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EFFECTIVE MANAGEMENT OF SAFETY AND HYGIENE INFORMATION TO PROMOTE SAFE HANDLING OF CHEMICALS

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Summary

The legal obligations for providing safety and hygiene data are discussed Aspects affecting the usefulness of material safety and hygiene data in reducing risk are highlighted, including the quality of information provided, a consideration of all factors which influence the precautions for handling the substance, and the effectiveness of the communication of the data Strategies for managing data in different organisation structures are outlined with reference to modern computer techniques Future trends in communication of the information are mentioned

1. Introduction

Risk is associated with all activities in life, including the exposure of persons to conditions of work, and the philosophy debated seriously nowadays is not whether this should be so, but rather the level of risk which is acceptable and the mechanisms for arriving at such values [1—5] Potential sources of industrial hazards are mechanical, radiating energy, biological, ergonomical and psychological In addition, and of particular relevance to the Chemical and Process Industries, is the potential danger from chemicals stemming from their flammability, explosivity, corrosivity, radio-activity, toxicity, carcinogenicity, etc

In arriving at "acceptable levels of risk" it is essential first to assess, then to communicate to all persons involved, the nature and magnitude of the risk Indeed, there are many statutory requirements to fulfil [6] Exactly how these are satisfied varies from company to company, depending upon such criterian as company size, organisation structure, the complexity of the work situation, the nature of the products etc This paper concentrates on the legal duties and the problems relating to the provision of information such as data sheets by suppliers to their customers and by employers to their employees

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2. Legal obligations

Besides moral desires to reduce risk, there are legal obligations such as those defined by the Health and Safety at Work etc Act of 1974 (hereafter referred to as The Act) and the Safety Representatives and Safety Committees Regulations of 1977 Thus, The Act identifies duties of employers to different fractions of the community such as to its employees (Section 2), to visitors, contractors etc , (Sections 3 and 4), the neighbouring populace (Section 5) and to customers (Section 6)

Clearly, wherever chemicals are involved, a knowledge of the properties of the substances is essential in the discharging of the above duties and the importance of the provision of safety and hygiene data in this respect is acknowledged in several sections of The Act, aimed primarily at protecting employees and customers Thus, Section 2 of The Act states that every employer has a duty to provide information as is necessary to ensure so far as is reasonably practicable, the health and safety at work of his employees

Sections 6(4)a and b highlight the responsibility of suppliers to carry out tests or arrange for testing of chemicals to ensure they can be used safely These data together with information about any conditions necessary to ensure that it will be safe and without risk to health when properly used must be made available to the customer as emphasised in Section 6(4)c

In turn the customer has responsibility to make available such information to Safety Representatives as described in Section 7 of the Regulations and in the related Code of Practice [7]

General information is normally given on container labels and more detailed advice provided on Data Sheets

Occasionally suppliers request recipients of Data Sheets to sign and return a covering letter "thereby signifying that the information provided has been received and understood within the organisation" In some cases this can be interpreted as an attempt to shift to the customer responsibility regarding the adequacy of the information so provided However, the only way a supplier can be relieved of his liability is explained in Section 6(8) of the Act which stipulates that

"Where a person designs, manufactures, imports or supplies an article for or to another on the basis of a written undertaking by that other to take specified steps sufficient to ensure, so far as is reasonably practicable, that the article will be safe and without risk to health when properly used, the undertaking shall have the effect of relieving the first mentioned person from the duty imposed by subsection 1(a) to such an extent as is reasonably having regard to the terms of the undertaking"

Nevertheless, even here this provision relates only to *articles* as opposed to *substances* and these are defined in Section 53 of The Act, thus

"*substance* means any natural or artificial substance whether in solid or liquid form or in the form of a gas or vapour "
"*article* for use at work means —

a) any plant designed for use or operation
(whether exclusively or not) by persons at work, and
b) any article designed for use as a component in any such plant "

Since the present reference to Safety Data Sheets relates to substances and not articles, the Act contains no provision for the supplier to be relieved of his duty in criminal law even by signed receipts or agreements It is possible, however, that signing such a document could have implications for the signatory in common law

Other attempts to escape responsibility by small-print disclosures at the bottom of Data Sheets such as

"The information provided is to the best of our knowledge true and accurate, but all instruction, recommendations and suggestions are made without guarantee Since the conditions of use are beyond our control we disclaim any liability for loss or damage suffered from use of this information"

have no legal standing since Section 2 of the Unfair Contract Terms Act (1977) states

2(1) "A person cannot by reference to any contract term or to a notice given to persons generally or to particular persons exclude or restrict his liability for death or personal injury resulting from negligence"
2(3) "Where a contract term or notice purports to exclude or restrict liability for negligence a person's agreement to or awareness of it is not of itself to be taken as indicating his voluntary acceptance of any risk"

3. The effectiveness of the data in reducing risk

Though the provision of information is clearly important in complying with The Act, its usefulness in reducing risk when handling materials will be determined by

- the status of the data
- the effectiveness of its communication

3 1 The status of the data

The amount of general information on the hazardous properties of chemicals is vast and useful sources of such data have been reviewed [8], including conventional textbooks and on-line computerised data banks For commercially available materials the onus is on the supplier, manufacturer or importer to provide safety and hygiene literature with their products, as stated in the previous Section Usually, this is most conveniently presented in the form of a Safety (or Hazard) Data Sheet Standard sheets are also available from various Associations such as The Fire Protection Association and the Manufacturing Chemists' Association, whilst other bodies such as The Chemical Industries Association provide detailed advice on storage, handling and disposal of a range of specific chemicals

Theoretically, suppliers' Data Sheets can be the most valuable source of information for new substances or formulated mixtures and, indeed, for

small companies, may represent the only readily available source However, the standard of data sheets varies enormously between suppliers, frequently with little regard for quality and accuracy of information [9] Deere [10] recently highlighted the lack of guidance on this subject in the literature for practicing hygienists

Material Safety and Hygiene Data can be divided conveniently into two categories which we term *primary data* (raw data, e g , physical properties, toxicological information) and *secondary data* (applied data, e g , advice on storage, handling, disposal, first-aid) It is crucial to differentiate between these two types of information since there are separate implications for the strategies of management Also the factors influencing the status of the two types of data differ and affect the supplier and user to varying extents

3 1 1 Primary data

In some cases a lot of information can exist but reports may conflict and expert assessment is essential In other instances, because the generation of reliable primary data, especially toxicology data, is time-consuming and expensive, there is a dearth of information in certain areas, particularly with regard to the chronic toxic effects of chemicals and a "None Known" entry frequently appears for this section of the Data Sheet It is important to emphasise that making such a statement, no matter how true, in no way absolves manufacturers/suppliers from further endeavours to establish these facts, as indicated by Section 6(4) of The Act (See earlier)

Thus it may be necessary for manufacturers to initiate practical research either with their own resources or those of contract houses or universities

Attention must also be directed to the quality of raw data With this in mind Good Laboratory Practice Regulations [11—14] have been drafted with wide implications for product safety testing

3 1 2 Secondary data

Whilst primary data identify the hazardous properties of the substance, secondary data describe how to minimise risk A popular misconception is that the latter are determined solely by a consideration of the inherent properties of the material, whereas in reality they are governed by many other factors To illustrate, handling procedures for a specific material will be determined by the following

(a) *Its inherent properties* e g , physico-chemical characteristics (such as boiling point, vapour pressure, density, particle size, flammability limits) and toxicology (irritancy to eye, skin, or respiratory system, sensitising potential, carcinogenicity)

(b) *The scale of the operation* e g , very different handling/storage conditions would be required for gallon volumes of concentrated aqueous ammonia on the plant compared with millilitre quantities in the laboratory Gen-

erally, it is the scale intermediate between laboratory and full-scale production which creates the greatest problem For example pilot-plant operations are required frequently for new materials and the pressure is always there to handle these substances in large quantities before all data, particularly toxicity data, are available Also, the scale of operation often necessitates the manhandling of drums, kegs, sacks, etc , whereas in full-scale production mechanical handling of tanker quantities is more often encountered

(c) *the nature of the process.* e g , handling procedures for chemicals in open vessels at ambient pressures would differ from those involving the same material used in high-pressure processes Table 1 illustrates the effect of the nature of the process on the specification required for extract ventilation systems [15]

TABLE 1

Range of exhaust ventilation capture velocities for various types of processes

Condition of dispersion of contaminant	Examples	Capture velocities (ft/min)
Released with practically no velocity into quiet air	Evaporation from tanks, degreasing, etc	50—100
Released at low velocities into moderately still air	Spray booths, intermittent container filling, low speed conveyor transfers, welding, plating, pickling	100—200
Active generation into zone of rapid air motion	Spray painting in shallow booths, barrel filling, conveyor loading, crushers	200—500
Released at high initial velocity into zone of very rapid air motion	Grinding, abrasive blasting, tumbling	500—2000

(d) *the presence of co-reagents* e g , a safe procedure for operations involving a mixture of formaldehyde and hydrochloric acid would not be arrived at by simply "adding" the instructions for handling the individual chemicals because of the possible interaction to form bis(chloromethyl) ether, a potent carcinogen Clearly not every hazardous interaction can be foreseen and indeed few could be accommodated on material safety data sheets To put this in context the hazardous interactions of nitric acid occupy 22 pages in one text [16]

(e) *The level and duration of exposure* e g , use of personal protection may be acceptable for short exposure to chemicals during maintenance or in emergencies but unacceptable to protect against exposures to the same substance continuously throughout the work-day

(f) *The presence of indirect hazards* e g., the nearby existence of unrelated hazards such as noise may demand the use of personal protection not identifiable by consideration of any of the foregoing factors

Hence, while suppliers cannot be relieved of their responsibilities to provide information on their products as mentioned earlier, clearly some elements of the applied data can only be provided by the user

3 2 The effectiveness of the communication

Although the provision of information is crucial in complying with The Act, in order to achieve its objective of reducing risk the data must be communicated effectively

Interestingly, the Robens' Report [17] observed that

"It is apparent that a great deal of research and advisory literature is provided What is lacking is an effective means of ensuring that the information is always available to those who need to know"

One study [18] concluded that communication failure in one form or another is responsible for the majority of accidents Communication can be considered as a chain of events as summarised in the simple model in Fig 1 It follows that to ensure a communication brings about the desired actions, all aspects of the communication process need to be considered, with the provision of feedback mechanisms at each stage to monitor its effectiveness

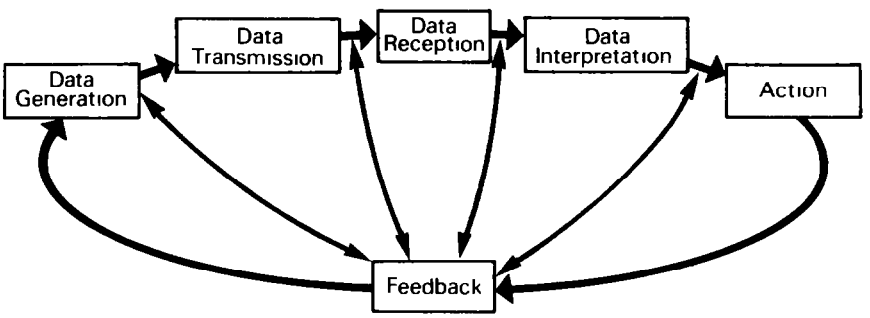

Fig 1 Communications model

In the present context, responsibility for the first two stages in the chain (data generation and transmission) are primarily the responsibility of the manufacturer or supplier Equally, however, it is essential for the user (customer) of the chemical to ensure that the data, once received, are disseminated throughout the organisation and not filed unannounced in the Buyer's Office or in the stores

For the information to be effective the employer also has a duty at the interpretation stage Thus he must check that it can be understood This necessitates some consideration of the background of the recipients of the data, since this dictates their information needs and their ability or responsi-

bility with regard the different stages of the communication network For example, Medical and Hygiene Departments may require detailed primary data whilst plant operatives will demand precise handling instructions for the substances. Feedback facilities must be set up, for example,

- between the Hygiene and Safety Departments and the supplier (amongst others), and
- between the operators plus their Safety Representatives, line management and the Company Safety and Hygiene Departments (amongst others)

The requests by suppliers for the recipients of Data Sheets to provide written acknowledgement of receipt of the information, referred to earlier, is an understandable attempt by some to establish a feedback loop between the "transmission" and "reception" stages

4. Implications for management strategies

For operations involving simple and unchanging technology, a small variety of chemicals, and where the homogeneity of the workforce background can be guaranteed, it may be feasible to rely solely on well-constructed, commercially available material safety and hygiene data sheets. As the situation becomes more complex the employer must assume more and more responsibility for devising an in-house document In some situations such as in large Research laboratories the position is further complicated by the following

(a) wide selection of compounds in small-scale use at the bench (typically a large laboratory may hold several thousand reagents, solvents, gases etc in stock)
(b) large-scale use of a smaller number of materials at the pilot-plant stage of development
(c) wide variety of complex technology available, embracing sources of ionising radiation, extremes of pressure and temperature, etc
(d) study of novel reactions and synthesis of new substances of unknown hazard; the necessity and logic for this has been discussed by Gardiner [19]
(e) diverse background of its employees including scientists (chemists and non-chemists), technicians with varying degrees of experience, tradesmen, craftsmen, process operators and unskilled labour, all of whom at some stage may handle chemicals, either knowingly or inadvertently

In such circumstances the organisation must identify routine tasks for which detailed Codes of Safe Working Practice can be developed These should list the precautions required for each process, both under normal conditions and for all foreseeable contingencies A more flexible arrangement is essential for non-routine operations when a greater reliance must be placed on the qualifications, experience and judgement of line management This requires there to be readily available a library containing suppliers' literature, standard texts (a small selection is included in the references [16,20—29]), official publications, and in-house safety data Depend-

ing upon the size of the organisations several such libraries may be required in strategically useful locations for maximum use For most up-to-date information access to relevant journals and/or abstracting services, on-line literature retrieval systems and current awareness bulletins are required The latter may be obtained commercially or constructed within the organisation Staff will need to be trained in relevant aspects of safety and hygiene and in use of the literature However one report [30] concludes that to-date The Act has had no impact on modifying academic syllabi and suggests graduates are as ill-equipped as ever to cope with this additional responsibility If this is so then employers must accept the challenge of training their employees themselves in order to fully discharge their duties This in turn requires access to "experts", such as hygienists, occupational physicians, information scientists, etc The inevitable growth of application of computerisation in this field may be helpful Already the use of computers in Health and Safety has been demonstrated for storage of environmental monitoring data, medical reports, for epidemiology surveys, for storage and analysis of accident statistics, chemical registers, and for rapid on-line literature searches [31—38] Computerised transmission of data and the rapid searching of the most recent versions of documents constantly requiring revision (such as company manuals and data banks of primary information) can be effectively achieved using View Data systems However for guidance on specific materials in a particular situation, a more interactive computerised system would be needed for obtaining such advice because of the variety of factors which influence the handling requirements Development of such Expert/Knowledge systems would enable logical interrogation of the programme package by a novice with the view to obtaining a solution to his specific problem without the necessity for direct access to hygienists, etc for everyday problems Though several in-house attempts of this approach have been described [39,40] it is currently restricted by availability of commercial software

5. Conclusions

Provision of information on chemicals is crucial in promoting the safe handling of materials Suppliers have legal obligations to provide (and generate where necessary) data on their products. Employers also have a duty to ensure information is available to employees but they must also make sure it is understandable and relevant to their specific operations In certain situations, employers may need to ascertain data from the literature For large or complex organisations modern computerised techniques in information science may be beneficial, e g , access to on-line data bases, View Data systems, Expert/Knowledge systems etc

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