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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

International Workshop on Foam Applications Announced

The Foam Task Group (including the Canadian Forestry Service) is sponsoring an International Workshop on Foam Applications for Wildland and Urban Fire Management, to be held in Lakewood (Denver), CO, June 7-9, 1988. This event is designed to bring together, by invitation, many of the people that can guide us in designing foam formulations, planning for research, providing fire suppression tactics, and the development of training. The Workshop will play a major role in determining the direction to be taken in foam applications during the next several years. Objectives will be to:

- Develop a common understanding of foam technology
- Gather information and cultivate a common base of knowledge
- Produce action plans
- Establish contacts and networks
- Unify our approach.

We Still Need Your Help

While this publication's next issue will be mainly devoted to the Workshop proceedings, we still need informative articles for future issues. We want to publish your experiences with foam applications, tactical use, equipment innovation, and other noteworthy information. Please submit articles or any comments to: H.B. "Doc" Smith, Foam Task Group Chairperson; 800 South 6th Street, Williams, AZ 86046; 602/635-2681 (DG, H.SMITH:R03F07A). Do not be concerned about the style or format of your submittals, since the technical editor at the Forest Service San Dimas Technology and Development Center takes rough draft material and "cleans it up" prior to its being published here.

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MANUFACTURER SUBMISSION PROCEDURES FOR WILDLAND FIRE FOAMS

by Paul Hill, USDA Forest Service

A submissions procedure booklet, designed specifically for use by a manufacturer in submitting a wildland fire foam for evaluation, has been published by the USDA Forest Service, San Dimas Technology and Development Center (SDTDC). It outlines in detail the procedural steps to be followed by a firm to have a foam evaluated and tested for "interim approval." This booklet also details the test procedures to be used for laboratory testing. The present evaluation program is based on the Forest Service "Interim Requirements for Foam, for Wildland Fires, Aircraft or Ground Application," dated August 1986.

As of now, the agency has approved four foams for field evaluation in engines (ground use) and by helicopters with buckets: (1) Fire-Trol Fire Foam 103B, produced by Chemonics Industries; (2) Silv-ex, produced by Ansul/Wormald; (3) Phos-Chek WD 861, produced by Monsanto Co.; and (4) ForExpan, produced by Angus Fire Armour Corp. These are also the foams approved for use in fixed-wing aircraft under the guidance of the Operational Retardant Evaluation (ORE) program being conducted at Redding, CA, through the office of the Director, Fire and Aviation Management, Washington Office.

USDA FOREST SERVICE DEVELOPS LONG- AND SHORT-RANGE PLANS FOR WILDLAND FOAMS

by Bill Shenk, Paul Hill, & Chuck George, USDA Forest Service

The Forest Service, in an effort to be more responsive to field needs and obtain more quantifiable information as to the effectiveness of wildland fire foams, has developed a Long-Range and a Short-Range Wildland Fire Foam Implementation and Evaluation Plan. The *long-range plan* is to accomplish the following:

1. Fully implement the "Interim Requirements for Wildland Fire Foams," dated August 1986.

2. Consider changes in requirements or development of specifications as more becomes known about wildland fire foams.

3. Conduct fundamental laboratory studies on the characteristics and effectiveness of various foams.

Under the *short-range plan*, limited operational evaluation of foams, broken down into two categories—ground and air, are to be conducted. In all cases, the interim requirements must have been met for a foam to be operationally used. This plan covers the following:

1. Ground Use (Engines) and Helicopters with Buckets—Allow field to use and evaluate foams with ground equipment and helicopters with a bucket. Users are to provide documentation of their experience as a condition of use. Evaluation forms have been developed for this purpose. (See the article on foam evaluation forms in Vol. 1, No. 1 of this publication.)

2. Fixed-Wing Airtankers and Helicopters with Fixed Tanks—This use and evaluation is limited to a controlled, conceptual study as a part of the ORE study, Redding, CA.

Specifics regarding the Forest Service foam evaluation plans can be obtained by contacting the Director, Fire and Aviation Management, Washington, DC 20090-6090; 703/235-8039; DG, FIRE:W01B.

DESCHUTES NATIONAL FOREST COMPRESSED AIR FOAM SYSTEMS (CAFS) UNIT

by Dan McKenzie and Dewey Warner, USDA Forest Service

The Deschutes National Forest, Bend, OR, has assembled a unique CAFS unit. (See Vol. 1, No. 1, p. 7 of this publication for information about the availability of a comprehensive report on CAFS.) It is unique because it is driven by the truck engine; it can make a running attack with either CAFS or water only. No foaming agent is added to the main water tank. This is made possible by (1) the use of two hydrostatic drives powered by the truck engine—one powers the centrifugal pump; the other a 25-cfm air compressor—and (2) the direct injection of the foaming agent into the water stream on the discharge side of the pump in the proportion and rates desired.

When the CAFS nozzle at the end of the hose is shut off, the injection of foaming agent into the water stream is also stopped. The main water tank on this unit holds 200 gal; the centrifugal pump is a Gorman-Rupp model O2F1-G; and the unit is mounted on a 10,000-lb GVWR truck. It demonstrates that a CAFS unit can be driven by the truck engine and make a running attack, and that direct injection of the foaming agent into the water stream—requiring no foaming agents be added to the main water tank—is possible.

While the performance of this unit has certainly been satisfactory; it should be considered a demon-stration/validation unit, not to be duplicated without further engineering of the complete system. For more information and details on the use of this unique CAFS unit contact Dewey Warner, Assistant Fire Management Officer, USDA Forest Service, Fort Rock Ranger District, Deschutes National Forest, 1645 Highway 20 E., Bend, OR 97701; 503/388-5664; FTS 422-6690.

PLEASANT VALLEY RANGER DISTRICT, TONTO NATIONAL FOREST CAFS UNIT

by Dan McKenzie and Jim Costantino,
USDA Forest Service

The Pleasant Valley Ranger District, Tonto National Forest, Young, AZ, has recently completed assembling a CAFS unit. This unit is basically a standard centrifugal pump, 200-gal slip-on unit mounted on a 10,000-lb GVWR truck, plus a truck-engine-driven, 25-cfm air compressor. The air compressor is belt driven from the front of the truck engine, and is engaged and disengaged by an electric clutch mounted on the input shaft of the air compressor. The compressor and other CAFS hardware were installed on the truck in 1 day at the field location (Young, AZ), which is quite a feat, considering that Young is over 40 mi by dirt road from the nearest settled community.

The Pleasant Valley Ranger District CAFS unit has had considerable use this last fire season and has been found to be very useful. When operating with CAFS, flow rates of water are generally in the 3 to 5 gpm range, and sometimes up to 6 to 10 gpm. At a 3 to 5 gpm flow rate, a thick, relatively dry foam, is produced. It reached a distance of 10 to 15 ft, adhering to everything in its path for 3 to 4 hr. At a flow of 6 to 10 gpm, a much wetter foam is produced; it reached out 40 to 50 ft. It also adhered well, but only for 2 to 3 hr. The District believes the installed water flow rate meter is a necessity, and they would like the unit to be able to make a running attack with CAFS.

However, when the District field tested the unit, they discovered that this unit, with its direct truck-engine-driven air compressor, cannot make an acceptable running attack with CAFS. For more information and details on the use of this unit contact Jim Costantino, Fire Management Officer, USDA Forest Service, Pleasant Valley Ranger District, Tonto National Forest, P.O. Box 268, Young, AZ 85554; 602/462-3311; FTS 261-4440.

CALIFORNIA DEPARTMENT OF FORESTRY & FIRE PROTECTION STUDIES ASPIRATING NOZZLES

by John Machado,
California Department of Forestry & Fire Protection

California Department of Forestry and Fire Protection (CDF) Region IV has been testing foam in ground attack units. Before actual testing begun, the Region designed and built several low- and high-volume adjustable aspirator tubes. These were fitted to some of the standard nozzles normally carried on our wildland engines. The nozzles then were used to perform the following evaluations:

1. Petroleum fires—Fire foam performed well to extinguish burning gasoline and diesel fuel pits; the surface of the fuels was thoroughly covered with a 1 to 3 inch layer of foam. No flashovers were experienced during three separate tests. Further testing may prove these suppressants to be a valuable asset in combatting vehicle and other fires where petroleum fuels are encountered.

2. Exposure; structure protection—Our testing of fire foam in the pretreatment of wooden structures was very encouraging. The foam hangs well on moderately sloped rooftops of shake or wooden shingles, and should stick even better if there is an accumulation of leaves and needles. A foam layer, 1 to 2 inches thick, was applied to the roof and sides of a small wooden structure. The weather conditions were 96° F, 32 percent humidity with a calm wind.

Several of the aspirator tubes that were built and tested by CDF, Tulare Ranger Unit, can be seen in figure 1. Each of these tubes can be adjusted to provide everything from a solid, far-reaching, unobstructed straight stream to a dense-flowing, widely dispersed foam by simply twisting the tube to various positions. All interior mixing devices are attached to the tube sides, but do not cross over the center of tube. This allows a clear pathway for straight stream application. Foam is developed as the adjustable nozzle is turned from the straight to the wide-stream position. The tubes shown in figure 1, from left to right, are:

1. One of the earlier 1 x 1-1/2 inch tubes, with smooth flowing interior and a set of air ports. It produces acceptable foam with a large percent of heavy water; 22 to 45 gpm at 100 psi.

2. A multi-expansion tube, 1 x 1-1/2 x 2 inches, utilizing a double set of venturi ports. Interior sides are smooth, producing a somewhat superior foam compared to the No. 1 tube.

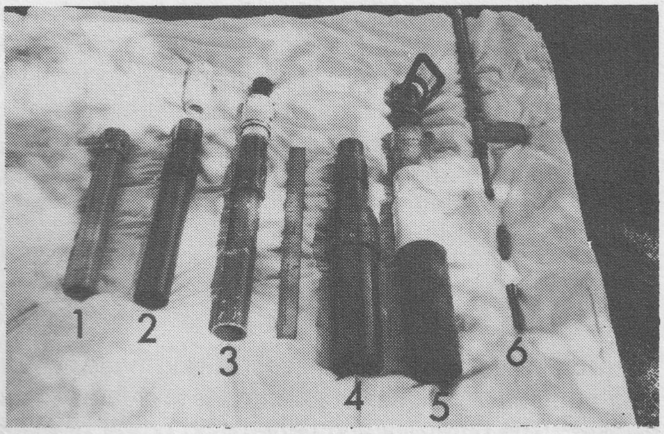

Figure 1. Series of CDF adjustable aspirator tubes.

3. A 1 x 1-1/2 x 2 inch tube with nozzle and nozzle attachment, is similar in size and shape to previous model, but contains three sets of agitation devices attached to inner sides of the 1 and 1-1/2 inch section. It produces a quick-covering, sticky foam; 22 to 45 gpm at 100 psi.

[An 18-inch rule—for size reference.]

4. A 1 x 1-1/2 x 2 x 3 inch tube that utilizes three sets of venturi ports and contains interior mixing devices which produce a wide flowing foam pattern; 35 to 45 gpm at 100 psi. (See figs. 2 and 3.)

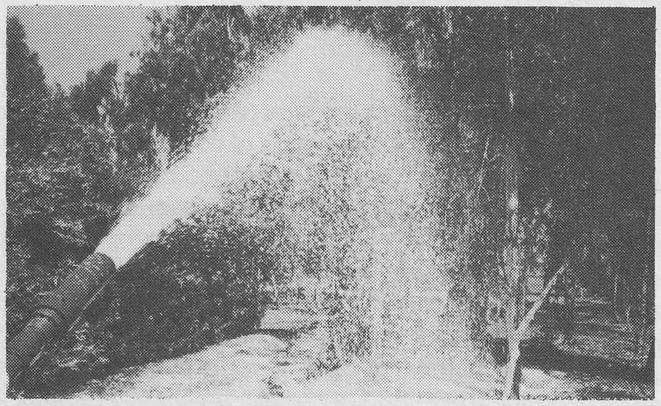

Figure 2. No. 4 aspirator, when adjusted to full-foam flow, produces a very effective pattern.

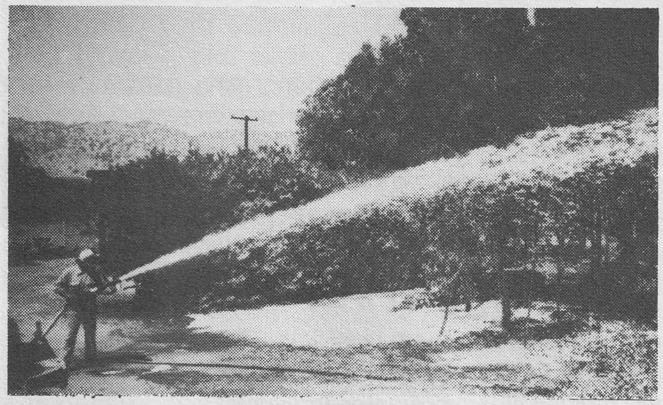

Figure 3. No. 4 aspirator, when adjusted to nearly straight stream, gives a much greater reach, but with less foaming action.

5. CDF's most recent prototype 1-1/2 x 2-1/2 x 3 inch tube that contains three sets of venturi ports plus a series of stainless-steel deflectors and spinners which mix the agents with minimal effect on velocity. (See figs. 4 and 5.)

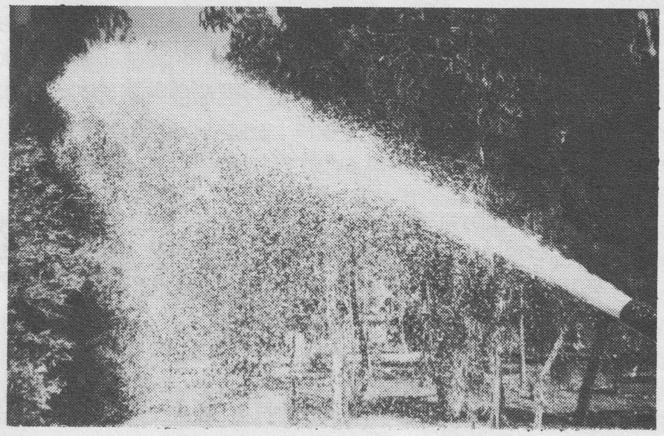

Figure 4. No. 5 aspirator, when adjusted to full-foam position, provides quick and heavy coverage at approximately 60 gpm.

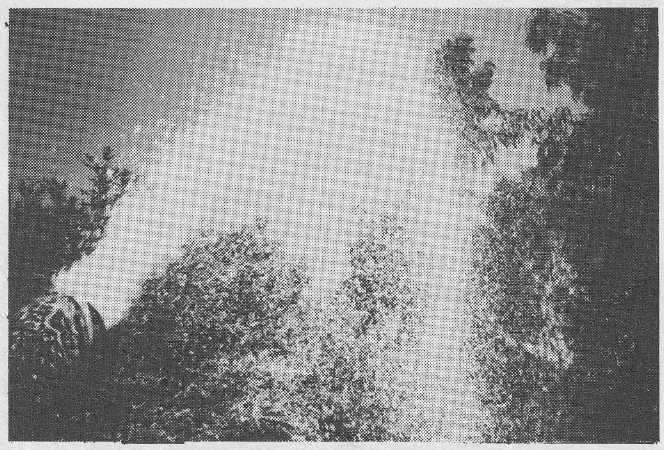

Figure 5. Closeup of the No. 5 adjusted fo full-foam flow.

6. Three types of aspirator tubes, designed for use on standard backpack hand pumps, that all produce a good covering foam which should be very suitable for mop-up and light fuels. The two unattached tubes can provide adjustable streams; the attached unit provides a single flow. Each has a 3/8-inch brass or copper tube that contains a set of airports with a single internal crossover mixing device.

The results of our findings are as follows:

- A high-volume applicator would be necessary to completely cover an average size building in a reasonable time frame.

• Foam applied to the roof covered excellently, and remained that way for 20 minutes before beginning to break up; by 30 minutes, all evidence of foam had disappeared—leaving a moisture-laden roof that showed no signs of dry spots for an additional 15 minutes.

• Foam will stick well to wooden siding of structures, but our tests indicate an expectation of no more than 15 minutes before complete drying takes place.

For further information or clarification on the aspirating nozzles, contact CDF, Attn.: John Machado, State Forest Ranger II; 1968 South Lovers Lane; Visalia, CA 93277-5650; 209/732-5954.

USDI BUREAU OF LAND MANAGEMENT EXPERIENCES IN USING FOAM AS A BARRIER IN PRESCRIBED FIRE AND FOR MOP-UP

by Ron Rochna,
USDI Bureau of Land Management

Foam and Prescribed Burns

Foam has been successful as a barrier in preventing fire spread. This has given managers a new tool for protecting resource values and minimizing potential fire hazards associated with prescribed burning. The use of foam has been primarily in addition to a fire trail cut to bare mineral soil. Over 30 such lines have been documented and fire has burned through none of them. These foam lines have been 100 to 1,400 feet long, 10 to 100 feet wide, and up to 80 feet high. Foam has remained effective after over 5 hours of heating by fire. Time between treatment and burning has been 0 to 30 minutes. Foam-treated canopies have repelled fire moving through thickets adjacent to the line. Application rates vary with local conditions, but 30 square feet of foam per gallon of water has been a successful formula.

The use of foam as the only barrier to fire has also been 100 percent successful. In one example, a 10-foot wide foamline was placed across heavy lodgepole pine and alpine fir slash. The line stopped a prescribed fire moving rapidly, with 30-foot flame lengths torching trees to 60-foot flame lengths. No handtools were used; no soil exposed. Proper technique is critical for success.

Foam has been used on resource values other than midslope lines. Snags, riparian buffers, and wildlife trees that are potential spotting hazards have been coated with foam to prevent their ignition. A typical 80-foot discharge distance, 1,500 feet from the pump, gives the compressed air foam the capability for this application. Log decks have also been pretreated to protect firewood or prevent costly mop-up of the deck during burning season. Seed trees, sensitive plants, and headwalls can also be treated to prevent undesirable ignition. Foam is a cost- and resource-saving tool for prescribed fire.

Foam and Mop-Up

Foam offers fire managers new cost-saving measures for mop-up. One technique, for example, is to create a foam blanket. The durability and penetrating power of foam equates to more water for extinguishing and less application time. For managers with Simpson Timber Company, the Bureau of Land Management, and the Oregon State Department of Forestry, foam use data indicate a significant reduction in mop-up costs.

AN EVALUATION OF FOAM AS A FIRE SUPPRESSANT IS AVAILABLE

by Paul Schlobohm and Ron Rochna,
USDI Bureau of Land Management

Background and Abstract

The Bureau of Land Management (BLM) is evaluating the effectiveness of foam as a means of controlling fire. The impetus for this study can be described by the reality of current ground-applied fire control efforts. Wildfire suppression capability is limited where water is scarce and real property values are threatened. Prescribed fires are often difficult to contain. Time-consuming mop-up reduces further burning opportunities. We have published an evaluation of the use of foam for ground-applied fire control during the 1986 fire season entitled, "Foam as a Fire Suppressant: an Evaluation." (It was presented at the *Symposium on Wildland Fire 2000*, April 27-30, 1987, South Lake Tahoe, CA.)

Foam chemicals and foam-generating hardware were examined. Performance evaluations were made for direct attack, fuel protection, and mop-up. Foam was found to suppress and repel fire in situations where straight water would not. Extinguishment can be instantaneous with two-thirds less water. Short-term foam barriers can prevent fire spread. Cost comparisons of mop-up work showed straight water to be 40 to 50 percent more expensive. Compressed air foam systems (CAFS) have greater performance capability than air-aspirated systems. Foam will replace all current water applications and present new suppression opportunities to the fire management community.

As recently as 1985, foam systems relied on foam-making substances not specifically designed for fire suppression. Since 1985 foaming agents designed for wildland fire suppression have been available. These products combine relatively stable bubble structure, improved wetting ability, and vapor suppressants. They provide the capability of instantaneous extinguishment, construction of an impenetrable barrier to fire, and reduced mop-up time. Foaming agents can be utilized by a variety of means. Synthetic foaming agents have sparked new interest in the foam generating systems made popular by pine soap. CAFS have been modified with centrifugal pumps and metering devices, and enlarged with 40 cubic feet per minute (cfm) or greater air compressors. Air-aspirating and conventional water systems also have applications for foam.

Technology offers improvements from conventional equipment for mix methods, hose types, hoselays, and nozzles. The inefficiencies of batch mixing concentrate and water are overcome with eductors or proportioners. Eductors also make possible the use of foam when the sole motive force is a water pump. A portable pump, for example, can draw concentrate into the hose as it pulls water out of a stream. Proportioners, which pump concentrate as desired into the water line, have the accuracy and dependability necessary to be integral engine components.

Applications

The applications phase of the project directly evaluated fire control potential of foam in the field. Where possible, comparisons were made to water performance. Evaluations occurred on prescribed fires and wildfires throughout the West. *Direct Attack*—Visual evaluations of foam's extinguishing capability were made. Flames burning in light, flashy, ground fuels, tall snags, pitchy stumps, red slash concentrations, and desert sage were treated. Extinguishment was instantaneous. *Protective Barrier*—Applications of foam for protection include prescribed burn boundaries, fuel wood piles, snags, wildlife trees, and fragile sites, and backfire wetlines. Twenty firelines adjacent to prescribed fire units have been pretreated with foam. The foam-treated areas adjacent to firelines ranged from 300 feet to 1,500 feet in length. Width (25 to 100 feet) and depth (0.25-2 inches) depended on the foam generation system and site conditions. The time between application and ignition ranged from 0 to 45 minutes. Spotting beyond the foam lines occurred on occasion, but no foam line was crossed by moving fire. *Mop-Up*—Direct foam versus water performance and cost comparisons were made during mop-up operations. Personnel involved were not informed of the comparison to avoid any changes from standard instructed procedure. In each case, the foam crew was mopping up with foam for the first time.

The Future

Over the past 2 years foam has developed into a tool for the future. The full potential of foam has yet to be realized. In fact, the technology of class A foam firefighting is expanding beyond class A fires. Cost-effective, successful applications have been demonstrated with hydrocarbon fires, vehicle fires, and structure fires. Methods of delivery are also expanding to fit different needs and resources. The wildland/urban interface fire protection program may have the most to gain from foam development. Research must increase our understanding of foam processes. Training of application techniques must begin. The days of fighting fire with plain water are numbered. Water has served us well in fire suppression over the years. As we move into the twenty-first century, water will serve us even better as foam. Please direct requests for copies of the evaluation or questions to the authors of this article, Fire Management Specialists, USDI Bureau of Land Management District Office, 1717 Fabry Road S.E., Salem, OR 97302; 503/399-5845.

SAN DIMAS TECHNOLOGY AND DEVELOPMENT CENTER FOAM PROJECT ACTIVITIES

by Dan McKenzie, USDA Forest Service

The Forest Service San Dimas Technology and Development Center (SDTDC) has pursued, in cooperation with the USDI Bureau of Land Management (BLM) at the Boise Interagency Fire Center (BIFC), ID, three areas of foam technology:

1. <u>Hydrostatic-drive compressed air foam systems (CAFS) developments</u>—SDTDC is working with BLM at BIFC and at Salem and Roseburg, OR, to equip a fire truck with a hydrostatic drive and control system, powered only by the truck engine, for a CAFS unit that allows the truck to stand or make a moving attack while producing compressed air foam or only pumping water.

2. *<u>Air-aspirating nozzle tests</u>*—The Center has assisted BLM, at BIFC and Salem, in the testing and evaluation of air-aspirating foam nozzles. BLM is preparing a short report on the results.

3. <u>Development of foaming agent direct-injection proportioning equipment for use on the high-pressure outlet (discharge) side of the main water *pump*</u>—SDTDC is working on the development and evaluation of direct-injection proportioning systems for injecting the foaming agent directly into the water stream on the high-pressure outlet side of the pump. The advantages of direct-injection systems are:

- No chemicals are added to the fire engine main water tank, run through the pump, or circulated back to the tank by way of the tank fill valve pump bleed line and, thus, foam does not overflow out the top of the tank, and pump priming problems—caused by foaming in the suction line to the pump—are eliminated.

- While operating, the proportion of foaming agent to water can be easily changed.

- Dip sticking or gauging is not required when refilling a partially used tank of water, because the foaming agent is not added to the main water tank.

- The fire engine equipped with a direct-injection system can draw water directly from a nurse tanker or hydrant to make foam (expanded water).

SDTDC's approach has been toward mechanical metering and proportioning systems instead of electric or electronic systems. If a mechanical metering and proportioning system can be developed, it would have a greater probability of being low cost, simple, and more easily understood and maintained by field personnel than an electric or electronic metering and proportioning system. Also in the SDTDC approach, the use of standard, "off-the-shelf" components is being emphasized to reduce development time and costs, reduce the cost of production systems, and make production systems available from several sources and in shorter time frames.

Air-Operated Injection Pump with Orifice Metering

A brassboard air-operated injection pump with orifice metering was assembled and operated by SDTDC. In this system the foaming agent is injected directly into the water stream on the high-pressure side of the water pump at a rate that provides the desired percentage of foaming agent. This rate of injection is controlled by both the air pressure being used at the injection pump and the size of the injection orifice, which is adjustable. The pressure of the air operating the air pump is controlled by the flow of the water; the water flow rate is adjustable. The unit operates very well in the upper half of the maximum flow rating; however, the maximum flow rating can easily be adjusted down to one half, one quarter, or even less. Estimated cost of the system, using known off-the-shelf components, is $2,000 to $3,000. It is believed that further search will uncover presently undocumented off-the-shelf components to bring the cost down to approximately $1,000.

Meter Motor

Several brassboard meter motor units have been assembled using off-the-shelf components. In the meter motor proportioning system, a positive-displacement pump, driven by a positive-displacement meter motor, pumps the foaming agent directly into the high-pressure side of the water supply pump. Low-cost gear pumps were tried for the meter motor. It was found that they would work as long as the shutoff valve was upstream from the gear pump; but when the shutoff valve was located downstream of the gear pump, the gear pump would not start. The problem is that low-cost gear pumps have only one shaft exiting from the pump housing and this serves as a rod (as in a pressure cylinder), resulting in the pulling of one of the gears against the pump housing—preventing the pump from starting. Therefore; low-cost, single-output-shaft gear pumps cannot be used as a meter motor.

One way to overcome this problem is to select a gear pump that has a through shaft exiting both sides of the gear case. With this arrangement, the forces trying to push the gear against the pump housing are balanced and the gear pump will start. A Wajax/Pacific WX-10 positive-displacement gear pump, which has its shaft coming out each side of the gear case, was tried as the meter motor. This pump would start when the shutoff valve was located downstream, but the pressure drop through the WX-10 pump was 75 psi, which is considered too large of a pressure drop for the desired operation. SDTDC has purchased a positive-displacement meter that is believed will start when the shutoff valve is located downstream, but will not have a high pressure drop. Estimated cost of a meter motor direct-injection system is $1,500.

Positive-Displacement Pump with Venturi or Restrictor Valve

Another direct-injection system assembled at SDTDC is a venturi or restrictor valve metering system. In this system, a positive-displacement pump moves the foaming agent at a rate slightly above the maximum use rate of the CAFS. The pressure of the foaming agent is controlled and made equal to the main water supply pressure by the use of a pilot-operated relief valve—the pilot pressure being the main water supply pressure. This relieves the excess pumped foaming agent back to the foaming agent reservoir. The main water supply passes through a venturi or through a restrictor valve—depending on the system design—resulting in at least a 20 psi pressure drop at maximum system water flow rate. The foaming agent is metered into the water stream at the desired rate through a needle valve. By adjusting the needle valve, the percent of foaming agent can be changed.

In this system, when water flow rates are reduced, the foaming agent injection rate is also reduced—keeping the percentage of foaming agent the same. When the water flow is stopped, the foaming agent flow is also stopped because now the main water pump pressure at the point of foaming agent injection is equal to the foaming agent pressure; hence, no foaming agent flows into the water stream. In a CAFS where the water flow rate is being controlled by a ball valve, a restrictor valve can be used with no adverse effect because, in the control of the water flow rate, a pressure drop is required that is more than the pressure drop through the restrictor valve.

If a permanent pressure drop is undesirable, a venturi can be used, and most of the pressure drop will be recovered (maybe only a loss of 1 to 5 psi). The foaming agent pump can be powered by a 12-volt dc motor, air pressure, hydraulic pressure, or even main water pump pressure. The venturi or restrictor valve metering system will only work well in the upper half of the rated flow; if a restrictor valve is used, the rated flow can easily be reduced to one half—or even one quarter or less—of rated flow, allowing the restrictor valve metering system to function very well at these reduced water flows. The cost of the system will be $400 to $700 (or even higher), depending on the cost of the foaming agent pump and drive that is used.

In summary, of the mechanical direct injection systems that SDTDC has investigated, the venturi or restrictor valve metering system would be the best selection because of the use of standard off-the-shelf components, low cost, simplicity, and ease of use and maintenance by a typical firefighting crew. For further information on any of the three project areas, contact Dan W. McKenzie, Mechanical Engineer, USDA Forest Service, Technology and Development Center, 444 East Bonita Avenue, San Dimas, CA 91773; 818/332-6231 or 714/599-1267; FTS 793-8000 (DG, D.MCKENZIE:W07A).

FOAM APPLICATIONS—A PRESENTATION OUTLINE

by Chuck George, USDA Forest Service

In outline format, here is an overview of a recent presentation on the Intermountain Fire Sciences Laboratory (IFSL) foam studies that have been conducted in the laboratory and the field. Research needs are related to the use of foams in wildland fire suppression, and the perceived niche for foams in wildland/urban interface fire suppression is noted.

1. Video presenting a perspective of the wildland/urban interface fire suppression problem (5 min).

2. Why the present interest in foams for wildland fire suppression?:

- Potential to increase effectiveness of water—and overall suppression effectiveness
- Minimal logistical requirements (small chemical demand, ease of mixing, etc.)
- Reduced cost (as compared to other chemical requirements)
- Optimism on the part of fire managers—in finding a simple, inexpensive solution
- Market development activities of industry.

3. How does the current interest and use of foams relate to the wildland/urban interface fire problem?:

- *Improved suppression effectiveness*

  —Key to the solution of the wildland/urban interface fire problem

- *Ground suppression*

  —Foams can improve effectiveness and efficiency

  —Provide multipurpose suppressant/system for both structural and wildland fires

  —Offer mechanism for standardization of suppression techniques, chemicals, equipment, and training

- *Aerial suppression*

  —Use of foam may provide a more acceptable method for structure protection than current long-term fire retardant chemicals (elimination of impact of color and chemical residues)

  —Improve the effectiveness of water for delivery systems (helicopter, scooper aircraft, etc.) where conventional systems are severely limited by logistics

- *Protective measures/techniques to reduce fire risk*

  —Foams may provide homeowners a cost-effective method for structure protection in advance of exposure to wildland fire; i.e., exterior sprinkler systems and fuel pretreatment.

4. What is the niche for wildland fire foams and where can foams be used effectively in wildland/urban interface fire suppression?:

• Although there is a wide variety of foams, and approaches to the use of foams available, the foams presently being used are physical (as opposed to chemical) in nature. The use of these foams is aimed at improving the effectiveness of water. Their effectiveness is derived from:

—Cooling effect as a result of the water content
—Insultating effect
—Barrier to escaping flammable vapors
—Wetting action of surfactant (affecting placement of moisture within the fuel complex).

• Wildland fire foams have no chemical or long-term retardant effect. The availability and/or location of the moisture is altered by the water-containing foam through control of the rate at which moisture is released. The released water has wetting characteristics similar to conventional wetting agents, and a greater ability to penetrate many fuel types.

• Although clear definition of the niche for foams has yet to be defined, experience to date indicates a number of advantages may be gained by the use of foam—depending on the fuel, fire, and tactical application.

5. What research is needed relative to the use of foams in wildland fire suppression?:

• Research is needed in a number of areas to better characterize foams and quantify the mechanisms of foam action, in regard to combustion suppression relative to fuel/fire intensity and, especially, tactical application. The potential of utilizing foam technology in conjunction with long-term retardant chemicals should be investigated.

6. Research initiated/on-going at IFSL:

• *Laboratory studies*

— Characterization of foams

*Chemical/physical properties
Expansion
Foam break-down rate (stability)
Uniformity (bubble size distribution)
Corrosivity

*Health and Safety

— Foam effectiveness

*Drying/evaporation of foam moisture on actual fuel

*Combustion effectiveness tests
Thermal insulative/vapor barrier value in actual fuel fires (indirect and direct attack or application situations)

• *Field studies (ORE program)*

—Conceptual evaluation of the use of foam from aerial delivery systems

—Evaluation of procedures/methods and characterization of foam in operational applications

—Effectiveness of foam applications as related to type of application (direct or indirect attack) and environmental application conditions.

7. Preliminary findings of IFSL studies:

• *Laboratory studies*

—Quantification of various foam expansion/breakdown characteristics; e.g., the ability to develop wet or dry foams at the same expansion rate.

—Foam characteristics greatly affect both physical and combustion performance; lack of characterization and knowledge of foam differences (properties) often explain performance differences observed by field personnel.

—The drying rate of foam applied to natural fuels does not vary greatly from the drying rate for water.

• *Field studies (ORE program)*

—Foam applied from helicopters (buckets) can be very effective in direct attack on fires of lower intensities, and greatly aid in reducing mopup efforts (using concentrations that produce foam and lower concentrations that produce only wet water).

—Wet foams are generally more effective than dry foams. Dry foams are intercepted to a greater degree by aerial vegetation and are more easily dispersed by wind.

—Foams have limited effectiveness in suppression situations requiring indirect attack and where used against higher intensity fires.

—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 related advantages as compared to alternatives involving chemicals and coloring agents, when cleanup is considered.

—Fixed-wing aircraft using foams have a narrow-use window as compared to long- or short-term retardants; increased drop speed, and especially drop height, can have a very deleterious effect on foam delivery; low drop heights do not provide the time needed for foam to develop.

—Distances/time required for breakup/ development of foam is not significantly different from normal aerial delivered retardant.

8. Video showing examples of some of the foam use/applications during the ORE program 1986-1987 (10 min).

For complete details on any aspect of this presentation outline, contact: USDA Forest Service, Intermountain Fire Sciences Laboratory, Attn.: Fire Suppression Research; P.O. Box 8089, Missoula, MT 59807.

FOAM TECHNOLOGY SUGGESTED READING

The Foam Task Group has compiled a list of over 30 references that contain valuable information on the world of fire foams. Volume 1, No. 1 of this publication presented 10 such documents from the list; here are 11 more. (The remainder of the articles, papers, and reports on foam technology for your suggested reading will appear in the next issue.)

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11. Peterson, H. B., Neill, R. R., and Jablonski, E. J. Research studies in foam generating equip ment. Indstrl. & Engrg. Chem. 48(11):2031-2034; 1956.

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