

## POST WELD CLEANING USING PICKLING PASTES

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### INTRODUCTION

1 This document revises and replaces the July 2000 version of Information Document HSE 652/1. The main changes are at paragraphs 37, 46 and 49. The document contains internal guidance which has been made available to the public. The guidance is considered good practice (rather than compulsory) but you may find it useful in deciding what you need to do to comply with the law. However, the guidance may not be directly applicable in all circumstances and any queries should be directed to the appropriate enforcing authority.

2 This document is intended to increase awareness of the risks to health associated with the use of pickling pastes containing hydrofluoric acid and to offer advice on how these risks may be controlled. The pastes considered are primarily used to post weld clean stainless steels. Pickling surface cleaners and passivating solutions are **not** covered as they do not generally contain hydrofluoric acid. The guidance contained in this document is not exhaustive and should be read in conjunction with the product's health and safety data sheet. If the product supplier does not supply the data sheet it is essential to ask for it.

3 All publications referred to are published by HSE unless otherwise stated and can be obtained from HSE Books, PO Box 1999, Sudbury, Suffolk CO10 2WA tel 01787 881165 or via their website <http://www.hsebooks.co.uk>.

### HAZARDS

4 Pickling pastes typically contain 20% nitric acid and 5% hydrofluoric acid by weight, although this can vary.

5 Hydrofluoric acid is a highly toxic, reactive chemical. Skin contact with diluted solutions can cause very serious and extremely painful burns. The extent of these burns can readily be missed at the initial stage, as it can take up to 24 hours after contact before the pain is felt. The acid is also capable of destroying flesh long after initial efforts have been made to wash it from the skin. Very small quantities of diluted hydrofluoric acid can cause irreparable damage to the eye. It is toxic by

inhalation and has a long-term occupational exposure standard (OES) of 1.8 parts per million (ppm) (as fluoride) (8-hour time weighted average reference period) and 3 parts per million over a 15-minute reference period. This reflects the level of exposure which based on current scientific knowledge will not damage the health of people exposed to it by inhalation day after day.

6 Nitric acid is highly corrosive and will produce lesions of the skin, eyes and mucous membranes on contact. The severity of the lesions will depend on the length of contact and the concentration of the acid. It has an OES of 2 ppm over an 8-hour time weighted average reference period and 4 ppm over a 15-minute reference period.

## LEGAL CONSIDERATIONS

7 The Control of Substances Hazardous to Health Regulations 2002 (COSHH) require a suitable and sufficient assessment to be made of the risks to health from working with pickling pastes. The assessment has to consider the risks to health and ways of preventing or adequately controlling exposure. This is particularly important where pickling pastes are used on an infrequent basis as this can otherwise result in a lack of awareness of the health hazards and the required safety precautions.

8 In reducing the risk to health a hierarchy of measures has to be followed consisting of elimination, substitution, isolation (ie separating the process from those not directly involved), control using engineering means and personal protective equipment (PPE) including respiratory protective equipment (RPE). Respiratory protective equipment should only be used as a final measure and then only in addition to other controls. The regulations also place a duty upon employers to ensure that procedures for the provision of appropriate first-aid (see paragraphs 45-50) are prepared, which can be put into effect should there be an incident involving a hazardous substance such as pickling paste.

9 The Personal Protective Equipment at Work Regulations 1992 require employers to undertake an assessment of risks of injury that have not been adequately controlled by any other means. For any such risks, suitable PPE has to be provided free of charge. In the case of pickling pastes this involves providing suitable protection against splashes to the skin and the eyes (see paragraphs 36-39). Additional guidance is contained in *Personal protective equipment at work: Personal Protective Equipment at Work Regulations 1992* (L25) ISBN 0 717604152.

10 The Confined Spaces Regulations 1997 (CS Regulations) apply to work involving the application of pickling pastes in a confined space such as a tank or similar fabrication. The CS Regulations in particular require:

- (1) the need to avoid entry to confined spaces, where reasonably practicable;
- (2) if entry into a confined space cannot be avoided, a safe system of work must be followed; and

- (3) adequate emergency (rescue) arrangements must be in place before work starts.

11 For further guidance see *Safe work in confined spaces: Confined Spaces Regulations 1997: Approved Code of Practice (ACoP), Regulations and Guidance (L101)* ISBN 0717614050.

12 The Health and Safety (First Aid) Regulations 1981 require employers to provide adequate and appropriate equipment, facilities and personnel to enable first aid to be given to their employees should they be injured or become ill at work. As a result of the serious nature of hydrofluoric acid burns an antidote gel should be kept on site and first aiders trained in its use (see paragraphs 45-50 and the free leaflet INDG307 *Hydrofluoric acid poisoning - Recommendations on first aid procedures* ).

## CONTROL METHODS

### Elimination

13 Before using pickling paste consideration should be given to whether it has to be used. This largely depends on the fabrication's intended process environment. Where for example a fabrication is destined for a high temperature, heat resistant application, scope may exist to eliminate post weld cleaning and hence the need to use pickling paste. However, in most cases where stainless steel is used, some form of post weld cleaning will be necessary particularly where ultra-clean surfaces are required, as in the case of pharmaceutical and food process equipment.

14 The scale of this cleaning may however be controlled, eg by avoiding embedded iron contamination. Ways of achieving this include:

- (1) ensuring abrasive tools previously used on ordinary steel or iron are not used on stainless steel;
- (2) where possible, locating stainless steel fabrication away from carbon steel fabrication to avoid iron contamination from steel grinding, cutting, etc;
- (3) avoid leaving stainless steel sheets on the floor exposed to traffic; and
- (4) avoiding intimate contact between iron or steel surfaces and stainless steel.

### Substitution

15 Where post weld cleaning cannot be avoided consideration should be given to using a less hazardous alternative to pickling paste. Where a contract specifies that pickling paste has to be used, the employer is not exempted from this requirement. In such circumstances the employer should challenge the specification.

16 A number of alternative methods of post weld cleaning exist, these can be broken down into two broad categories; mechanical and chemical.

### Mechanical cleaning

17 Mechanical cleaning includes:

- (1) blasting with clean glass beads, walnut shells, steel shot or grit (although steel shot may result in surface contamination and grit can produce a roughened surface);
- (2) brushing with a stainless steel brush (provided it has not previously been used on materials other than stainless steel);
- (3) grinding with an abrasive disc; and
- (4) mechanical buffing and polishing (although this can cause smearing which may later result in corrosion).

18 Consideration should be given to adopting either one or a combination of these methods before selecting chemical cleaning.

19 The resulting quality of finished surface will vary depending on the method or methods chosen. Depending on the final process environment it may not be possible to completely avoid the use of pickling paste. A follow on application of pickling paste may for example be necessary for a high-purity process where a high standard of finish is required. Where this is not the case pickling paste can more readily be avoided.

20 Pickling paste is sometimes used where it is not possible to access a weld using mechanical cleaning methods. This may be partially offset by careful planning of the order in which a fabrication is assembled and by cleaning welds as fabrication progresses.

### Chemical cleaning

21 The main chemical alternative to using hydrofluoric acid is electrochemical cleaning. The surface to be cleaned is made the anode and a current is applied which initiates the surface's controlled corrosion. A number of electrolytes are available such as dilute phosphoric acid or a mixture of phosphoric acid and sulphuric acid. The fabrication can either be immersed in the acid or alternatively hand-held devices are available.

22 In the case of hand-held devices the acid solution is either pumped to a contact pad at the tip of a hand wand or the tip is simply immersed in the solution. The connection of an earth lead and the hand wand making contact with the work piece, completing an electrical circuit. This in turn locally heats the work surface and the acid solution, activating the cleaning process. The resulting fumes can be controlled either by local exhaust ventilation (LEV) or by an extraction system fitted to the cleaning unit. While the acids used are mild in comparison with hydrofluoric

acid, a COSHH assessment is still required which should include consideration of whether PPE is necessary.

23 The surface produced is smooth and requires only a wipe down. Due to the size and shape of the contact pad it may be possible to access welds that are inaccessible to mechanical cleaning methods. However, there are variations between different manufacturers' makes and models as to the weld type and plate thickness on which these devices can be used.

## PRECAUTIONS

24 The hydrofluoric acid concentration of the various proprietary pickling pastes differs slightly. Where it is not reasonably practicable to use an alternative to pickling paste, consideration should be given to using a lower concentration paste. A higher viscosity paste is also less likely to splash when applied. However, before starting work with any pickling paste an assessment should be made of the risks associated with this work. This enables any necessary precautions to be identified and put in place.

### **General precautions**

25 The following precautions should be followed:

- (1) store the paste in its original, acid resistant container which should be kept upright, away from possible sources of damage and away from strong alkalis;
- (2) keep the container's lid firmly closed when not in use;
- (3) prevent unauthorised access to the paste;
- (4) provide suitable PPE/RPE (see paragraphs 36-42) and make sure it is worn;
- (5) avoid accidental contact with the paste, in particular take care when stirring the product and keep the outside of the container clean;
- (6) take measures to avoid the spread of contamination (see paragraph 27);
- (7) only use the paste on metals specified by the supplier;
- (8) allow surfaces to cool before applying the paste (when heated the paste releases nitrous gases);
- (9) prohibit employees from eating, drinking and smoking when handling the paste; and

- (10) ensure employees wash their hands and face after working with the paste.

26 Pickling paste can be made up using pickling bath solution and an inert material such as graphite. This increases the handling of the solution and therefore increases the risk of splashes and/or spillage. It is therefore recommended that a proprietary brand of pickling paste is used instead. These are available in different container sizes. It is recommended that smaller container sizes are purchased as this helps to avoid future decanting of the paste into a smaller, possibly unmarked container that may also be unsuitable.

27 Care will be needed to avoid the spread of contamination. Spillages/splashes of pickling paste should therefore be cleaned up as soon as they occur, using a suitable cloth. Used cloths should be put in a suitable clearly-marked container, and disposed of according to local waste disposal authority guidelines. Where possible, contaminated clothing and equipment should be neutralised and cleaned prior to leaving the immediate work area. Where this is not possible it should be put in a suitable, clearly marked receptacle until cleaning can take place. During cleaning suitable hand protection should be worn. Care should be taken to avoid touching surfaces or items such as door handles and taps while wearing contaminated gloves. Further guidance on the cleaning of PPE is contained in paragraph 39.

### **Ventilation**

28 Good general ventilation is necessary when applying pickling paste. Where the COSHH assessment identifies that the OES may be exceeded, LEV should be considered as a means of control. Such a situation may arise where for example, a large area has to be treated or where the paste is applied in a semi-confined or a confined space. Where possible however, the use of the paste in a confined space should be avoided due to the potential for a build up of fumes.

29 The need for LEV should be identified before work commences to ensure that it is both available and suitable. Local exhaust ventilation should always be used in preference to RPE which should only be used as an additional control measure and not as a substitute ( see paragraph 40).

### **Hand application**

30 Pickling paste can be applied by brush or by roller, both of which should be acid resistant. Using a roller generates more splashes. While a splash guard can be fitted, brushing remains the preferred option. Using a roller is also not recommended due to the contours of weld surfaces. The paste normally has to be applied in a relatively thick layer. However, care should be taken to avoid applying excess quantities particularly when applying it overhead. In the case of large fabrications the work should be organised to avoid accidental contact with the paste. For example weld seams that are towards the inside of the fabrication should be cleaned first.

### **Spray application**

31 Spray application generates fine air borne droplets which increases the risk of exposure. This method of application should therefore only be selected where application by hand is not reasonably practicable, eg where it is difficult to reach a weld or where a large surface area has to be treated. It is essential that where pastes are applied by this method that this is taken into consideration in the COSHH assessment. This should consider not only the people carrying out the work but also other people in the area, who may also be at risk. Safety precautions capable of addressing these risks should also be established.

32 Only pickling pastes that have been identified by the paste supplier as suitable for spraying should be used. The spray unit should also be of a type specified by the paste supplier. This in most cases will be a pressure pump, hand spray unit fitted with a hand held lance. Such units are typically available from the paste supplier. Where possible, compressed air-driven spray units should be avoided due to the greater potential for over spray.

33 When decanting the paste into the spray unit care should be taken to avoid spillage; using a funnel may help. Spray activities should as far as possible be segregated from the rest of the work area particularly when applying the paste to a large surface area or when using a compressed air-driven, spray unit. Non-essential personnel should be prohibited from the immediate vicinity unless they are wearing suitable PPE.

### **Final rinsing**

34 A number of different cleaning methods are available for removing the paste from the fabrication involving either one, or a combination of:

- (1) a stainless steel brush (although this could cause surface damage);
- (2) a damp sponge or cloth;
- (3) a hose pipe; or
- (4) a pressure washer.

35 Using a damp sponge or cloth creates the least amount of splashes and the smallest quantity of waste water and is therefore the preferred method. Using a pressure washer is the least preferred option. However, for large fabrications it may be the only practical option. The resulting waste water will be acidic and may contain residues of heavy metals. This water should not be allowed to enter the public drainage system without prior treatment including neutralising with slaked lime. Alternatively, neutralising pastes are also available which can be applied to the pickling paste prior to its removal from the fabrication. In either case the local water company should be contacted for further details before discharging waste water into the public drainage system.

### **PERSONAL PROTECTIVE EQUIPMENT**

36 Before pickling pastes are used a risk assessment should be conducted to establish the need for PPE (see paragraph 9). As part of this assessment the product's health and safety data sheet should be consulted. This should specify the type of PPE that may be required. If this information is not detailed the product supplier should be contacted for further advice. When the assessment is completed, any PPE identified as necessary should be provided to those people who need it.

37 Typically the equipment will consist of:

- (1) face/eye protection - a full-face shield capable of protecting the throat. Eye injuries have resulted from splashes of paste passing behind a person's safety glasses. Sole reliance should not therefore be placed on safety glasses especially if they are not close fitting. Wearing the correct eye/face protection is particularly important when the paste is either applied overhead, sprayed or rinsed using a pressure washer.
- (2) waterproof, acid resistant, chemical protective clothing - with elasticated cuffs to prevent contaminated water or paste running down the inside of the sleeves. To be worn when spraying the paste or rinsing with a pressure washer. Acid resistant clothing fitted with a hood should also be worn when the paste is applied over head.
- (3) neoprene rubber gloves or gauntlets - which overlap the sleeves.
- (4) rubber boots - primarily for when applying the paste by spray or using a pressure washer.

38 Care should be taken to avoid contact with contaminated equipment, eg, by not raising face protection with soiled gloves as this can result in facial burns. Personal protective equipment should be thoroughly cleaned with water after use and checked for wear such as pinholes or cuts in the gloves, especially in the fingertips. These can be detected by filling the gloves with water before leaving them to dry.

39 Contaminated clothing should be removed at once and neutralised with sodium bicarbonate solution before washing separately. When handling the contaminated clothing suitable hand protection should be worn such as neoprene rubber gloves.

## RESPIRATORY PROTECTIVE EQUIPMENT

40 Respiratory protective equipment should only be used where the COSHH assessment has identified LEV on its own, cannot achieve adequate control. The RPE should protect against any residual risk to health.

41 The RPE selected should be suitable for both the task and the individual, and should fit the wearer correctly. Respiratory protective equipment must either be CE marked or HSE approved. While HSE ceased to be the approval authority in June 1995, HSE approved equipment may still be used if it is suitable and well maintained.

42 Where the COSHH assessment identifies residual exposure levels that may exceed the OES, a full or a half-face mask fitted with the correct filters (details of which can be obtained from the RPE supplier) may be necessary. In either case it is still important to ensure the face and throat are adequately protected. The need to use a full-face shield is therefore likely to remain. For higher exposure levels a 'powered visor' (for which the correct filters will again be necessary) or a visor connected to a compressed air supply may be required. However, where work takes place within a confined space and the risk assessment identifies that RPE is necessary, in most cases breathing apparatus will be required. This will be the case for entry into the confined space and for emergency rescue. Further information can be found in HSG 53 *The selection, use and maintenance of respiratory protective equipment, a practical guide* ISBN 0717615375.

## TRAINING AND SUPERVISION

43 Before any employee uses a pickling paste they should be informed of the associated hazards and risks. In particular they should be made aware of the potential for serious burns and the required safety precautions. This should involve detailed instructions and training on the safe use of the paste and the protective equipment that is needed. The training should also include the measures required to prevent accidental skin contact with the paste, both by those working with the paste and those who are not. They should also be fully briefed as to the action that needs to be taken in the event of paste getting on their skin or in their eyes. As part of this training, the Hydrofluoric acid poisoning leaflet (see paragraph 12) could be issued.

44 The use of the paste should be supervised to ensure all the required precautions are followed. This should include supervising the correct use of PPE.

## FIRST-AID TREATMENT

45 As pickling pastes contain hydrofluoric acid which causes severe burns that may not at first be painful, first aid treatment needs to be urgent. First aiders should receive specific training in the hazards of hydrofluoric acid burns and their treatment. This training will not normally be included in general first aid training and may need to be arranged separately. When treating a casualty the first aider needs to ensure both they and the casualty are protected from further exposure. Casualties should be sent to hospital as soon as possible. In all cases the hospital should be informed of the cause of the injury so they in turn can give appropriate treatment.

### **Skin contact**

46 Contaminated clothing should be removed and it is essential that the affected area is flooded with plenty of clean, cool water, for at least 5-10 minutes. Calcium gluconate gel should be applied on and around the affected area and continuously massaged into the skin until at least 15 minutes after any pain is relieved. The first aider should ensure their own hands are protected with neoprene rubber gloves of adequate strength when removing contaminated clothing and when applying this treatment. The casualty should be taken to hospital and treatment with calcium gluconate gel should be continued whilst in transit, particularly if any pain has returned to the injured area. After pain has been relieved the area can be covered with a dressing soaked in calcium gluconate gel and lightly bandaged.

47 Calcium gluconate gel is essential to the first-aid treatment of hydrofluoric acid burns. The first aider or another nominated person should therefore closely monitor the availability of the gel to ensure a sufficient quantity is always available. As the gel has a limited shelf life of two years a method of checking the expiry date and replacing the gel as necessary, should also be in place. Pickling paste should not be used unless the gel is available as this will otherwise increase the severity of any injuries that may be sustained.

### **Eye contact**

48 If pickling paste enters the eye urgent action is again required. The eye should be flushed with water for at least 20 minutes. While this is carried out the casualty should be transported to hospital.

### **Gassing**

49 In the event of gassing the casualty should be removed from the contaminated area and placed in fresh air, if necessary they should be resuscitated. The casualty should be sent to hospital.

### **Ingestion**

50 If pickling paste has been swallowed do not attempt to induce vomiting. If the casualty is still conscious, continuously rinse their mouth out with clean, cool water whilst they are transported to hospital.

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