

# Immersion and cold cleaning of engineering components

# **Engineering Sheet No 21**

# Introduction

Cleaning and degreasing metal and other parts by dipping, soaking or spraying them with liquid cleaners is a common process in industry, often referred to as 'immersion' or 'cold' cleaning (although the cleaning liquids are sometimes warmed). Many other components have to be degreased or cleaned in situ on plant or equipment, particularly during maintenance.

This leaflet outlines what is good practice in these types of operation and explains the main legal requirements which apply, to minimise risks to health and risks from fire and explosion. It replaces Engineering Information Sheets 8 and 9. Information given is current at 6/98.

# Environmental controls

1,1,1-Trichloroethane has been widely used for cold and in situ cleaning but is now regulated by the Montreal Protocol on Substances that Deplete the Ozone Layer. This has been implemented in the European Union (EU) by Council Regulation (EC) No 3093/94 of 15 December 1994 on substances that deplete the ozone layer and subsequently in the UK by The Environmental Protection (Controls on Substances that Deplete the Ozone Layer) Regulations 1996. Production in, and importation into, the EU has been phased out and very little is now available. There are further proposals to ban the supply of this solvent for use in diffusive applications. This ban came into effect on 30 June 1998. Businesses will still be able use up any remaining supplies they have in stock.

The Environmental Protection Act currently applies to the use of organic solvents in certain cleaning and degreasing applications associated with a coating process. Local Authority Environmental Health Departments enforce this legislation and should be consulted where necessary.

# Alternatives

Hydrocarbon solvents of a wide variety of types and water-based formulations are now being more widely used for the cleaning processes formerly done with 1,1,1 trichloroethane, but there is an even more fundamental option to consider.

# Is cleaning necessary?

This is the first question to ask. Some businesses have already found that by changing their process or operation they can avoid components becoming soiled, or they can reduce the level of soiling. This makes subsequent cleaning easier. Some companies have discovered that cleaning was not critical and was not needed. In many of these cases the changes have saved money.

# Information from suppliers

The Chemicals (Hazard Information and Packaging for Supply) Regulations 1994 (CHIP)<sup>1</sup> require the supplier of a dangerous substance or preparation to provide a safety data sheet. This should contain information to enable the recipient to take necessary measures relating to the protection of health and safety at work and the environment.<sup>2</sup> Employers should use this information to address the risks from chemicals in their particular operations and to determine the precautions which are appropriate to them. There are additional duties on suppliers in section 6 of the Health and Safety at Work etc Act 1974.

# Risk assessment

Employers should use the information from suppliers and on safety data sheets to help them carry out the risk assessments required by The Control of Substances Hazardous to Health Regulations (COSHH)<sup>3</sup> and the Management of Health and Safety at Work Regulations.<sup>4</sup> The inherent hazards of the chemicals used should be linked by the assessment to risks arising in an employer's particular operations, and the assessment should determine the appropriate precautions.

# Chlorinated solvents

Trichloroethylene, perchloroethylene and methylene chloride (dichloromethane) are available and widely used for vapour degreasing operations. Guidance on this type of work is given in the publication Vapour degreasing. <sup>5</sup> These solvents are all volatile, although the degree varies, and, if used for cold or in situ cleaning, all would be likely to present an increased risk to employees' health compared with 1,1,1 trichloroethane. Suppliers do not normally recommend them for cold or in situ cleaning. Control measures would be necessary to prevent operators breathing the solvent vapours if it were necessary to use them.

# Other organic chemical solvents

A wide variety of other organic chemical solvent cleaners is available, including petroleum distillates, terpenes and alcohols. A number of products based on bromine compounds are also now being marketed. In selecting a product, users have to take into account not only how well it cleans but also any health or fire risks it may present in the way they propose to use it.

#### Health hazards

Many of the products available are of low toxicity. Some are not. Suppliers should advise on hazards and any precautions which may be needed. In some cases good natural ventilation may be adequate to minimise the risks from solvent vapours, but in other cases, local exhaust ventilation will be needed. In some circumstances, respiratory protective equipment may also be necessary. The COSHH assessment should indicate the precautions needed.

In any enclosed or confined space such as the inside of a tank, even a non-toxic solvent may have anaesthetic or asphyxiating effects if it is used in sufficient quantities. Breathing apparatus and other precautions may be required to prevent serious injury or even death. The Confined Spaces Regulations will apply to such work.<sup>6</sup>

Since all of the products are designed for cleaning and degreasing they will present some possibility of skin irritation or dermatitis. Some solvents are also able to penetrate intact skin and enter the bloodstream. This may not be a problem for intermittent or short-term skin exposures but may cause problems for prolonged skin exposure.

Handling and application methods which avoid skin exposure, or the use of suitable protective equipment such as chemical protective gloves and sometimes overalls, may be required. Care should be taken in selecting gloves and other protective clothing as different solvents affect the materials from which they are made in different ways. Some solvents may, for example, pass through some glove materials in a very short time. Suppliers' advice should be sought on suitability for particular jobs.

Chemical splashes to the eyes are always undesirable and can be very dangerous. The effects may range from minor stinging and irritation to more serious and possibly lasting effects. Prolonged exposure to solvent vapours may also cause eye irritation. Some eye protection will be advisable for most operations. Chemical-resistant goggles or a face shield will be required where there is a significant risk of splashing with a chemical which may be harmful to the eyes.

#### Fire and explosion risks

Most of the hydrocarbon solvents likely to be used are flammable or combustible to some extent. Flashpoint is a crude indication of flammability of a solvent, although the method of use is also important in minimising the actual risk of ignition.

Some solvents are highly flammable (having a flashpoint less than 32°C) and are subject to specific controls in The

Highly Flammable Liquids and Liquefied Petroleum Gases Regulations 1972. Those with a flashpoint between 32° and 55°C are generally described as 'flammable'. Those with a flashpoint above 55°C should be described as 'combustible'. They will burn in some circumstances and still present a potential fire risk, though depending on the method of use, this will often be low.

Solvents for cold and in situ cleaning should be chosen with as high a flashpoint as is reasonably practicable. Most of the proprietary formulations available have flashpoints around  $45^{\circ}$ C or above. This is about  $15^{\circ}$ C above the ambient temperature on a hot summer day in the UK.

Lower flashpoint solvents may be used for some operations, particularly where drying time is important. Such solvents, when used for immersion cleaning, should be used in purpose-designed plant incorporating specific precautions to contain solvent vapours. If lower flashpoint solvents are used for any cold or in situ cleaning, measures to minimise flammable solvent/air mixtures and to eliminate sources of ignition will be essential.

Detailed guidance on the use of flammable liquids is available in The safe use and handling of flammable liquids. $^{7}$ 

#### Immersion cleaning

The cleaning vessel can range from a bucket to a large sophisticated plant with handling equipment for components, means of agitating or spraying solvent or the provision of ultrasonics. Whatever type of installation is used, to avoid fire risks the supplier's guidance should be followed.

A bucket or other simple container will, in practice, sometimes be used for ad hoc, short jobs but still needs to be used in a way which minimises risks of solvent spillage and vapour release. For routine work properly engineered and installed equipment, even if relatively simple in design, should be provided.

If solvents are warmed to assist cleaning, the maximum permissible operating temperature should be at least 15°C below the flashpoint of the solvent used. Reliable, properly maintained thermostats and safety cut-outs will be needed to prevent overheating.

Measures appropriate to the plant and solvent will be required to control flammable vapours. Sources of ignition should be excluded from the area.

High pressure spraying of flammable or combustible solvents can increase the risk of ignition. Some high flashpoint solvents sprayed under high pressure are much more readily ignitable than they are in bulk. The risk of ignition in these circumstances may be very little different from that which would arise with low flashpoint material. Static may be a source of ignition for some solvents.

Where high pressure spraying is contemplated, suppliers should be able to advise on the suitability of their particular products and on a safe method of use. This should include an appropriate standard of enclosure and the provision of suitably protected electrical equipment.

Appropriate and adequate maintenance of any cleaning plant will be necessary to ensure continued solvent and vapour containment.

Precautions should be taken to avoid spillage when transferring solvent from storage to the cleaning plant. Piped systems may be appropriate for large users. Closed containers and drum pumps are useful precautions. Open buckets should not be used for transporting solvents.

#### In situ cleaning

In general, the use of highly flammable solvents is not recommended for in situ cleaning. If, exceptionally, such materials have to be used, stringent precautions will be necessary to prevent a flammable mixture forming and to remove the sources of ignition.

Bulk solvents should be dispensed for use into smaller, stable containers which should be closed when being carried and when not actually being used. Open buckets should not be used. Specially designed non-spill swab pails are available to dispense flammable solvent safely. Their use is strongly recommended and would be essential in a confined space.

Flammable or combustible materials sprayed from an aerosol (or other high pressure spray device) may also ignite readily whatever their flashpoints. Aerosol propellants may also be flammable. If aerosols or sprays are used, stringent precautions will be required to prevent a flammable vapour/air mixture forming and to ensure that there are no sources of ignition in the vicinity. The use of aerosols containing low-flash solvents may be particularly attractive to those needing rapid drying of cleaned parts such as electrical switchgear. Particular care must be taken not to spray flammable materials on to hot or electrically 'live' equipment.

Rags or swabs soaked in flammable solvent should be disposed of carefully, as some materials can ignite spontaneously. They should be removed promptly from workrooms and kept in fire-resisting bins. Suppliers may recommend soaking them in water before disposal.

#### Assisted drying

High-flash hydrocarbons will take longer to dry at ambient temperatures than low-flash solvents or trichloroethane. If forced drying is required, special care needs to be taken to avoid flammable solvent/air mixtures and sources of ignition. With in situ wipe cleaning, using the minimum amount of solvent necessary to remove the soil will greatly assist drying times.

#### Storage of solvents

Bulk supplies of flammable solvents should be stored in a safe place in the open air or in a fire resisting store as described in The storage of flammable liquids in containers.<sup>8</sup>

#### Aqueous cleaning

Water-based formulations using detergent-type substances may also be used for immersion and in situ cleaning. These may be alkaline or acid and therefore corrosive to skin and eyes. Working solutions and, more particularly, concentrates, may contain ingredients harmful to health if breathed or ingested, for example as dust or spray. Some organic solvents may also be used in water-based mixtures. In all cases a COSHH assessment should be made and appropriate precautions taken to avoid risks to health. Certain flammable solvents can also be used mixed into aqueous formulations. These should present no fire risk when in an aqueous working solution.

#### References

1 The complete idiot's guide to CHIP2: a guide to the Chemicals (Hazard Information and Packaging) Regulations (Free leaflet; ISBN 0 7176 0901 4 for priced pack of 10 copies)

2 Safety datasheets for substances and preparations dangerous for supply. Guidance on regulation 6 of the CHIP Regulations 1994. Approved Code of Practice L62 HSE Books 1995 ISBN 0 7176 0859 X

3 COSHH: the new brief guide for employers INDG136 (rev) (Free leaflet; ISBN 0 7176 1189 2 for priced pack of 10 copies)

4 Management of Health and Safety at Work Regulations 1992 Approved Code of Practice L21 HSE Books 1992 ISBN 0 7176 0412 8

5 Vapour degreasing Guide GG15 (up to 5 copies free from Environmental Technology Best Practice Programme, Helpline Tel: 0800 585794) 6 Safe work in confined spaces L101 HSE Books 1997 ISBN 0 7176 1405 0

7 Safe use and handling of flammable liquids HSG140 HSE Books 1996 ISBN 0 7176 0967 7

8 The storage of flammable liquids in containers HSG51 HSE Books 1998 ISBN 0 7176 1471 9

Further information

Metal and precision cleaning 1998 (available free from the National Physical Laboratory, London, tel 0181 943 6636; fax 0181 943 2989)

The Montreal Protocol: health and safety implications for cleaning and degreasing of engineering components HSE Conference Paper 1993, updated 1996 (available only from HSE Birmingham Tel: 0121 607 6200)

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