Developing a Generic Scheme to Help Small and Medium Sized Firms Control Chemicals in the Workplace - The UK Experience

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Summary

The UK has developed a novel scheme to help small and medium sized firms control occupational exposure to supplied chemicals in the workplace. The scheme uses a set of generic risk assessments to identify an appropriate control approach and supports this with control guidance sheets which show how each control approach can be applied to a range of common industrial tasks. Since its inception, the scheme has undergone extensive peer review, market testing and piloting. This paper, which was first presented at the 8th NVvA symposium in Rotterdam in 1999, describes how this validation has been undertaken and identifies areas where the scheme has been revised and improved prior to its publication in the UK in May 1999 as Health and Safety Executive (HSE) guidance note HSG193 'COSHH Essentials: easy steps to control chemicals [HSE 1999a].

Introduction

The main legislation for the control of health risks from chemicals in the UK is 'The Control of Substances Hazardous to Health Regulations (COSHH), [HSE 1999b].' This legislation is goal setting. It requires the employer in a company using a hazardous substance to undertake a risk assessment and implement any necessary control measures to ensure that employees do not suffer ill health as a consequence of workplace exposure to that hazardous substance. Occupational exposure limits are an integral part of this legislation and compliance with these limits is an important way of demonstrating adequate control. Whilst the system works well for large companies and those companies able to employ the services of occupational hygienists, the paper by Topping et al. [1998] shows that the UK legislative framework and occupational exposure limit system does not work as well for the growing number of small and medium sized companies (SMEs). These companies prefer to be told what to do.

Through the UK Health and Safety Commission's Advisory Committee on Toxic Substances, the Health and Safety Executive (HSE) initiated a project to develop simple practical guidance that would enable these firms to understand better what the COSHH regulations require and help them to comply. The project was constrained in that it had to work within current UK and European chemicals regulations and it had to make use of readily available information.

Samenvatting

Het Verenigd Koninkrijk heeft een nieuw schema ontwikkeld om het midden- en kleinbedrijf te helpen beroepsmatige blootstelling aan industriële chemicaliën op de werkplek te beheersen. Het schema maakt gebruik van een aantal generieke risicoschattingen om een juiste benadering voor beheersmaatregelen vast te stellen en ondersteunt deze met voorlichtingsbladen die laten zien hoe iedere benadering van beheersmaatregelen kan worden toegepast op een serie veel voorkomende industriële werkzaamheden. Sinds de opzet is het schema uitgebreid becommentarieerd, in de markt getest en beproefd. Dit artikel, dat eerder gepresenteerd is tijdens het achtste NVvA-symposium in Rotterdam in 1999, beschrijft hoe de validatie is uitgevoerd en geeft gebieden aan waar het schema is herzien en verbeterd alvorens te worden gepubliceerd in het VK in mei 1999 als HSE guidance note HSG193 'COSHH Essentials: easy steps to control chemicals' [HSE 199a].

The solution was developed by simplifying the basic risk assessment process. (Fig. 1). Firstly, the key factors which can

Fig 1 COSHH Essentials generic risk assessment

be used to identify the health hazard of the chemical and its exposure potential were defined. Hazard is defined by the R-phrases assigned to the substance by suppliers under the EU classification system; the classification criteria are set out in Annex VI to the Dangerous Substances Directive (67/548/EEC). The approach allocates R-phrases into groups such that the substances defined by the R-phrases within each individual group present a roughly equivalent level of hazard and require control to within a narrow occupational exposure range. Exposure potential considers the ability of the substance to become airborne and is represented by the physical properties of the substance (dustiness for solids, volatility for liquids) and the amount used in an operation or batch process.

Secondly, a set of generic risk assessments was developed and defined in a series of control approach selection tables (Fig. 2). By using the tables, the non-expert user is able to identify

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Amount used	Low dustiness or volatility	Medium volatility	Medium dustiness	High dustiness or volatility
Hazard Group A				
Small	1	1	1	1
Medium	1	1	1	2
Large	1	1	2	2
Hazard Group B				
Small	1	1	1	1
Medium	1	2	2	2
Large	1	2	3	3
Hazard Group C				
Small	1	2	1	2
Medium	2	3	3	3
Large	2	4	4	4
Hazard Group D				
Small	2	3	2	3
Medium	3	4	4	4
Large	3	4	4	4
Hazard Group E				
For all Hazard Group E substances, choose Control Approach 4				

Fig 2. Control Approach Selection Tables as Published in COSHH Essentials: easy steps to control chemicals (HSE, 1999)

which of four control approaches is appropriate for the task. Three of these approaches are based around engineering levels of control (Control Approach 1 - general ventilation, Control Approach 2 - local exhaust ventilation and Control Approach 3 - industrial containment). The fourth, Control Approach 4, identifies those high-risk activities where a more detailed site specific risk assessment is required.

General information on how to apply each control approach is contained in a series of control guidance sheets. These are complemented by task-specific control guidance sheets that give details of how to apply the control approach to specific common industrial tasks.

This work was first reported to the scientific community at the British Occupational Hygiene Society Conference in April 1998 and subsequently published in a series of papers by Russell et al. [1998], Brooke [1998] and Maidment [1998].

Consultation

Following the publication of the scientific basis in 1998, the scheme underwent a substantial period of consultation and evaluation to address three main areas: its ease of use to the target audience, its technical credibility amongst the scientific community and its ability to deliver practical, cost effective solutions in real situations. A range of activities has been undertaken to ensure these objectives were achieved. The results of these activities were incorporated in to the scheme before publication in May 1999.

Usability

An independent firm of market researchers was commissioned to randomly select small chemical-using companies from identified industry sectors. The market researchers provided the companies with draft copies of the guidance, then interviewed them. These companies were asked if the guidance was user friendly, easy to understand and provided the type of information they required. Comments on presentation and clarity were taken into account as subsequent drafts of the guidance were developed.

Technical credibility

The British Institute of Occupational Hygienists (BIOH) held a two-day Autumn Conference in November 1998 to review the scheme within the UK occupational hygiene community. The conclusions from that conference were that the scheme was an important new tool for the occupational hygiene community. Whilst generally technically sound it had limitations, for example it did not address process generated hazards and the link to dermal risk and control was poorly addressed. There was a need for the scheme to offer a limited degree of scope for interpretation by the more expert user.

Since the conference, the dermal aspects of the scheme have been strengthened. There is now a clear link between R-phrases defining a skin hazard group and new control guidance sheets giving advice on preventing or controlling dermal exposure and selection of personal protective equipment. The flexibility needed by the more expert user has been addressed by supporting the main guidance by a technical basis publication [HSE 1999c].

User pilot - effective solutions

A pilot study was undertaken to determine whether SMEs found the guidance easy to apply to their own processes and whether it led them to suitable controls. A market research company randomly selected small to medium sized firms from industries likely to have a significant use of supplied chemicals. The person in each firm responsible for health and safety was sent a copy of the guidance and control guidance sheets and asked to try it out on one or more of their activities and an arrangement made for a follow up meeting with a consultant occupational hygienist. An independent occupational hygienist was commissioned to visit each of these firms to assess how the firms coped with the guidance and to evaluate the suitability of the controls the guidance recommended.

31 firms in the north west of England took part in the study. Their size ranged from 5 to 160 employees with a median size of 38 employees. All were significant users of supplied chemicals generally handling between 0.5 and 10 tonnes of 'total chemicals' in batch operations. Most work activities involved the addition of more than one substance to the process, with major ingredients being present in tonnes and minor components present in only kilogram quantities. The mixing of solids and liquids was commonplace.

These firms were engaged in a wide range of chemical using activities. Approximately half were blenders, formulators or repackers (17 of 31). Materials produced or handled included inks, hydraulic fluids, adhesives, sealants, speciality oils and greases, polymers, fire extinguishants, bleach, pharmaceuticals, pesticides, textile treatments and dairy health products. The balance of the survey sample was made up of metal platers,

plastic coating companies, chemical manufacturers and distillers.

Most of the firms found the scheme simple and straightforward to follow. Four fifths of them managed to successfully select the correct control approach. Where a control guidance sheet was available, about two thirds of them managed to select the correct control guidance sheets. Of the remaining fifth, most had not had time to attempt to use the guidance prior to the consultant's follow up visit. The consultant estimated that most of these would have been able to use the guidance unassisted had they tried. Only one site was identified where the occupier would have struggled to use the guidance. On average it took about one hour for a user to become familiar with the guidance, but once familiar, subsequent substance-task assessments took between five and ten minutes each.

The guidance was applied to 48 substance-task combinations encompassing a very wide range of substances, with only sodium hydroxide, hydrochloric acid and methyl ethyl ketone appearing more than once. Twelve of these tasks were found to require a Control Approach 1 solution, nine a Control Approach 2 solution, thirteen a Control Approach 3 solution and fourteen a Control Approach 4 solution.

The control solutions recommended by the scheme were assessed for practicability by the company and for technical correctness by the consultant occupational hygienist. Over 70% of the companies thought the solutions to be reasonable.

The occupational hygienist used his expert judgement to assess the technical correctness of the solutions to provide adequate control. His view was that 33 (69%) of the 48 substance-task examples solutions provided the same or an equivalent degree of control to the advice he would have given. He judged the scheme to overprotect for 12 (25%) of the examples and to underprotect for three (6%) of the examples. No exposure measurements were taken to confirm these judgements. The scheme was found to be difficult to apply to aqueous solutions.

Discussion

Circumstances where scheme underprotects

The three examples where the scheme underprotected were studied in more detail to see if the scheme could be improved. Two of these examples were for medium scale use of high dustiness / volatility hazard group A substances. In both examples, the consultant hygienist would have expected to see Control Approach 2 used, whereas the scheme led to Control Approach 1.

In response to this finding, the generic risk assessments and control approach selection tables were re-examined and a more stringent control approach (level 2) allocated to this scenario. The third example where the scheme was found to under protect was a process where a volatile solid was used. Subsequent evaluation suggests that volatile solids are more appropriately addressed if they are treated as a liquid and their vapour pressure used to identify a volatility band. The technical basis guidance [HSE 1999c] relates vapour pressure for solids to volatility bands to allow this.

Circumstances where scheme overprotects

Areas where the scheme overprotected were also examined. Three key areas were identified:- short duration charging operations, water based solutions and tasks involving methyl ethyl ketone (MEK).

Short duration tasks

For short duration operations, the scheme overprotects because time weighting has not been addressed in the risk assessment. For the non-expert user the solution has been achieved by the addition of an extra control guidance sheet that deals specifically with single short-term additions.

For the expert user, the ability to undertake limited time weighting is recognised as improving the performance of the scheme. Maidment [1998] suggests a ten-fold change in exposure between control approaches. Thus if the exposure to a hazardous substance lasts for less than one tenth of a shift, time weighting will allow a reduction of the control approach by one control band. The technical basis publication allows this reduction in control band if exposure is less than a thirty minutes in any one day. Thirty minutes was chosen, as it is the major fraction of an hour that is closest to, but less than one tenth of a typical working day.

Solids in solution

When solids are converted to solutions the scheme overprotects because the physical properties of the material which lead it to become airborne are changed. For example, when a dusty solid is dissolved in water it is no longer dusty or a solid. A series of rules has been developed to cope with this situation:

(a) solids dissolved in water may be treated as low-volatility liquids;
(b) solids dissolved in a non-aqueous solvent may be treated as low-volatility liquids, but the control approach required for the solvent will also need to be considered.
(c) if a material in solution is allocated to hazard group S (hazardous by skin and/or eye contact) the hazard group S allocation should be retained and appropriate controls applied.

Ketones.

Where methyl ethyl ketone (MEK) was used the cause of overprotection can be traced back to the hazard classification system. (MEK is classified as R36/37, Irritating to eyes and respiratory system and the scheme allocates MEK to hazard group C, with a target exposure range of 0.5 - 5ppm, whereas its UK occupational exposure standard is 200ppm.)

The reason for this is that whilst R-phrases and the classification system are of use to the occupational hygienist, their application in this area has limitations as some classification criteria do not involve potency considerations. For example,

the criteria for classification for respiratory tract irritation (R37) and respiratory sensitisation (R42) are based on a simple "is it" or "isn't it" decision. These R-phrases can be applied to substances with occupational exposure limits spanning four orders of magnitude.

In order to adequately control the more toxicologically potent materials in these hazard groups, a precautionary approach has been adopted. This leads to a degree of overprotection for less potent substances within the same hazard group. This approach was preferred to one that did not adequately protect for some substances. The validation work by Brooke [1998] has attempted to minimise the extent of over protection.

For certain R-phrases where potency considerations are not included in the classification criteria, then some flexibility is allowed in the allocation of the hazard band. To do this user of the scheme has to have access to toxicological information on the dose-response relationship for the effect of the substance which shows that allocation to an alternative hazard group is more appropriate. More information on how this flexibility can be applied is given in the technical basis publication.

The revisions and refinements discussed above, are described in the Technical Basis publication [HSE 1999c]. When they are applied to the 48 examples in the pilot study, the technical performance of the scheme improves significantly. 42 of the solutions now provide the correct degree of control and only six solutions overprotect. No solutions underprotect.

Conclusions

The Health and Safety Executive has developed structured guidance to help SMEs undertake workplace chemical risk assessments and select solutions that are expected to provide adequate control for the large majority of supplied substances. At present the scheme has been developed for supplied chemicals and does not apply to process generated dusts, fumes or aerosols. This guidance has undergone extensive peer review, market testing and piloting to demonstrate that the system is easy to use and provides the type of practical advice on control of chemicals that the small and medium sized employer requires. Limitations identified in the initial publications have been addressed by means of revisions to the main guidance and the provision of additional information in a technical basis publication. (For example, the basic version of the scheme may not provide adequate protection for a small number of volatile solids such as iodine.)

The technical basis publication provides detailed information on the operation of the scheme for the expert user and gives advice on how the basic scheme can be refined.

It is believed that by using the basic version of the guidance the user will be able to identify a control approach that will provide adequate control in most applications involving supplied chemicals, but in some circumstances it will provide varying degrees of overprotection. An expert user, following the additional advice in the technical annex will be able to improve on this performance.

As the scheme is based on readily available information and uses R-phrases as defined by the EU classification system, we believe that the scheme may be of use to other member states within the EU and will require only minor fine-tuning to be applicable worldwide.

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Comments on article "Developing a Generic Scheme to Help Small and Medium Sized Firms Control Chemicals in the Workplace – The UK Experience" by Steve Maidment

In the article the authors describe the validation of the "COSHH Essentials." The authors refer to three earlier publications (reference number 4-6) where the method is explained. In the validation study by Brooke (ref. 5) toxicological considerations were taken into account. More than 100 substances were assigned to hazard bands and corresponding target airborne exposure ranges. For 98% of all substances evaluated it was shown that the scheme recommended a control strategy equivalent to or better than that required by the OEL. A major advantage of the hazard banding based on R-phrases is its simplicity: just by reading an MSDS employers can allocate a compound to a hazard band. Expert judgement is needed to account for differences in potency between compounds with the same R-phrase (for further reading see reference 7). Of course, the system heavily relies on the quality of the MSDS,

but this aspect is not further discussed here.
In contrast to the well defined validation of the hazard banding system is the much weaker validation of the exposure rating system. Due to lack of large amounts of exposure data the validation heavily relied on expert judgement and peer review within the UK Hygienist Community (reference 6). In the present article a user pilot is described: an occupational hygienist used his expert judgement to assess if adequate control was advised by the model; no exposure measurements were taken. In my opinion this means that validation is well described and performed in building the model (keeping in mind that the validation is still much weaker than the validation of the hazard banding system), but until now not in using the model. Therefore the conclusion of the authors "that by using the basic version of the guidance the user will be able to identify a control approach that will provide adequate control..", is premature. A crucial validation step still has to be done. Only if a complete validation study has been undertaken, i.e. using the model in daily practice combined with exposure measurements, this conclusion can be drawn. This means that for the time being users of the method have to check by exposure measurements if the proposed control measures are adequate.

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Author's reply

COSHH Essentials is a different philosophical approach to control to the traditional exposure limit / measurement approach used in large well regulated companies. The reality of modern workplace in the UK and much of the world is that these workplaces are comprised of small firms and these small firms do not use or understand exposure limits. What COSHH Essentials does is to transfer the control solutions used in these large firms to the small firms that need help.

There is a second important difference between COSHH Essentials and the traditional method of using exposure limits and that is that COSHH Essentials is a 'Task based' tool where as exposure limits are used to assess individual exposure and it is here that the validation misunderstandings arise.

The large companies with access to occupational hygiene experts have taken hundreds of thousands of measurements of personal 8 hour time weighted average (TWA) exposures of their workers. For most of these measurements, workers have undertaken a range of tasks during that 8 hour period. When compliance with the exposure limit has not been achieved these occupational hygienists have used their experience, observation and judgement to identify where control improvements need to be made, implemented those changes and then reassessed the 8 hour TWA. Seldom have they assessed the individual task based exposures within that 8 hour period.

In assessing compliance with an 8 hour TWA limit, most experienced occupational hygienists do not see the limit as a clear de-marcation between 'safe' and 'unsafe'. Thus in assessing compliance they would normally select control solutions that would enable the measured exposures to be well below the limit (typically by a factor of 3 or more). This is to allow for variations over time and between individuals doing the same or similar jobs.

Therefore when COSHH Essentials was developed, the specific task based exposure data needed for validation was missing, but there was an enormous pool of 8 hour TWA exposure data that had been accumulated by occupational hygienists. Underlying that data was the occupational hygienists knowledge of the task based control solutions that enabled the 8 hour TWAs to be complied with. In developing and validating COSHH Essentials we tapped into that vast pool of knowledge (supported by the 8 TWA measurements taken) and chose those task based solutions that were commonly applied and when combined with the other task based solutions, enabled exposure limits to be complied with. Thus I believe that properly applied COSHH Essentials solutions do provide adequate control and that the peer review validation used is a sound approach.

Steve Maidment