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Use of Fire Chemicals in Aerial Fire Fighting

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Phos-Chek® Fire Retardant, Class A Foam and Gel

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Agenda

- Why Fire Chemicals
- History of Aerial Use of Fire Chemicals
- Types of Fire Chemicals and How They Work
- Importance of testing
- Guide to Proper Use
- Practical Aspects of Fire Chemical Use
- Myths and Realities

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Why Fire Chemicals

- Water has been dropped from aircraft to fight fires since the 1930's
- Water is very inefficient
  - Shear, heat and wind cause evaporation in the air
  - Wind causes drift and decreased drop accuracy
  - Potentially very low recovery under fire conditions
- Fire Chemicals – Long-term retardant, fire suppressant foam and water enhancers improve the effectiveness of aerial fire fighting
  - Thickeners improve drop characteristics, increasing recovery
  - Long-term retardants are as effective even after they lose their moisture
  - Gels and foams hold water on the fuel longer, effectively slowing evaporation, and increasing the time they are effective

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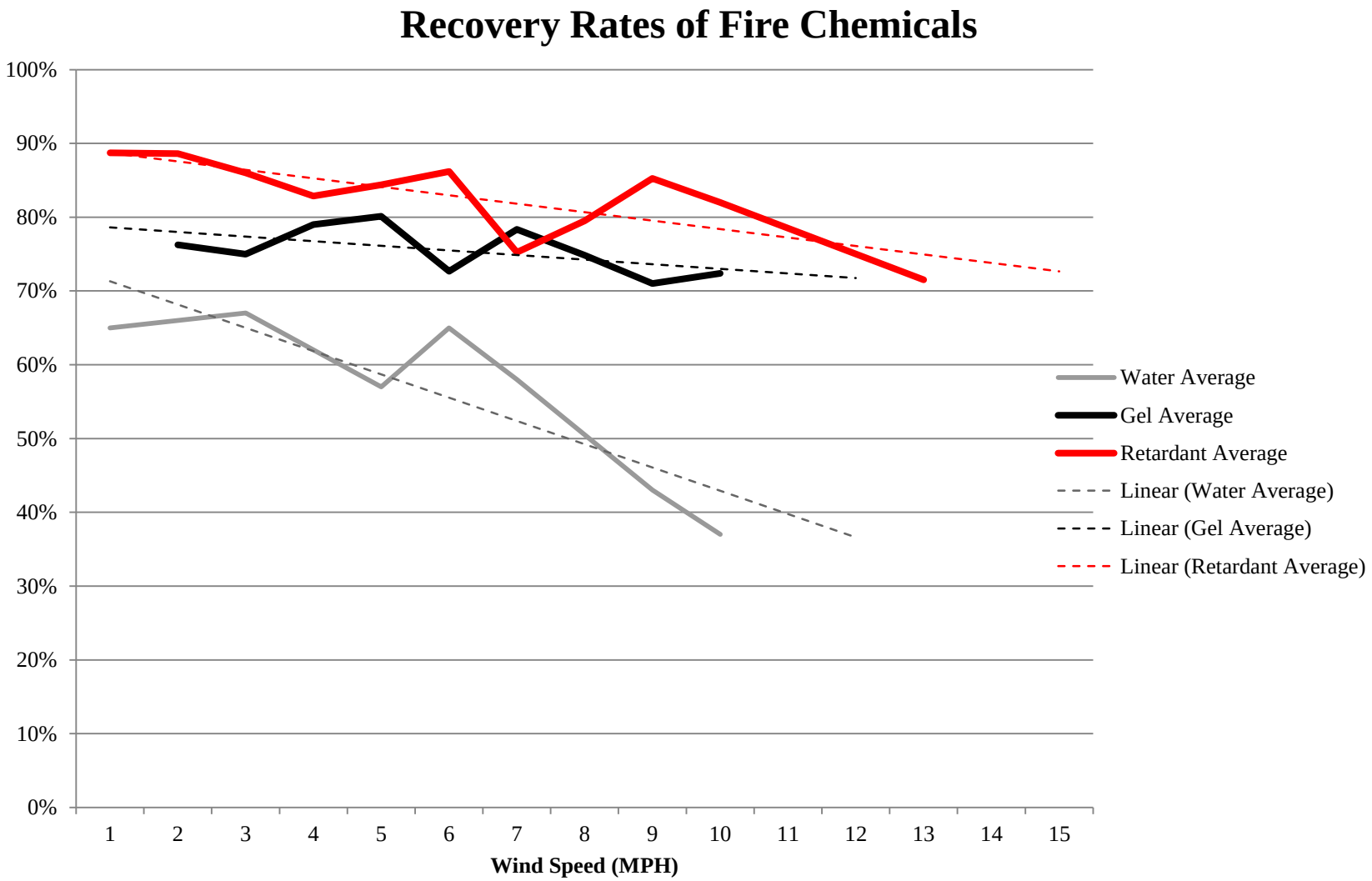
Recovery Rates



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History of Wildland Fire Chemicals

Almost since the beginning of routine air travel, aircraft have been used to fight wildland fires. Advances in fire chemical technology has significantly increased the effectiveness of aerial fire fighting.

- **1930's to 1950's - Water and "Wet Water"**
- **1954-55 Operation FireStop**
  - **interagency effort to test chemicals, aircraft (fixed wing and helicopter), application techniques, and tactics**
  - **Gels, clays, borate and phosphates (and combinations)**
- **1955 to early 1960s - borate and bentonite**
- **Early 1960s – gum thickened phosphates and clay thickened sulfates and then unthickened polyphosphate**
- **1960 – Use of thickened water – Algin gel. Gel use would continue on and off throughout the next decades**

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History of Wildland Fire Chemicals

- 1975 – Fugitive colored retardants
- Early 1980's
  - Gum thickened sulfate
  - Gum thickened phosphate/sulfate blends
  - Aerial use of Class A foam (helicopters and scoopers)
- 2003 – First single component gum-thickened Liquid Concentrate retardant

Throughout the history of fire chemical use formulations have been improved to increase effectiveness, improve drop characteristics, and to increase safety and environmental friendliness.

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How Fire Chemicals Work

There are three main types of aerial applied fire chemicals. All work differently, and each is suited to specific applications.

- **Long-term Retardant**
  - **Provides long-term fire breaks that slow or stop fires and allow deployment of ground troops**
  - **Is applied as a slurry, but does not depend on water for effectiveness**
  - **In the presence of heat, reacts with the fuel to reduce its flammability**
    - **Untreated cellulose decomposes under heat into flammable gases**
    - **Retardant-treated cellulose decomposes into non-flammable gases, carbon and water vapor**
  - **Water released as part of the reaction serves to further cool the fire**
  - **Retardant will remain effective until physically removed from fuel**
  - **Performance additives improve drop characteristics, lower corrosion and improve environmental safety**

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How They Work – Continued

- **Water Enhancers (Gels) - Super absorbent polymers, or other materials, thicken water**
  - **Allows water to be held on vertical surfaces and prevents runoff when applied to ground fuels**
  - **More available water reduces evaporation impacts, provides more insulation and heat absorbing capacity, and longer effectiveness (10 to 40 minutes under fire conditions)**
  - **Gel viscosity enhances drop characteristics**
  - **Only effective when water is present; cannot be effectively rehydrated**
- **Class A Foam – Creates bubbles that increase insulation and slow evaporation; surfactants increase penetration into the fuel**
  - **Effective when used in direct suppression or mop-up tool**
  - **Bubbles increase insulating capacity of water and slow evaporation**
  - **"Wetting" properties allow water to penetrate into fuels**
    - **Particularly good for deep seated fires (like Peat fires)**
    - **Excellent for mop-up to prevent re-ignition**

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Importance of Testing

Product testing and qualification is CRITICAL to ensure the products used are safe for firefighters and the public, won't damage equipment, and wont harm the environment.

USFS testing ensures products

- ❑ **meet the minimum required health and safety standards**
- ❑ **will not corrode sensitive aircraft components**
- ❑ **are stable**
- ❑ **for retardants, meet clear effectiveness standards**

Using *untested* or *unqualified* products may expose people, equipment and the environment to unknown and potentially *severe* hazards

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Chemical Use Guide

The variety of available fire chemicals provide fire managers with a box of tools, each suited for particular missions.

	Long-Term Retardant	Gel	Class A Foam	Water
Indirect Attack	√ √ √ √	√ √	√	
Direct and Parallel Attack	√ √ √ √	√ √ √	√ √	√
Interior Structure Attack		√ √	√ √ √ √	√
Structure Protection - Indirect	√ √ √ √	√ √ √	√ √	√
Structure Protection - Direct		√ √ √ √	√ √ √	√
Mop-Up	√ √	√ √	√ √ √ √	√
Prescribed Burn Control	√ √ √ √	√ √ √	√ √	√

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Practical Aspects of Fire Chemical Use

While each tool is suited to particular jobs, it may not be practical to manage three types of products in the same mission

- **Aircraft missions often change in flight; flexibility is key**
  - **Retardant can be used for both direct and indirect attack**
  - **With Gel or Foam, effective tactics are limited to direct attack**
- **Aircraft cost is generally much higher than the chemicals so aircraft should always carry the most effective tool possible**
  - **Gel is ideal for structure protection, but is less effective than retardant for line building or initial attack**
  - **Foam is ideal for mop up, where gel and retardant are less effective**
- **Water quality impacts gel performance; no impact on others**
- **For scoopers, foam is proportioned on board; retardant and gel require ground loading**
- **Mixing equipment for all three types of chemicals are straight forward, reliable and portable**

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The Trouble With Water

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Wet Line with Gel

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The Benefit of Retardant

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Myths versus Reality

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Myth: "Our Product is the Only Thing You Need"

Facts: There are several tools in the toolbox.
Choose the right tool for the job.

	Long-Term Retardant	Gel	Class A Foam	Water
Indirect Attack	√ √ √ √	√ √	√	
Direct and Parallel Attack	√ √ √ √	√ √ √	√ √	√
Interior Structure Attack		√ √	√ √ √ √	√
Structure Protection - Indirect	√ √ √ √	√ √ √	√ √	√
Structure Protection - Direct		√ √ √ √	√ √ √	√
Mop-Up	√ √	√ √	√ √ √ √	√
Prescribed Burn Control	√ √ √ √	√ √ √	√ √	√

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Terms and Definitions

Terms like “retardant foam” or “retardant gel” are misleading and can cause people to make incorrect and possibly dangerous decisions about fire fighting tactics

- **Long-Term Retardant**
  - **Alters fuel decomposition to render fuel noncombustible**
  - **Does NOT need water to be effective; water is a carrier only, to get the retardant salts to the fuel**
  - **Is effective until it is physically removed**
- **Suppressants (Water, Foam, and Gel)**
  - **Are essentially water**
  - **Make the contained water more effective**
  - **Are not effective once the water is gone**

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Myth: Retardant Needs to be Re-wetted Once Dry

Facts:

- **Retardants are as effective dry as they are wet. Water is a carrier to get the retardant to the fuel and improve adhesion.**
  - **Demonstration**
- **Don't try to re-wet a retardant line**
  - **Its not necessary, ever**
  - **It wastes resources**
  - **Re-wetting a retardant line could physically wash away the retardant, reducing effectiveness**
- **You can reinforce a retardant line when necessary due to a change in conditions**

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Myth: Gel will be effective for 8 hours or more

Facts:

- **Gel longevity and effectiveness vary widely depending on:**
  - **Exposure to UV, temperature, wind, and RH**
  - **Adequacy and uniformity of coverage**
  - **Ground and Fuel conditions**
- **Experience indicates wet-line effectiveness ranging from only a few minutes to several hours and is influenced by**
  - **"Coverage level" – CL4 provides 1/16 inch of gel or less; higher coverage levels may be required**
  - **Mix ratio – free water reduces effectiveness**
- **Experience in California - On average, *aerially applied* gel for *indirect attack* under actual fire conditions, averages 20-30 minutes of effectiveness**
- **Gel should be targeted for direct attack and structure protection**

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Myth: Aerial Applied Gel Can Be Re-hydrated

Facts:

- **Technically, under certain circumstances, gel *may* be rehydrated, if its**
  - **Applied uniformly**
  - **Mixed at a high concentration and applied in a thick coat**
  - **Gently *misted* with water so the remaining superabsorbent is not washed away**

- **For aerial application gel is typically mixed at low concentration (1%+/-) and applied in a very thin layer**
  - **Contains very little polymer**
  - **Remember – CL4 is <1/16 inch thick**

- **For aerial rehydration, an aircraft would have to**
  - **Hit exactly the same spot as the original drop…during fire conditions**
  - **Drop in a way that gently mists the original line to avoid washing away the polymer**

And THAT is the myth

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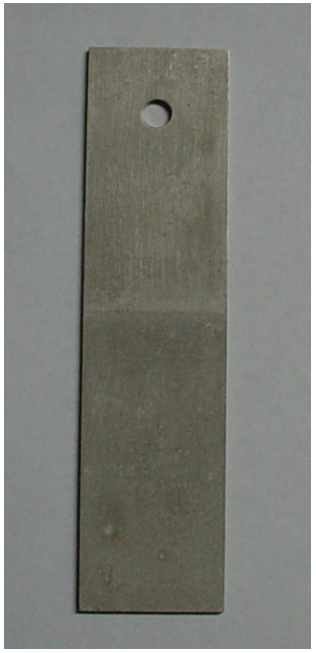
Myth: "Our product is Approved for FT Helicopters"

Facts:

- **Maybe, maybe not.**
- **Only a few products (retardant, foam or gel) meet the USFS corrosion requirements for use in a fixed tank helicopter, like a Skycrane.**
- **If the product you are using, is not ACTUALLY qualified for FTH, DON'T DO IT.**

Don't believe…

ask for proof



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Myth: For Direct Attack, a Gallon is Gallon

Facts:

- **For direct attack volume of usable water on the fire is what counts. Drift and evaporation (reduced recovery rate), and runoff reduce the amount of water available to suppress the fire.**

For Each Gallon Dropped	Retardant	Gel	Foam	Water
Water Contained	0.90	0.98 to 0.99	.990-999	1.0
Recovery at Target	70% - 90%	70% - 80%	35% - 65%	35% - 65%
Water on the Fire	0.65-0.80	0.70 – 0.80	0.35 – 0.65	0.35 – 0.65

- **With retardant, water is GENERATED from the fuel as it decomposes**
  - **Cellulose + Heat + Retardant-------→ Carbon and Water**

- **Foam will penetrate deep seated fires better than any other fire chemical**

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Myth: All Class A Foams on the QPL Perform the Same

Facts: USFS Testing and QPL Listing ensures that a Class A foam is safe and non-corrosive. It says nothing about suppression effectiveness.

- **USFS Qualified Foams vary widely in foam generation, foam stability, and the concentration needed to generate foam**
- **UL Wetting Agent listings are a good guide for the concentration needed to be effective**
- **Different foams perform differently depending on delivery system, water temperature and salinity**

Two Foams (10 minutes after drop); Same aircraft, same water, same altitude.

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Myth: Gel is Half the Price of Retardant

Facts:

Depending on water quality, the cost of gel can be more or less than retardant.

Cost per square foot depends on coverage level

Retardant coverage levels are well understood.

How much gel is enough?

Source of Data: USFS 2009 BPA Prices plus $0.05 to $0.08 per mixed gel gallon for color

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Myth: Gel is a New and Innovative Technology

Facts:

- Gel was first used for fire fighting in the 1960's
- Re-emerged three times since then but faded each time due to lack of effectiveness and operational issues
- Basic technology has not changed since the original gels
  - Superabsorbant
  - Starch
  - Gum
- Operational issues have improved and there is a place for gel in the toolbox

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Finally

Each of these tools is suited for specific missions. Success depends on knowing the facts. Pick the right tool and know what it can and can't do.

	Long-Term Retardant	Gel	Class A Foam	Water
Indirect Attack	√ √ √ √	√ √	√	
Direct and Parallel Attack	√ √ √ √	√ √ √	√ √	√
Interior Structure Attack		√ √	√ √ √ √	√
Structure Protection - Indirect	√ √ √ √	√ √ √	√ √	√
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Mop-Up	√ √	√ √	√ √ √ √	√
Prescribed Burn Control	√ √ √ √	√ √ √	√ √	√

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Knowing the Facts and Making the Right Choice Matters

Because their safety depends on it.

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