SAFETY AND ENVIRONMENTAL CONSIDERATIONS IN THE USE OF CHEMICAL FIRE RETARDANTS

R. Sneeuwjagt

INTRODUCTION

Chemical fire retardants are being used more and more widely in mop-up and wildfire situations in Western Australian forests. The benefits of these chemicals over water alone have been demonstrated by the U.S. Forest Service and other fire fighting authorities throughout the world. Some of the advantages of retardant chemicals are:

1. They multiply the effectiveness of water when used as a fire suppressant or as a mop-up agent.

2. They are still effective as retardants after the water has evaporated.

3. They can be used to quickly widen and reinforce control lines.

4. They can be used for both air and ground applications.

There are however some problems associated with chemical fire retardants which must be taken into account. Some of these include:

1. Their cost is much higher than water alone.

2. Increased logistics are needed for mixing, storage and distribution.

3. Additional equipment care and modifications are required to prevent corrosion.

4. They can be irritating to the eyes and respiratory system in certain circumstances.

5. They can be environmentally damaging if used in excess and concentrated on and near open water.

The possible effect of forest fire fighting chemicals on people and the environment has been of concern to forest managers since the retardant programme began in the United States in the 1950's. Research done in that nation on the interaction of retardant chemicals with the environment has recently been published, and it is the aim of this article to highlight some of the published results for the interested reader.

THE CHEMICALS

Fire retardants are chemicals that have the ability to inhibit the spread of flames through chemical reactions between the products of combustion and the applied chemicals. Water is used as a dispersing agent, however the chemicals remain effective as flame inhibitors after the water has evaporated. They are thus named long-term retardants.

These retardants contain relatively inexpensive fertilizer-grade ammonium phosphates or sulphate and are available in either a dry powder or liquid concentrate form. In addition other chemicals are added in low concentrations to increase the efficiency of the primary active retardant materials. These may include wetting agents, thickeners, corrosion and spoilage inhibitors, and colouring agents.

The widespread use of these chemicals in our forests raises questions about their possible effects on the environment and people. The following considers the influence retardant chemicals can have on people, animals, fish, plants and soils and outlines the precautions that must be followed to minimize harmful effects and safety hazards associated with the use of chemical retardants.

PEOPLE

Dust from ammonium compounds can be irritating to respiratory system and to the eyes. This effect was confirmed in tests on mice and rabbits which were fed up to 25,000 mg of diammonium phosphate (D.A.P.) per kilogram of body weight. The chemical was found to be a mild eye or skin irritant only and had no oral toxicity whatever.

Certain corrosion inhibitors such as sodium ferrocyanide may have some side effects if they are heated. In this case toxic fumes of cyanide are emitted, however, they are present in extremely low concentrations and thus do not represent a health hazard.

Strong ammonia fumes are emitted when retardant is applied directly to flames or burning logs. These fumes, although not toxic, can be discomforting to the hose operator if he should be working in a confined space where ventilation is limited. To overcome these irritations it is suggested that mixing crews wear goggles and suitable dust masks to minimize dust contamination. Hose operators should wear goggles for eye protection and use extended nozzle attachments or work upwind from the heat source to minimize respiratory discomfort.

Retardant spilled on arms, hands etc. should be thoroughly washed off with clean water. When hands and arms are in contact with liquid retardants for long periods, they become dry and chapped. Some type of allergic hand lotion should be made available to eliminate chapping.

If ammonium phosphate or sulphate are splashed in a persons eyes, they would be no more damaging than common table salt, but should be immediately flushed out with clean water to reduce irritation.

If a persons clothes are soaked they should be rinsed thoroughly before wearing again. The salt particles will chaff the skin if left in the clothing and worn during the work period.

LIVESTOCK

Fire retardants used in combating U.S. forest and range fires have been accused of killing livestock by nitrate poisoning. Ammonia-based retardants cannot cause nitrate poisoning directly. They must first enter the soil, be converted to nitrates, then be absorbed and accumulated by plants. This process apparently occurs only under special climatic conditions and requires two or three weeks. These conditions are low light intensity and high temperatures; or when drought occurs late in the growth cycle. Even when these special climatic conditions occur, trouble can be avoided by deferring grazing for three or four weeks after application so the plants can convert the extra nitrates into normal, harmless protein. The possibility of injury to livestock by ingestion from fire retardant materials is very slight - much less than that from a pasture fertilization programme.

PLANTS

Toxicity to plants has not been considered a problem with currently used materials. Ammonium phosphate and sulphate compounds do not usually create adverse effects to plants, since current materials are commonly used agricultural fertilizer. If applied in too heavy concentrations these chemicals can temporarily dessicate vegetation. The phenomenon can be observed when fertilizer is applied too heavily on green lawns and the grass is temporarily burned. To date, there are no reports of this being a real problem with brush or timber species.

FISH AND AQUATIC ORGANISMS

Chemical fire retardants can be toxic to fish and other organisms when present in heavy concentration in their aquatic environment. Ammonia is the major cause of the problem. All currently used retardants contain ammonia and are therefore potentially toxic agents. Ammonia is toxic up to a 200 000:1 dilution rate and dead fish will start coming to the surface within two to three minutes.

The sulphate components and dichromate (corrosion inhibitor) can be lethal for other aquatic organisms. The lethal dilution rate extends upwards to 1,000:1.

The following guidelines should be followed to minimize the entry of retardant chemicals into bodies of water.

1. Inform field personnel of the potential problem of fire retardants in streams or lakes.

2. Locate retardant mixing and loading points where natural water contact is minimal.

3. Exercise care in prevention of accidental or careless spills at mixing, loading and assembly areas, especially near live streams.

4. Avoid direct application of retardants into rivers or lake shores. Use alternative methods of fire suppression or fire line building.

5. Spills should be cleared up immediately. These should not be flushed down a drainage ditch or into a live stream, but rather be spread thinly over a land surface.

SOILS

No currently used fire retardants are known to produce a sterilizing effect at the presently used application rates. The nitrogen available in the ammonia compounds such as mono-ammonium phosphate, diammonium phosphate and ammonium sulphate are fertilizers, and sold as such commercially.

DOMESTIC WATER SUPPLIES

When retardants are used near domestic water supplies, the same precautions must be exercised as mentioned in the Fish and Aquatic section. Leave at least 40-60 metre buffer zone from the water line. Under normal conditions, plants and soil can absorb a majority of the chemicals before they wash or leach to the body of water. The exception would be an area with extreme surface erosion.

SUMMARY

Some precautions are necessary in the application of chemical fire retardants in the field. Hose operators should be provided with goggles for eye protection and position themselves upwind from the heat source. Similarly mixing crews should wear goggles and dust masks as protection from dust irritation.

Retardants should be kept away from live streams or ponds of water. Spills should be avoided and kept away from drainage ditches. Excessive application rates should be avoided. These could be toxic to plant life as would occur with any fertilizer.

REFERENCE

"Southern Guide for Using Fire Retardant Chemicals in Ground Tankers". U.S. Dept. of Agriculture, Forest Service, State and Private Forestry, Southeastern Area.