

BIOGRAPHICAL SKETCHES

R.P. (BOB) BAILEY

Bob completed a Diploma in Forest Technology and a Bachelor's degree at Lakehead University in 1971 and 1973 respectively. Prior to moving to the Northwest Territories in 1974 he was employed on fire crews at Thunder Bay and in woodland operations for Abitibi Paper. He has held progressively more responsible positions in the Forest Fire Management Program in the Northwest Territories at Inuvik and Fort Smith. He assumed his current role in 1987 when the program was transferred from the Government of Canada to the Government of the Northwest Territories.

CYNDI BAILOR

Cyndi Bailor is a senior environment scientist and task manager with 5 years experience in risk assessment and environment impact analysis. She has conducted human health and ecological risk assessments on insecticides, herbicides, fungicides, and fire suppression chemicals for the Forest Service and the USDA Animal and Plant Health Inspection Service (APHIS). She has managed the preparation of a programmatic Biological Assessment on proposed APHIS activities, and has led Endangered Species Act Section 7 consultation with the U.S. Fish and Wildlife Service on pesticide issues. She has surveyed and analyzed biodiversity issues for the Department of Energy, and has served as a senior specialist on EPA's Wetlands Protection Hotline. Ms. Bailor is an M.A. candidate in Environmental Earth Sciences and Policy at Johns Hopkins University, and received a B.S. in Natural Resources Management from the University of Maryland.

JUDI BECK

Education—B.Sc. in Forestry, April 1985, University of New Brunswick, Canada; M.Sc. in Forestry, April 1988, The Australian National University, Australia; Ph.D. Candidate, Curtin University, Perth, Western Australia

During my sojourn in Australia (7 1/2 years), I was fortunate to have had the opportunity to work with a number of forest and land management agencies including the Tasmanian Forestry Commission, the Department of Conservation and Land Management in Western Australia, the National Parks and Wildlife Service in New South Wales and the Bushfire Council in the Australian Capital Territory. I worked on fire behaviour and effects research in eucalypt forests and hummock grasslands, was involved in operational prescription planning and burn implementation, and developed GIS based decision support systems for fire management. I was a GIS, modelling and FORTRAN lecturer at Curtin University, and was involved in basic

fire behaviour training for the Department of Conservation and Land Management in Western Australia. I am currently a Research Analyst with the Fire Management, Analysis and Development section of Protection Branch, and have been working for the British Columbia Ministry of Forests since May 1993.

RICHARD P. BIELEN

Mr. Bielen is a Senior Fire Protection Engineer with the National Fire Protection Research Foundation. He has been with the Research Foundation for three years. Prior to working for the Research Foundation, Mr. Bielen was a Senior Fire Protection Engineer for the National Fire Protection Association and worked for several fire protection engineering firms.

Mr. Bielen has a Bachelors of Science in Electrical Engineering and a Masters of Science in Fire Protection Engineering, both from Worcester Polytechnic Institute. He is also a registered Fire Protection Engineer.

Mr. Bielen is presently the project manager for the National Class A Foam Fire Test Project, conducted by the Research Foundation at Underwriters Laboratories Inc.

CHRISTINE BOIVIN

Christine Boivin is a senior environmental scientist and project manager at LABAT-ANDERSON Incorporated, where she directs the Risk Assessment/Environmental Analysis Group. She has led human health and ecological risk assessments of chemical, radiological, and biological substances for the U.S. Forest Service, Department of Defense, Department of Energy, State Department, Bureau of Land Management, and Animal and Plant Health Inspection Service. She has also developed briefings and reports on risk communication approaches for the Department of Defense and Department of Energy.

Ms. Boivin recently developed and presented a training course on the use of health-based risk assessment in the site restoration process at the U.S. Air Force School of Aerospace Medicine in San Antonio, Texas. She is currently managing a contract to provide technical support to the U.S. Forest Service for human health and ecological risk assessment, as well as overseeing LABAT-ANDERSON'S international environmental projects. Ms. Boivin has an M.S. in Environmental Science from George Washington University and a B.S. in Environmental Chemistry from the University of Michigan.

BILL CAREY

Bill Carey is a Senior Staff Engineer in the Fire Suppression Section of the Engineering Services Division at Underwriters Laboratories Inc. (UL) main office and test station in Northbrook, Illinois. He started his career at UL in 1966 and has a bachelor of Science Degree in Fire Protection Engineering and a Masters Degree in Business Administration from Illinois Institute of Technology. Mr. Carey is a registered Professional Engineer and Past President of the Chicago Chapter of the Society of Fire Protection Engineers.

Bill is a member of numerous National Fire Protection Association (NFPA) technical committees including Foam, Halon, Carbon-Dioxide, Dry and Wet Chemicals, Water-Mist and Clean Agent Fire Extinguishing Systems. He is also a member of the U.S. Delegation to the International Standards Organization (ISO) committees of Fire Extinguishers, Foam and Sprinkler Systems.

Mr. Carey has served as Project Manager for several National Fire Protection Research Foundation (NFPRF) research projects including the National Class A Foam Research Project. Bill also managed a Class A Foam Research Project sponsored by the U.S. Army.

DR. BOGDAN DLUGOGORSKI

Dr. Bogdan Dlugogorski is a Research Associate at the National Fire Laboratory. He joined the NFL in 1993 after completing a Ph. D. degree in Chemical Engineering at Ecole Polytechnique in Montreal. He also holds M. Eng. in Chemical Engineering from McGill University and undergraduate degrees in Geophysics and Chemical Engineering, both from the University of Calgary. He is a professional engineer with the Ordre des ingénieurs du Québec, a member of the American Institute of Physics, a member of the Canadian Society for Chemical Engineering, and an associate member of the Society of Fire Protection Engineers. In his research, he investigates suppression of fires, both experimentally and by a means of numerical modelling. His other interests include measurement of heat release rates, investigation of the interaction between water mist and unconfined fires, and the development of fixed foam systems.

DR. LUC C. DUCHESNE

Dr. Luc Duchesne obtained a Bachelor's degree in forestry from Laval University in 1983, a Master's degree from the University of Toronto in forest pathology in 1985, and a Ph.D. in botany from the University of Guelph in 1988. From there he conducted post-doctoral studies at Michigan State University in East Lansing, Erindale College in Toronto, University of Toronto, and Petawawa National Forestry Institute. He has been employed as a fire ecologist at the

Petawawa National Forestry Institute since 1991, working on aspects of fire ecology including regeneration following fire, management of old-growth forests, biodiversity, and ecological impact of fire protection.

C. BRUCE EDWARDS

C. Bruce Edwards is Research Director of Firetech Engineering Inc. in Vancouver, which was incorporated for fire suppression research.

While living at Wabasca in northern Alberta, where he gained experience in wildland firefighting, his interest in better methods was awakened at 5:00 a.m. Nov. 30, 1978 when called to fight an arson fire, with Mark 3 pumps, in a new hospital. Noticing that plain water didn't wet fuel, he developed Class A foam systems for urban interface fires and developed the concept of Critical Flow Rate (CFR), below which application of suppressant is ineffective.

On his return from six years of consulting in Zimbabwe, Pakistan, Philippines, and Indonesia, he conducted exploratory burn tests in 1990 with Ronald R. Rochna of the National Interagency Fire Center. It seemed that combining the CFR concept with Class A foam, CAFS could produce dramatic results. However, to determine the effectiveness of this advanced fire suppression system, scientific full-scale research is needed. Ron therefore asked him to initiate and coordinate this research. Bruce D. Lawson of Forestry Canada and Lt-Col. Gaétan Perron of the Canadian Forces secured initial funding, supplemented by funding from Task Force Tips, KK Products, Angus, Chemonics, Ansul and Robwen/Flameco.

He has established and headed departments of Nuclear Medicine and Computer Studies, cofounded a geophysics research group, lectured in electrical engineering, and served as advisor to governments on computer applications and technical education. He has a BSc in Electrical Engineering and a MSc in Biomedical Electronics from the University of Toronto, and is a graduate of the Institution of Fire Engineers in England.

SUSAN E. FINGER

Susan E. Finger is an aquatic toxicologist with the National Biological Survey and serves as the Deputy for the Field Research Division at the National Fisheries Contaminant Research Center in Columbia, Missouri. Her research interests include effects of contaminants on survival of striped bass in the Chesapeake Bay ecosystem, effects of irrigation drainwaters on the aquatic ecosystems of the western United States, ecotoxicological effects of oil spills in freshwater systems, and effects of fire retardant and suppressant chemicals

on terrestrial and aquatic ecosystems. She has authored or coauthored over 40 publications.

CHARLES W. (CHUCK) GEORGE

Chuck's work experience with the Forest Service began in 1958 and consists of seven seasons on the Custer and Nez Perce National Forests in seasonal fire positions before joining the Fire Control Technology Unit of the Northern Forest Fire Laboratory. There he assisted in the conduct of prescribed fire and fire control systems research. He conducted graduate work at the Laboratory in prescribed fire research before joining the Fire Management Research Project in 1965 with responsibilities for fire retardant research studies. Besides conducting prescribed fire studies, he has conducted studies and programs related to fire retardants, aerial delivery systems, effectiveness, physical and chemical characteristics of wildland fire chemicals, and operational retardant applications. He was project leader for the operational retardant effectiveness (ORE) study and is now Program Leader for the National Wildfire Suppression Technology (NWST) Unit.

Chuck received a B.S. degree in Forest Engineering from the University of Montana in 1964, and a M.S. degree in Forestry (Fire Science) in 1969.

DR. STEVEN J. HAMILTON

Dr. Steven J. Hamilton is an aquatic toxicologist with the National Biological Survey. He is currently Leader of the National Fisheries Contaminant Research Center's Field Station in Yankton, SD. His research interests include development and evaluation of biological indicators of contaminant stress in fish, toxicological studies of inorganic contaminants associated with placer mining activities in Alaska on fish such as Arctic grayling, effects of inorganic contaminants associated with irrigation return flows on West Coast salmonids and endangered fish in the Colorado River basin, and fire retardant chemical effects on aquatic organisms. He has authored or coauthored over 30 publications.

DR. ELWOOD F. HILL

Dr. Elwood F. Hill is a research toxicologist for the National Biological Survey. He serves as Leader of the Wildlife Toxicology Group at the Patuxent Wildlife Research Center in Laurel, Maryland. He performs independent research on toxicity of pesticides and other contaminants to wildlife and leads multidisciplinary field and laboratory investigations of research scientists and graduate students. In addition to his work on the ecotoxicological effects of fire retardant chemicals, his current research focuses on agricultural pesticides, mosquito abatement practices, effects of microgold mining operations and cyanidation on wildlife, and toxicity and hazard of white phosphorus on Alaskan

wildlife. He has authored or coauthored over 50 publications.

DOUGLAS G. HIGGINS

Following graduation in Mechanical Engineering Technology from Eastern Ontario Institute of Technology in 1968, Doug joined the Canadian Forest Service, Forest Fire Research Institute (FFRI) in Ottawa. In 1970 he joined Phillips Cable Limited in Brockville, Ontario as a Section Manager, returning to the Forest Fire Research Institute in 1971. In 1979 he transferred to PNFI as an equipment specialist where he continues to work on the development of national standards for fire suppression equipment and products, along with studies related to equipment and product development and fire suppression methods and techniques.

Doug serves on various National Committees, acts as a technical advisor, and provides a technology transfer service to fire management agencies internationally on various aspects of firefighting technology.

ROBERT (BOB) L. JOENS

Bob started his career on the Mark Twain NF in Missouri. For the next 19 years he served as Asst. Ranger and District Ranger in Missouri, Minnesota, and Ohio. From 1982 to 1990 he was Fire, Aviation and Communication Staff Officer on the Superior NF in Minnesota. During this time he supervised the Northeast Fire Cache, the DHC Beaver program, started the Prescribed Natural Fire in the Boundary Waters Canoe Area Wilderness and was the chairperson of the Minnesota Incident Command System for the first four years. His fire experience started as firefighter and engine foreman to 12 years as Planning Section Chief and Incident Commander on the Regional Fire Team. He served on the Prescribed Fire Review Committee after the Yellowstone Fires, served as National Intelligence Officer and Military Liaison.

Present duties include responsibilities for the Forest Service fire equipment and fire chemicals program, liaison with Missoula and San Dimas Technology and Development Centers, chair of NWCG's Fire Equipment Working Team, and FS representative to National Fire Protective Association Forest Fire Protection committee.

Bob graduated from Iowa State in 1960 in Forest Management. He also served in the U.S. Army from 1961 to 1964 in Germany.

CECILIA W. JOHNSON (CECI)

After receiving a bachelor's degree in chemistry and mathematics from Whitworth College, Ceci attended graduate school in chemistry at the University of Montana. While still a student, she joined the staff of the Forest Service's Intermountain Fire Sciences Laboratory in 1970.

Since then Ceci has worked in the National Wildfire Suppression Technology Program, formerly the Fire Suppression work unit, studying the effectiveness and safety of wildland fire chemicals. Studies have included combustion and pyrolysis, retardant-caused corrosion, rheology of long and short-term retardants. Recently efforts have been directed toward the fire chemicals qualification and evaluation, test methods and performance requirements, and quality assurance.

Since 1986 Ceci has also been working on the evaluation of the application and use of foam. She has participated in previous foam workshops in College Station (1987) and Denver (1988). Ceci was involved with the preparation of "Foam vs. Fire" and participated in the International Foam Specification Workshop in February 1992 and helped to draft the Proposed International Foam Specification. She is responsible for the coordination of the laboratory characterization of foam. Currently a major effort is to complete the first phase of the Foam Characterization study which will provide information on the performance of all of the approved wildland fire foams when tested in accordance with the International Class A Foam Specification.

R.R. LAFFERTY

Randy graduated from the University of Montana with a B.Sc. in Wildlife Technology and a M.Sc. in Forest Sciences.

He worked as a Fire Research Officer for the Canadian Forest Service for six years, spending most of his time on the Mission Tree Farm pioneering fire intensity ecological studies. He also developed the first safe helicopter rappell system, along with his partners in a private company, in the early 1970's.

In 1978, he brought the first gelled fuel helitorch into Canada and used it to backburn in the Northwest Territories.

After several years in private business in BC, Randy went to work for the forest industry. He has been working as a fire management officer and an environmental land use auditor since 1981 for MacMillan Bloedel Ltd. on the BC coast. During the 1985 Invermere fire bust, Randy was introduced to Class A fire foam and he says that this experience convinced him of a better way to fight fire. He was asked by the U.S.

BLM to lead the subcommittee of NFPA that wrote the first international foam standard (#298) which deals with health, safety, and corrosion.

He was chairman of the Canadian Committee on Forest Fire Management for two years and the Northwest Fire Council for one term. He is also a member of the National Fire Protection Association Committee on Forest and Rural Fire Protection and a member of the Society of Professional Biologists of BC.

Randy will present a brief history of Class A foam in Canada up to 1986.

ROBERT LANGEVIN

In charge of workers and environmental health and safety with fire extinguishing foams.

Work experience: 1992 - Ministère des Ressources naturelles du Québec. Evaluation of the impacts of contaminants (herbicides, foams, fuel) used for forest management, on workers and the environment.

1992 - Hydro-Québec. Toxicity of mercury towards the avian, terrestrial and aquatic fauna.

1990-1992 - Environment Canada. Remediation of contaminated sediments in the Lachine canal (Montreal, Quebec).

Selection of bioassays for the evaluation of the toxicity of the St. Lawrence river sediments. Ecotoxicological study of St. Lawrence river sediments elutriates. Survey of the existing bioassays for the toxicity evaluation of the aquatic environment.

DR. DIANE L. LARSON

Dr. Diane L. Larson is a research wildlife biologist with the National Biological Survey at Northern Prairie Wildlife Research Center. Dr. Larson's research interests center on the effects of disturbance and stress at different levels of biological organization. She is currently applying her expertise to studies involving global climate change and to investigations concerning the response of the vegetative community to fire retardant and suppressant chemical application. She has authored or coauthored over 10 publications.

FRANÇOIS LEFEBVRE

François Lefebvre is a forestry engineer with the "Société de protection des forêts contre le feu," the organization mandated to ensure the protection against fire of all the forests in the province of Québec. Involved in forest fire protection since 1978, he is now in charge of development and special services. One of his responsibilities is to make sure that the use of wildland

fire foam is worth it, that the techniques for applying it conform to the legislation, that it respects the environment and doesn't pose any threat to the persons using it.

DANIEL MADRZYKOWSKI

Education: University of Maryland, B.S. Mechanical Engineering.

Mr. Madrzykowski has worked in fire suppression and large fire research at the National Institute of Standards and Technology (NIST) since 1986. He began studies at NIST to measure the ignition inhibiting properties of compressed air foam (CAF). Utilizing new measurement methods developed at NIST, the ignition delay time of "foamed" wood samples relative to untreated wood samples was compared at different heat flux levels. The technique could be used to characterize CAF exposure protection capabilities.

Mr. Madrzykowski has conducted studies on gas and oil well fire suppression, fire sprinkler activation and effectiveness and large scale fire testing. He is a registered professional engineer and is a member of the National Fire Protection Association and the Society of Fire Protection Engineers.

DAN W. MCKENZIE

Dan received his formal engineering training at the University of Arizona, where he was graduated in 1958 with a Bachelor of Science degree in Mechanical Engineering. His first work experiences after graduation were with the U.S. Army as an Ordnance Officer and with Shell Oil Company, drilling oil wells. For the past thirty-three years he has been employed by the United States Department of Agriculture, Forest Service, at the Technology & Development Center, San Dimas, California. During this time he has served as the supervisor of the Design Section of the Development and Testing Branch and as a Project Engineer.

At the Forest Service Technology & Development Center, he has been involved in the development of the Forestland Tree Planter, the Rangeland Drill, range vegetative equipment, range water pumping equipment, firefighting equipment, slash treatment equipment, and reforestation equipment.

Dan was recently awarded the Forest Service Chief's award for Excellence in Technology Transfer for his work in transferring firefighting foam technology. He was also selected to receive the Federal Laboratory Consortium Award for Excellence in Technology Transfer for 1994, for this same work.

Dan holds a Certificate of Proficiency as a Research and Development Manager from the U.S. Department

of Army, which was earned through his activities in the U.S. Army Reserve.

SIG PALM

Sig's Forest Service career began in 1961 with seasonal assignments (fire, recreation maintenance, timber and visitor information service) on the Roosevelt NF (R2). He was the first superintendent of the Wyoming Hotshots (Greybull, WY) from 1967-70. Sig held fire and multi-resource staff positions on the Bighorn NF (R2) from 1970-78, Staff Officer Prescott NF (R3)— Recreation, Lands, Minerals, Visitor Information and Law Enforcement. District Ranger on the Gila NF (R3) while concurrently administering the Gila Cliff Dwellings National Monument (NPS) from 1980-82, District Ranger on the Tonto NF (R3) from 1982-85. Regional Office Timber Management (R3) in 1986. Northeastern Area, State and Private Forestry, Cooperative Fire Protection (Prevention, Training, Emergency Management planning for FEMA).

Sig has spent his entire career in various incident management positions from firefighter to operations section chief, logistics section chief, planning section chief and incident commander on type 1 and type 2 incident management teams in the Rocky Mountain, Southwestern, and Eastern Regions, and Multi-Agency Coordination Group coordinator for the Northern and Southwestern Regions, plus FEMA Regions V and VII. He completed the Advanced Fire Management Course (I-520) in 1982 and the Area Command Course (I-620) in 1990. Sig is currently the Program Leader for the Fire and Aviation Program at the USDA Forest Service Technology and Development Center, San Dimas, California.

Sig also spent a total of 28 years in the U.S. Army, Army National Guard and Reserve in various Battery staff and Command assignments up through Support Brigade Logistics Officer (S-4).

Sig completed a B.S. degree in Forestry and Range management at Utah State University in 1970.

DR. BARRY C. POULTON

Dr. Barry C. Poulton is an aquatic entomologist with the National Biological Survey. He is currently the Leader of the Aquatic Ecology Section for the Field Research Division at the National Fisheries Contaminant Research Center in Columbia, Missouri. His current research involves community and ecosystem level effects of contaminants in small stream and river ecosystems influenced by such things as oil spills, mining-related activities, and exposure to fire retardant chemicals.

GORDON S. RAMSEY

Gordon began his career in forestry with the Ontario Ministry of Natural Resources (Dept. L&F) in 1961. Between 1961 and 1965 he was employed in the Ministry's Forest Management, Forest Tree nursery and Fish and Wildlife programs. In 1965 he joined the Canada Dept. of Forestry, Forest Fire Research Institute (FFRI) in Ottawa where he was Project Leader. He was responsible for studies focusing on forest fire suppression equipment performance and development. In 1979, following the closure of FFRI, he transferred to the Petawawa National Forestry Institute at Chalk River, Ontario, where he assumed the role of Project Leader, Equipment Development, Standard, and Technology Transfer.

In 1981 he became involved in the early development of Class A Foam and subsequently in the development of foam apparatus and standards. He is a member of the Underwriters Laboratories of Canada (ULC) Committee on Fire Fighting Apparatus and Equipment and serves as Chair of several related ULC subcommittees (i.e., hose, couplings, back pack pumps).

Gordon was a founding member of the Canadian Committee on Forest Fire Management (CCFFM), Forest Fire Equipment Working Group in 1982 and served as Chair for many years and has now assumed the role of permanent coordinator. In 1987 he was instrumental in the establishment of the permanent liaison between the National Wildfire Coordinating Group (NWCG), Fire Equipment Working Team (FEWT) and the FFEWG. He presently is Canadian advisor to FEWT and a member of FEWT's Task Group for International/Interagency Foams and Applications Systems. FEWT and FFEWG meet jointly every two years, alternating between the United States and Canada. This International Foam Symposium is an example of one of the US/CAN joint initiatives. Others include the Denver International Foam Conference; Abbotsford International Foam Workshop; Remote Sensing for Forest Fire Management International Workshop; and several foam workshop training sessions held throughout North America.

ROBERT J. SABOL

Robert J. Sabol, CEO/President, STILLMEADOW, Inc., 12852 Park One Drive, Sugar Land, Texas, 77482. Bachelor of Science degree in Animal Husbandry from Delaware Valley College, Doylestown, PA. Sabol has worked in the field of toxicology since 1966. He became the founder and owner of STILLMEADOW, Inc. in 1975. Almost his entire work experience has been in the contract toxicology field. He has witnessed the development and sophistication, as well as the quality and regulation of toxicology testing. By managing

and overseeing over 12,000 routine sample evaluations (mostly routine acute screening studies) over the years he can attest to the change in attitude and respect for the necessity of acute toxicology testing.

PAUL SCHLOBOHM

Paul received a bachelor's degree in Forestry from UC Berkeley in 1983. He began his career in fire management in 1984 working on prescribed fire and wildfire for the BLM in Salem, Oregon. In 1986, he started on a new project to develop Class A foam as a fire management tool and has been with this project until this year. For eight years Paul has used, evaluated, and documented foam products and equipment during prescribed fires and wildfires. Paul has been a part of international efforts to coordinate foam technology advancement, including: Developing and conducting foam training; producing user guides, videos and product specifications for the National Wildfire Coordinating Group; creating and revising a foam standard for the National Fire Protection Association; and writing and speaking about foam use.

DR. NIMISH B. VYAS

Dr. Nimish B. Vyas is a research toxicologist for the National Biological Survey. He works with the Wildlife Toxicology Group at the Patuxent Wildlife Research Center, Laurel, Maryland.

His current research focus is on effects of agricultural pesticides on migratory behavior in birds and the effects of fire retardants and foam suppressants on western wildlife populations.

GROUP RECOMMENDATIONS THUNDER BAY SYMPOSIUM PARTICIPANTS

Based on the information obtained from the professional papers presented at the Symposium, the Symposium participants broke into four groups to make recommendations for action and guidance for future efforts in foam application and use.

Following is a rough draft of the groups' recommendations.

FOAM PROPERTIES GROUP

Recommendations	Rank	Time to Complete	Chance of Success	Cost Estimate U.S. Dollars
1. Develop an end-use matrix, by product, for all properties, including storage.	H	Ongoing	Good	Supplier Cost
2. Develop a technical use matrix, by product, for all properties. Include all uses (Fixed Systems).	H	Ongoing	Good	Supplier Cost
3. Educate or train end users on properties to level required using existing training materials. Include NFPA 298.	L	Done— Now Need Implementation	Excellent	Low
4. Concentrate the concentrate to facilitate logistics.	L	Long-Time 5-10 Years	Fair	-----

FOAM EFFECTIVENESS GROUP

1. Tie performance of foam products to existing list of properties ("X") through continuing tests of all sorts.	H	1-3 Years	Excellent	-----
2. Educate or train end users when and how to apply foam.	H	1-3 Years	Excellent	-----

FOAM AND THE ENVIRONMENT GROUP

Recommendations	Rank	Time to Complete	Chance of Success	Cost Estimate U.S. Dollars
1. Biodegradability (Spec. 298).	H	1 Year	High	\$50K
2. Inhalation Toxicity.				
—Foams	L	1 Year	High	\$60K
—Combustion/smoke interaction	M	1 Year	High	\$100K
—Vapor toxicity concentrates	M	1 Year	High	\$60K
3. Mobility (fate, persistence and entry to water systems).	H	3 Years	Medium	\$3-500K
—Concentrates				
—Materials as applied				
—Soils (Geographic variations)				
(Costs based on 8 products).				
4. Monitoring water body contamination operationally by bucketting, scooping, engines, and other operations.	H	5 Years	High	\$200K/Year
5. Interaction of foam/retardants on aquatic and terrestrial systems, (how prevalent is this operationally).	M	3 Years	High	\$200K/Year
6. Foams that are more environmentally friendly.		Inform/monitor market developments.		
7. Better communication/exchange between wildland fire chemical researchers. Input/interchange between researchers and tactical "operations" types.	H	Ongoing	High	Negative cost
8. Faster technology transfer of interim and final results. Investigate electronic mail/bulletin board options. Retain the Foam Newsletter. Poll researchers regularly for updates on research.				
9. Broaden Interior studies to include all approved retardants and foams. Need to share retardant formulations. (Could look at selection of chemical in study to choose a foam more representative of those in field.) Should conduct chinook tests.	VH	Ongoing	High	\$25K

FOAM AND THE ENVIRONMENT GROUP (CONTINUED)

Recommendations	Rank	Time to Complete	Chance of Success	Cost Estimate U.S. Dollars
10. User Guidelines (interim/ updates). Spot and/or Fixed Operations—Mobile Operations (engines/portable equipment). On-site applications.	H	1 Year	High	Program Funding

FOAM APPLICATION & USE— GROUND GROUP

1. Environmental Effects Video	H	1.5 Years ++	++	\$30K (USP)
2. Foam Equipment Guide				
3. A broad review of International Foam Specifications to be distributed to Foam Newsletter recipients.	H	2 Years	Good	\$8K (camera ready)
4. Foam Chemicals Properties Matrix	H	2-5 Years	Good	\$2K (camera ready)
5. Technology transfer between agencies including continuing Foam Newsletter.	H	Ongoing	Good	----
6. Expand H ₂ O handling. USA Position (ICS) to include technical foam knowledge.	H	2-4 Years	Good	*
7. Encourage manufacturers to produce desired products such as: lightweight accurate proportioners and CAFS unit.	H	Ongoing Workshop Objective	High	----
8. Decision/ring/Users' Guide	M	1-2 Years	Good	\$3-10K
9. Field kit for testing proportioners (test proportioners direct from manufacturers).	L	2 Months	High	\$2K equipment

* Close coordination w/NWCG
TWT/ICS WT

FOAM APPLICATION & USE— AIR GROUP

Recommendations	Rank	Time to Complete	Chance of Success	Cost Estimate U.S. Dollars
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Review of International Foam Specifications to Address:

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|---|---|---------|--|--|
| 1. Product testing with water temperature to 0°C/32°F. | H | OVERDUE | | |
| 2. Product testing with product flow at 0°C/32°F. | | | | |
| 3. Product testing with deep-cycle freezing to -30, -40°C. | | | | |
| 4. Product shelf life up to 3 years. | | | | |
| 5. Address compatibility of products. (What happens when mixed together). | | | | |
| 6. Address corrosion problems. Experienced with some applications. | | | | |
| 7. Container recycling issues. | | | | |

Development of Foam vs. Fire (Aerial Application) Guidelines:

H 10/95

\$15K
Plus Travel

- | | | | | |
|--|--|--|--|--|
| 1. Establish Canada/U.S. working group to complete guidelines. | | | | |
| 2. Environmental application considerations. | | | | |
| 3. Optimum drop height/speed. | | | | |
| 4. Optimum load application. | | | | |
| 5. System calibration. | | | | |

Effectiveness Study of Coverage Levels, Load Size vs. Fuel Types and Fire Intensity:

H

- | | | | | |
|--|---|--|--|--|
| 1. Foam use in F/W airtankers in U.S. should be studied with the purpose of issuing a specification and authorization for use. | M | | | |
|--|---|--|--|--|

FOAM APPLICATION & USE— AIR GROUP (CONTINUED)

Recommendations	Rank	Time to Complete	Chance of Success	Cost Estimate U.S. Dollars
2. Support the continued study and testing of foam and long-term retardant mixes.	L			
3. Recognizing the value of the exchange of information occurring through the Fire Equipment Working Group and the Foam Workshop, recommend that an Air Operation and Air Attack International Working Group be established at the operational level.	H	1995		



Canadian Committee on Forest Fire Management
Comite canadien de gestion des feux de forêt

FOREST FIRE EQUIPMENT WORKING GROUP

Foam Tactics and Applications Workshop

May 5-7, 1994 — Thunder Bay, Ontario

Reidar Vollebekk, Co-Chairperson
Aviation, Flood & Fire Management Branch
Ministry of Natural Resources
70 Foster Dr., Suite 400
Sault Ste. Marie, Ontario, Canada P6A 6V5

Doug Higgins, Co-Chairperson
Canadian Forest Service
PNFI
Chalk River, Ontario, Canada
K0J 1J0

AGENDA

Thursday, May 5 1330-1800

- Company presentations
- Company displays

Friday, May 6 0830-1700

0830-1100 Agency Presentations

1100-1300 Field lunch sponsored by the OMNR. Lunch will be provided at a portable fire basecamp.

1300-1700 Field Operations
-OMNR foam initial attack demonstration with helicopter
-Application techniques (various agencies)
-Retrieval procedures (various agencies)

Saturday, May 7 0830-1500

0830-1000 Panel discussion

1030 Tour of Thunder Bay Service Centre
-Regional cache
-Equipment maintenance facilities
-Hose plant
-Lightweight equipment
-Aviation (CL-215)

1500 Workshop concludes

CANADIAN COMMITTEE ON FOREST FIRE MANAGEMENT

FOREST FIRE EQUIPMENT WORKING GROUP

FOAM TACTICS AND APPLICATIONS WORKSHOP

By: Doug Higgins, Canadian Forest Service and

Reidar Vollebakk, Ontario Ministry of Natural Resources

The Canadian Committee on Forest Fire Management (CCFFM), Forest Fire Equipment Working Group, sponsored a Foam Tactics and Applications Workshop in Thunder Bay, Ontario, Canada, May 5 - 7, 1994. The Workshop was hosted by the Ontario Ministry of Natural Resources and had approximately 75 participants, representing forest fire management agencies and various companies from across Canada and the United States.

The objectives of the Workshop were to:

1. Discuss the tactical application of foam.
 - when should foam be used?
 - when should foam not be used?
 - application techniques
 - indirect attack
 - direct attack
 - mop-up
 - Width and depth of foam application based on wind, temperature, fuel moisture, fuel loading, etc.
 - Use of foam in various situations/fuel types (e.g., grass, slash, brush piles, ground fires, snags, prescribed burns, etc.).
 - How is overall foam effectiveness measured?
2. Discuss equipment maintenance and good housekeeping practices.
 3. Discuss various fire management foam system configurations.
 - Foam kits used with ground delivery systems using portable pumps.

- Tanker truck systems.
- Helicopter systems.
- Airtankers.

The first part of the Workshop was dedicated to an exchange of information between forest fire management agencies and company representatives. Following a brief presentation from each company on their new products, etc., a discussion was held on various aspects of foam and foam equipment (products presently being utilized, new product requirements, shortcomings of present systems, etc.).

At the conclusion of this session, participants had the opportunity to tour the company displays and talk to each company representative individually.

The second part of the Workshop included presentations from: (1) John Hadley, Ontario Ministry of Natural Resources (OMNR), (2) Klaus Barth, New Brunswick, Dept. of Natural Resources and Energy, (3) Dave Brown, Alberta Forest Service, (4) Mark Stanford, Texas Forest Service and, (5) Paul Schlobolm, Bureau of Land Management.

These presentations outlined their individual foam programs with respect to history, problems encountered, tactics, present state of program as well as what the future of foam will be in their respective agencies.



Following the presentations, field operations were held. The session began with a demonstration of foam drops from the Canadair CL-215 water bomber using various drop patterns to demonstrate how foam can be applied from this type of aircraft.



Figure 1.—Canadair CL-215 foam drop.

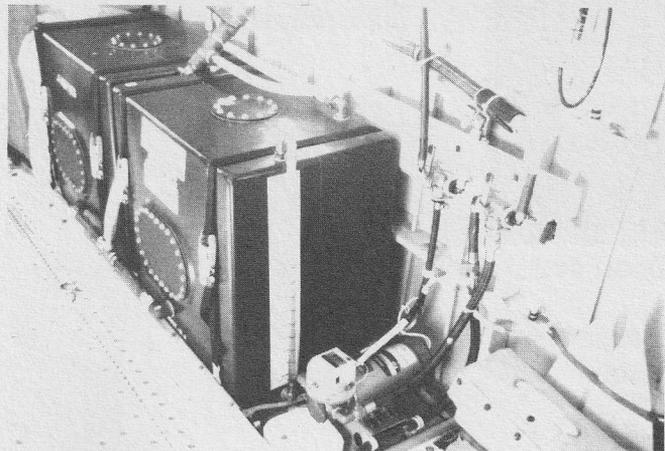


Figure 2.—Foam Tank in Canadair CL-215.

A fire crew from the OMNR demonstrated how they use foam on an initial attack of a wildfire with respect to equipment used and application techniques, etc.

As a follow up to his formal presentation, Paul Schlobolm, BLM, demonstrated various application techniques using different types of nozzles, etc.

The Workshop was concluded with a panel discussion on various aspects of foam technology. It was concluded by participants that the Workshop had more than attained the initial objectives and that it was now up to the individual agencies to explore the future use of foam within their fire management program. Also, the exchange of information between industry and user will be of great benefit with respect to future development in foam technology.

The final conclusion of the workshop was that the required information on most aspects of foam is available—we now must package all this information together to meet the needs of all agencies and industry.

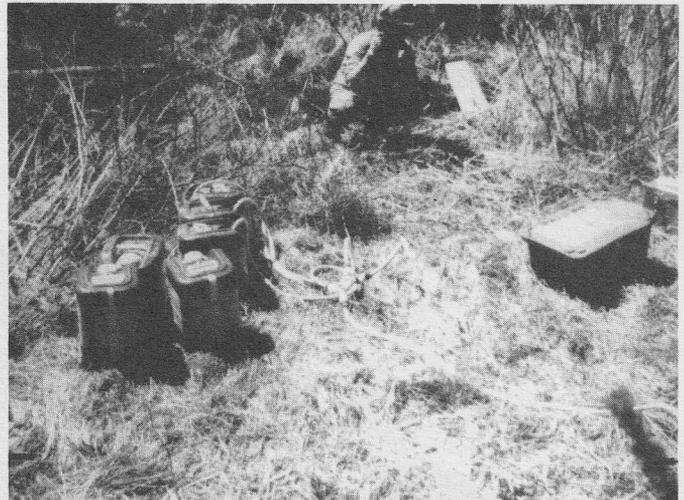


Figure 3.—Foam Concentrate.

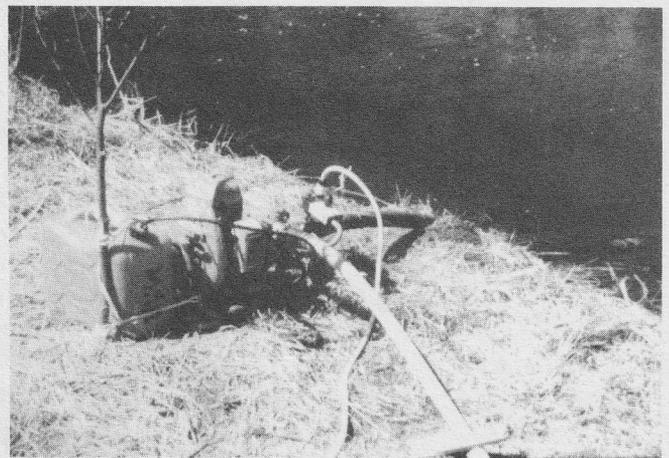


Figure 4.—Mark 3 pump with around the pump proportioner.



Figure 5.—Foam Application by OMNR foam crew.

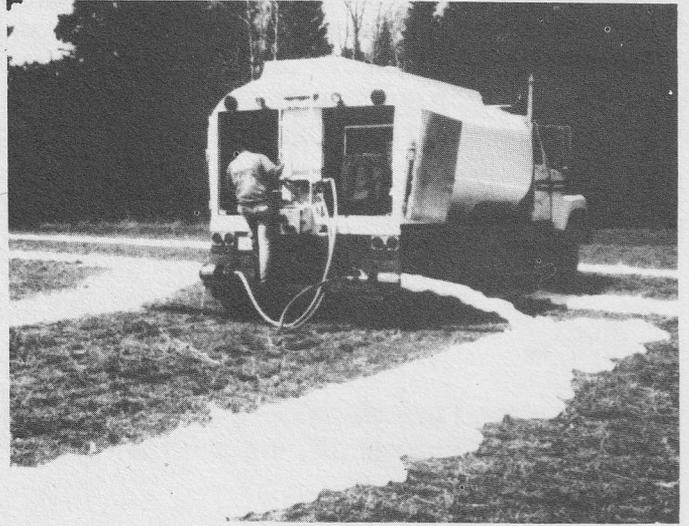


Figure 6.—Engine laying foam line.



Figure 7.—High expansion foam nozzle laying foam.

Figure 8.—Ontario Ministry of Natural Resources initial attack crew with helicopter.



NOTES FROM 1993 SOUTHERN CALIFORNIA FIRES

HOMEOWNER INTERVENTION IN MALIBU

*By: Tom Gardner, Project Engineer
Brushfire Hydrant Co.
Walnut Creek, California*

The Old Topanga Fire arrived in this neighborhood of upper Las Flores Canyon sometime after 3:00 p.m. on Tuesday, November 2, 1993. Virtually every home survived the initial 10-minute passage of the flame front. However, nearly all fell victim to a rain of hot embers which continued past dawn on Wednesday.

The surviving home was protected by pool water, Class A foam concentrate, and a fire pump designed

for homeowners living in the wildland/urban interface. This Malibu resident is the first known civilian to save a structure from wildfire using Class A foam technology. The fire pump, a Defender Foam System Model #501, manufactured by Brushfire Hydrant Co., in Walnut Creek, California, was delivered in March 1991.

The system sustained extensive damage by the fire, but never failed during six hours of operation.

The original design was awarded U.S. Patent 4,671,315 in 1987 as the portable brushfire hydrant. When the Patent expires in 2004, the surviving system will be offered to the Smithsonian Institute.

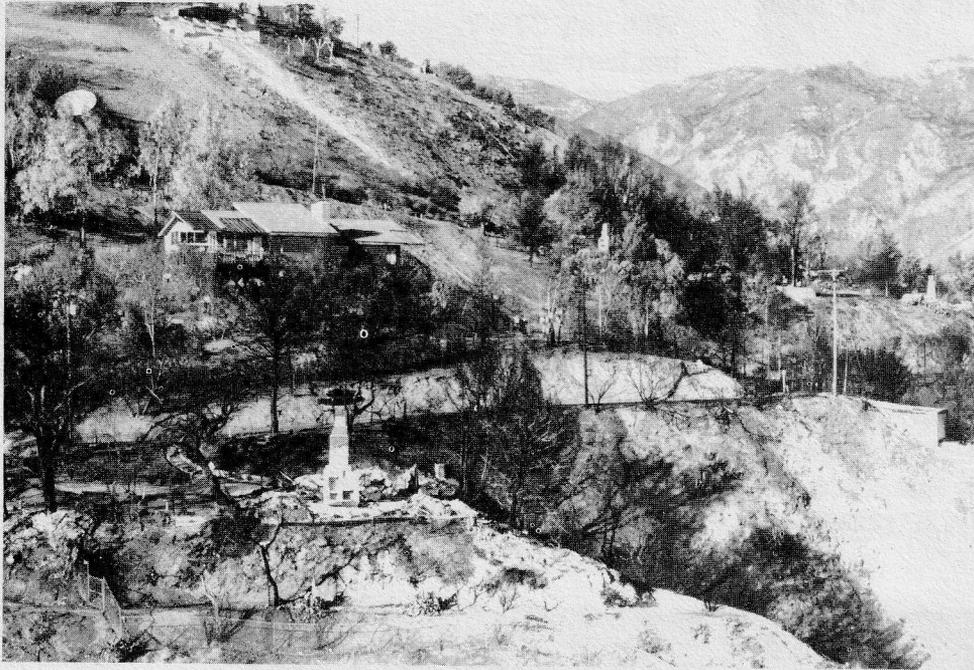
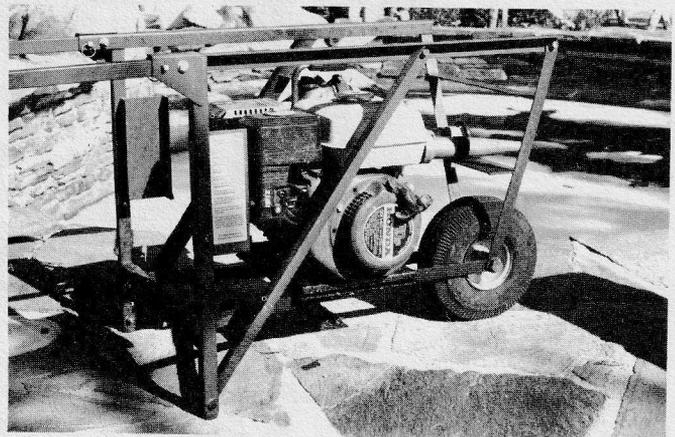


Figure 8.—Upper left of photo shows home saved by pool water and Class A foam concentrate in the Las Flores Canyon during Old Topanga Fire on Tuesday, November 2, 1993.

Figure 9.—Defender Foam System fire pump used for six hours to defend saved home.



FOAM USE ON URBAN INTERFACE FIRES, SOUTHERN CALIFORNIA, NOVEMBER 1993

By: Sylvia McKenzie, Volunteer, USDA Forest Service, San Dimas Technology & Development Center, San Dimas, California

Forest Service fire engines with foam capability were among the many emergency vehicles that responded to the devastating fires in Southern California in November 1993. In a two-week period 26 fires raged in a six-county area, burning approximately 200,000 acres with over 1000 homes damaged or destroyed.

Forest Service fire engines worked in conjunction with traditional pumpers from city and county fire departments. Many city and county personnel saw foam used for the first time and they commented on the water and work-saving capabilities of the foam-equipped Forest Service units.

As a result, the Los Angeles County Fire Department is now in the process of retrofitting 84 fire engines with foam units using information provided by the San Dimas Technology and Development Center.

Foam can be particularly valuable in urban-interface fires. The penetrating qualities allow pre-treatment of structures in the path of the blaze and mop-up on burnt structures goes much quicker as a covering blanket of foam makes unnecessary any mixing or moving of the rubble. According to Randy Masters, engineer on Engine 21, Dalton Station, Mt. Baldy Ranger District, Angeles National Forest, "Foam really cuts down your work time."

John Smith, captain on Engine 25 of Lower San Antonio Station, Mt. Baldy Ranger District, Angeles National Forest, estimates mop-up time to be cut in half with the use of foam.

Foam also stretches the available water. Eric McCormick, captain of Engine 21 states, "Fifty gallons of foam solution acts like 200 gallons of water." Water, even in urban areas, becomes scarce with fire advancing on many fronts.

Wildland fire units can access homes and other structures located on narrow, unimproved roads inaccessible to Type 1 and Type 2 engines. A Forest Service strike team, led by Gary Powers, engine captain at Chantry Flats Station, Arroyo Seco Ranger District, Angeles National Forest, was able to save a pocket of expensive homes in a remote area of the Malibu burn with the use of foam.

With only 30 minutes to work before the advancing fire, his team foamed the exteriors of the buildings plus the adjacent brush. After the fire went through, two engines went back to put out spot fires on the buildings and cool the brush.

Powers states, "Because of our small size and foam capability we turned a lot of heads. With the use of foam, the available water is extended and the personnel and units can foam and pull back to a safe area."

The engines written about in this article were Region 5 Model 60/61 Engines with a 250 gpm Hale CBP centrifugal pump. They are equipped with automatic regulating, pump discharge side, Class A foam, proportioning systems.



Figure 10.—Forest Service Model 61 Fire Engine 21 from the Dalton Station, Mt. Baldy Ranger District, Angeles National Forest.

TESTING METHODS AND EQUIPMENT

FIRE PUMP AND PROPORTIONER TESTING METHODS AND EQUIPMENT

*By: Dan W. McKenzie, Mechanical Engineer,
USDA Forest Service, San Dimas Technology &
Development Center, CA*

To test an engine pump flow, pressure, and proportioner, the following equipment is needed:

Flowmeters

Portable digital flowmeter, Fire Research Corp. Model MFPD-1 1/2 (flow from 20 gpm to 350 gpm) with:

1. an internal rechargeable battery
2. an external charger for the battery
3. a paddlewheel flow sensor in a 1 1/2-inch flow tube with 8 feet of connecting cable to
4. a digital display unit (to display in gallons per minute) with low battery indicator.

Flowmeter, Lake flowmeter B4B6W25D (flow 2 to 25 gpm)

Foam Percent Meter

Foam percent meter, 9-volt battery (internal), portable, with 1/2 BSP mount, (available from New Zealand Institute of Geological and Nuclear Sciences, Ltd or W. S. Darley & Co.)

Note: An improved model of this foam percent meter, which will be temperature compensated, is under development. This improved meter should be available at the time of publication of this article.

Pressure gauge, test, correct range

Sources of equipment:

Digital Flowmeter

Fire Research Corp
26 Southern Blvd.
Nesconset, NY 11767
Phone: (516) 724-8888
(800) 645-0074

Lake Flowmeter

Lake Monitors Inc.
1405 16th Street
Racine, WI 53403
Phone: (414) 637-6789

Foam Percent Meter

Institute of Geological and Nuclear Sciences, Ltd.
Attn: Dr. Gavin Wallace
30 Gracefield Rd
P. O. Box 31212
Lower Hutt, New Zealand
Phone: 64-4-569-0637
FAX 64-4-569-0657

W. S. Darley & Co.
2000 Anson Drive
Melrose Park, IL 60160-1087
Phone: (708) 345-8050

With the above equipment the pressure, flow, and the percent of foam the proportioner is dispensing can be tested. There are two flowmeters, one a high flow meter (20 to 350 gpm) and one a low flowmeter (2 to 25 gpm).

To test the foam proportioner, hook up pressure gauge, flowmeter(s), and foam percent meter. Follow instructions for using the foam percent meter (zero meter with plain water flowing, then turn on the proportioner). Flow the pump at the pressures and flow desired and record the percent foam from the foam percent meter. To gain an understanding on the performance of the proportioner, plot the percent foam against pump flow. This plot should be a straight level line.

HOW TO USE A STANDARD CONDUCTIVITY METER TO DETERMINE FOAM SOLUTION PERCENT

By: Dan W. McKenzie, Mechanical Engineer, USDA Forest Service, San Dimas Technology & Development Center, and Jim Bronner, Bronner Chemical, Glendale, California

In the last issue of "Foam Applications For Wildland & Urban Fire Management," information was provided on where to purchase standard conductivity meters for use in determining the percent of Class A foam concentrate in a foam solution. Instructions for using a conductivity meter to determine foam solution percent were not included. There are two methods that can be used, a "field method" (sometimes known as a "quick and dirty method") and a more accurate and time consuming "laboratory method."

To use the "field method," take the conductivity of the water and the conductivity of the foam solution made from the water. Now subtract the conductivity of the water from the conductivity of the foam solution and divide by 500. This will give the percent of foam concentrate in the foam solution.

$$\frac{\text{Conductivity of foam solution} - \text{Conductivity of water}}{500} = \% \text{ foam}$$

Note: 500 is used assuming that the conductivity meter units are uS/cm (microsiemens/cm). The divisor 500 is also used assuming the foam concentrate is Silv-Ex, FireFoam 103, Phos-Chek WD 881, or ForExpan S. The number 500 may work with other foam concentrates but they have not been tried. The Cole-Parmer conductivity meter, G-19800-20 reads in uS/cm, reading from 0 to 1990 uS/cm. Other units of conductivity can be used but the 500 number must be changed.

The more time consuming, but more accurate, "laboratory method" is to make known samples of foam solution using the water available and measure the conductivity of each known sample. Then plot the known percent of foam concentrate against the measured conductivity and obtain a calibration curve. Now the percentage of foam concentration in an unknown foam solution can be determined by measuring the conductivity of the unknown foam solution (the unknown foam solution must

have been made from the same water as the test samples) and the percent of foam concentrate in this unknown solution can now be determined from the calibration curve.

In making up the known samples two methods can be used. The easier method is to use a very accurate scale so only small amounts of water and foam concentrate are used. These scales are expensive and cost about \$1000. Another method is to use a graduated cylinder and a pipette. In using this method, a 1000-ml graduated cylinder and pipette reading to 1 ml work well. Add 1 ml of foam concentrate to 999 ml of water, measure conductivity of the foam solution, record, and discard. The measured conductivity is the conductivity of a 0.1 percent foam solution made from the available water. Now 2 ml of foam concentrate can be added to 998 ml of water, the conductivity measured, recorded, and the foam solution discarded. The measured conductivity is the conductivity of a 0.2 percent foam solution made from the available water. Repeat this process until you reach 1.0 percent.

To use the scale method, make a series of foam concentrations ranging from 0.1 to 1.0 percent of a specific class A foam concentrate. Look at the data sheet or the MSDS for the product density. The density in this example is 1.04.

To make one liter of 1 percent foam concentration by weight, make the following calculation:

$$0.01 \times 1000\text{g} \times 1.04 = 10.4\text{g of foam concentrate}$$

Weigh 10.4g of foam concentrate into a 1000-ml beaker

Weigh 990.0g of water into the beaker and stir thoroughly

(In the metric system 1 gram mass of water is 1 ml in volume)

The beaker now contains one liter of accurately measured 1 percent foam solution.

Next weigh 10.0g of this solution and 90.0g of water into a 150-ml beaker. The new beaker contains 100-ml of 0.1 percent foam solution.

contains 100-ml of 0.1 percent foam solution.

Follow this same procedure to make 0.2 through 0.9 percent concentrations. This results in an accurately measured range of foam solutions from 0.1 to 1.0 percent on which to base the calibration curve.

Take the conductivity of each sample and record. Now make a calibration curve. See example on next page of a calibration curve which has been developed from information obtained by this method.

Equipment required:

Gram scale, 1500 gram capacity accurate to 0.1g

One 1000-ml beaker, several 150-ml beakers

Stirring rods

1500-ml of water that represents, as closely as possible, the water that will actually be used in operations.

Foam Concentration
Using Cole Palmer TDS Tester 19800-20

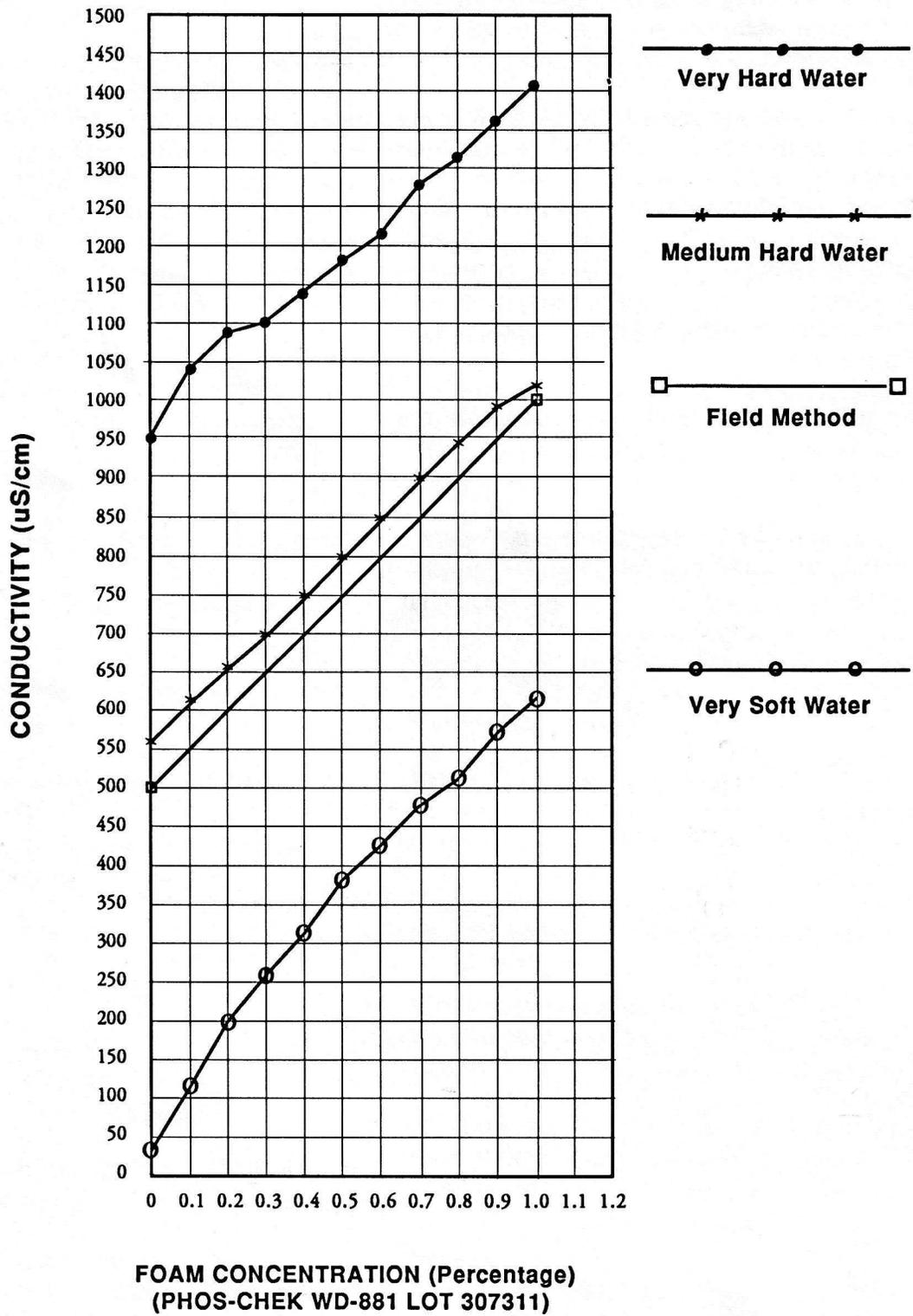


Figure 11.—Calibration curve using very hard water, medium hard water, and very soft water. Also drawn in is a "field method line" (using a divisor of 500) to show the relationship between an actual laboratory calibration curve and a "field method line."

OBTAINING COPIES OF THIS PUBLICATION SERIES

Are you reading your own copy of this document, or a hand-me-down copy? Do you wish to obtain back issues and get on the mailing list for future issues? Do you even know who put this together and what the objectives are? Read on!

The National Wildfire Coordinating Group (NWCG)—which is sponsored by the United States Departments of Agriculture and the Interior and the National Association of State Foresters—in cooperation with the Petawawa National Forestry Institute and Forestry Canada, has been issuing documents jam-packed with information on "Foam Applications for Wildland & Urban Fire Management."

This publication series contains articles presenting background, historical, health and safety, use, equipment, and suggested reading data on foams and applications systems. The series of publications represents a complete compendium on everything you ever wanted to know about foam but perhaps didn't know enough about to ask.

Authors from numerous agencies, worldwide, have been contributing to the issues in the series. Publications group personnel at the USDA Forest Service San Dimas Technology and Development Center (SDTDC) have been taking the original inputs and performing editorial and graphic functions to produce each issue in the series. So far, the following have been published: Vol. 1, No's 1 to 3 (1988); Vol. 2, No's 1 to 3 (1989); Vol. 3, No's 1 and 2 (1990); Vol. 4, No. 1 (1991) and 2 (1992); Vol. 5, Nos. 1 and 2 (1993); and now this present issue, Vol. 6, No. 1 (1994).

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