

Ground Delivery of Fire Chemicals



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

Objectives

This presentation will provide the viewer:

- Basic information and recommended applications for wildland fire chemicals dispensed from ground equipment such as fire engines, backpack pumps and other portable pumps.
- An explanation of where to find approved fire chemicals, the safe way to mix and apply them, recommended tactical use, and clean up.

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

Contents

- I. Use of Ground Equipment – General Information
- II. Foams
- III. Gels
- IV. Retardants
- V. Backpack and other Portable Pumps
- VI. Clean-up

Part I. Use of Ground Equipment – General Information

- Fire chemicals applied from ground equipment are primarily foams and gels.
- Foams and gels have no chemical retarding effects. It is water that extinguishes the fire; we're just using it in different forms.
- If applied improperly, gels and foams can form a barrier over the tops of fuels, preventing the fire chemical from penetrating the fuel and allowing the fire to burn underneath and through the line.

Appropriate Applications

- It is important to remember that ground crews put the fire out, not fire chemicals. Chemicals are just one tool in the fire crew's arsenal.



Appropriate Applications

➤ Foam

- Suppression/Direct attack.
- Suppression/Indirect attack (application of wet line prior to burning out).
- Protection of structures or other resources.
- Mop-up.



Photo: Gialo, Altidena Fire 93

Appropriate Applications

➤ Gel

- Suppression/Direct attack.
- Protection of structures or other resources.



➤ Retardant

- May not be practical for logistical reasons.
- Suppression/Indirect attack.
- Pretreatment of fuels near structures & prescribed fireline.



Fire Chemicals – Historic Sites

Be careful when using any type of fire chemical on historical or archeological sites. Chemicals can stain surfaces or result in destructive drying of old wood. Chemical residue should be removed after the fire. Consider treating surrounding fuels with chemicals, but carefully weigh all options for protecting the structure or site itself.



Handling and Personal Safety

- Follow the directions on the Material Safety Data Sheet (MSDS).
- Follow safety directions on the label of the fire chemical container.
- Follow any applicable job hazard analysis (JHA).
- Use proper Personal Protective Equipment (PPE) i.e. goggles, gloves, long sleeve shirt, boots, dust masks for dry chemicals.

Handling and Personal Safety, continued

- All fire chemicals have been tested and exceed certain mammalian toxicity criteria.
- If you inhale or ingest excessive quantities of a fire chemical, follow MSDS guidelines for treatment.
- Fire chemicals can be irritating to eyes and skin. Rinse exposed areas immediately with clean water.

Handling and Personal Safety, continued

- Be careful not to touch your eyes when you're handling fire chemicals.
- Creams or lotions can help alleviate skin irritation.
- Fire chemicals may be extremely slippery. Be aware that falls and serious injury could occur.
- See the Wildland Fire Chemical Systems website for more information at: www.fs.fed.us/rm/fire/wfcs/

Mixing – Water Quality

- Gels in particular are sensitive to water quality. Very hard water or salt water will give much runnier consistencies than the same mix ratio in softer or purer water.
- Foams mixed with hard or salt water may show decreased wetting and foaming ability.
- Water quality may affect the viscosity (fluidity) of retardants if stored for an extended period of time (e.g. over 1-2 days), but retarding effectiveness should not be impacted.

Mixing

- In batch mixing, stir the concentrate thoroughly before adding to water (stir gently with foam concentrates to avoid excessive foaming). Does not apply when using a foam or gel proportioner.
- Never mix different brands of the same product type (e.g. two different brands of Class A foam).
- Don't mix foams, gels or retardants with each other.
- Foam solutions stored over a period of time in metal tanks may show a decrease in foaming and/or wetting ability.

Part II. Foams

Photo courtesy of wildlandfire.com



Foams

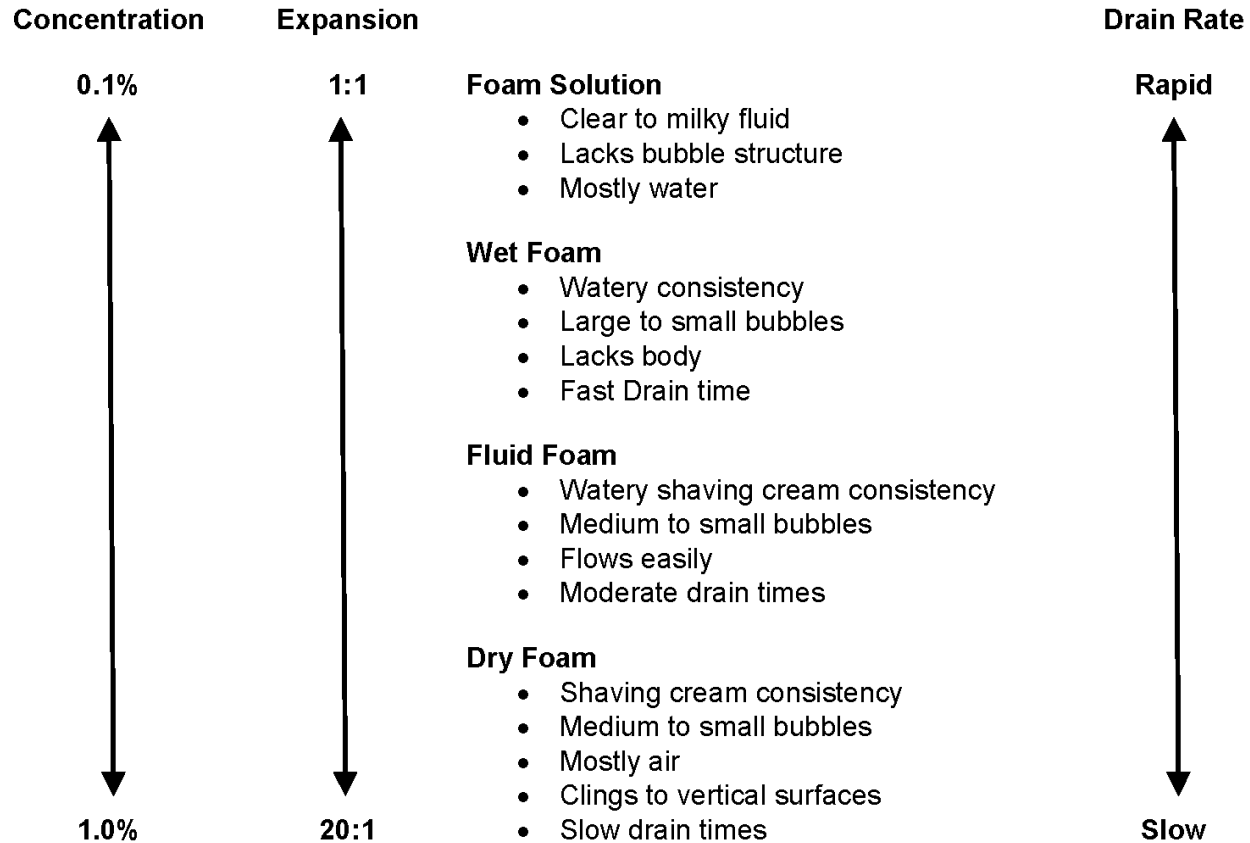
- Foams contain surfactants which reduce the surface tension in water allowing it to soak into fuels better.
 - One gallon of foam concentrate per 1000 gallons of water will begin to lower surface tension.
- Thick foam is not required for wetting/soaking fuels.



Foams, continued

- Equipment can influence the consistency and structure of the foam, such as a compressed air system or a proportioner.
 - Lower mix ratios mean faster drainage times (wetting ability). These solutions are better for soaking/wetting fuels (e.g. mop-up).
 - Higher mix ratios mean thicker foams and slower drain times. Higher mix ratios are good for creating insulating barriers (e.g. structure, log deck protection).

Relationship Between Foam Concentration, Expansion, and Drain Rate



Q: How Does Foam Concentration Effect Expansion and Drain Rate?

A: As the concentration increases, so does the expansion (more foaming) and the drain time (slower soaking).

Foam – Application Equipment

- Proportioning – Equipment adds the right amount of foam concentrate to water.
 - Batch mixers – use manual or automatic regulators
 - Aspirating nozzles – use energy from a water pump to create low, medium or high expansion foam
 - Compressed air foam systems (CAFS) – inject compressed air into a foam/water mixture

Foam – Application Equip., continued

Examples:



Water driven
foam
proportioner
(FireDos)

Automatic
DC -
powered
foam
proportioner
(FoamPro)



Foam tips
(Guardian)



Foam nozzles (Scotty)



Foam – Application Equipment, continued

Recommended publications which explain foam application equipment and proper usage in detail:

- Foam VS Fire, Primer. NWCG. PMS 446-2, NFES 2270. Oct 1992.
- Foam VS Fire, Class A Foam for Wildland Fires. NWCG. PMS 446-1, NFES 2246. Oct 1993.
- Water Handling Equipment Guide. NWCG. PMS 447-1, NFES 1275. Oct 2003.

Foam – Suppression/Direct Attack

- Foam solution or wet foam should be used for direct attack.
- Foam solutions should be applied directly to the base of the linear flame front.
- While attacking the edge, direct a portion of the foam stream onto adjacent unburned fuels.
- On wide hotspots, secure the edge and move toward the center.



Photo courtesy of wildlandfire.com

Foam – Suppression/Direct Attack, continued

- Apply enough for extinguishment.
- As steam becomes visible, continue to apply the foam solution to wet and cool the fuel.
- Leave a foam blanket over the hot fuels to smother and continue wetting.
- It is important to return to the treated area after the foam dissipates to check for any missed spots.



Foam – Suppression/Indirect Attack

- The foam line should be at least two and a half times as wide as the expected flame length.
- Wet the entire fuel layer so that the fire will not burn under the foam line.



Photo courtesy of wildlandfire.com

Foam – Suppression/Indirect Attack, continued

- All foam types may be effectively used for indirect attack but as the water evaporates the foam loses its effectiveness.
- The effectiveness of a foam line in indirect attack is limited by the time it takes the water to evaporate.
- The foam line becomes useless once the water has evaporated.

Foam - Prescribed Fire

- When other barriers are not available, foams can be used to create a temporary control line during prescribed fire and backfires until a permanent “black” line can be built with an ignition device.
- Foams used for this purpose should be wet and quick-draining (lower ratio of foam concentrate to water). Depending on the brand of foam concentrate start at 0.2% - 0.3% and adjust accordingly.
- Width of the foam line should be 1.5 – 2.5 times the expected flame lengths.

Foam – Structure & Resource Protection

- Thicker foams can be used to protect specific trees (seed trees, snags, wildlife trees) or other resources and properties (log decks, structures, telephone poles). Treat surrounding fuels a distance of 25-50' out from the base of the object.
- In general, the more adverse the burning conditions, the shorter the time between foam application and ignition should be.

Foam - Structure & Resource Protection, continued



Photo courtesy of wildlandfire.com

- The effectiveness and life of the foam blanket is dependent on foam dryness and the depth of application. At least 0.5 inch of foam should remain on all surfaces, even if excess amounts slough off.

Foam – Mop-Up

- The penetration of the foam solution can be used soon after flames subside to extinguish fire before it burns underground, eliminating residual smoke, reducing re-burn potential and minimizing soil erosion.



Foam – Mop-Up

- Avoid applying dry, thick foam during mop-up. Wet foams penetrate quickly to cool and smother, while dry foams can form a “lid” over fire and trap flame and heat.
- Care should be taken during application in order to prevent potential spread of embers from air movement created by impact of fire chemical.

Part III. Water Enhancers (Gels)



Gels

- There are many unknowns with gel use. Optimal viscosities/consistencies for various types of applications are not well documented.
- If you plan to use gels in fire situations, you may find you will need to experiment to get the best results.
- Gel products and foam systems are NOT compatible.
- Depending on the mix ratio, gel consistencies can vary from thickened water to a very thick consistency similar to petroleum jelly.

Gels, continued

- In general, expect gels to last longer than foams however they are still dependent on the water they contain.
- Once water evaporates gels are no longer effective.
- Gels are not retardants.
- Gels are effective for smothering a fire or creating an insulating barrier for structure protection as long as it retains its water.
- It is important to try to remove gel residue from structures once the danger of fire has passed.

Gels, continued

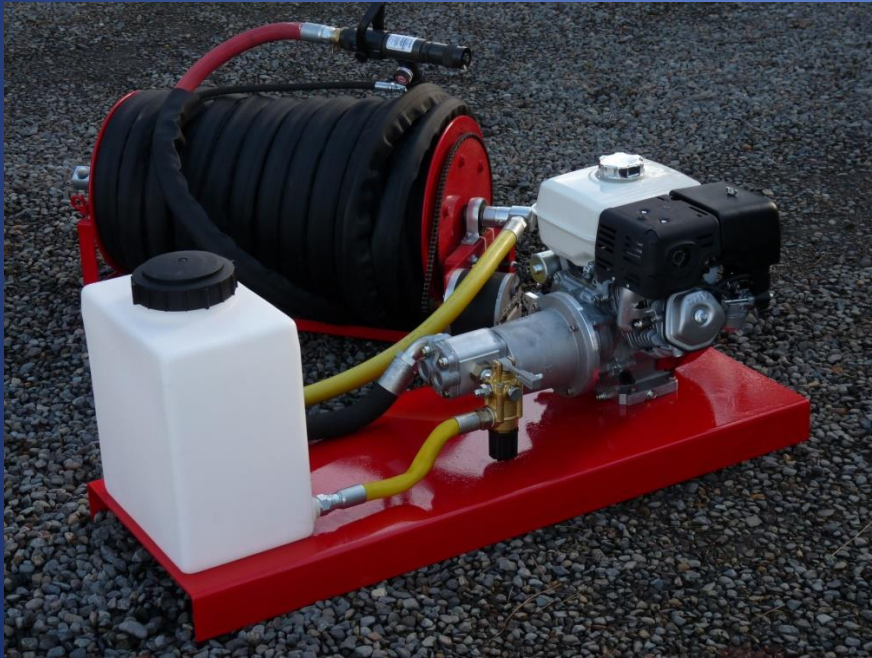
- Gels not thoroughly mixed in the correct proportions can clog equipment and will be difficult to remove.
- Rewetting gels after they have dried has not been proven. Do not assume that you can add water to dried gel and get the same, or any, effectiveness that the gel originally provided.
- So far, there have been no FS evaluations of gel proportioners for (proportioning) accuracy, reliability, etc.

Gels – Application Equipment

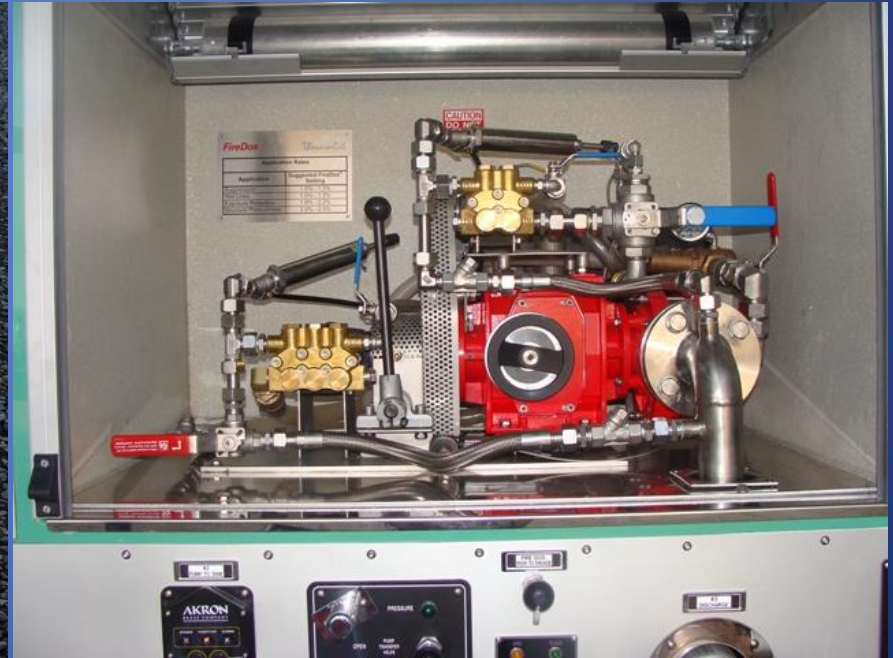
There are some commercially available gel application systems available. The Forest Service in Region 5 is currently field testing an engine mounted system made by FireDos. This company makes one version that applies gels only and another that applies gels and foams. Individual gel companies (i.e. Barricade) have developed specialized systems for applying their products. Contact the gel companies on the Qualified Products List (QPL) vendor list to identify additional gel dispenser options.

Gels – Application Equip., continued

Examples:



Retro-fit gel system by Barricade



FireDos FD500 combination gel/foam system

Gels – Suppression/Direct Attack

- Lower mix ratios (thinner consistencies) are best for smothering fires and should be applied directly to the base of the flame front.
- Higher mix ratios (thicker consistencies) are better for coating and protecting fuels.
- If the mix ratio is too high, you may run the risk of the product sloughing off the fuel.
- Treat standing vegetation, such as trees, by spraying the gel in an arc for best coverage.
 - Use gels as an insulating barrier to provide protection from radiant heat, scorching, flame impingement, and fire.

Gels – Suppression/Indirect Attack

- The effectiveness of a gel line in indirect attack is limited by the time it takes the water to evaporate.
- As the water evaporates the gel loses its effectiveness.
- The gel line becomes useless once the water has evaporated.



Gels – Structure & Resource Protection

- Higher mix ratios with thicker consistencies are very effective at protecting structures. They are quite durable and fairly long-lasting.
- Gels can be used to protect telephone poles, cell-phone and microwave towers, wood fences, etc.

Gels – Prescribed Fire

- When other barriers are not available, thinner gels can be used to create a temporary control line during prescribed fire and backfires until you can build a permanent “black” line with an ignition device.
- In general, the more adverse the burning conditions, the shorter the time between gel application and ignition should be.
- Gel solutions can be used to reinforce an existing line by applying it next to the line or on both sides of the line.
- Gel can also be used to try to slow the fire before it hits the fireline.

Gels – Mop-Up

- Gels are not recommended for mop-up because:
 - They are not wetting agents.
 - They bind the water so it is not available to penetrate into the fuels to extinguish embers.

Part IV. Retardants



Retardants

- Low viscosity retardant can be applied with standard fire engine nozzles if it is batch-mixed beforehand. Dispensing retardants from engines may have a niche for pretreatment of fuels provided the mixing infrastructure to support it is available.
- Storing powder or liquid concentrate and mixing the retardant on a fire engine may not be practical.
- If you choose to use retardant, see the Qualified Products List (QPL) for appropriate products and proper mix ratios. Phos-Chek 259F (powder) and LC95W (liquid concentrate) have been used in the past.

Retardant – Suppression/Direct Attack

- Retardant can be used as a suppressant, but gels and foams are better suited for direct attack.
- Retardant can be used to suppress the flame front in fine fuels and simultaneously build a contingency reinforcement line to guard against re-ignition.

Retardant – Suppression/Indirect Attack

- Retardant is the primary wildland fire chemical used for indirect attack operations.
- Retardant can be used to slow the fire or reinforce an existing line.
- Use retardant to treat a line prior to backfiring or burning out (up to multiple days as long as no rain, snow or high winds are expected).

Retardant – Suppression/Indirect Attack

- Retardant is most effective when it is placed ahead of the fire, allowing the fire to burn into the retardant line. Using the entire width of the line allows the chemical reaction between the retarding salts and the heat of the fire to occur, decreasing its intensity.



Retardant – Structure & Resource Protection

- Red-colored retardants have the potential to permanently stain finishes. Fugitive-colored and uncolored products may cause less staining.
- Retardant is heavier than water so care must be taken to avoid damaging structures during application.
- Retardant can be applied to adjoining fuels to slow the fire (can be done well in advance of the fire).

Retardant – Structure & Resource Protection, continued

- There are residential systems that use retardant to protect individual homes (i.e. Firebreak Spray Systems).
- Retardants can also be used to protect telephone poles, cell-phone and microwave towers, wood fences, etc.

Retardant – Prescribed Fire

- Use retardant to pre-treat a line prior to burning (up to multiple days as long as no rain, snow or high winds are expected).
- Retardant can be used to reinforce an existing line.
- A retardant line will last longer than either foam or gel.

Part V. Backpack and Other Portable Pumps

Examples:



Scotty backpack foam system



Mark III w/ Scotty foam system



Barricade AtakPak (gels)

Backpack and Other Portable Pumps

- Ground firefighters may apply fire chemicals through engines, backpack pumps, or other types of portable pumping equipment.
- Backpack pumps are used in direct attack and mop-up. They are most commonly used to deliver foam solutions and other wetting agents to the fire.
- Application techniques are the same for foam solutions and wetting agents as for water, except that the quantity required for the given task may be less.

Backpack and Other Portable Pumps, continued

- Some companies, such as “www.scottyfire.com”, offer attachments for small portable pumps (e.g. Mark III), backpack style, or hand held applicators for delivering foam. They offer backpack units that are self contained and other backpack units that hold the concentrate in the backpack and attach to the hose lay.
- Contact the vendors on the QPL list to determine which application equipment they recommend for use with their product.

Backpack and Other Portable Pumps, continued

- It is important to remember that only approved fire chemicals may be used in any equipment (e.g. foam sticks have not been approved and are not on the QPL).

Part VI. Clean-up - General

- Clean all equipment well away from waterways and riparian areas.
- Soak up any excess chemical with kitty litter or other absorbent material (this will probably be most effective with foams, less so with retardant or gel).
- Clean up materials can be put into garbage bags and disposed of in the trash.
- After the excess chemical has been removed thoroughly rinse the equipment.
- All fire chemicals can degrade leather. Keep clothes and boots clean and maintained.

Equipment Clean-up - Foams

- Flush internal parts with clean water to help prevent potential clogging of equipment.
- Foams are strong detergents which may dislodge existing rust and scale and possibly clog equipment.
- Equipment may require lubrication after cleaning.

Equipment Clean-up - Gels

- Flush nozzles and hoses with water. Be sure all concentrate is removed.
- Nozzles may be cleaned with liquid dishwashing detergent or with a salt water solution.
- If vehicles have been exposed to gel, rinse off with water.

Equipment Clean-up - Retardants

- Flush internal parts with clean water to help prevent potential clogging of equipment.
- Retardant can permanently stain paint and certain metals on fire engines and equipment. Wash off any retardant as soon as possible after exposure. Wax may minimize this problem.
- Retardant may be somewhat corrosive (especially to steel), increasing the possibility of rust and scale buildup that may clog equipment.
- Equipment may require lubrication after cleaning.

Structure Clean-up – Fire Chemicals

- For fire chemical clean-up tips and procedures for structures visit the Wildland Fire Chemical Systems (WFCS) website at:
www.fs.fed.us/rm/fire/wfcs
- Contact the manufacturer of the specific product.