants that have a favourable cost/performance ratio. They are synthesised by reaction of nonylphenol (NP) with ethylenoxide (EO). Depending on the degree of ethoxylation NPEO with different properties are available which make them very versatile chemicals that could be used for a wide variety of applications, e.g. in metalworking fluids. Therefore, NPEO have been, and are still produced in high volumes. However, over the years it turned out that the use of NPEO especially in consumer products (e.g. household detergents) may have adverse environmental effects. As a consequence the EU detergent industry agreed not to use NPEO anymore in consumer products. The problematic environmental properties of NP/NPEO have recently been confirmed on a scientific basis by a risk assessment conducted by the EU Commission. To protect the environment the EU Commission has subsequently developed and implemented a risk reduction strategy. The EU risk reduction strategy is based on an immediate ban of all NPEO applications, which result in significant direct emissions to waste water. According to EU Directive 2003/53/EC it is not allowed to use NPEO with more than 0.1 % in products applications with high environmental relevance, including metalworking applications (see table 2). If these measures are not sufficient to reduce the environmental concentrations of NP/NPEO to a safe level, then additional (technical) uses of NP/NPEO will be banned. This article describes the ecological and toxicological properties of NPEO, and discusses the implications for technical uses of NPEO.

Ecological properties of nonylphenol ethoxylates

Ecotoxicity of NPEO

Studies with aquatic organisms have shown that nonylphenol ethoxylates have a toxicological potential comparable to other non-ionic surfactants. The acute effect concentrations (LC/EC_{50}-values) are in the range of 1-10 mg/L for NPEO $\leq$ 10 EG (=Ethylene glycol units), characterising them as toxic for aquatic organisms. NPEO with > 10 moles EG are less aquatoxic. From chronic studies No Observed Effect Concentrations (NOEC) in the range of 1 mg/L are established. As indicated above the aquatic toxicity of NPEO is dependent on the degree of ethoxylation. The lower the numbers of EO in the molecule, the higher is the aquatic toxicity observed. Similar effects have been reported for other non-ionic surfactants e.g. fatty alcohol ethoxylates. This structure/activity relationship is explained by the specific mode of action, which in case of surfactants is a general narcotic mode. Narcosis is linked to the hydrophobicity of the molecules. Shorter EG-chains, respectively longer alkyl (side)chains, increase the hydrophobicity of the molecules and therefore increase their aquatic toxicity.

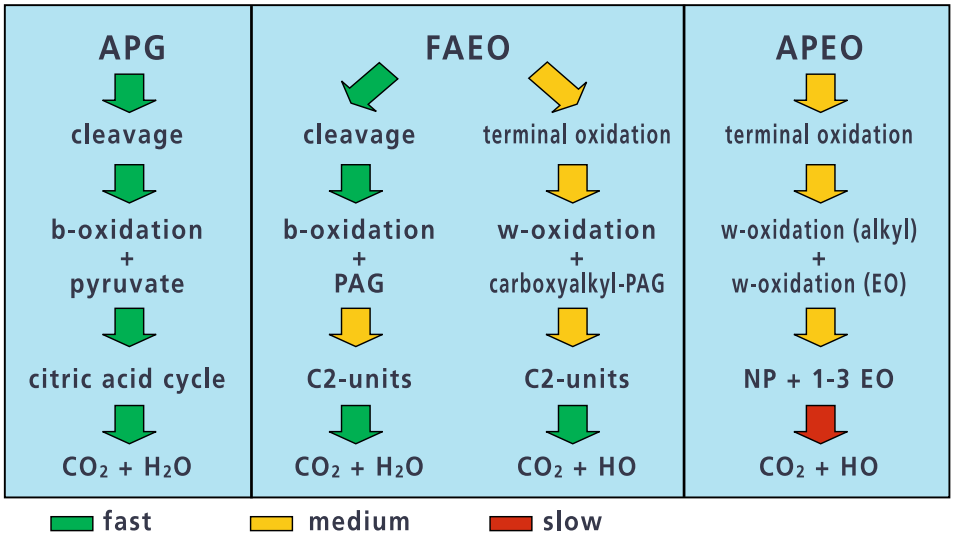
Biodegradability of NPEO

The biodegradability of nonylphenol ethoxylates has been studied comprehensively. However, it is not easy to assess these data, as the results vary over a very broad range. For example, data contained in the IUCLID file (the EU database format for Existing Substances) range from 0% primary degradation in the OECD Screening test to 99% primary degradation in the OECD Confirmatory test, and from 0% ultimate degradation in the Closed Bottle test (OECD 301 D) up to 90% ultimate degradation in the Coupled Units test (OECD 303 A). Biodegradability seems to have improved over the years probably because the waste water treatment plant (WWTP) micro organisms have become increasingly adapted to this type of chemistry (the standard laboratory tests use WWTP effluent as inoculum). Similar observations have been described for fatty alcohol alkoxylates.

As conclusion it can be stated that NPEO are biodegradable. Further, it is not expected that biodegradation leads to the formation of stable metabolites. However, almost all degradation studies indicate that the overall degradation kinetic of NPEO is slower than that of comparable surfactants with aliphatic structures (APG = Alkylpolygucosides, FAEO = linear fatty alcohol ethoxylates). **This is shown in figure 1 below.**

This is reflected in the environmental classification recommendation issued recently by the European Surfactant Producers Association (CESIO) as (not readily biodegradable), whereas most other commonly used detergent surfactants (e. g. FAEO, fatty alcohol sulfates (= FAS)) are classified as (readily biodegradable). The slower degradation kinetic is most likely related to an adverse steric effect of the aromatic ring, making it increasingly more difficult for the degradation enzymes to attain a proper reaction position. This has the consequence that the closer the cleavage site gets to the aromatic ring, the slower the degradation kinetic

Figure 1. Degradation pathways and kinetic of degradation steps for different surfactants



becomes. Therefore, the lower ethoxylated degradation intermediates are slower (more difficult) degradable than the parent compounds, which could – depending on the actual exposure situation – result in an increased environmental concentration. Studies in the so-called "Henkel Metabolite test" (a modified Coupled Units test) indicate that the degradation kinetic of NPEO (tested was NP 10 EG) is indeed significantly lower than of other commonly used detergent surfactants (e.g. FAEO, FAS). Whereas the oleochemical based surfactants (FAEO, FAS) are completely mineralised under these experimental conditions, biodegradation of petrochemical based NP 10 EG leads to recalcitrant metabolites which enrich over time in the test system. Similar results have been published for petrochemical based linear alkyl benzene sulfonate (LAS), another technical surfactant containing an aromatic ring system [1]. Furthermore, a recent publication indicates that recalcitrant metabolites from technical surfactants are not artefacts observed only under special experimental conditions, but may indeed be of environmental relevance, e.g. the cause for the declining fish population in Swiss rivers [2].

Environmental Risk Assessment for NPEO

In 1993 the EU Commission issued Council Regulation 793/93/EEC on the evaluation and control of the risks of existing chemicals, requiring that the chemical industry has to provide all available information on the physicochemical, toxicological and ecological properties of HPV-substances that have been on the EU market before September 1982. Based on the high production volume and the ecological and toxicological profile nonylphenol (NP, CAS-No. 25154-52-3) has been classified as a priority substance with the consequence that the corresponding IUCLID dataset had to be submitted to the authorities by June 1994. Based on these data the authorities established priority lists for substances for which in-depth risk assessments should be conducted. NP (nonylphenol and phenol, 4-nonyl-, branched) is on the second priority list (Commission Regulation No. 2268/95). Subsequently, an environmental risk assessment according to the EU Technical Guidance Document has been conducted. As NPEO are a major source of environmental NP (NP is formed as a brake-down product during biodegradation) NPEO have been included in the official EU risk assessment on NP.

The basic principle of the environmental risk assessment comes down to the derivation and comparison of two concentrations: the Predicted Environmental Concentration (PEC) and the Predicted No Effect Concentration (PNEC) for a given environmental compartment (water, soil, sewer sludge) **(see table 1)**. If the PEC is below the PNEC, then the substance is of no concern. If, however, PEC > PNEC it can not be excluded that the organisms in the environment are adversely affected by the chemical. In this case the authorities shall define appropriate risk reduction measures.

The PEC is generally derived from the production volume, the environmental release factor, the biodegradability and the waste water treatment situation. Based on the environmental exposure situation, taking into account all applications (also of derivatives like NPEO) an EU-wide regional environmental concentration of 0.8 µg/L is predicted for NP ($PEC_{regional}$ = 0.8 µg/L). The PNEC is derived from data on the aquatic toxicity of the substance applying appropriate safety factors to extrapolate to the situation of real environment. Based on the long-term toxicity studies a No Observed Effect Concentration of 0.33 µg/L is predicted for NP (PNEC = 0.33 µg/L). Based on these figures the EU risk assessment for NP (including NPEO) comes to the conclusion that there is concern for the aquatic environment (PEC/PNEC >1).

Risk reduction strategy

To reduce the environmental risk to an acceptable level the EU authorities have recommended a risk reduction strategy (2001/838/EEC). This strategy is based on a stepwise approach. In the first step marketing and use restrictions for applications that result in direct emissions of NPEO into waste water (detergents and cleaning products, cosmetics, textile and leather processing products, paper and pulp production, etc.) are established (see table 2 in part 2). In addition to the above, and recognising development of new Community procedures, additional pollution control measures for NP and NPEO should be considered for the following sectors:

- production of NP and NPEO
- use of NPEO in the synthesis of other chemicals (e.g. NPEO phosphates)
- use of NPEO in emulsion polymerisation in particular use in acrylic esters for specialist coatings, adhesives and fibre bonding
- production of phenol/formaldehyde resins using NP
- production of plastic stabilisers using NP

The results achieved through marketing and use restrictions and pollution control measures should be monitored and if necessary additional measures should be considered. If the above measures should turn out to be not sufficient to reduce the environmental risk to an acceptable level, in a second step marketing and use restrictions for additional applications will be considered, e.g. for use of NPEO in emulsion. To safeguard the sustainable development of the European surfactant industry including downstream industries and to assist customers, that want to substitute NPEO with safer alternatives, some surfactant manufactures have developed NPEO substitutes for specific applications, e.g. for emulsion polymerization [3].

	Concentration in the environment	**Toxicity for wild life organisms**
I. Substance-inherent properties **(Hazard assessment)**	Evaluation of biodegradability λ e.g. OECD 301 A-F	Evaluation of ecotoxicity under standardized laboratory conditions λ e. g. OECD 201-203
II. Environmental frame conditions **(Exposure assessment)**	Evaluation of exposure λ Production volumes λ Use pattern λ Waste water treatment	Extrapolation of the laboratory data to wild life organisms λ Safety factors
III. Risk assessment **(Risk assessment)**	Exposure analysis λ Predicted environmental concentration (PEC)	Ecotoxicity analysis λ Predicted No Effect Concentration (PNEC)
	Comparison PEC vs. PNEC **Environmental compatible if PEC < PNEC**	

Table 1: Environmental risk assessment on the basis of environmental concentration and toxicity for wildlife organisms.

Continued in LUBE 75.