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FOAM APPLICATIONS FOR WILDLAND & URBAN FIRE MANAGEMENT

Prepared by: **NWCG Fire Equipment Working Team's Task Group for International/Interagency Foams and Applications Systems**

CHAIRPERSON'S CORNER

by Doc Smith, USDA Forest Service

Why a Foam Task Group and How *You* Can Help

Foam is a hot topic for discussion in planning sessions, in fire camps, at fire meetings, and many other gatherings. Discussions deal with safety, testing, standards, costs, environmental concerns, mix ratios, and a large number of other items related to foam. In response to this interest, the U.S. National Wildfire Coordinating Group (NWCG)—in cooperation with the Petawawa National Forestry Institute of the Canadian Forestry Service—has appointed an International/Interagency Foams and Applications Systems Task Group with a charter to:

- Improve International and Interagency communication and cooperation in foams and their related systems
- Reach agreement on the questions and concerns to be dealt with in foam research, apparatus, and applications
- Guide establishment of performance requirements for foams
- Provide communications, training, direction, and support to all foam users.

The Foam Task Group is made up of men and women from the United States and Canada. They are from the field, research, and management. They represent States and Provinces (the U.S. and Canada), research and users (aviation and ground), and numerous agencies within these spheres. With so much interest in foam, coupled with the extensive use and experimentation across several nations, it was felt that a Task Group could help pull together the various interests and entities to consolidate information. This publication represents just one facet of the Charter implementing the Group.

This is our first shot—so help us out. Does this publication assist you? Do you have any contributions for future issues? While we may not be able to use everything we receive, we do want to present, abstract, or refer to the "world of foam." Please send any thoughts, comments, articles, or publication ideas to: H.B. "Doc" Smith, Foam Task Group Chairperson; 800 South 6th Street, Williams, AZ 86046; 602/635-2681 (DG, H.SMITH: R03F07A).

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THE TASK GROUP FOR INTERNATIONAL/ INTERAGENCY FOAMS AND APPLICATIONS SYSTEMS

by Pat Ebarb, Texas Forest Service

This Task Group, sponsored by the NWCG in cooperation with the Petawawa National Forestry Institute of the Canadian Forestry Service, comprises a voluntary membership of fire service professionals. Their task is to coordinate the worldwide gathering and distribution of information related to the use of firefighting foam products and equipment. Today, fire professionals are generally faced with the dilemma of ever-increasing values to protect, while program dollars and manpower continue to be reduced. This results in increased vulnerability to improved property of all kinds, to rural homes and families. and to our precious natural resources. The *Foam Task Group* is persuaded that foam delivery systems offer several important advantages that can improve the effectiveness of fire protection in wildland, rural, and suburban areas throughout this hemisphere and abroad.

Foams and foam systems are well past the experimental stage in the wildland/urban interface scenario. Many exciting and innovative developments are now being adopted as a result of early efforts by fire protection entities in the United States and Canada. New foaming agents and new equipment represent major breakthroughs in rural fire protection programs.

However, please keep in mind that the fire problems we are called upon to solve are as much social and political as they are technical and physical. The rural homeowner who lives more than 10 minutes from the fire station is in a vulnerable majority. This homeowner is also the long-range key to finding effective solutions to the vulnerability. This may require that we get serious about developing a primary system of affordable. on-site fire protection with secondary support from the local fire department. It may also require a re-evaluation of traditional fire protection priorities. practices, and expenditures. We invite your active participation in the *Foam Task Group*, as we attempt to assimilate additional knowledge and experience in the use of foams in the wildland/urban interface.

USDA FOREST SERVICE PROGRAM DIRECTION FOR WILDLAND FIRE FOAM

by Paul R. Hill, USDA Forest Service

The USDA Forest Service has issued a document, "Interim Requirements for Foam, for Wildland Fires, Aircraft or Ground Application." This document, dated August 1986, details minimum requirements that must be met before a product can be approved for operational evaluation by the Forest Service. These requirements assure that these products meet established health and safety standards. In the future, additional requirements (such as effectiveness) will be incorporated, based on results of field evaluations and laboratory tests. The interim requirements have been furnished to potential suppliers and agency personnel. If you need a copy, contact the USDA Forest Service; Director, Fire and Aviation Management; PO Box 96090; Washington, DC 20090-6090; 703/235-8039 (DG, FIRE: WO1B).

FOAM CHEMICALS FOR WILDLAND FIRE CONTROL

by R. R. Lafferty, MacMillan Bloedel Limited, Nanaimo, B.C., Canada

The National Fire Protection Association Proposed Standard No. 298

The National Fire Protection Associations (NFPA) is a non-profit organization made up of volunteers. They have contributed to the development of more than 1,600 fire protection standards which are used worldwide. Foam fire suppressants have proven to be one of the most important new tools in fire caches in a long time. Foam smothers fires; it absorbs heat and wets fuels. A foam product, which revolutionized fire control, was introduced to the wildland fire control community in 1985. The breakthrough came about because the product could be used at very low concentrations. Because of the low concentrations. we can now use foam very efficiently in water-delivery systems—especially from aircraft. Because of this breakthrough and the experimentation with foam in North America and overseas, the use of foams should increase many times over.

As foam use increases, concerns arise. These include firefighters coming in contact with the concentrate, foam entering watersheds and fish-inhabited water, and metal delivery systems that could become corroded. To help protect ourselves and the environment we must ask:

- Are there health and safety problems?
- How can we protect the environment?
- What corrosive impact will foam have on metals?
- Who is to take responsibility for the concerns?

These questions *were* asked at the International Water Expansion Symposium sponsored by the USDI Bureau of Land Management, held November 1986 in Salem, OR. Because I was a symposium participant and also a member of the NFPA Committee on Forest and Rural Fire Control, I presented a proposal to the committee to write a standard. They accepted. and made me chairman of the subcommittee on foam. A new standard was born called NFPA No. 298. "Foam Chemicals for Wildland Fire Control." Several individuals and agencies participated in a major effort towards the standard's completion—Chuck George, USDA Forest Service; Paul Schlobohm. USDI Bureau of Land Management; Ed Stechishen, Canadian Forestry Service; and of course the full Committee on Forest and Rural Fire Control. which represents users, chemical manufacturers, and consultants. The standard was developed using many existing standards, regulations, protocols and references. Some of these were:

- NFPA Standards No. 11 and 12
- American Society for Testing and Materials standards
- Stillmeadow Testing Laboratory test protocol
- Various USDA Forest Service publications
- U.S. Department of Transport regulations
- Canadian Transport Commission standard
- National Association of Corrosion Engineers test protocol.

Scope, Purpose, and Outline of the NFPA Standard

The first paragraph of the standard states:

> "This standard specifies minimum requirements for foam chemicals which are applied to vegetation and other fuel to help control wildland fires. The purpose of this standard is to establish minimums for safety, health, protection of environment and corrosion."

The major sections and subheadings in the standard are:

I. Requirements Section

- A. Corrosion
  1. Uniform corrosion
  2. Intergranular corrosion
  3. Metal containers
- B. Health & Safety
  1. Toxicity
  2. Health and safety testing
  3. Protocols are dermal, oral, and inhalation toxicity; eye and skin irritation
- C. Environment
  1. Biodegradability
  2. Fish toxicity
- D. Packaging & Labeling
- E. Foam Characteristics
  1. Foam concentrate compatibility
  2. Stability of concentrate
  3. Action after freezing

II. Recommended Procedures Section

- A. Water source protection
  1. Filling water tenders
  2. Filling aircraft
- B. Mixing. handling and tanking concentrate solution
  1. Personal protection
  2. Concentrate handling
  3. Solution handling

Status of the NFPA Standard

The NFPA subcommittee on foam will present Standard No. 298, "Foam Chemicals for Wildland Fire Control" for public review in the spring of 1988. It will then be submitted to the full NFPA committee for adoption at their annual meeting in Nashville, TN, November 1988. Upon adoption. it will be published for distribution (possibly early in 1989). NFPA Standard No. 298 is meant to help fire control people at every level work safely and give them confidence in the products they are using; manufacturers will have health and safety, environmental, and corrosion standards to comply with.

ALL ABOUT FOAM AND HOW TO SAFELY USE IT

by Ceci Johnson, USDA Forest Service

The How, Why, What, & When of Foam

Fire control foam is a relatively stable aggregation of small bubbles which can adhere to wildland fuels. *Foam is made by* forcing air into a water solution containing a foam concentrate. The air can be introduced by means of suitably designed equipment or by cascading, at high velocity, the water/foam mixture through the air. The foam attaches to, and builds upon class A fuels—thereby excluding the air from the fuel and enveloping the volatile combustible vapors at the fuel interface. The foam absorbs the heat generated by combustion and releases water from its bubble structure at a reduced measurable rate. When applied in adequate quantities. it resists disruption due to wind or heat and to flame attack, and is capable of re-sealing. Firefighting foams retain these properties for varying periods of time, depending on the foam solution and the fire environment. (Adopted from NFPA proposed Standard No. 298, "Foam Chemicals for Wildland Fire Control.")

Foam is an aerated solution of water and foam concentrate. As air is forced into the solution, small bubbles are formed. This collection of small bubbles is the foam. Fire control foams can be made with consistencies ranging from very stiff to very fluid—depending on the equipment used to prepare the foam and the use for which it is intended. The foam concentrate contains a *wetting agent*. This increases penetration of the water released from the foam and of the foaming agent itself. Other *minor ingredients* (such as corrosion inhibitors and stabilizers) may also be added. *Foam works* in several ways to fight fire; it:

- Cools the fire
- Acts as an insulating blanket
- Forms a vapor barrier
- Is a wetting agent
- Forms a reflective surface.

Foam consistency is a major factor in determining how effectively it will perform any of the above functions. For example, a *stiff foam* (one which holds its shape, adheres well, and releases the water it contains slowly) will be a better insulating blanket than a very *fluid foam* (one which flows easily and releases water quickly). On the other hand, the very fluid foam may be a better coolant and wetting agent than the stiff foam. Therefore, it is necessary to determine the specific application before applying foam so that the proper choice can be made.

Foams are often characterized by sets of mutually exclusive terms, although in reality the characteristics are a continuum. A *wet foam* generally has large bubbles; is fast draining and very fluid. A *dry foam* is generally made up of smaller, uniform bubbles that drain slowly and will adhere to a vertical surface. (These foams are sometimes called stiff or dense.)

Two measurable properties of foam are often discussed. They are independent of each other, but are dependent on the type of foam concentrate used and the equipment that produced the foam. *Drain rate* is the speed at which the fluid is lost from the bubble structure. One way in which foam increases the effectiveness of water is to control the release of the water to a rate slow enough that the fuel can more easily absorb the water. *Expansion* is the ratio of the volume of foam to the volume of solution used to make the foam. Although the range of expansions that may be obtained is large, most of the foams used for wildland fire control are in the range of 10:1 to 20:1. That is, 1 gallon of solution can be expanded to yield 10 to 20 gallons of foam.

The Safe Handling Of Foams

In general, foams used by wildfire control agencies have been tested to assure that they do not present a hazard to personnel when they are used in the manner prescribed. This does *NOT* mean that they are completely harmless. A very small percent of the general population—and, therefore, of firefighting personnel—will have an allergic reaction to any substance that might be used. People having this type of reaction should be particularly careful about following safe-handling instructions and/or should request alternate assignments.

For that much larger portion of the firefighting population who are not allergic to the foams (especially the concentrate), there are still reasons for following safe handling instructions that are printed on the foam concentrate container and in the material safety data sheet that comes with the product. By their very nature—*foams are basically detergents*—they are drying to skin. Care should be taken to avoid exposure of the skin to the concentrate, especially for long periods of time. Since concentrates are generally handled in an area near a source of water, this should not constitute a problem. However, be alert for exposure and remove the concentrate from the skin as soon as possible. *Rubber gloves* and *long-sleeved shirts* are recommended. If clothing becomes wet with the concentrate. rinse out the item of clothing. Failure to follow these steps may result in extreme dryness of your skin. characterized by chapping and even broken skin.

The eyes are potentially the biggest problem. *Goggles* should be worn whenever the concentrate is being handled. Also, be sure hands are clean before rubbing eyes. The eye is especially sensitive to detergents and the alcohol that is contained in some formulations. Irritation and redness may be minor; or could be severe enough to warrant several days (or weeks) off work. Dizziness may also occur, and may take several days to subside.

Foam is a useful fire management tool. However, remember to respect the harm it can do to you and use it safely. Follow the manufacturer's suggestions; they are for your safety.

TEXAS FOREST SERVICE FOAMS AND WATER EXPANSION PROGRAM

by Pat Ebarb, Texas Forest Service

In 1977, the Texas Forest Service pioneered the development of water expansion systems (WES) with foam delivery for use in rural fire protection throughout the State. At that time, an estimated 1,500 rural Texas communities were without organized fire protection of any kind, and many others were operating with worn-out or obsolete fire equipment. Using Federal funds, through the Rural Community Fire Protection (RCFP) program—plus modest amounts of State funds earmarked for the purpose—several prototype ground tanker WES units were developed for field tests and experimentation. The early WES units met with unexpected and universal acceptance by volunteer fire departments. The discovery of "pine soap," a low-cost foaming agent produced by a local paper mill obviated historic problems associated with expensive synthetic foams.

The standard Texas Forest Service WES unit evolved into a slip-on tank/pump/reel assembly that could fit into a military or conventional 3/4-ton pickup truck. The 240-gallon WES unit produced 2,400 gallons of usable foam that appeared to be effective on wildland, small structure, and vehicle fires (or on 80 percent of the rural fire load in Texas). The extended operating time of WES over water units of comparable size was, and continues to be, a major advantage.

The Texas Forest Service will soon deliver its 300th WES unit through the RCFP program. We are also beginning to formally collect fire statistics and individual fire reports from the 300 rural communities that operate WES units. WES is now an integral part of the fire arsenal in rural Texas. We are beginning to see that it also has some application in hazardous materials incidents, in aerial delivery, in crash/rescue work, and in prescribed burning programs—as well as in fire suppression. The advent of low-cost synthetic foaming agents tailored to specific uses will enhance the continued evolution of WES as a universal fire suppression concept for the wildland/urban interface fire regime in Texas.

The Texas Forest Service will continue to support the development and use of WES because of its demonstrated success in suppressing fires in rural areas. This system is based on an infinitely flexible concept when coupled with foam, a universal fire suppressant. It promises to fill the wide historic gap between the tractor/plow and the water tanker in rural fire protection in the U.S. For additional information contact Pat Ebarb, Head Fire Control Department, Texas Forest Service, P.O. Box 310, Lufkin, TX 75901; 409/639-8100.

CANADIAN FORESTRY SERVICE WILDLAND FOAM STUDIES AT PETAWAWA NATIONAL FORESTRY INSTITUTE

by Ed Stechishen, Canadian Forestry Service

Interest in foam has been riding high in Canada for the last several years, but agencies were reluctant to use any of the wildland firefighting foams operationally. The tide is turning, and 1988 will be the first year when extensive use will be made of such products. To assist the user agencies in coming to grips with this innovation, the Canadian Forestry Service (CFS) has maintained a program of research focusing on foam expansion, drainage, mix ratio requirements, temperature stability, product variability, dispersion in water, water quality effects, adhesion to fuels, and absorption by fuels. Much of the work is carried out using laboratory generated foams; however, some fire pump and airtanker data have also been acquired.

Calibration of airtanker injection systems and injector efficiency in dispersing the concentrate will continue at an accelerated pace this year, primarily using the CL-215. Slash bed burning trials are in progress to derive a superiority rating for Ansul/Wormald's Silv-ex, Monsanto's Phos-Chek WD 861, Chemonics' Fire-Trol Fire Foam 103B, and Forexpan relative to water. Work in a conditioning chamber will continue to acquire more adhesion and evaporation data relative to foam quality. Contact me (E. Stechishen. Research Forester); I will be glad to share my results with interested parties; phone me at 613/589-2880, ext. 209; or write to the Petawawa National Forestry Institute, Chalk River, Ontario, Canada KOJ 1JO.

USDA FOREST SERVICE FOAM RESEARCH ACTIVITIES

by Dave Blakely and Ceci Johnson, USDA Forest Service

The fire suppression research work unit at the USDA Forest Service Intermountain Fire Sciences Laboratory, Missoula. MT, is conducting studies to characterize foams for fighting wildfires. The studies have quantified various foam expansion/breakdown characteristics; e.g., the ability to develop wet or dry foams at the same expansion rate. Because foam characteristics greatly affect both physical and combustion performance, the poor characterization and lack of knowledge of foam properties may explain performance differences that are often observed by field personnel. It was found that the drying rate of foam applied to natural fuels does not vary greatly from the drying rate of plain water. Studies are being performed to measure the corrositivity of foam concentrates at different dilutions. The toxicology of foams is being determined to help protect the health and safety of firefighters.

Field studies—part of the Operational Retardant Evaluation (ORE) program at Redding, CA—have confirmed that foam applied by helicopters using buckets can be very effective in direct attack on fires of lower intensities and greatly aid in reducing mop-up efforts—using concentrations that produce foam and lower concentrations that produce only wet water. Foams have limited effectiveness in suppression situations requiring indirect attack and when used against higher intensity fires. Wet foams are generally more effective than dry ones. Dry foams are often intercepted by aerial fuels and are more easily dispersed by wind.

Foams can be effective when applied from fixed-wing airtankers in direct attack situations on lower intensity fires. Use in and around structures, vehicles, etc. can have definite advantages when compared to alternatives involving chemicals and coloring agents; especially when cleanup is considered. Fixed-wing aircraft using foams have a narrow use window compared to long- or short-term retardants. Increased drop speed, and especially a low drop height, can have a very negative effect on foam delivery. Low drop heights do not provide the time needed for foams to develop. This is especially true of slow flying helicopters using buckets. Distances (time) required for breakup/development of foam is not significantly different from that of aerially delivered retardant.

COMPRESSED AIR FOAM SYSTEMS REPORT AVAILABLE

by Dan W. McKenzie. USDA Forest Service

The Forest Service San Dimas Technology and Development Center has issued Project Report No. 8751 1202, "Engineering Analysis of Threshold Compressed Air Foam Systems (CAFS)." This report presents information on approaches that have been used to inject compressed air into water that has an added foaming agent. Injection of air takes-place at the engine; the compressed air expands the water-foaming agent solution and, upon discharge from the hose, it has the appearance of snow.

Air is generally injected into the solution at a ratio of 10 to 50 parts by volume of free air to 1 part solution. CAFS units use positive-displacement gear pumps, and more recently centrifugal pumps (which work very well), to supply the water-foaming solution at 100 to 150 psi, and an air compressor to supply the air (also at 100 to 150 psi) to the mix point. This extends the water being carried by a fire engine, provides a wetting agent, and displays—with high visibility—the area of application.

The threshold range of operation for CAFS is considered to be a pumping rate of 4 to 5 gpm of water-foaming agent solution with a minimum of 20 cfm of air through 100 to 200 ft of l-in ID hose. The engineering analysis of how to expand water used three guidelines to determine if CAFS meets the needs of the Forest Service: (1) There should be no deterioration of the water handling capability or reliability of the engine, (2) the engine should be able to make a moving attack, and (3) the CAFS-equipped engine should be easy to operate. The use of centrifugal pumps for CAFS has been demonstrated, and a truck demonstration-validation engine hydrostatic pto unit was fabricated that totally meets the agency's CAFS guidelines.

To receive a copy of this report. or for further information on CAFS technology, contact Dan W. McKenzie, Mechanical Engineer, USDA Forest Service, Technology and Development Center, 444 East Bonita Avenue, San Dimas, CA 91773; 818/3326231 or 714/599-1267; FTS 793-8000 (DG, D.MCKENZIE: W07A).

FOAM EVALUATION BY OREGON STATE DEPARTMENT OF FORESTRY

by Dick Rondeau, Oregon State Department of Forestry

The State of Oregon had one 20-cfm, 500-gallon engine and one 40-cfm, 150-gallon engine in service in 1986. These are patterned after Boise Interagency Fire Center (BIFC) designed units. Both utilize foam concentrate hand mixed into the water tank. Foam development by Oregon was expanded in 1987.

Ground Engine Development

Development is proceeding on several levels, depending on the amount and "quality" of foam wanted by the using district:

1. Many districts use aspirating nozzles with foam solution mixed in the tank. They assume this wet foam will be adequate for most needs.
2. Low-cost, 20-cfm Ajax compressors—powered with 12-hp auxiliary gas engines—are designed to charge one 1-inch booster hose (four units in 1987).
3. Two "mid-sized" units are being developed to charge a 1.5-inch hose line. One will have a 40-cfm Ingersol-Rand compressor; the other a 39-cfm Ajax.
4. Two larger capacity units are being built for a district with both wildfire and prescribed burn missions. Both engines (a 500- and a 1,000 gallon) will have 60-cfm Champion compressors powered by 40-hp Kuboda diesel engines.
5. Two districts are assembling air/water manifolds to be used with trailer-mounted 100-cfm (minimum) compressors.

Because suitable commercial products are not available, we are also working on development of two components:

1. Several types of aspirating nozzles in the 5- to 16-gpm range.
2. A metering system to allow foam concentrate to be carried separate from the water tank. We need an injection system because of the difficulty with use of the available suction-type system with our centrifugal pumps.

Air Application of Foams

The airtanker stationed at Medford, OR (Black Hills P2V; 2,450-gal capacity) has been fitted with a foam concentrate tank and an injection system. The intent is to evaluate foams from three vendors (see the previous article by Ed Stechishen, CFS)—Silv-ex, WD 861 and 103B—in as wide a spectrum of fuels as possible. The Forest Service Pacific Northwest Region and the Intermountain Fire Sciences Laboratory ORE Project are cooperators with the State. As to rotary-wing aircraft, an evaluation of foam drops by helicopter buckets has not been formalized; however, we have been getting some experience with several operators.

USDI BUREAU OF LAND MANAGEMENT FOAM AND COMPRESSED AIR FOAM SYSTEMS DEVELOPMENT

by Bob Webber, USDI Bureau of Land Management

Historical Background

In 1978 wildland foam was introduced to BLM through a demonstration given in El Paso, TX, by the State of Texas Forest Service. The foam utilized was a by-product of the Kraft paper-making process. The BLM/BIFC Division of Fire Management tested this system under field conditions throughout the western United States. The limited capacity of the system, and the inability of the foam (pine soap) to develop quality foam with all types of water, slowed the development and utilization.

In the fall of 1985 the Salem, OR, BLM office used a larger unit to demonstrate the use of foam on structural and prescribed fires. Although the demonstrations were a success, it was felt that a more stable foam would be needed to offset any safety problems that could occur. A product from Canada was tried with tremendous success. The difference in product cost was offset by the stability and very low percent of actual agent used per gallon—pine soap was used at a 5 to 7 percent solution; the Canadian foam at 0.3 percent. Since that time, additional foaming agents have been tried with good results.

Current Developments

The BLM, in cooperation with other agencies, is conducting a 3-year program to develop foam and foam hardware support systems for use in all types of ground and aerial applications. *Ground application* has two methods currently proven to be effective. The less effective of the two is a standard water-pumping system with an air-aspirated nozzle that utilizes the velocity of the water/agent mix to provide a form of air injection. The drawbacks are that it requires a high mix ratio of agent to water, a high working pressure to develop foam, and relatively high water flows. The cost of this system is lower, but it is only an interim solution to the development of good foam at very low water/agent flows. The best system for the development of foam is CAFS (see previous article by Dan McKenzie, USFS). It develops a very good foam with uniform bubbles at very low flow rates. It extends use time on systems with limited water supplies and the foam can be adjusted wet or dry. It allows a very low mix ratio, while still providing good nozzle reach distance. It results in the hose line being lighter and provides for much longer hose lays.

As to *aerial application*, in the single-engine (agricultural) aircraft program, various concentrations of foam products and combinations of foam agents and long-term retardants are being tested and evaluated. Under more extreme burning conditions, the combination of foam and long-term agents appears to be superior in holding effectiveness, as compared to foam alone. Advisories to users are being developed in the form of tables to identify correct product mix ratios for different fire intensities, fuel conditions, and water source factors.

Interest in foam development and CAFS is becoming international in scope, with many nations participating in the development of these systems. The next 3 years will most likely show a substantial emphasis in the development and utilization of foam systems in many phases of fire protection.

FORMS AVAILABLE TO EVALUATE FOAM USE

by Paul R. Hill, USDA Forest Service

Forms to aid users in reporting results of field use of fire foams have been jointly developed by the Bureau of Land Management and the Forest Service. One form, designed specifically for *ground application* is available from USDI Bureau of Land Management, Boise Interagency Fire Center, Attn: Jack Wilson. 3905 Vista Avenue, Boise, ID 88705; from USDA Forest Service, Intermountain Fire Sciences Laboratory, Attn: Fire Suppression Research, P.O. Box 8089, Missoula, MT 59807; or from USDA Forest Service, Technology and Development Center, Attn: Program Leader-Fire Management, 444 East Bonita Avenue, San Dimas, CA 91773. A special form for *air application* is also available from either the Missoula or San Dimas addresses just presented.

CANADIAN PROVINCIAL FOAM PROGRAM

Canadian Air-Dropped Foams

The use of aerial forest firefighting foams in the Yukon and Northwest Territories is an accepted practice, but elsewhere in Canada it is slow to gain acceptance other than for experimental use. The main problem is the uncertainty associated with identifying its benefits and defining operational needs. This is especially evident when using foam in aerial attack where drop height, airtanker speed, and mix ratio all contribute to determining the quality of the foam that reaches a target. Each agency must identify what is expected of the foam: To hang up and remain on aerial fuels for an extended period of time; to hang up only momentarily then flow through the fuel complex to the lowest level; or, to hang up and then commence draining at some given rate.

During the drop trials by the Canadian Forestry Service in New Brunswick in June 1987. the provincial agency was asked to define its requirements; i.e., where did they want the bulk of the load to remain and how fast a drainage could be tolerated? The response was "percent drained in 5 minutes should not exceed 40 percent." Each manufacturer's product has its own set of peculiar characteristics; consequently, the mix percent had to be determined independently for each product. The trials indicated that the mix ratio had to be matched with the airtanker's flying speed to produce foams having similar drainage curves. Tests are continuing and more information may be obtained by writing to the Petawawa National Forestry Institute, Chalk River, Ontario, Canada KOJ 1JO.

1986 SEASON GROUND APPLICANT USE

by Dick Seaman, Yukon Forest Service

In using a ground applicant, we started with a helicopter filling a 1,000-gallon port-a-tank. Then we added 5 gallons of ground applicant to the full tank.

Pumps were used from the port-a-tank to the fireline. This approach was used to save the short water supply found in remote areas of the north half of the Yukon. Things were fine until the tank required refill. Once the helicopter started filling the tank again, the ground applicant commenced to foam. Each time the bucket was emptied into the tank the down wash from the helicopter-plus the agitation of the drop—resulted in a huge detergent "commercial." So much so, that the tank was hard to fill as the foam hid the tank and foam obstructed the pilot's vision.

Our solution was to erect a second 1,000-gallon port-a-tank approximately one hose length (100 feet) from the applicant tank. This was filled by the helicopter and pumped, or gravity fed, into the applicant tank. Very little agitation resulted. We mainly used a 206B helicopter since we do not, as a rule, use medium or heavy lift machines in Yukon. The 206B can keep up with the pump if the crew does not use full-pump throttle. There is no need for full-pump throttle, if ground applicant is used. The pump crew had to be retrained to handle the application of water with the ground applicant in order to conserve water. In 1982 we changed (except in exceptional cases) from helicopter bucket work directly on the fireline to filling port-a-tanks. This cut down on water waste by helicopters and conserved helicopter time. In the 1987 season we did not use ground applicant, except for two tests which have not been completed yet. Also, the toxicity clearance for various applicants is still to be completed.

FIREFIGHTING FOAM

by Glen Conacher, Province of Saskatchewan

The summer of 1987 in Saskatchewan proved to be one of the severest fire seasons in recent history. As a result, this Province called upon other jurisdictions to lend assistance in the form of aerial tanker aircraft. As a side benefit, we were—for the first time—exposed to the use of foam fire suppressant delivered by Candair CL-215's. Reports obtained from experienced bird dog officers and ground crews are very positive. Preliminary indications are that it takes three water drops to equal one foam drop. The Province is currently completing further evaluations of this product prior to installing foam injector kits on its fleet of four CL215's.

CALIFORNIA DEPARTMENT OF FORESTRY & FIRE PROTECTION FOAM STUDIES

by David Day, California Department of Forestry & Fire Protection

The California Department of Forestry and Fire Protection (CDF) is currently exploring the value of wildland foam in three use areas: Airtankers, helicopters, and ground attack units. *Airtankers*: The CDF operates airtankers out of the joint CDF-USDA Forest Service Redding, CA, airtanker base. The aircraft are equipped with injection systems that permit the "arming" of water loads with foam concentrate. Foam drops are under the general guidance of the Operational Retardant Evaluation (ORE) study. There wasn't an opportunity in 1987 to evaluate foam to the extent hoped for; increased foam use is anticipated in 1988. For further information, contact the Redding Air Attack Base, 6101 Airport Road, Redding, CA 96001; Attn: Reid Steinback, CDF.

Helicopters with Fixed Tank: The CDF is not utilizing foam in this type of aircraft. *Helicopters with Bucket*: The Bieber and Vina UHI-F helicopters (north- eastern California) have been equipped with pilot-activated foam systems, and are dropping foam under the general guidance of the ORE study. The foam system is comprised of a plastic, 15-gallon tank mounted on the exterior of the ship. A timer controls the amount of concentrate feeding bucket. A solenoid and pump, along with tubing and a check valve, make up the remainder of the system, thus far. For further information contact CDF at Bieber Helitack Base,P.O. Box 36, Bieber, CA 96009.

Ground Attack Units: The CDF is working on development of a foam proportioning and application system. This system will sense the water flow rate in the discharge from the fire pump. A high-pressure, low-volume pump will then "inject" the required amount of concentrate into the discharge. The injection pump will be controlled electronically from the flow sensor by a microprocessor, or a "black box." With this method, it is possible to be accurate over a wider range of discharge rates. And, accuracy is critical to the safety of the firefighters. Also, the system can revert to plain water and still provide a sufficient quantity to be effective on heavier fuels and on structures. Quality foam solution can be produced without utilizing large compressors and other heavy machinery. Adequate aeration can be achieved with a combination nozzle at the tip. The concentrate proportioning package is expected to be retrofitable on some apparatus now in service. For further information, contact Paul L. Blankenship, Manager, Mobile Equipment Management, 5950 Chiles Road, Davis, CA 96616; 916/ 322-5684.

USDI NATIONAL PARK SERVICE USE OF FOAMING AGENTS

by Dave Butts, USDI National Park Service

The USDI National Park Service (NPS) has responsibility in over 300 National Parks for total fire protection—both wildland and structural. Many of the structures are unique historic buildings; others contain irreplacable collections. There are thousands of overnight occupants, both employees and visitors, under our protection within the parks. NPS had made limited use of foam, especially air expanded foam. We have less than a dozen water expansion slip-on units now in use for wildland fire. Demonstrations to date appear favorable.

We have discouraged wholesale adoption of the units for our dual structural/wildland fire operations until full operational guidelines can be developed, including consideration for historic structures and their irreplaceable contents. Performance based standards are being developed to test the relative effectiveness of various delivery systems (tank, pump, hose, and nozzle)—with or without fire chemicals (including foaming agents) in hopes that the results will enable us to better select the right system for the conditions present in each park.

SUGGESTED READING

The Foam Task Group has compiled a list of over 30 references that contain valuable information on the world of fire foams. Here are 10 that provide either historical background or updates on current work. Future issues of this publication will present the remaining articles, papers, and reports for your suggested reading.

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5. Layman. Lloyd. Attacking and extinguishing interior fires. Boston: Natl. Fire Protect. Assoc.; 1955. 149 p.

6. National Fire Protection Association. Standard on low expansion foam and combined agent systems. Quincy, MA: NFPA; 1983.

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10. Ratzer, A. F. History and development of foam as a fire extinguishing medium. Indstrl. & Engrg. Chem. 48(11):2013-2016; 1956

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