

## TECHNICAL NOTE

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### INTRODUCTION

Pesticide residues inside and outside the tanks, hoses, nozzles, valves and pumps of mechanised spraying equipment can contaminate operators and possibly lead to crop damage. It is therefore essential that all internal and external surfaces of application equipment are thoroughly cleaned after use. It is also important that the surfaces of tractors and other specialist vehicles are also cleaned.

The Code of Practice for using plant protection products recommends that you clean the equipment you have used, inside and out, preferably before leaving the treatment area. It is also considered best practice to clean applicators before switching to a different pesticide.

Some types of mechanised spray equipment can retain significant amounts of pesticide solution. Depending on the size and design of the applicator, up to 27 litres can remain in a system. Components such as induction bowls, hoses, tanks and pumps retain the most solution.

This Technical Note sets out the procedures for cleaning pesticide applicators and proposes a cleaning regime drawn from current sources of best practice. Before cleaning any mechanised spray equipment it is important that you:

- Read the manufacturer's instructions for specific guidance on the best methods for cleaning the equipment.
- Consult the pesticide label for any special cleaning instructions.
- Wear the protective clothing described on the pesticide label.

### CURRENT STANDARDS AND RESEARCH

There is no standard procedure for cleaning mechanised spray equipment. However a series of International Standard Organisation (ISO) standards have been produced for determining the effectiveness of cleaning equipment.

**ISO 22368-1:2004** specifies tests for determining the performance of the rinsing systems fitted onto sprayers used in crop protection for the internal cleaning of the complete sprayer, including the tank.

**ISO 22368-2:2004** specifies two test methods for evaluating the performance of cleaning systems fitted onto sprayers used in crop protection for the removal of deposits on the external surfaces of the sprayer. The purpose of the tests is to provide sprayer designers with information on contamination of the sprayer and permit comparison of different attachments or adjustments in relation to external cleaning, and to allow the performance of different cleaning devices to be determined.

**ISO 22368-3:2004** specifies a test for determining the performance of the rinsing systems fitted onto sprayers used in crop protection for the internal cleaning of the spray-liquid tank or tanks.

Research has suggested that the level of residue on the external surfaces of some sprayers may exceed the acceptable operator exposure limit (AOEL)\* within five hours of contact with pesticide residues (Ramwell *et al.*, 2004). It is also thought that the material and the shape of the tank, the area of the exposed surfaces and the parts which are difficult to clean (such as hoses tied to the tank and hollows and bumps of the tank) play a major role in sprayer contamination rates. Results also indicate that the amount of spray deposit increases in areas with high temperatures and low humidity (Balsari *et al.*, 2002).

Although the use of high pressure as a cleaning method is not recommended, some studies have shown that cleaning sprayers using a hose or a high pressure washer removed less than 50% of the external residues. The maximum mean removal for an individual decontamination technique was 66%. This involved using an ammonium-based cleaning agent followed by a high-pressure rinse.

\*AOEL is the maximum amount of active substance to which operators may be exposed without any adverse health effects.

Examinations of the internal surfaces of tractor cabs have also demonstrated that pesticides can contaminate steering wheels, gauges and the fabric of seats (Landers, 2004).

Although it has been found that many operators are aware of engineering controls such as low-level induction hoppers or bowls, personal protective equipment (PPE) storage boxes and tank rinse systems, they are often reluctant to use them. These controls can be purchased as an option on some sprayers or installed later as an add-on kit.

## LEGISLATION AND CODES OF PRACTICE

The legal aspects of pesticide use are governed by the Food and Environment Protection Act (Part III) 1985 (FEPA). Under FEPA the following legislation also applies:

- The Control of Pesticide Regulations 1997
- The Plant Protection Products (Basic Conditions) Regulations 1997

There are various other acts and regulations that also govern the use of pesticides.

### Code of Practice for using plant protection products

The Code of Practice for using plant protection products provides the following advice about cleaning equipment:

- You can apply the washings to the treated or untreated crop or area within the terms of the product approval. But make sure you do not exceed the maximum dose.
- You can store the washings in a suitable container until a licensed waste-disposal contractor can collect it.

### Forests and water guidelines

The 4th edition of *Forests and water guidelines* (Forestry Commission, 2003) describes general best practice for forest operations. The sections that refer to pesticides and chemicals have the following recommendations for applicator cleaning and effluent disposal:

- Do not wash out sprayers, containers or similar receptacles near any watercourses, however small.
- Seek advice from the appropriate water or waste regulatory authority about the safe disposal of unwanted pesticides.

- Booms, absorbent sheets and/or pillows should be available to contain and absorb any spillage, preventing them from entering nearby watercourses.

### UK Woodland Assurance Standard

The *UK Woodland Assurance Standard* (UKWAS) gives general guidelines on pesticide use (UKWAS Steering Group, 2006). To comply, owners/managers must provide:

- Facilities for storage and disposal
- Safety equipment
- Locked boxes for transport
- Absorbent materials
- A written contingency plan

## CLEANING PRODUCTS

Several cleaning solutions are commercially available and should be selected to match the pesticide formulation used. Cleaning solutions can be used to wash both the inside and outside of the sprayer. Specific recommendations can be found:

- On the pesticide label
- From the pesticide manufacturer
- On the cleaning solution label
- From the cleaning solution manufacturer

For the best results you should follow the cleaning solution instructions. Chlorine bleach solutions should not be used.

### Cleaning agents

Many of the cleaning agents available use a surfactant, a sequestrant and solubiliser, in combination or individually, to aid removal of pesticides from the spray applicator.

- A surfactant reduces the surface tension and enables the product to penetrate into the crevices and hard-to-reach parts of the spray equipment. When the surfactants contact the sticky residues, they penetrate into the deposits and break them up into component parts to aid removal, helping to lift them from the tank surface.
- The sequestering agent helps to lock up materials in the washings; this helps prevent the residues from re-sticking to the equipment surfaces. This process helps in the efficient removal of harmful residues.
- The solubiliser helps to neutralise the pesticide residues as they are removed from the spray equipment.

## PERSONAL PROTECTIVE EQUIPMENT (PPE)

It may not be necessary to wear PPE during vehicle mounted spraying operations where the vehicle is fitted with an appropriate cab. The engineering control provided by the cab is considered to provide sufficient protection to the operator. In this case, the only items of PPE recommended are gloves and coveralls. However, the following PPE requirements for handling, mixing, filling of the concentrate and attending to maintenance and breakdowns should be viewed as being essential:

- Wellington boots
- Coveralls
- Hood
- Gloves
- Face shield

The methods of storing PPE vary. In many cases gloves are usually kept in the cab, for quick access, with other PPE kept in one or more of the following ways:

- Polythene bag in tractor cab
- External box secured to tractor
- Vehicle or purpose built trailer nearby
- Chemical store

Some applicators have separate compartments for dirty and clean PPE fitted to the vehicle.

## APPLICATOR AND MACHINE CLEANING TECHNIQUES

The need for cleaning can be reduced by good planning and equipment maintenance. You should:

- Carefully plan how much pesticide to mix, so that all mixed pesticides are used on site. This minimises the amount of waste for disposal.
- Be sure that the sprayer is clean before use.
- Make sure all parts of the sprayer are in good condition. Pesticide can collect in corroded and pitted surfaces. Any leaks in the applicator system will increase contamination rates. Replace any worn parts.
- Mix pesticides in the correct order. Some chemicals, when mixed in the wrong order, can actually become more difficult to remove from the equipment. Consult

the pesticide label for the proper mixing order.

- Follow any label instructions for cleaning equipment.
- Be sure that cleaning solutions contact ALL equipment surfaces.

Remove and clean filters, strainers and nozzle screens in isolation from the rest of the applicator to ensure a more thorough cleaning of these components. You should keep the volume of washings produced to a minimum. Ideally a tank rinse system should be used.

There are three levels of sprayer cleaning:

- Where the same or similar pesticides are to be used on consecutive occasions
- Where the type of pesticide is changed
- End of the season cleaning

Table 1 shows the operations that should be carried out for each level of cleaning.

### Pressure washers

Many operators use high pressure washers to remove stubborn deposits. However, high water velocities produce splash back and mist, increasing the risk of contamination.

The British Agrochemicals Association (BAA)\* leaflet *Sprayer cleaning: a practical guide* recommends low-pressure washing directed through a purpose built brush. The BAA considers that the system:

- is the most effective for cleaning;
- uses less water than a high-pressure washer;
- produces less splash back and mist than a high pressure washer.

When cleaning the tractor (prime mover) and applicator there is a tendency to use more water than required. This has economic consequences because more water is required and more washings is produced.

### Disposal of washings

It is possible to spray oil-free effluent on the site provided the maximum pesticide dose, stated on the product label, has not been exceeded. Washings can be sprayed on untreated or underdosed areas.

\*The BAA is now known as the Crop Protection Association.

**Table 1** Cleaning levels.

	Level 1	Level 2	Level 3
Flush the applicator with clean water (and cleaning agent where appropriate), making sure to wash all inside surfaces of the tank – including the underside of the lid.		✓	✓
If a tank rinse system is not available, fill the spray tank about half full with clean water and flush the system for at least five minutes using both agitation and spraying. Open and close any control valves during the rinse process. The washings should be applied to the site at recommended label rates. Repeat this procedure two more times.		✓	✓
Hose down the outside of the sprayer, ensuring that all external surfaces are covered. Scrubbing with a plastic brush may be necessary.		✓	✓
Remove suction, main and in-line filter elements and wash them thoroughly in clean water using a soft brush. Replace the filters on the cleaned applicator.		✓	✓
Remove the nozzles, nozzle screens and nozzle bar end caps (if used) and wash them thoroughly in clean water with the appropriate cleaning solution and rinse. Remember to use a soft bristle brush, such as an old toothbrush, when cleaning nozzle parts.		✓	✓
Partly fill the sprayer with clean water and run the sprayer to flush out all parts.		✓	✓
Re-install nozzles and nozzle screens.		✓	✓
Hose down the outside of the sprayer once again.		✓	✓
Applicator washings will be produced from internal and external cleaning. The washings should be applied on site to avoid handling and disposal issues at a maintenance base.	✓	✓	✓
Washings must be collected and either used in another load of the same pesticide and applied at the label recommended rates or disposed of at an approved pesticide waste handling facility.	✓	✓	✓
Remove nozzles and filters and store them in a secure container to ensure they are kept clean and damage-free. Leave valves open (to reduce frost damage) and the tank lid loosely closed. Spray any metal fittings with a lubricant and rust inhibitor.			✓

## FURTHER READING

### Forestry Commission publications

- Forests and water guidelines, 4th edition
- The use of herbicides in the forest. Field Book 8

### Other publications

British Agrochemicals Association

- *Sprayer cleaning: a practical guide.*

Department for Environment, Food and Rural Affairs (Defra)

- *Code of Practice for using plant protection products.*

UKWAS Steering Group (2006).

- *UK Woodland Assurance Standard.*

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