



Maintenance and cleaning of solvent degreasing plant

Engineering Information Sheet No 20(rev1)

Introduction

This information sheet highlights the risks involved in cleaning solvent degreasing plant (degreasers), particularly when tanks are entered, and describes the precautions which need to be taken to do the work safely. It places most emphasis on open-topped degreasers because these have the greatest potential for causing over-exposure.

Poorly maintained degreasers are still found in some workplaces. Some are in such poor condition that their use is prohibited by HSE inspectors, and there continue to be serious incidents, including fatalities, often as a result of poorly managed maintenance and cleaning activities. Fatalities are usually the result of very bad practice, such as entry into degreasers to clean them out without suitable breathing apparatus.

Fire risks associated with the use of flammable solvents or non-flammable solvents which have become heavily contaminated by oils and grease are not covered in this information sheet.

The word 'must' is used to indicate precautions which are either specific legal requirements or are essential to prevent risks to life.

What are the risks?

Various organic solvents are used in degreasing. The most commonly used are chlorinated solvents such as trichloroethylene, dichloromethane (methylene chloride) and perchloroethylene. Exposure to organic solvent vapour or liquids may be harmful to health, affecting the nervous system in particular. Ill-health effects can be both short-term and long-term and include headaches, dizziness, nausea, disorientation, unconsciousness and even death. Skin exposure may cause irritation and dermatitis. The severity of ill-health effects depends on the substance in use and the concentration and length of exposure. In general, all organic solvents used in degreasers exert a strong narcotic effect at high concentrations and can be fatal. The majority of incidents occur while:

- degreasers are being maintained;
- tanks are being cleaned out;
- solvent is being replaced;
- emergency rescues from tanks are being attempted.

Legal requirements

The Control of Substances Hazardous to Health Regulations 2002 (COSHH) require exposure to substances hazardous to health to be prevented or, where this is not reasonably practicable, adequately controlled. Regulation 9(1) of COSHH requires that measures provided to ensure adequate control of exposure are maintained in an efficient state, in efficient working order and in good repair. Care should be taken to minimise **any** exposure during maintenance and cleaning activities.

The implications of the reclassification of trichloroethylene to a category 2 carcinogen under COSHH are given in Engineering Information Sheet EIS34 *Surface cleaning: Solvent update including the reclassification of trichloroethylene*.

The Confined Spaces Regulations 1997 prohibit entry into a confined space, such as a degreasing tank, to carry out work where there is a risk of death or serious injury from hazardous substances or dangerous conditions (eg lack of oxygen), unless it is not reasonably practicable to carry out the necessary tasks without entry. Where people have to enter/leave or carry out any work in a confined space, this must be done only in accordance with a safe system of work. The preparation of suitable and sufficient arrangements for the rescue of people in the event of an emergency is also required under these Regulations.

Where degreasing is subject to the Solvent Emissions Directive (SED) and/or is part of an authorised, prescribed process under the Environmental Protection Act 1990, any maintenance and cleaning of the tank may need to be done in a way which minimises emissions to the air.

The need for maintenance

Degreasers need to be maintained to ensure their continued efficient and safe operation. Whatever solvent you use, it is fundamental to the protection of the health of workers that you maintain your plant in an efficient state, in efficient working order and in good repair, and follow good working practices. This information sheet highlights certain recommendations for maintaining and cleaning degreasers specifically to control personal exposure to solvent vapours or liquids. It is not intended to replace detailed guidance which should be provided by solvent and equipment suppliers. Equipment suppliers may recommend

alternative procedures or additional maintenance which have safety implications, particularly for the more enclosed or totally sealed end-loading plants. In either case, you should follow your suppliers' advice.

Plant maintenance

Solvent degreasing plants require routine maintenance and cleaning if they are to continue to perform and run effectively and safely. The following control checks should be included in the scheduled maintenance programme:

Cooling water supply: Check that the flow and temperature of water through the system is correct. This should be done on a daily basis by measuring the cooling water volume/flow and the outlet and inlet temperature. Where trichloroethylene is used, the inlet water temperature should be less than 20°C and the outlet temperature should be 30-40°C.

Condensing coils: These should be kept clean to ensure continuing efficient heat transfer. Frequency of cleaning will depend on how the plant is used, but weekly cleaning may be appropriate.

Rim ventilation: The duct work and vent slot should be inspected on a regular basis as they are susceptible to damage by heavy loads. Any damage or blockage should be repaired promptly.

An extraction rate of 640-915 m³/hr per m² (35-50 cu ft/min per sq ft) of bath surface is recommended. The whole system should be thoroughly examined and tested at least once every 14 months by a competent person and records of each examination kept for at least five years. For such tests to be meaningful it is essential that the design criteria for the particular plant are known.

Other ventilation systems: Any exhaust ventilation system provided should be inspected regularly and included in the 14-monthly examination schedule. This includes systems to remove vapours from the load/unload zone of retrofitted enclosures on conventional open-top degreasers, or from the sludge doors when these are opened, or from a pit in which a degreaser may be located.

Top safety cut-out: This should be set to operate at the correct temperature for the solvent in use. Suppliers recommend 30°C for methylene chloride, 55°C for trichloroethylene and 80°C for perchloroethylene. It should be tested weekly.

Bottom safety cut-out: This should be set to operate at the correct temperature for the solvent in use. For specific information on a particular solvent, refer to the manufacturer's safety data sheet. The sheath of any bottom safety cut-out fitted should be kept free from

adhering dirt by regular cleaning, with great care being taken not to damage or bend the sheath during cleaning. It should be tested weekly.

Solvent level: A daily visual check on solvent level is recommended. More frequent checks should be made if the throughput of work is heavy.

Some degreasers are additionally fitted with low-level cut-out devices. Where fitted, these should be tested according to the plant supplier's recommendations. Reliance should not be placed totally on such devices, and visual checks should still be made on the solvent level.

Solvent condition: As oil concentration of sump fluid rises, so too does the boiling point of the sump liquor. The higher tank temperature in turn increases vapour emissions. In general, solvent suppliers recommend that the plant should be cleaned out when the solvent in the sump is contaminated with between 35-50% vol/vol oil, grease etc. The contamination level can be determined by monitoring the temperature of the boiling sump contents. For example, trichloroethylene normally boils at 87°C. At 35% contamination this is increased to about 92°C and at 50% contamination to about 96°C. A system should be put in place to prevent excessive oil build-up which would lead to a rise in the sump fluid temperature. This may be achieved by ensuring that the sump thermostat is set at a correct temperature for the solvent in use.

The acid acceptance value recommended by the suppliers should be checked regularly. Solvent suppliers can provide simple chemical test kits to measure the acid acceptance value of the solvent and its alkalinity.

Leaks: Solvent leaks can occur from pipe joints, pump parts or sump door gaskets. The source of any leak should be investigated and repaired promptly. Checks for leakages should be made during plant operation, particularly when plants are started up from cold because leaks are often easier to see.

Water separator: Water separators are normally fitted for removing excess water and need to be drained at intervals, usually daily.

Lids: Lids, which range from lift-out panels to automated shutters, are essential to prevent excessive vapour loss. They should be fitted between the top of the freeboard zone and the rim extraction vents. Lids should be maintained so that they are kept in an efficient working order at all times.

Waste management: Good waste management practice is essential because degreasing plant wastes are hazardous to health. Different waste solvents should not be mixed. All spent solvent should be

properly segregated, packaged and labelled. Separate storage and clear identification are critical. Movement of spent solvent both for reclaim and for final waste should be correctly documented and recorded. Final waste must only be disposed of via an authorised licensed waste disposal contractor. The Duty of Care Regulations 1991 require careful management and documentation at all stages.

Common maintenance faults include:

- (a) incorrect balance between heating and cooling systems. This can arise from either mis-setting or failure of controls;
- (b) ineffective rim ventilation. The manufacturer's design criteria should be known and maintained. Damage to ducting is a common fault;
- (c) incorrect filling and top-up procedures. Charging of the degreaser should be by pump, discharging at low level in the bath, normally below the existing liquid level;
- (d) leaks from pipe joints, pump parts or sump door gaskets;
- (e) damaged lids.

Degreaser 'clean-out' procedure

Solvent will eventually need to be replaced, and sludge or other deposits removed from the base of the degreaser. How often this is needed depends on the level of contamination of the components cleaned and the degreaser throughput. Regular cleaning will be necessary both to maintain product quality and to prevent oil and grease deposits becoming baked on to the degreaser base plate. These deposits could adversely affect heat transfer and make clean-out more difficult.

Experience has shown that if a degreaser is cleaned regularly, entry will not be necessary in most cases. If you need to enter your degreaser each time it is cleaned, you are advised to review your maintenance procedures now!

Methods of cleaning

Incorrect clean-out procedures are of particular concern since a number of fatal accidents have occurred to people entering degreasers without adequate precautions.

There are two options:

- (a) Dirty solvent can be pumped out of the degreaser for safe disposal or recycling, either in a separate still on site, or by an outside contractor. This may be the only option for degreasers used for cold

cleaning or on sites having no distillation facility. Some sludge may need to be removed as described below, but solvent should be changed often enough to ensure that heavy sludge deposits do not build up. **Entry into the degreaser should then not normally be required;**

- (b) Many degreasers can be set to distil off most of the solvent to an external drum, leaving a smaller, heavily contaminated residue in the base. If the distillation and cleaning cycle is performed regularly, in most cases the cooled residue will be sufficiently mobile to be run from the degreaser drain line into a suitable, enclosed container. Any remaining deposits can be removed via the sludge door at the base of the degreaser, working from outside the degreaser using long-handled scrapers. **Entry into the degreaser should then not normally be required.**

Thick grease residues may need to be run off at above ambient temperature. This greatly increases atmospheric solvent vapour levels and the complexity of the precautions needed to control exposure to them. It should be avoided if practicable.

Wet vacuum cleaners may appear to be an attractive option for removing final traces of liquid solvent after the bulk of the solvent has been pumped out or for removing sludge deposits. However, experience has shown that high solvent-in-air levels will be generated in the air discharge of the cleaner. Solvent levels in excess of 4000 ppm have been measured.

Wet vacuum cleaners should be considered only if adequate arrangements can be made to duct solvent-contaminated air to a safe place, for example into the degreaser vent system.

Entry into degreasing tanks

A degreaser should be entered only if this is unavoidable, and then only under a rigorous, safe system of work, eg a permit-to-work-system (see figure on page 4).

Failures to take proper precautions have resulted in deaths.

Precautions

Precautions can be summarised as follows:

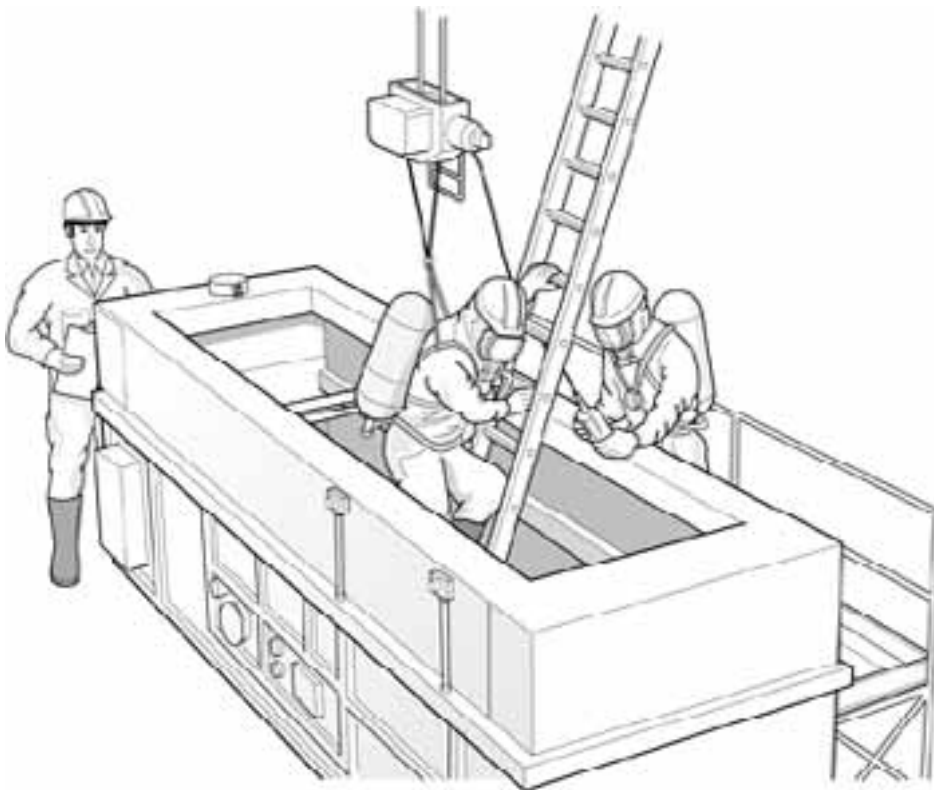
- (a) Employers must establish a safe system of work. This should be in writing, and must be followed each time entry is required. Entry should be authorised each time by a manager or supervisor. A written permit-to-work system is often used to implement these requirements

- (b) Before entry is allowed, as much solvent and sludge as is practicable must be removed by working from outside. Disturbing sludge deposits can generate very high solvent levels in the air. The degreaser must be cooled and ventilated from low level and via the rim ventilation, ideally for about 24 hours. Ventilation should also continue while cleaning is in progress. Solvent vapours should be vented to a safe location.
- (c) Anyone entering a degreaser must use suitable breathing apparatus (BA). This must meet the requirements of the Personal Protective Equipment Regulations 2002 (displaying a 'CE' mark) or should be of a type approved by HSE. BA providing adequate protection for the high solvent vapour levels likely to be encountered will be positive-pressure demand, full facepiece, self-contained compressed air, or compressed airline type (see examples below). However, they must be suitable for the wearer.
 - (i) *Self-contained open-circuit compressed air breathing apparatus* BS EN 137:1993;
 - (ii) *Compressed airline breathing apparatus* BS EN 139:1995.
- (d) Breathing air must be supplied from a clean, secure source. For compressed air, this will involve the use of purpose-designed filters in the supply line. The maximum allowable levels of contamination in a breathable air supply are detailed in BS 4275:1997;
- (e) A rescue plan must be part of the safe system of work;
- (f) Rescue and resuscitation equipment should be provided and it will need to be appropriate to the risks identified in the risk assessment. A suitable harness, attached to a rope, must be worn if this is practicable (it normally will be.) The free end of the rope must be held or secured outside the degreaser so that it can be used to pull the person out in an emergency;
- (g) A second person must be positioned outside the degreaser to raise the alarm if necessary, and start rescue procedures. This person must be in communication with the person in the confined space and be equipped with BA and other suitable protective equipment so that the degreaser can be entered, if necessary, to assist with the rescue.

Filtering respirators such as canister or cartridge types are *not* acceptable.

Lives may depend on the correct use of BA. The training of those using it and maintenance of the equipment are particularly important. Equipment suppliers should be able to assist.

One person outside the degreaser will not be able to pull out an unconscious body unaided. Enough people and the necessary equipment will therefore need to be immediately available. This could include a hoist with a lifting capacity exceeding the weight of the person entering the degreaser, positioned over the top of the degreaser. Hoists which may be suitable are already provided at many degreasers for handling work.



- (h) In the event of BA failure, a person inside a degreaser could be exposed to a toxic or oxygen-deficient atmosphere. An emergency breathing facility is required in these circumstances as part of the rescue plan. An example of such a facility would be a second independent air supply connected to the facepiece.
- (i) Resuscitation procedures, including respiratory and circulatory, may be required and must be immediately available with specialist equipment provided where the assessment considers this necessary.
- (j) Anyone likely to be involved in degreaser entry or rescue must be properly trained and familiar with the BA and all other equipment used, including the rescue equipment. Special training is required for anyone who might need to give resuscitation as part of any first-aid treatment.
- (k) All equipment used in connection with confined space entry and rescue should be maintained in efficient working order and good repair. This should include periodic examination and testing, as necessary, with records kept. If any equipment fails an examination, it must not be used until the fault has been remedied. BA should be inspected each time before use.
- (l) A sign clearly prohibiting entry to a degreaser without authorisation and use of BA should be fixed to each degreaser.

In addition to BA, people entering a degreaser need to wear suitable personal protective equipment including boots, overalls and gloves. These must be capable of preventing solvent and grease residues from reaching the skin. Often, skin contamination arises from solvent getting **around** the clothing, rather than through it, for example from contaminated hands put into clean gloves, or solvent splashes entering the tops of boots, or during removal of contaminated clothing. Protective clothing should form a barrier to the solvent - the material must be intact and resistant to the solvent and contaminants for the period of wear.

Commonly available materials may provide only short-term protection against solvents. The choice of protective clothing will depend on the particular application. Suppliers should be able to advise on suitability of clothing, how long it can be worn for, and whether it can be cleaned and reused.

Degreasers in pits

If the degreaser is in a pit, the pit must be treated as a confined space. If people climb into the pit during clean-out, the precautions for degreaser entry must be followed. The pit should always be ventilated to remove solvent vapour when cleaning has been completed.

Cleaning through sludge doors

Degreasers need to be cooled and ventilated, as described earlier, before residues are scraped out from low-level sludge doors. Local exhaust ventilation should be applied at the sludge door during clean-out by this method. This is fitted on modern degreasers. Older ones may have a fitting which can be connected to the rim ventilation duct.

If the degreaser is not in a pit and does not need to be entered, workers should still wear suitable protective equipment to prevent skin and eye contamination. They should also wear suitable respiratory protective equipment, as solvent exposures could still be high.

A suitable canister respirator **may** give adequate protection for short periods of up to 10-15 minutes, if properly selected, used and maintained. However, as exposures are often unpredictable, BA should normally be used. This can be one of the compressed air types described earlier or one of the following types:

- (a) compressed airline hood to BS EN 270:1995;
- (b) light-duty airline hood to BS EN 1835:2000;
- (c) light-duty airline mask to BS EN 12419:1999;
- (d) assisted or unassisted fresh air hose with hood or full facepiece to BS EN 138:1994 or BS EN 269:1995.

Cleaning from the top

Leaning over or into the top of a degreaser to clean out sludge deposits could also result in high solvent exposure and would require the same standard of respiratory and other personal protection as described for degreaser entry.

Degreaser entry without breathing apparatus

A degreaser can be entered without BA but only after it has been thoroughly cleaned to remove liquid solvent, sludge which may contain solvent, and solvent vapours. The air in the degreaser must also have been tested for the absence of solvent vapour, for example using detector tubes, and to ensure there is enough oxygen. The degreaser must have been certified by a competent person as safe for entry without BA for a specified period.

These circumstances are most likely to occur if a degreaser has to be entered after cleaning, for example for repairs to cooling coils or other internal parts. They could, very exceptionally, occur during clean-out if the only residue remaining is hard scale, with no possibility of there being trapped solvent behind it.

A degreaser would not normally be considered suitable for this entry procedure unless it had been boiled out with a suitable chemical cleaning solution such as soda ash. This is a specialised cleaning procedure and degreaser users are advised to seek specialist advice (for example, from solvent suppliers).

If a degreaser is entered without BA under a permit-to-work procedure, the other precautions detailed in subparagraphs (a), (b), (e-g) and (j-l) (under the heading 'Precautions' on pages 3-5) will still be required.

Further reading

Control of substances hazardous to health. Control of Substances Hazardous to Health Regulations 2002. Approved Code of Practice and guidance (Fourth edition) L5 HSE Books 2002 ISBN 0 7176 2534 6

EH40/2002: Occupational exposure limits HSE Books ISBN 0 7176 2083 2 (updated annually)

Surface cleaning: Solvent update including the reclassification of trichloroethylene EIS34 HSE Books 2002

Safe use of solvent degreasing plant EIS40 HSE Books 2003

Safe work in confined spaces. Confined Spaces Regulations 1997. Approved Code of Practice, Regulations and guidance L101 HSE Books 1997 ISBN 0 7176 1405 0

Safe work in confined spaces Leaflet INDG258 HSE Books 1997 (single copy free or priced packs of 20 ISBN 0 7176 1442 5)

Permit-to-work systems Leaflet INDG98(rev3) HSE Books 1997 (single copy free or priced packs of 15 ISBN 0 7176 1331 3)

BS EN 137: 1993 *Specification for respiratory protective devices: self-contained open-circuit compressed air breathing apparatus*

BS EN 139: 1995 *Respiratory protective devices: compressed airline breathing apparatus for use with a full face mask, half mask or a mouthpiece assembly. Requirements, testing, marking*

BS EN 270: 1995 *Respiratory protective devices: compressed air line breathing apparatus incorporating a hood. Requirements, testing, marking*

BS EN 1835: 2000 *Respiratory protective devices: light duty compressed air line breathing apparatus incorporating a helmet or hood. Requirements, testing, marking*

BS EN 12419: 1999 *Respiratory protective devices: light duty compressed air line breathing apparatus incorporating full face masks, half masks or quarter mask. Requirements, testing, marking*

BS EN 138: 1994 *Respiratory protective devices: Specification for fresh air hose breathing apparatus for use with full face mask, half mask or mouthpiece assembly*

BS EN 269: 1995 *Respiratory protective devices: Specification for powered fresh air hose breathing apparatus incorporating a hood*

The selection, use and maintenance of respiratory protective equipment: A practical guide HSG53 (Second edition) HSE Books 1998 ISBN 0 7176 1537 5

BS 4275: 1997 (as amended, 2001) *Guide to implementing an effective respiratory protective device programme*

BS 7184: 2001 *Selection, use and maintenance of chemical protective clothing. Guidance*

Surface cleaning and preparation: Choosing the best option GG354 (replacing *Vapour degreasing* GG15) and *Help in choosing cost-effective options for surface cleaning and preparation* EN354 available free (up to five copies) from the Envirowise helpline, Tel 0800 585794, or website: www.envirowise.gov.uk

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British Standards are available from BSI Customer Services, 389 Chiswick High Road, London W4 4AL Tel: 020 8996 9001 Fax: 020 8996 7001 Website: www.bsi-global.com

This leaflet contains notes on good practice which are not compulsory but which you may find helpful in considering what you need to do.

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