

Chapter 12 . . . DE-GREASING BY TRICHLOR-ETHYLENE PROCESS

LIST OF CONTENTS

Introduction

1. Metal parts frequently require cleaning prior to inspection, assembly, heat-treatment, or the application of a protective coating. One approved method for this is by the use of a chemical solvent; trichlorethylene is frequently selected for the purpose.

2. Trichlorethylene is a colourless, spirituous liquid which boils at 87° C. The vapour given off is much heavier than air; the liquid may therefore be boiled in the lower part of a deep container and condensed in the upper part without serious loss of fluid by diffusion.

Articles may be cleaned by:—

- (i) Suspending them in the vapour rising from boiling liquid; this is the method usually adopted for aircraft parts.
- (ii) Immersing them in boiling liquid.
- (iii) Immersing them in cold or boiling liquid, followed by suspension in the vapour.

General description of plant

3. A plant employing boiling liquid or trichlorethylene vapour consists of one or more deep vessels with means for heating the liquid in the lower part and provided with cooling pipes below the mouth of the vessel for condensing the vapour. Heating may be by means of:—

- (i) Steam pipes.
- (ii) High pressure hot water pipes.
- (iii) A gas or oil burner.
- (iv) Electric heaters.

4. Matter removed from the articles being cleaned passes into the sump, in solution or as solid sediment. The soluble materials raise the boiling point of the liquid and lower its specific gravity. The solid sediment may tend to insulate the source of heat and, in gas, oil or electrically-heated plants, may cause local overheating of the vessel if the sediment is not removed. Temperatures above 120° C. are to be avoided, as otherwise the trichlorethylene

	PARA.
Introduction	1
General description of plant ...	3
Installation	5
Heating	
Steam	7
High pressure hot water... ..	8
Gas or oil	9
Electricity	10
Maker's instructions	11
Servicing	
Introduction	12
Re-distillation	13
Temperature control	15
Acidity	17
Prevention of corrosion	21

may decompose and produce a detrimental acid (see paragraph 15). Cold water is passed through the cooling pipes, and thermostatic and/or mechanical controls are provided to shut down the plant when the sump becomes unduly hot or when the cooling system fails.

Installation

5. The plant is to be installed in accordance with the maker's instructions and with regard to the type and volume of work handled. If any existing plant is called upon to handle a new class of material or part, the maker is to be consulted regard-

ing the plant's suitability for use with the new part.

6. In view of the narcotic nature of trichlorethylene good ventilation is to be provided to remove any vapour which may be dissipated into the surrounding atmosphere. An efficient exhaust draught (natural or forced) from a convenient point a few feet above the plant rim to roof height is recommended. If the plant is near an outside wall a fan in the wall about 8 ft. above the plant, exhausting outside, is very efficient. Adequate fresh air inlets are to be provided near ground level, at the opposite side of the building if possible. If the plant is in a well more than 18 in. deep, suction ventilation is to be provided for use whenever the pit is to be entered.

Heating

Steam

7. This form of heating is very efficient. Superheated steam is not to be used and the gauge pressure must not exceed 30 lb. per sq. in. when pure trichlorethylene is in the plant. Higher pressures are permissible (with advantages in maintaining optimum performance) as the oil content, and consequently the boiling point of the sump contents, increases. If the supply is in excess of 30 lb. per sq. in. a reducing valve or an automatic control, which will regulate the pressure rise in accordance with the maker's recommendations, should be fitted.

High pressure hot water

8. This is also a very efficient method of heating. Control is effected by an orifice plate—supplied by the makers—in the supply line to the heating coils. The size of orifice required varies with the pressure and temperature of the supply, and should be determined by experiments so that the vapour generated is controlled by the condensing coils.

Gas or oil

9. Gas is the most usual form of heating: oil heating is only to be employed when other forms of heating are not available. In both instances it is desirable that the products of combustion be removed from the workshop as soon as possible. A flue pipe (fitted with a cowl to prevent down draught) is to be provided leading to open air by the shortest vertical route. If an outside delivery is not practical the flue should terminate high in the building near to a point where there is an efficient exhaust draught. The exit must be clear of any metal work and at no point is a flue pipe to pass over the tank. Precautions are to be taken to prevent the ingress of trichlorethylene vapour to the burners, otherwise decomposition and the production of hydrochloric acid will take place.

Electricity

10. There are no special points to stress in regard to electric heating.

Maker's instructions

11. The notices provided by the makers regarding the operation and precautions to be taken are to be exhibited prominently in close proximity to the plant.

Servicing

Introduction

12. Once the plant has been installed, successful operation depends upon:—

(i) Maintaining the trichlorethylene at the correct level in the sump of the plant.

(ii) The re-distillation of the liquid at sufficiently frequent intervals to prevent contamination increasing to such a degree that the trichlorethylene vaporised is not dense enough to de-grease the work satisfactorily.

(iii) The early removal of solid matter from the sump.

(iv) Keeping all internal surfaces, particularly those through which the liquid is heated, clean and free from deposit.

(v) The exclusion of water and water vapour from contact with trichlorethylene or its vapour,

Re-distillation

13. Re-distillation is to be done before the amount of oil and grease dissolved in the trichlorethylene becomes great enough to interfere with the efficient working of the plant. The necessity for re-distillation is usually indicated by:—

(i) The excessive time taken in de-greasing a normal batch of parts.

(ii) An excessive fall in the vapour line when new work is put in and delay in the line regaining its normal position (this should be between the second and third turns of the condensing coil, counting from the lowest).

14. The amount of oil present may be ascertained by:—

(i) Taking hydrometer readings of the liquor in the sump.

(ii) Analysing a sample of the liquor.

Note . . . The percentage of oil and grease present should not exceed 40 per cent.

Temperature control

15. Many plants are fitted with a thermostatically controlled fuel cut-off valve to prevent excessive temperature rise. If steam heating or high pressure hot water heating is employed, the temperature cannot rise excessively. The cut-off devices operate when the temperature of the mixture reaches 120° C., as trichlorethylene heated above this point decomposes, forming hydrochloric acid which can corrode the plant or parts treated. It is important that immersion cut-off thermostats, steam coils, etc., are never uncovered as the level of the sump mixture falls. If flame heating is employed and if no automatic cut-off valve is fitted, one of the methods described in paragraph 14 to determine the amount of oil present must be used at frequent intervals. When a plant is in regular use on work of a uniform character it is good practice to standardise the time between re-distillations, making the period short enough to preclude the possibility of excessive contamination.

16. If, after re-distillation and topping-up, the symptoms described in paragraph 13 (i) and (ii) persist, the heating equipment is probably defective.

Acidity

17. Aluminium and magnesium (and their alloys) in finely-divided form react with trichlorethylene and cause its decomposition. The consequent acidity corrodes the plant and work if the plant is not cleaned out regularly and thoroughly. Reaction may be indicated by unusual fumes, and by the formation of a black, sticky substance. To prevent such

reaction it is essential that the following precautionary measures should be taken:—

(i) Pre-clean the parts by air blast or by washing in a light fuel oil. Paraffin or white spirit may be used where there is no fire risk, but if de-greasing plants are heated by gas, oil or electricity, these solvents are not to be used.

(ii) Clean the plant thoroughly at least every seven days, ensuring that all finely-divided metal is removed from the sump, heating coils, etc.

(iii) Ensure that the level of liquid in the sump never falls too low.

(iv) Add small quantities of anhydrous sodium carbonate (soda ash) twice daily, preferably when the solvent is not boiling. The soda ash is to be sprinkled evenly over the surface of the liquid. The amount added over a period of seven days should approximate to 1% of the trichlorethylene charge.

(v) The trichlorethylene is to be checked periodically to verify that it is not acid, as follows. Shake up 100 c.c. of trichlorethylene distillate with 50 c.c. of distilled water and add a few drops of bromophenol blue to act as indicator. A similar volume, i.e. 50 c.c., of distilled water is also to be treated with the indicator. Both solutions should be blue in colour. The alkalinity of each is then to be determined by titration with N/10 hydrochloric acid to a yellow end-point. The volume of acid required to neutralise the extract should exceed that required to neutralise the distilled water by at least 0.2 c.c.; otherwise the plant must be thoroughly cleaned and the solvent reconditioned.

(vi) Many of the larger de-greasing installations have small auxiliary plants which are used as stills for the sump liquor from the main plants. It is advisable to carry out distillation in these plants in the presence of sodium carbonate and water as this assists in re-conditioning the solvent. To a gallon of water, $\frac{1}{4}$ lb. sodium carbonate should be added.

18. If, in spite of these precautions, acidity develops, the fact is to be reported to higher authority. The plant is not to be used until it has been rectified.

19. If a plant has been acidic it should, after cleaning out, be treated as follows:—

(i) Filled up to a point above the condensing coils with a solution of sodium carbonate in water, boiled for several hours and then emptied. A $\frac{1}{4}$ lb. of sodium carbonate should be added to each gallon of water.

(ii) Swilled with water.

(iii) Dried out.

(iv) Re-charged with fresh trichlorethylene.

20. In addition to the normal precautions for excluding water, care is to be taken to ensure that the plant is not installed near escaping steam. Excessive cooling may result in the condensation of atmospheric moisture which will fall into the sump. Water in a plant can cause rapid corrosion of the structure, particularly in the zone just below the cooling coils where it condenses and remains on the sides.

Prevention of corrosion

21. Corrosion of parts, particularly those made in light alloys, may occur if they are subjected to heat before all trichlorethylene has been removed. Care is therefore to be taken to ensure that parts of complicated form or containing blind holes are carefully turned about so as to remove all liquid. Bundles of parts intended for immediate heat treatment are to be shaken to ensure that liquid is not retained by capillary attraction between surfaces in contact. In any event, parts are not to be immersed in a salt bath until they have acquired atmospheric temperature after removal from the de-greaser; it is advisable to allow an interval before treatment. As, however, de-greasing produces a clean surface whose resistance to corrosive attack is at its lowest, a protective coating is to be applied, at the very earliest opportunity after de-greasing, to parts made of readily corrodible materials.

Note . . . Where the requirements of Specification D.T.D.901 apply, parts and materials, even if effectively de-greased, may need a further cleansing operation to remove insoluble solid matter.





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