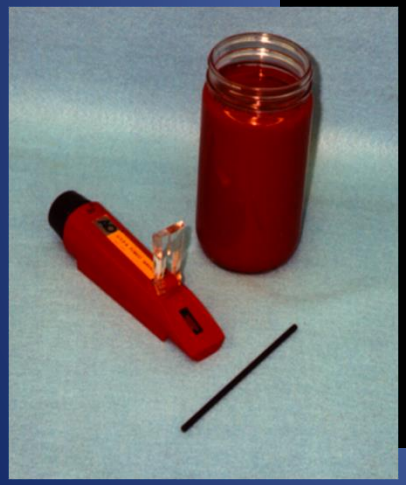
Introduction to Wildland Fire Chemicals



Wildland Fire Chemical Systems (WFCS)
Missoula Technology and Development Center

Objectives

- This presentation will provide the viewer with an introduction to:

- Basic information on wildland fire chemicals.
- How fire chemicals decrease or stop fire spread.
- How fire chemicals are tested.
- The Qualified Products List.
- Guidelines for fire chemical use.
- Required actions if fire chemicals land in sensitive areas.

Note: The term fire chemicals as used throughout this training refers to wildland fire chemicals.

Contents

I. Fire Triangle

II. Retardants and Suppressants
- 3 categories of fire chemicals and characteristics of each.

III. Qualified Products List (QPL)
- Fire chemical specifications.
- Testing and evaluation of products, including their approval and addition to QPL.

IV. Safety & Health

V. Guidelines for Using Fire Chemicals

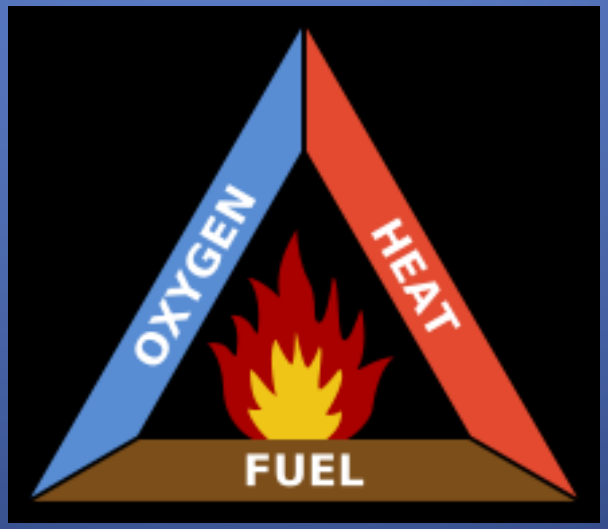
I. Fire Triangle

- Fire needs three things to burn:
  - Fuel
  - Oxygen
  - Heat
- These are legs of the fire triangle.
- Remove any one of these and the fire will go out.

Fire Triangle, continued

Fire chemicals work by:

- Removing heat from the fire by cooling it.
- Removing oxygen from the fire by smothering it.
- Making fuels less combustible.



Why Use Wildland Fire Chemicals?

Water:

- can be an effective firefighting tool
- cools and smothers fire
- is usually readily available

So, why not just water?

- It evaporates quickly
- It doesn’t cling to fuel, but rather runs off easily

Wildland fire chemicals can be a more effective alternative!

Firefighting Chemicals Are Used To:

- Improve the efficiency of water (direct attack).
- Treat fuels to make them less combustible even after the chemical has dried (indirect attack).
- Reduce fire intensity making it possible for firefighters to work the fire line.
- Protect life and property.

Firefighting Chemicals:

- Although they are sometimes used in such a manner, firefighting chemicals are not designed to put out a fire by themselves. They are designed to slow the fire, allowing time for ground crews to put it out.

Direct Attack & Indirect Attack

Direct Attack means the fire chemical is applied directly on the burning fuel so the water content can smother and cool.

Indirect Attack means the fire chemical is applied ahead of the fire so there is unburned fuel between fire and retardant line.

Direct Attack

Indirect Attack

II. Suppressants and Retardants

Definitions:

Suppressant – an agent that extinguishes the flaming and glowing phases of combustion by direct application to the burning fuel.

Retardant – an agent that reduces the flammability of combustibles by chemical action.

Class A Foam (Suppressant)

- Foaming agents affect how well the product clings to the fuel surfaces.
- Wetting agents increase the ability of water to soak into fuels.
- Foams depend on the water they contain to suppress the fire.
- Foams can be used for direct attack, mop-up or pretreating fuels for prescribed burning.

Foam Composition
(as delivered to the fire)

- 99.0 – 99.9% water
- 1.0% - 0.1% =
  - wetting agents (surfactants)
  - foaming agents
  - corrosion inhibitors

Water Enhancers/Gel (Suppressant)

- Gels change the physical characteristics of water to increase effectiveness, decrease drift or enhance adhesion to fuels.
- Gels depend on the water they contain to suppress the fire.
- Gels can be used for direct attack.

Water Enhancer/Gel Composition
(as delivered to the fire)

- 97% - 99.5% water
- 3.0% - 0.5% =
  - superabsorbent polymers (thickeners)
  - other minor ingredients
    - stabilizers
    - corrosion inhibitors

Long-Term Retardants

- Long-term retardants contain fertilizers (retarding salts) that alter the way the fire burns, decreasing the fire intensity and slowing the advance of the fire.
- Long-term retardants are effective even after the water they contained has evaporated.
- Long term retardants are used for indirect attack and can be used for direct attack.

Retardant Composition
(as delivered to the fire)

- 85% water
- 10% retarding salts (fertilizer)
- 5% minor ingredients:
  - colorant (iron oxide or fugitive)
  - thickeners
  - corrosion inhibitors
  - stabilizers

Retardant is a Good Choice for Indirect Attack

- Note there is unburned fuel between the fire and the retardant line. Let the fire burn into the line for maximum retarding effectiveness.

Gel, Foam, and Water are Good for Direct Attack

Put chemicals directly on the burning fuel for maximum suppressing effectiveness.

III. Qualifying Fire Chemicals and the Qualified Products List (QPL)

FS/BLM/NPS/
BIA/FWS Policy.

All wildland fire chemicals must be evaluated and approved prior to use by these agencies.

(Forest Service Manual 5162.03, Interagency Standards for Fire and Aviation Operations [Red Book] Chapter 12.)

Qualifying Criteria

Performance requirements are established through input from firefighters in the field. These requirements ensure effectiveness and safety of the products and are unique to wildland firefighting.

Qualifying Fire Chemicals

- Evaluation of fire chemicals takes 18-24 months.
- Cost of evaluation is paid by the fire chemical manufacturer.

Qualifying Fire Chemicals

- Products must meet performance requirements for:
  - Effectiveness
  - Safety and Environmental Protection
  - Materials Protection
  - Stability

Retarding or Suppressing Effectiveness

- Chemicals must be effective at slowing down or putting out fire, or slowing or inhibiting ignition.
- Products must be at least as effective as 10.6% diammonium phosphate in combustion retarding tests.

Human Health and Safety

- Products are tested to meet human health and safety requirements.
  - Acute (short term) oral toxicity.
  - Acute skin (dermal) toxicity.
  - Skin irritation.
  - Eye irritation.

Aquatic Toxicity

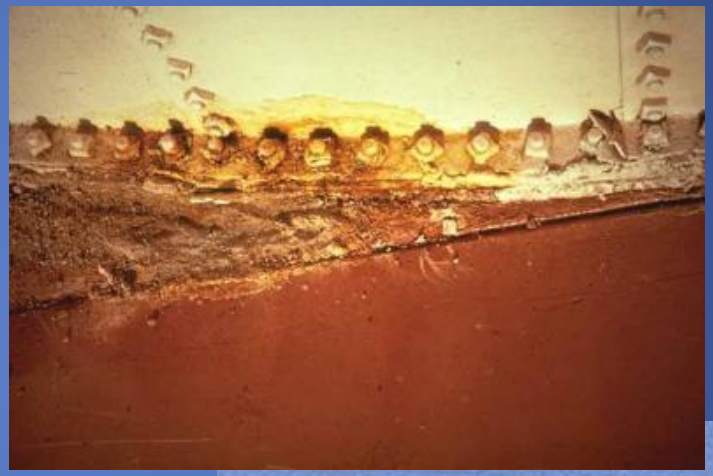
- Acute toxicity testing.
  - Tests for short-term exposure (96 hrs) of juvenile rainbow trout to the wildland fire chemical.

Biodegradability

- Biodegradability is the measure of decomposition of a product by bacterial action.
- Foams are required to be biodegradable.

Corrosion

- Uniform corrosion is the removal of metal over the entire surface by chemical means.
- Intergranular corrosion occurs within the metal's grain boundaries and must be viewed with a microscope.



Stability

- Stability is the ability of a product to maintain its effectiveness over time. Products are stored outdoors for 1 year.

Operational Field Evaluations

- New products may be field tested for the ease of mixing and handling, effectiveness, and quality control.

Qualified Products List (QPL)

- Products must meet the requirements of the applicable specification before being listed.
- All fire chemicals purchased must be listed on the QPL.
- Current listings can be found on Wildland Fire Chemical Systems (WFCS) web site:

  www.fs.fed.us/rm/fire/

IV. Safety & Health

- Human
- Environmental
- Environmental Monitoring
- Risk Assessments
- Transportation

Safety - Human

- Material Safety Data Sheet (MSDS) (available on WFCS website)
  - Every fire chemical has one.
  - Must be available to anyone working with the fire chemical.
  - MSDS doesn't necessarily mean a product is hazardous.
  - Contains general safety information (PPE, safe handling practices, proper disposal).

ANSUL

SILV-EX FOAM CONCENTRATE MATERIAL SAFETY DATA SHEET

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

2. COMPOSITION/INFORMATION ON INGREDIENTS

Safety – Human, continued

- Personal Protective Equipment (PPE)
  - Consult MSDS for additional PPE requirements.
  - Some chemicals can be irritating to eyes and skin.
    - Use goggles when working with concentrates.
    - Wear dust masks when mixing powdered products.
    - Use gloves, wash off skin as soon as possible.

Safety - Environmental

The policy for the aerial delivery of fire chemicals is to avoid their application within 300 feet of **waterways.** A waterway is defined as any body of water including lakes, rivers and ponds, whether or not they contain aquatic life.

Safety – Environmental, continued

Deviation from the policy is acceptable when:

- Life or property is threatened and the use of retardant or foam can be reasonably expected to alleviate the threat.
- Potential damage to natural resources outweighs possible loss of aquatic life, the unit administrator may approve a deviation. (Chapter 12, Red Book)

Safety – Environmental, continued

Any aerially applied chemical must be reported if it occurs within 300 feet of a waterway (buffer zone) or in an area that contains one of the 45 Threatened and Endangered Species (TES) identified by US Fish & Wildlife Service.

(See WFCS website for complete TES list)

Safety – Environmental, continued

- If you observe an intrusion as previously described report it to:
  - Incident Commander
  - Resource Advisor
- They will complete the Interagency Wildland Fire Chemical Reporting Form, NIFC 9210-18.
- Form can be found at: www.fs.fed.us/rm/fire
- Submit form to Shirley Zylstra at: szylstra@fs.fed.us (406-329 -4859).

Environmental Monitoring

- If a TES is exposed to a fire chemical, monitoring may be required by the local unit, FWS or NOAA Fisheries.
- For more information on monitoring protocols, visit the WFCS website: www.fs.fed.us/rm/fire/

Risk Assessment

- A risk assessment estimates the risks to people and the environment associated with the use of fire-fighting chemicals. Risk assessments are primarily based on current toxicity literature and studies.
- They are completed every 5-10 years as needed.

Safety – Transportation

- DOT Regulations
  - Fire chemicals are not regulated as hazardous chemicals.
  - Transportation of fire chemicals are not subject to hazardous material regulations.

Safety – Clean Up

- Handling: Take precautions to minimize and contain spills.
- Don’t spray water onto spilled concentrates, especially foams and gels. Use absorbent materials such as kitty litter or sand to absorb as much product as possible before completing the clean up with water.
- This material can be disposed of by placing in a garbage bag and throwing in trash.

V. Guidelines for Using Fire Chemicals

- Effectiveness vs. time:
  - Foams last for minutes.
  - Gels may last for minutes to hours.
  - Retardants may last for weeks to months.
- Use of chemicals in high winds, extreme fire conditions, or high flame heights may not be effective.
- Retardants may not be effective when flame lengths are greater than ~4 ft. high.

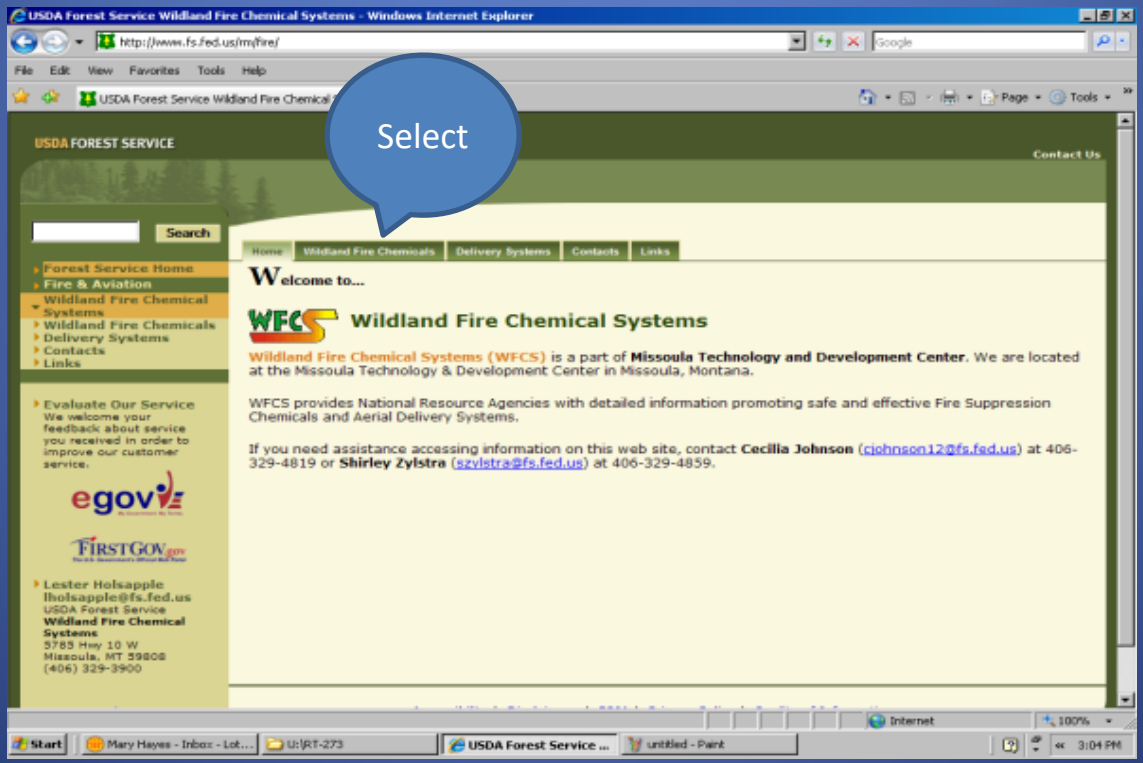
The information you just reviewed can be found in more detail on the Wildland Fire Chemical Systems (WFCS) website:

www.fs.fed.us/rm/fire/

In addition, the website contains information on safety, environmental, product quality, mixing ratios, aerial delivery systems, and other related topics.

http://www.fs.fed.us/rm/fire/

One stop shopping for all fire chemical reference materials !



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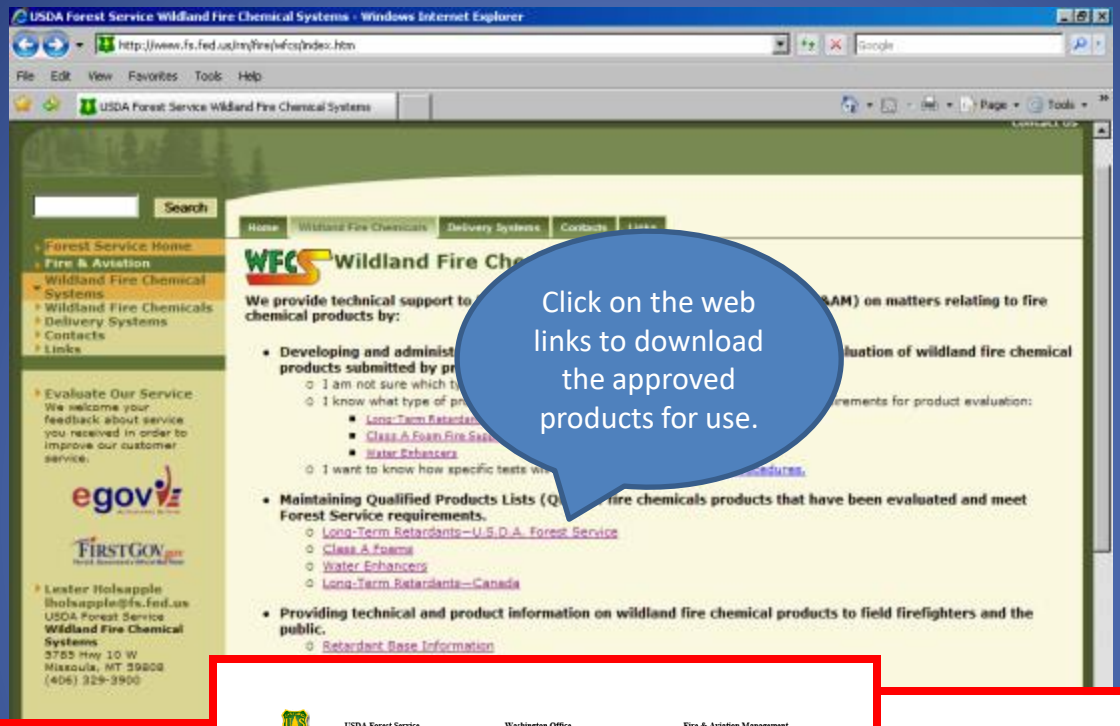
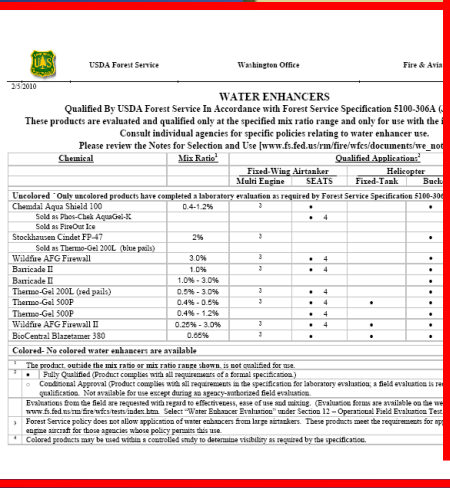




USDA Forest Service — Washington Office — Fire & Aviation

2/5/2010

WATER ENHANCERS

Qualified By USDA Forest Service In Accordance with Forest Service Specification 5100-306A (

These products are evaluated and qualified only at the specified mix ratio range and only for use with the i

Consult individual agencies for specific policies relating to water enhancer use.

Please review the Notes for Selection and Use [www.fs.fed.us/rm/fire/wfcs/documents/we_not

Chemical	Mix Ratio[1]	Qualified Applications[2]			
		Fixed-Wing Airtanker		Helicopter	
		Multi Engine	SEATS	Fixed-Tank	Buck
Uncolored - Only uncolored products have completed a laboratory evaluation as required by Forest Service Specification 5100-306					
Chemdal Aqua Shield 100	0.4-1.2%	3	•		•
Sold as Phos-Chek AquaGel-K			• 4		
Sold as FireOut Ice					
Stockhausen Cinder FP-47	2%	3			•
Sold as Thermo-Gel 200L (blue pails)					
Wildfire AFG Firewall	3.0%	3	• 4		•
Barricade II	1.0%	3	• 4		•
Barricade II	1.0% - 3.0%				•
Thermo-Gel 200L (red pails)	0.5% - 3.0%	3	• 4		•
Thermo-Gel 500P	0.4% - 0.5%	3	• 4	•	•
Thermo-Gel 500P	0.4% - 1.2%		• 4		•
Wildfire AFG Firewall II	0.25% - 3.0%	3	• 4	•	•
BioCentral Blazetamer 380	0.65%	3	•	•	•
Colored- No colored water enhancers are available					

[1] The product, outside the mix ratio or mix ratio range shown, is not qualified for use.

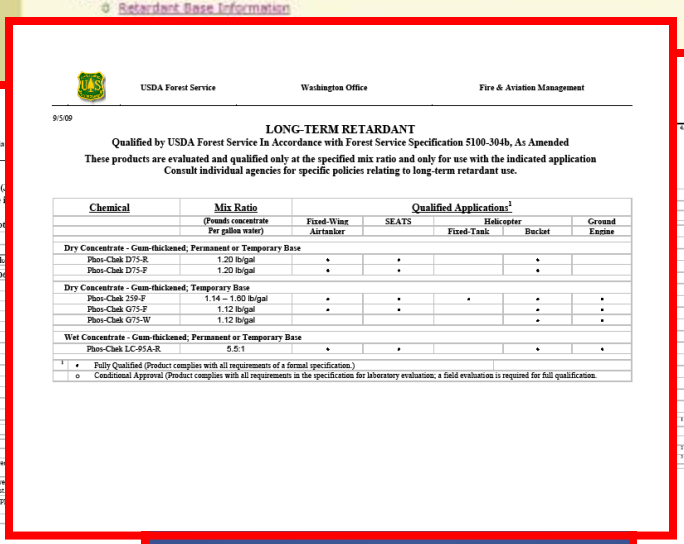
[2] • Fully Qualified (Product complies with all requirements of a formal specification.)

○ Conditional Approval (Product complies with all requirements in the specification for laboratory evaluation; a field evaluation is re qualification. Not available for use except during an agency-authorized field evaluation.

Evaluations from the field are requested with regard to effectiveness, ease of use and mixing. (Evaluation forms are available on the we www.fs.fed.us/rm/fire/wfcs/tests/index.htm. Select "Water Enhancer Evaluation" under Section 12 – Operational Field Evaluation Tes

[3] Forest Service policy does not allow application of water enhancers from large airtankers. These products meet the requirements for sy engine aircraft for those agencies whose policy permits this use.

[4] Colored products may be used within a controlled study to determine visibility as required by the specification.



USDA Forest Service — Washington Office — Fire & Aviation Management

9/5/09

LONG-TERM RETARDANT

Qualified by USDA Forest Service In Accordance with Forest Service Specification 5100-304b, As Amended

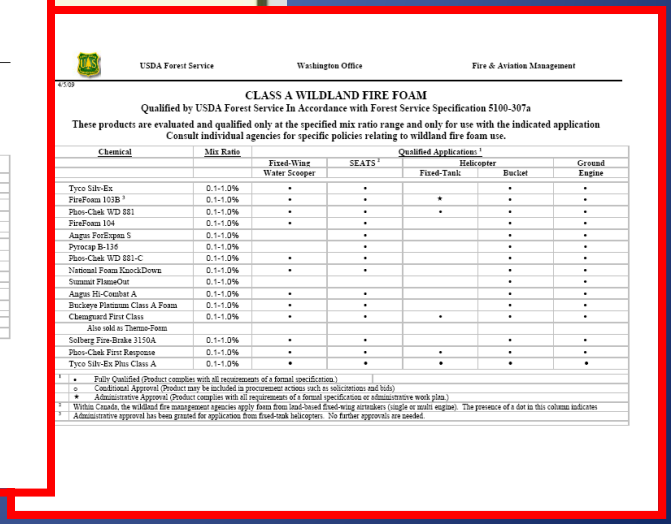
These products are evaluated and qualified only at the specified mix ratio and only for use with the indicated application

Consult individual agencies for specific policies relating to long-term retardant use.

Chemical	Mix Ratio (Pounds concentrate Per gallon water)	Qualified Applications[3]				
		Fixed-Wing Airtanker	SEATS	Helicopter Fixed-Tank	Helicopter Bucket	Ground Engine
Dry Concentrate - Gum-thickened; Permanent or Temporary Base						
Phos-Chek D75-R	1.20 lb/gal	•	•		•	
Phos-Chek D75-F	1.20 lb/gal	•	•		•	
Dry Concentrate - Gum-thickened; Temporary Base						
Phos-Chek 259-F	1.14 – 1.60 lb/gal	•	•	•	•	•
Phos-Chek G75-F	1.12 lb/gal	•	•		•	•
Phos-Chek G75-W	1.12 lb/gal				•	•
Wet Concentrate - Gum-thickened; Permanent or Temporary Base						
Phos-Chek LC-95A-R	5.6:1	•	•		•	•

[1] • Fully Qualified (Product complies with all requirements of a formal specification.)

○ Conditional Approval (Product complies with all requirements in the specification for laboratory evaluation; a field evaluation is required for full qualification.



USDA Forest Service — Washington Office — Fire & Aviation Management

4/5/09

CLASS A WILDLAND FIRE FOAM

Qualified by USDA Forest Service In Accordance with Forest Service Specification 5100-307a

These products are evaluated and qualified only at the specified mix ratio range and only for use with the indicated application

Consult individual agencies for specific policies relating to wildland fire foam use.

Chemical	Mix Ratio	Qualified Applications[1]				
		Fixed-Wing Water Scooper	SEATS[2]	Helicopter Fixed-Tank	Helicopter Bucket	Ground Engine
Tyco Silv-Ex	0.1-1.0%	•	•		•	•
FireFoam 103B[3]	0.1-1.0%	•	•	*	•	•
Phos-Chek WD 881	0.1-1.0%	•	•	•	•	•
FireFoam 104	0.1-1.0%	•	•		•	•
Angus ForExpan S	0.1-1.0%		•		•	•
Pyrocap B-136	0.1-1.0%		•		•	•
Phos-Chek WD 881-C	0.1-1.0%	•	•		•	•
National Foam KnockDown	0.1-1.0%	•	•		•	•
Summit FlameOut	0.1-1.0%				•	•
Angus Hi-Combat A	0.1-1.0%	•	•		•	•
Buckeye Platinum Class A Foam	0.1-1.0%	•	•		•	•
Chemguard First Class	0.1-1.0%	•	•	•	•	•
Also sold as Thermo-Foam						
Solberg Fire-Brake 3150A	0.1-1.0%	•	•		•	•
Phos-Chek First Response	0.1-1.0%	•	•	•	•	•
Tyco Silv-Ex Plus Class A	0.1-1.0%	•	•	•	•	•

[1] • Fully Qualified (Product complies with all requirements of a formal specification.)

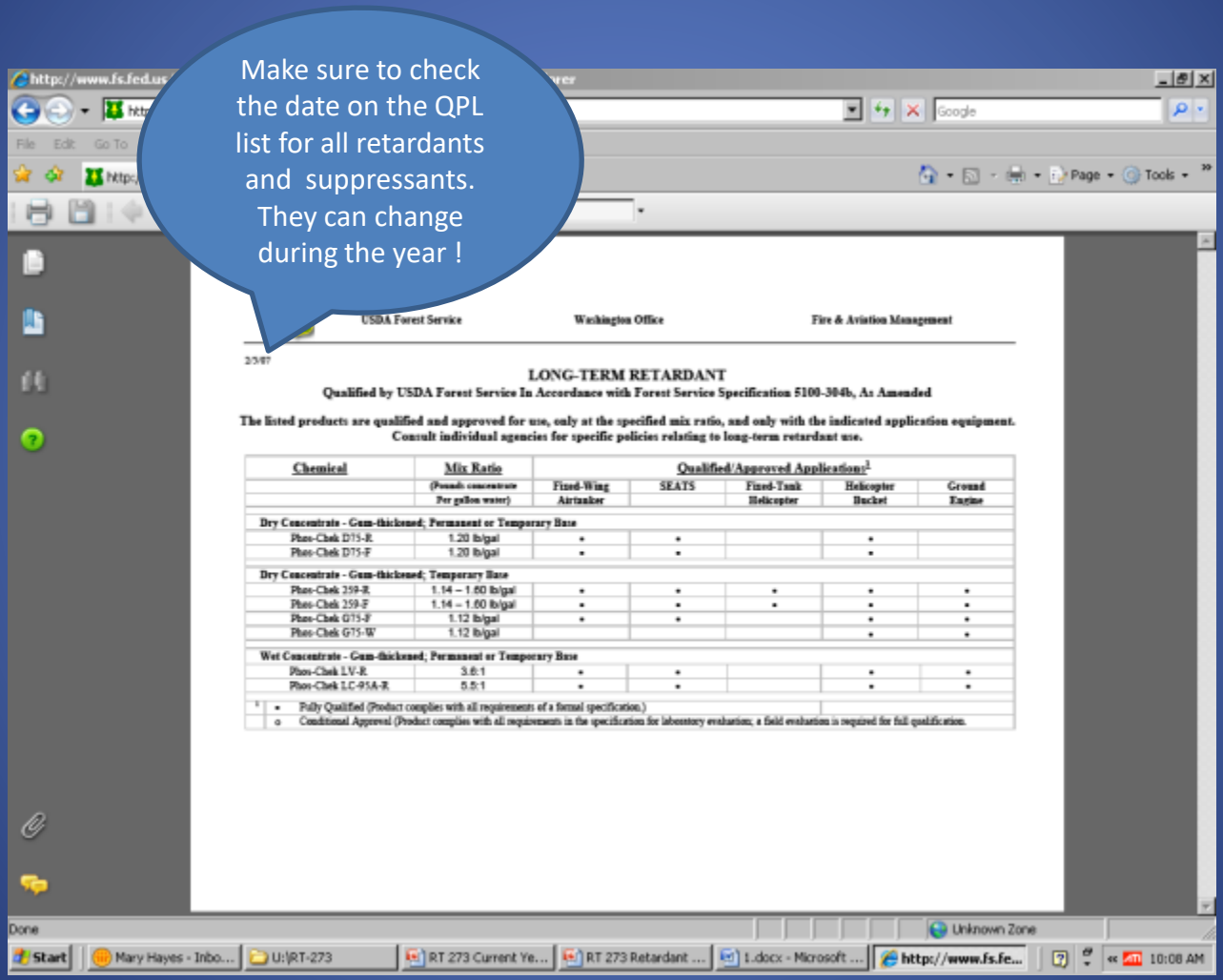
○ Conditional Approval (Product may be included in procurement actions such as solicitations and bids)

* Administrative Approval (Product complies with all requirements of a formal specification or administrative work plan.)

[2] Within Canada, the wildland fire management agencies apply foam from land-based fixed-wing airtankers (single or multi engine). The presence of a dot in this column indicates

[3] Administrative approval has been granted for application from fixed-tank helicopters. No further approvals are needed.

http://www.fs.fed.us/rm/fire/wfcs/



Direct Attack

Q. Would you use foam, gels, water, or retardant for direct attack?

A. You can use any of the fire chemicals or plain water. Water, foams, and gels are the most commonly used. To be most effective for direct attack use lower concentrations in order to penetrate and coat the fuels most effectively. Retardant could be used, however it may be the least desirable alternative due to cost.

Indirect Attack

Q. What type of chemical(s) would you use for indirect attack?

A. Retardant - because it retains it’s effectiveness even if the water has evaporated.

Structure Protection

Q. What type of chemical would you use for structure protection?

A. You could use any of the fire chemicals or plain water. Gels in higher concentrations (up to 3%) are very durable and resist wind erosion. Foams can also be used (0.8-1.0% concentration), but aren't as wind or heat resistant. Retardant could be used, however this may be the least practical alternative. Water could be used as a last resort but it will not last long. All chemicals used may require clean-up.

Mop-Up

Q. What type of fire chemical, if any, would you use for mop-up?

A. You could use either foam or water. Foam would be the most efficient use of your water. You would only need a 0.1% - ~0.6% concentration to get the wetting characteristics you'd need for mopping up. However, if you are in an environmentally sensitive area (near water, TES habitat), plain water may be the better alternative.

Summary

This training has provided you with the basics of what fire chemicals are all about. The key points to remember from this module include:

- Only use products listed on QPL.
- All fire chemicals must go through an evaluation process.
- Report all aerially applied fire chemical intrusions into waterways, 300' buffer zones and TES habitats.
- Foams – Good for direct attack.
- Gels – Good for direct attack.
- Retardant – Good for indirect attack.

What you've just learned is covered in more depth in the Aerial & Ground Delivery training modules.