Roscommon Equipment Center Program

Project No. 7

HIGH-DENSITY FOAM

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Northeast Forest Fire Supervisors

In Cooperation with

Michigan’s Forest Fire Experiment Station

ROSCOMMON EQUIPMENT CENTER
EQUIPMENT DEVELOPMENT AND TESTING COMMITTEE

Northeast Forest Fire Supervisors

REPORT ON
REC PROJECT NO. 7
HIGH-DENSITY FOAM

Cover Photo – Jackpine and aspen thoroughly coated with foam during tests at Roscommon Experiment Station in July 1973.

INTRODUCTION

The proposal to evaluate several mixtures of high-density foam for construction of firelines was one of the original eight projects assigned to the Roscommon program in 1972. The intent of the project was to first evaluate the effectiveness of the foams in wildland fuels, and if the results were positive, to determine effective methods of delivery.

In previous tests foam proved unsatisfactory because it lacked stability in wind and fire had a tendency to burn underneath the foam fireline.

TESTING

In July 1973, we observed a demonstration of foam generated by a foam generator produced by the Waukesha Foundry Co., Inc., of Waukesha, Wisconsin. Mr. Gordon H. Allard, Manager, Foam Products Division made the presentation. The equipment demonstrated was the Model 620 Foam Generator driven by an 8 horsepower Briggs and Stratton gasoline engine (this model generator requires an 8 to 10 horsepower motor). This total unit, including the mounting board, weighs approximately 100 pounds; the Model 620 generator itself weighs 32 pounds.

There are three principle methods of making foam: 1) A high-pressure water system connected to an eductor. 2) Blowing air through screen devices. 3) A pump-type generator. The Model 620 is a pump-type foam generator.

This generator produces foam from two types of foam concentrates; the first type is a high protein form concentrate made from a protein base such as egg whites, fish meal, bone meal, feather meal, or soybeans. This base is becoming very expensive and the cost will probably be prohibitive in the near future. The second type of foam concentrate is synthetic and is made from a petroleum base; however, there are not oily compounds in the formula.

The Model 620 foam generator has an expansion ratio of 20:1, that is, it will make 20 gallons of foam from 1 gallon of water mixed with a concentrate.

The generator mixes controlled amounts of air with the liquid mixture. The foam is developed instantly and can be delivered through a hose. Foam characteristics are controlled by the operating speed, solution flow rate, outlet design, and of course the chemistry of the foam concentrate.

Expansion ratios vary from a high of 50:1 to a low of 7:1. The ratio is adjusted by changing the monitoring gear in the pump. The gear can be changed in the field by partially disassembling the pump. A field-adjustable expansion ratio changer could be added at extra cost.

The Foam concentrate was simply poured into water to make 3 to 4 gallons of solution in an open plastic container. The solution was then drafted into the pump, or foam generating system, through a short piece of suction hose. The discharge side had a 1-inch inside diameter clear plastic hose with a Lexan Wilco 1-1/2 inch nozzle operated in the fully opened position to prevent undue back pressure on the pumping equipment. The foam generator worked best when operated at a pumping pressure between 30 and 40 psi. The nozzle was virtually unnecessary and much of the foam was laid directly from the open end of the hose.

The first demonstration began at 10:30 a.m. Wind speed was 5 to 8 mph in the tree tops, and 3 to 5 mph at ground level; temperature was 86 degrees Fahrenheit, skies were partly cloudy with the test area being in shade approximately 50 percent of the time. The demonstration area was a portion of the dirt driveway behind the Roscommon shop.

Four different solutions were used in the demonstration. The solutions and volume of foam they produced were:

(1) Twenty-four ounces of National Foam System concentrate mixed in 4 gallons of water. This 4% solution produced a 3-inch thick layer of foam 16 feet long by 6 feet wide (24 ft.^{3}).

(2) Twenty-four ounces of National Foam System concentrate mixed in 3-1/2 gallons of water. This 5% solution produced a 1-inch thick layer of foam 30 feet long by 7 feet wide (17.5 ft.^{3}).

(3) Fifteen ounces of Waukesha Foundary Company's formula 303 (without stabilizers) concentrate mixed in 3-1/2 gallons of water. This 3% solution produced a 3/4- to 1-inch thick layer of foam 40 feet long by 6 feet wide (20 ft.^{3}).

(4) Fifteen ounces of Waukesha's formula 303-2 concentrate (with stabilizers) mixed in 3-1/2 gallons of water. This 3% solution produced a 1-inch thick layer of foam 50 feet long by 6 feet wide (25 ft.^{3}).

The Model 620 foam generator required approximately 1-1/2 minutes to pump each solution. Solution (4) was considerably more cohesive than the others, resulting in a back pressure of slightly over 40 psi in the generator.

The 10:00 a.m. weather readings taken at the Houghton Lake Weather Station 16 miles southwest of the test site were: Temperature 73°F, RH 70%; at 12:00 noon the temperature was 76°F and RH 57%.

Within one-half hour after the demonstration, small gusts of wind blew away small patches of the National Foam material. Foam from solutions (3) and (4) were unaffected.

One-half hour after the demonstration the following observations were made: Solution 1 – 33% had evaporated, Solution (2) – 50% had evaporated, Solution 3 – nearly all of the foam was gone and the ground was completely dry, Solution 4 – 50% had evaporated.

An hour and fifteen minutes after the demonstration the following observations were made: Solution 1 – 60% evaporated, Solution 2 – 80% evaporated, Solution 3 – no trace remaining, Solution 4 – 75% evaporated.

Two and one-half hours after the demonstration the following observations were made: Solution 1 – no trace remaining, Solution 2 – no trace remaining, Solution 3 – no trace remaining, Solution 4 – 98% evaporated, however, the few fragments of foam remaining in Plot 4 still contained moisture.

At 1:30 p.m. a demonstration was conducted in a forested area where ground cover consisted of grass, blueberry, other shrubs, and several small trees and saplings. The temperature remained at 86°F. and the sky was still partly cloudy. The foam concentrate used in this demonstration was Waukesha's 303-1 (another stabilized base) in a 3 to 5% solution. Two applications were made on the ground cover; one about 2-inches deep and the other about 4-inches deep. Half of each application was shaded by trees and half was in the open, exposed to the intermittent sunlight. Foam was also applied to several small trees; aspen, oak, and pine, and also to the trunk of a larger pine. The foam adhered well to all the leafy surfaces but particularly to the pine where it resembled the flocking used to decorate Christmas trees.

A layer nearly 2-inches thick built up on the larger tree trunks. Some blow-off of the foam occurred shortly after application when gusty winds about 8 mph blew through the area.

The treated areas were examined one and one-half hours after the demonstration. The layer of material applied in the shaded areas was 75% evaporated; that in the open was 95% evaporated. The remaining material in both areas was still moist. The foam applied to the small aspen and oak trees had all evaporated. However, about 5% of that applied to the pine still remained.

The areas were examined again two and one-half hours after the demonstration and all the foam had evaporated with no traces remaining. No adverse effects were noted on any leaf surfaces.

An estimate of the cost of the foam involved in a field application was determined as follows. A layer of foam 6-feet wide, 2-inches thick, and 1-mile long would require 39,474 gallons of foam. This would require 2,033 gallons of foam-producing solution consisting of 1,975 gallons of water and 58.5 gallons of foam concentrate. At the 1973 price of $4.75 per gallon for bulk purchases this amounts to $278.00 plus the cost of the water and generating equipment.

Various state and local fire control organizations have experimented with foam and foam delivery systems since the Roscommon studies were completed. One of the most promising systems, called the "Texas Snow Job" has been developed by Mark Cummins of the Fire Control Department, Texas Forest Service. The system was originally developed as an experimental water expansion system for tractor and operator protection and was later applied to ground tanker systems.

The system comprises two pressure vessels, one for water/surfactant storage, the other for compressed air or gas. The water expansion system differs from a "regular" foam system in that it uses a unique air injector process rather than the standard, expensive high-pressure equipment. This allows the use of a low pressure pumping system and is therefore inexpensive and simple to operate. The system can use a variety of foam concentrates, including soap skin, a by-product of the paper making process. The average liquid to foam expansion ratio is 10:1. Foam density can range from complete fluidity to the consistency of shaving cream by altering the initial change ratio of water to foaming agent. Several types of foaming agents have been used in the system with varying results in water retention and in lasting characteristics. Additional tests with popular retardants may show increased effectiveness and reduced costs when expanded in the system.

The Texas Forest Service has equipped several excess property vehicles with the "Texas Snow Job". The system has been designed for a jeep, and for 5/4-ton military truck. Three such units have been placed in the field with selected volunteer fire departments. The system shows much promise as an effective fire fighting system for grass and range fires. Field users are enthusiastic about the system as a line holding device. For further information on this system contact:

Texas Forest Service
P.O. Box 310
Lufkin, TX 75901

CONCLUSIONS

The equipment demonstrated at Roscommon can generate foam in quantities and in a manner that, with some reasonably attainable modification, would be suitable for use in wildfire suppression or prescribed burning. The cost of making the foam is not exorbitant if it would materially increase the efficiency of water.

The main disadvantage is the short life of the foam. This results in two problems; one is the relatively short duration of the foam itself, and the other is the apparently low moisture content of the foam after only a short period of time. This characteristic would often require a line to mineral soil adjacent foam line since fuels, particularly the heavier and larger fuels, would burn under the foam and once escaping the inhibiting effects of the foam would continue to spread as before.

The primary advantage of a foam system is its water conserving properties. In areas where water is scarce and response times with heavy, water-laden units is slow, foam systems may provide a partial solution. However, foam characteristics will have to be improved before foam systems will enjoy wide-spread use in wildland fire control.

RECOMMENDATIONS

1. No additional work should be undertaken on this project until the foam itself is improved. Improvement seems necessary in three specific areas:

   (a) A foam with longer life.

   (b) A foam which retains a higher moisture content for a longer period.

   (c) A foam which is less susceptible to blow-off by gusty winds.

2. If the foam can be perfected, consideration will have to be given to the environmental consequences of its use. For example, it is known that in its concentrated form the soap skin chemical has oxygen-robbing properties. The effects of concentrate spills is small bodies of water or slow moving streams is unknown.

3. We should continue to maintain contact with foam manufacturers and those manufacturers generating equipment in order to be alerted to any new developments in the field.

4. We should keep informed on work at San Dimas that relates to this project.

5. This report will be the final report on REC Project No. 7 unless new technology and field input cause the ED&T Committee to reopen or assign a new project to this area.

REFERENCE MATERIAL

Fire Management Notes; Vol. 39, No. 3, Summer 1978, pp 3-5.

Texas Forest Service News; Volume 59, Summer 1978.