

## Effects of Fire-Control Chemicals Investigated

### Introduction

Fire-control chemicals are an important tool used to manage and suppress wildland fires. In addition to water, the two most commonly used types of fire control chemicals are long-term fire retardants and short-term fire-suppressant foams.

Fire retardants are used to slow the spread of a fire and are composed of ammonium salts, thickeners, corrosion inhibitors, and coloring agents.

Fire-suppressant foams are used to extinguish fires and to provide a short-term fire barrier. Foam concentrates typically consist of surfactants, stabilizers, and solvents.



*Aerial application of long-term retardants provides fire fighters the opportunity to slow the spread of fire in areas that are hard to access.*



*Fire suppressant foams can be applied from the air or sprayed directly on vegetation or structures to create a short-term barrier to fire.*

In the United States alone, over 92 million gallons of these chemicals were used in fire fighting operations between 1994 and 1996. In many cases, these chemicals are used in environmentally sensitive areas that may contain endangered, threatened, or economically important species. Since most fire-control chemicals are applied using aircraft, aquatic habitats near the drop zone are subject to accidental inputs. Although much effort has been expended on improving the delivery of these chemicals, accidental inputs and fish kills have occurred in streams during fire control operations.

## Research

Fire retardants and foams are often used in areas adjacent to aquatic habitats.

As part of an extensive five-year research effort to better define the responses of terrestrial and aquatic communities to fire chemicals, the CERC Yankton Field Research Station characterized the toxicity of six fire retardants and seven foam suppressants, to juvenile rainbow trout (*Oncorhynchus mykiss*).

Juvenile trout were exposed under laboratory conditions to various concentrations of each chemical for four days, in soft water; monitoring mortality and abnormal behavior.

This exposure scenario simulated an accidental drop, or spill, of a fire-control chemical into a water body. Acute toxicity was calculated and expressed as a 96-h  $LC_{50}$ , the concentration of a toxicant expected to kill 50% of the test organisms in 96 hours. The 96-h  $LC_{50}$  values were used to rank the chemicals according to their toxicity to these trout, from most to least toxic.

### Foam Suppressants

- FireFoam 103B
- FireFoam 104
- Phos-Chek WD-881
- ForExpan S
- Silv-Ex
- Fire Quench
- Pyrocap B-136

### Fire Retardants

- Powders
  - Phos-Chek 259F
  - Phos-Chek D75F
  - Fire-Trol GTS-R
- Liquids
  - Fire-Trol LCA-F
  - Fire-Trol LCG-R
  - Fire-Trol LCM-R

Results show variation in the acute toxicity of these chemicals to young rainbow trout.



*Even though caution is used in aerial application of fire chemicals, aquatic environments may be at risk from accidental spillage or overspray.*

The foam suppressants were more toxic at lower concentrations to the trout than the fire retardants. Among the fire retardants, the powder formulations were more toxic to the trout than the liquid compounds.

Additional research suggested that the toxicity of some fire retardants was related to the ammonia component in their formulations, and for the foams, to the surfactant component.

## Environmental Considerations

Recommended application concentrations compared to the test results indicate that any inputs of these chemicals into surface waters require substantial dilutions to reach concentrations that are not acutely lethal to young rainbow trout.

Although wildland fires themselves are likely to have a major impact on fishes in streams located in the fire perimeter, this research addressed the potential direct effects of fire control chemicals on rainbow trout.

Information obtained from this research may be used to plan fire-control operations in areas containing

trout and salmon streams, and in assessing the potential damage to fish populations in streams at risk from accidental spillage or overspray.

## Contact Information

[http://www.cerc.usgs.gov/frs\\_webs/yankton/](http://www.cerc.usgs.gov/frs_webs/yankton/)

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