BIOGRAPHIES & ABSTRACTS

ENHANCING THE DURABILITY OF LUMBER & ENGINEERED WOOD PRODUCTS

February 11-13, 2002
Radisson Resort Parkway
Kissimmee (Orlando), Florida, USA

The conference is sponsored by the Forest Products Society, with sponsorship support from APA - The Engineered Wood Association; Arch Wood Protection, Inc.; Chemical Specialties, Inc.; Janssen Pharmaceutica; J.H. Baxter & Company; Lonza Group; Osmose, Inc.; Troy Corporation; Trus Joist, A Weyerhaeuser Business; U.S. Borax, Inc.; and Willamette Industries, Inc.

CONFERENCE CO-CHAIRS

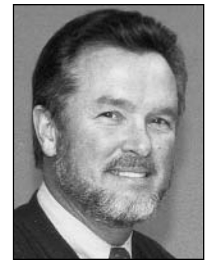
Alan F. Preston
Vice President, Technology
Chemical Specialties Inc.
Charlotte, North Carolina, USA

Dr. Alan Preston is Vice President of Technology for Chemical Specialties Inc. (CSI) in Charlotte, North Carolina. He is responsible for the R&D and Quality Control aspects of Rockwood Specialties' wood products preservation businesses worldwide. Dr. Preston received a Ph.D. degree in Organic Chemistry from the University of Auckland, New Zealand, where his research focused on synthetic pathways from natural products. Prior to joining CSI in 1986, he had been a Post-Doctoral Fellow at the University of British Columbia in Vancouver; Research Scientist at the New Zealand Forest Research Institute in Rotorua; and served as Director of the Institute of Wood Research at Michigan Tech University. He is Finance Chairman of the International Research Group on Wood Preservation (IRG) and is a Past President of the American Wood Preservers' Association.

Jerrold E. Winandy
Project Leader
USDA Forest Service
Forest Products Laboratory
Madison, Wisconsin, USA

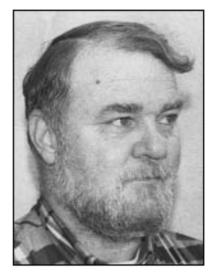
Dr. Jerrold Winandy is the Project Leader of the Performance Designed Composites Research Work Unit at the USDA Forest Products Laboratory (FPL) in Madison, Wisconsin. As Project Leader, Dr. Winandy's research work unit is responsible for developing new and improved composites from wood and other non-wood fiber sources using thermoset, thermoplastic, inorganic, and other naturally-derived binders. He is also an Adjunct Professor in the Department of Wood and Paper Science at the University of Minnesota. He received B.S. and M.S. degrees from Purdue University, and a Ph.D. degree from Oregon State University. His personal research has historically dealt primarily with the modeling effects of chemical, thermal, and biological agents on the engineering properties on wood and wood composites. More recently, his work has begun to study serviceability/durability issues for wood-based composites. Prior to April 2001, he was the Principal Wood Scientist in the Engineering Properties Research Unit at FPL. He was Team Leader of FPL's FRT Serviceability team from 1991 to 1999. Much of that research has lead to changes in Design Codes and Standards. He served for 3 years as the Division Coordinator for the Wood Engineering Technical Interest Group in the Forest Products Society (1991-1994). He currently serves as General Chair of the Treatments Committees of the American Wood Preservers' Association and as Chair of the ASTM D7.06 Wood Protection and Treatments Subcommittee.

PLANNING COMMITTEE MEMBERS AND SESSION MODERATORS



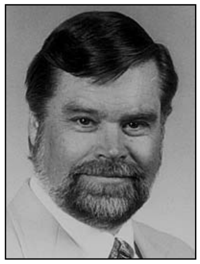
Terry L. Amburgey
Professor
Mississippi Forest Products Laboratory
Mississippi State University
Starkville, Mississippi, USA

Dr. Terry Amburgey received B.S. and M.S. degrees from the State University of New York College of Environmental Sciences and Forestry, and a Ph.D. degree in Plant Pathology from North Carolina State University. Following graduation, he accepted a position as Plant Pathologist with the USDA Forest Service, Southern Forest Experiment Station in Gulfport, Mississippi. By the time he left the Forest Service in 1979, Dr. Amburgey was a Principal Plant Pathologist (Wood Decay Specialist). That year, he joined the staff of the Forest Products Laboratory at Mississippi State University as Professor of Forest Products. Dr. Amburgey has authored over 125 publications, including four patents, and has achieved University honors, such as the 1986 Faculty Achievement Award, Outstanding Faculty Member in the department (5 years), Outstanding Teacher Award for the School of Forest Resources (1993), and appointment as a Giles Distinguished Professor. Dr. Amburgey frequently is asked to make presentations on preventing and controlling wood decay at local, regional, national, and international meetings. He currently holds memberships in the American Wood Preservers' Association, Forest Products Society, Society of Wood Science and Technology, International Research Group on Wood Preservation, National Institute of Building Sciences, and the Railway Tie Association. He is President of AMBAR, Inc., a consulting service dealing with the prevention and control of wood deterioration in buildings and other wooden structures, and is a Principal in two other consulting companies, TASKPro and Vibewood.



H. Michael Barnes
Professor
Mississippi Forest Products Laboratory
Mississippi State University
Starkville, Mississippi, USA

Dr. Michael Barnes is a Professor in the Department of Forest Products at Mississippi State University, Starkville, Mississippi. His research interests include physical properties of treated wood, preservative and fire-retardant treatments to extend the durability of building components, studies of biodeterioration of wood and wood-based materials in wooden test structures, treatment variables affecting the uniformity of treatment of wood, terrestrial tests on the biodegradability of treated wood, and new treatment technologies for wood preservation. He received a B.S.F. degree in Forestry and an M.S. degree in Forest Products Technology from Louisiana State University, and a Ph.D. degree in Wood Products Engineering from the State University of New York College of Environmental Science and Forestry.



Arthur B. Brauner
Executive Vice President
Forest Products Society
Madison, Wisconsin, USA

Arthur Brauner received B.S. and M.S. degrees in Wood Science and Technology from the University of Michigan. He has been Executive Vice President of the Forest Products Society since 1976. He came to the Society in 1968 as Editor of Publications and Director of the Society's computerized information retrieval system. Previously, he was a Research Assistant and Assistant Professor at West Virginia University's School of Forestry.

Paul A. Cooper
Associate Professor
Faculty of Forestry
University of Toronto
Toronto, Ontario, Canada

Dr. Paul Cooper was recently appointed Associate Professor in the Faculty of Forestry, University of Toronto following a 3-year appointment as Research Scientist and Manager of the University of New Brunswick, Wood Science and Technology Centre in Fredericton. Prior employment experience included Lecturer and Assistant Professor appointments at the Faculty of Forestry, University of Toronto; Research Chemist with Iroquois Chemicals Ltd.; Wood Preservation Specialist with the Western Forest Products Laboratory; and he also worked as a consultant for a number of consulting firms, industry associations, government agencies, and wood preservation companies. His current responsibilities include teaching and research on wood deterioration and protection and sustainable forest products use. His research interests focus on minimizing environmental impacts of wood preservative use at all stages of the product life cycle. He received a B.S. degree in Wood Science from the University of Toronto, an M.S. degree in Wood Products from Oregon State University, and a B.Ed. degree in Mathematics and Chemistry and Ph.D. degree in Wood Science from the University of Toronto.

Huck DeVenzio
Manager, Marketing Communications
Arch Wood Protection, Inc.
Smyrna, Georgia, USA

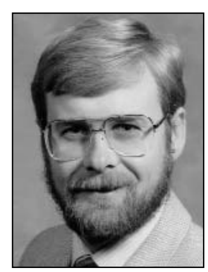
As Manager of Marketing Communications at Arch Wood Protection, Inc. (originally Hickson Corporation), Huck DeVenzio is responsible for planning and executing the promotional programs that support wood products treated with Arch's preservative chemicals and fire retardant. He received a B.S. degree in Industrial Engineering from Cornell University, and a B.A. degree in Administration of Justice from the University of Pittsburgh.

Mike H. Freeman
Consulting Wood Scientist
Memphis, Tennessee, USA

Mike H. Freeman is a Consulting Wood Scientist in Wood Preservation from Memphis, Tennessee. Previously, he was Technical Manager of ISK Biosciences, Industrial Biocides Division in Memphis, Tennessee, where his managing responsibilities included Product Chemistry, Patents, Research and Product Development, and Regulatory Affairs. He is a member of the Society of Wood Science and Technology, American Wood Preservers' Association, American Society of Testing and Materials, International Research Group on Wood Preservation, American Wood Preservers Institute, and Xi Sigma Pi - National Honor Society in Forest Products. He is a Past Chair of the AWPA Committee on Organic and Organo-Metallic Wood Preservatives and a Past Chair of the Forest Products Society Treated Wood Technical Interest Group. He is the author or coauthor of over 70 publications in Wood Preservation. He received B.S. degrees in Wood Science and Chemistry from North Carolina State University.

D. Pascal Kamdem
Associate Professor
Department of Forestry
Michigan State University
East Lansing, Michigan, USA

Dr. Pascal Kamdem is an Associate Professor in the Department of Forestry at Michigan State University in East Lansing, Michigan. His current responsibilities include teaching in the area of Wood Science and Technology and research. His research interests include wood biodeterioration and protection; protection of engineered wood products; recycling of waste wood, including urban wood from demolition, construction, and poles; and chemistry of organometallic fixation in wood. He is the author or coauthor of numerous publications. He received B.S. and M.S. degrees in Chemistry from the Universite de Yaounde, Cameroon; an M.S. degree in Pulp and Paper Engineering from the University of Quebec, Trois-Rivieres, Quebec, Canada; and an M.B.A. degree and Ph.D. degree in Wood Science from Universite Laval, Quebec, Canada



Peter E. Laks
Professor
School of Forestry & Wood Products
Michigan Tech University
Houghton, Michigan, USA

Dr. Peter Laks is a Professor in the School of Forestry and Wood Products at Michigan Tech University in Houghton, Michigan. His research interests include wood preservation - the development of low mammalian toxicity wood preservatives based on agricultural chemistries, and the use of chemical additives to improve the properties of wood composites; phytochemistry - investigation of the chemical mechanisms by which plants protect themselves from pathogens; and Phytoalixins - structure/activity relationships, semisynthetic analygues, mode of action, chemistry and utilization of condensed tannins, and occurrence and properties of chitinase as a protective enzyme. His is the author or coauthor of numerous publications. He received a B.S. (1st Class Honors) degree in Bio/Organic Chemistry, and an M.S. degree in Physical Organic Chemistry from Simon Fraser University in Burnaby, Canada; and a Ph.D. degree in Wood Science from the University of British Columbia, Vancouver, Canada.

Mark J. Manning
Manager, Technical Development
U.S. Borax, Inc.
Valencia, California, USA

Dr. Mark Manning is Manager of Technical Development at U.S. Borax, Inc. in Valencia, California. He is responsible for technical and market development efforts in support of boron-based wood preservatives. More recently, his primary focus has been in the area of preservative treatments for engineered wood products. He is active in the technical subcommittees of the American Wood Preservers' Association and a member of the International Research Group on Wood Preservation. He received a B.S. degree in Chemistry from Arizona State University, Tempe; and a Ph.D. degree in Inorganic Chemistry from the University of California, Los Angeles.

Paul Merrick
Manager, Preservation Technology
Trus Joist, A Weyerhaeuser Business
Plymouth, Minnesota, USA

Paul Merrick joined Trus Joist Corporation in 1988. He spent 4 years at Trus Joist's Laminated Veneer Lumber manufacturing facility in Natchitoches, Louisiana. He is currently part of the Trus Joist Research and Product Development Team in Plymouth, Minnesota. His professional research experience has been in the field of water repellents, sealers, and wood protecting additives. In most cases, his research has been related to company sponsored projects designed to improve the durability and performance of composite products used in construction of homes and light commercial structures. He received a B.S. degree in Wood Technology from the University of Maine, and an M.S. degree in Wood Science from the University of Massachusetts.

Jeffrey J. Morrell
Professor
Dept. of Wood Science & Engineering
Oregon State University
Corvallis, Oregon, USA

Dr. Jeffrey Morrell is a Professor in the Department of Wood Science and Engineering at Oregon State University in Corvallis, Oregon. His field of expertise includes wood preservation and biodeterioration. His current research programs include effect of incisions on preservative fluid flow and wood strength; feasibility of using biological control against wood staining fungi; improving the performance of wood poles; evaluation of remedial treatments for U.S. species; performance of surface treatments; and high-pressure wood treatments. He is the author or coauthor of numerous publications. He received a B.S. degree in Forest Biology from the State University of New York College of Environmental Science and Technology, an M.S. degree in Plant Pathology from Pennsylvania State University, and a Ph.D. degree in Forest Pathology and Mycology from the State University of New York College of Environmental Science and Forestry.

Eugene A. Pasek
Research & Development Associate
Arch Wood Protection, Inc.
Conley, Georgia, USA

Dr. Eugene Pasek is a member of a Research and Development team focusing on the development of new products for the Treatments Division of Arch Chemicals, Inc. - industrial biocides, personal care, coatings, and wood protection. His work experience includes: Wood Preservation - preservative interactions with wood components, fixation mechanisms, thermal and chemical degrade of wood, moldicides, fire-retardant chemistry, redundant wood remediation, and organic biocides/formulations; and Industrial Catalysis - transitional metal chemistry, solid state reactions, petroleum hydrotreating, acid-anhydride manufacture, and auto converters. He received a B.S. degree in Chemistry/Mathematics and an M.S. degree in Inorganic Chemistry from John Carroll University in Cleveland, Ohio; and a Ph.D. degree in Inorganic Chemistry from the University of Pittsburgh.

W. Ramsay Smith
Program Leader, Louisiana Forest Products Laboratory
School of Forestry, Wildlife & Fisheries
Louisiana State Univ. Agri. Center
Baton Rouge, Louisiana, USA

Dr. Ramsay Smith is the Program Leader of the Louisiana Forest Products Laboratory and Professor of Wood Science and Technology, School of Renewable Natural Resources, Louisiana State University Agricultural Center, Baton Rouge, Louisiana. His research interests include physical properties of wood and wood products, wood product durability in residential construction with emphasis on Formosan subterranean termites, and international wood construction. Dr. Smith is Past President of the Society of Wood Science and Technology. He has organized a number of workshops and symposia and has authored over 70 publications. He has made numerous trips to Europe, Africa, Caribbean, South America, Asia, South Seas, Australia, Eastern Europe and the former Soviet Union to study international trade in forest products, wood construction practices and softwood and hardwood wood products industries and markets. In addition, he has been a consultant to FAO of the United Nations and the World Bank. He received a B.S. degree in Wood Science and Technology from North Carolina State University, Raleigh; and M.S. and Ph.D. degrees in Wood Science and Technology from the University of California at Berkeley.

George E. Woodson
Technical Manager, Building Materials Group
Willamette Industries, Inc.
Ruston, Louisiana, USA

As Technical Manager, Dr. George Woodson oversees technical issues within the Building Materials Group at Willamette Industries, Inc. in Ruston, Louisiana. Dr. Woodson has been employed by Willamette Industries since 1985. Prior to 1985, he was an Associate Professor at Louisiana Tech University in Ruston. He received a B.S. degree in Forestry from Louisiana Tech University, an M.F. degree from Yale University, and a Ph.D. degree from Colorado State University.

SESSION SPEAKERS

Kevin J. Archer
Product Development Manager
Chemical Specialties, Inc.
Charlotte, North Carolina, USA

Dr. Kevin Archer is Product Development Manager for Chemical Specialties Inc. (CSI) in Charlotte, North Carolina. In that role, he provides a liaison between R&D and Business Development for CSI. His responsibilities include commercialization of R&D projects and management of CSI's regulatory affairs activities and intellectual property. He received a Ph.D. degree in Forest Microbiology from the University of Canterbury, Christchurch New Zealand. His Ph.D. dissertation focused on the use of bacteria to improve the treatability of refractory Douglas fir. Before joining CSI in 1988, Dr. Archer worked as a Wood Preservation Mycologist at the New Zealand Forest Research Institute in Rotorua. Much of his scientific career has been associated with the development and testing of new wood preservation chemistries. He was formerly Chair of the IRG Section 2 - Test Methodology and Assessment, Chair of the AWPA P6 Committee - Methods of Evaluation of Wood Preservatives and currently holds that position with the ASTM D07.06.03 subcommittee.

Randall T. Baileys
Technical Services Manager
J.H. Baxter & Company
Eugene, Oregon, USA

Randy Baileys graduated from the College of Agriculture's School of Forestry at Pennsylvania State University in 1976 with a B.S degree in Forest Products. He continued his education in wood technology at Pennsylvania State University and received a M.S. degree in Forest Resources in 1979. His first full-time employment following his educational instruction was with General Woods and Veneers, Inc., a hardwood veneer producer who manufactured high-quality furniture veneers in Canada, the United States and also exported logs to Europe. His next phase of experience came as a Land Agent for Shawmut Development Corporation, a coal and gas producer in the Western Pennsylvania area. At the end of 1984, a career opportunity was presented with Koppers Company as a Technical Representative involved in the Wood Preservation and Technical Services Department. The next 14 years provided a broad base of experience in the field of wood preservation with this employer that served as the world's largest wood treating company and also a manufacturer of preservative chemicals. Field experience, professional growth, and participation in national organizations, such as American Wood Preservers' Association (AWPA) and the Railway Tie Association provided ample opportunity to work with utilities, railroads, university, and government representatives, along with many experts in the area of wood treating chemicals and treated wood products. In 1999, Randy and his wife Janet moved to Eugene, Oregon where he accepted a position with J.H. Baxter & Co., a major West Coast wood-treater and preservative supplier. He is the Quality Control Manager in the Engineering and Technical Services Laboratory in Eugene. He currently serves as the General Preservatives Chairman in AWPA, the ANSI-05 representative for the Western Wood Preservers' Institute, a member of the American Society for Quality, and the Forest Products Society. He has authored or co-authored over 15 technical papers and has been a speaker and presenter in national conferences and seminars involving wood preservation chemicals, processes, and products.

Stephen M. Bratkovich
Forest Products Specialist
USDA Forest Service
Northeastern Area State & Private Forestry
St. Paul, Minnesota, USA

Dr. Stephen Bratkovich is a Forest Products Specialist at the USDA Forest Service, Northeastern Area State and Private Forestry in St. Paul, Minnesota. His current responsibilities include providing technical and administrative assistance to state forestry and conservation agencies and related organizations (seven Midwest states) in the subject areas of forest products marketing and utilization and natural resources-based economic development. He received a B.S. degree in Forest Science from Pennsylvania State University, an M.S. degree in Forest Resources from the University of New Hampshire, and a Ph.D. degree in Adult Education from Ohio State University.

Kenneth M. Brooks
Senior Scientist
Aquatic Environmental Sciences
Port Townsend, Washington, USA

Dr. Kenneth Brooks is the Owner and Chief Scientist of Aquatic Environmental Sciences in Port Townsend, Washington. He has also held the following positions: Director, Fisheries Technology Program, Peninsula College, Washington State; Chairman, Washington State Conservation Commission; Owner, Whispering Ridge Farms; and Cdr. USN Fighter Pilot and Physicist, U.S. Navy. He received B.B. and M.S. degrees in Physics from the Naval Post-Graduate School, and a Ph.D. degree in Philosophy from the University of Washington.

Jim Creffield
Forest Products Entomologist
CSIRO Forestry & Forest Products
Melbourne, Victoria, Australia

Jim Creffield is a Forest Products Entomologist and has worked with the Australian Commonwealth Scientific and Industrial Research Organisation (CSIRO), Forestry and Forest Products Division for over 30 years. His fields of expertise include the biology and control of termites, preservative and insecticide evaluations, preservation of panel products and wood-based composites, natural durability of timbers, and the development of laboratory and field test methodologies. He provides a range of entomological services to industrial clients in the field of wood protection and management of termites and other wood-destroying insects. He also provides expert entomological advice and guidance to State and Federal Government authorities, the public, Standards Australia, the pest management industry, the building and construction industry and the forest products and chemical industries both in Australia and overseas.

Futong Cui
Senior Research Scientist
Chemical Specialties, Inc.
Charlotte, North Carolina, USA

Futong Cui is a Senior Research Scientist at Chemical Specialties, Inc. in Charlotte, North Carolina. His current responsibilities include development and testing of water repellents for various preservative systems, development and testing of organic preservative formulations, and physical properties (corrosivity, gluing properties, paint adhesion, and weathering) of preservative-treated wood. Previously, he was a Research Chemist at Forintek Canada Corporation, Vancouver, British Columbia, Canada. He received a B.S. degree from Nankai University, P.R. China, and a Ph.D. degree from the University of British Columbia.

Gérard Deroubaix
Environment Manager
Centre Technique du Bois et de l'Ameublement (CTBA)
Bordeaux, France

Dr. Gérard Deroubaix is a Chemical Engineer and received a Ph.D. degree in Chemistry from Paris VI University. He has been working for the past 3 years as an Environment Engineer in a technical assistance office, providing technical support to industry on environment and safety issues. He has been with the CTBA for 7 years, and has been the Health and Environment Executive in this organization for 4 years. His role is to help the different sectors in CTBA (sawmills, construction, and furniture) with the health, safety, and environment issues and to coordinate those activities in the center. He is also specialized in environmental issues connected with wood preservation. His activities cover the fields of research, studies, but also assistance to industry. Through these activities, he has been working on various topics like waste wood management, soil pollution, VOC emissions, environmental management, life-cycle assessment, eco-labeling, risk assessment, and wood in food contact. He is a member of the International Research Group on Wood Preservation.

Philip D. Evans
Professor and Director
Centre for Advanced Wood Processing
University of British Columbia
Vancouver, British Columbia, Canada

Dr. Philip Evans is a Professor of Wood Science and Director of the Centre for Advanced Wood Processing at the University of British Columbia, Vancouver, British Columbia, Canada. Dr. Evans is responsible for the leadership, organization, and daily management of the Centre; Canada's national centre of excellence for the wood products industry. The Centre is responsible for an interdisciplinary research program, graduate education, technology transfer and extension, and a national program of continuing education. Dr. Evans is also involved in research and teaching in the fields of wood finishing and protection. Previously, he was Director of the Australian National University's Centre for Science and Engineering of Materials. He received B.S. and Ph.D. degrees from the University of Wales, Bangor, United Kingdom.

Brian T. Forschler
Associate Professor
Department of Entomology
University of Georgia
Athens, Georgia, USA

Dr. Brian Forschler is an Associate Professor in the Department of Entomology at the University of Georgia, Athens. He is the Principal Investigator for the Household and Structural Entomology research program. His research program has involved aspects of the biology and control of subterranean termites and the Argentine ant. His current research interests include laboratory evaluations of termite behavior; field efficacy of several termite baits; new chemistries for novel termite control tactics; and determination of subterranean termite social structure using agonism, morphological characters, cuticular hydrocarbon analysis, and genetic markers.

Christopher Gaston
Director, Markets & Economics
Forintek Canada Corporation
Vancouver, British Columbia, Canada

Dr. Christopher Gaston received degrees in Forestry Economics (Ph.D.) and Agricultural Economics (B.S, M.S.) from the University of British Columbia and the University of Guelph, Ontario, Canada. He has worked in both academics (teaching and research) and industry (management, consulting, research), with over 15 years experience in agribusiness and forestry. His research and consulting has focused on price risk management strategies, market research, econometrics, and trade modeling. Dr. Gaston is presently Director of Markets and Economics at Forintek Canada Corporation in Vancouver, British Columbia, Canada. Forintek is Canada's wood products research and development institute, with nearly 200 employees in their Vancouver and Quebec laboratories. His most recent projects have involved a comprehensive wood products market research study in Japan, a global competitor analysis of wood products exported to Japan, and a thorough review of wood-use in the United States. The latter has led to a number of market research studies on various wood end-use markets in Canada and the United States. He also organizes an annual conference on wood product markets, "Exploring New Paths," in addition to being an invited speaker at a great number of conferences annually, both in North America and abroad. He is also the Chair of the "Team of Specialists for Forest Products Markets and Marketing" for the United Nations Economic Commission for Europe in Geneva.

George J. Goroyias
Research Wood Scientist and Wood Technologist
Kronospan Ltd.
Wrexham, United Kingdom

Dr. George Goroyias is a Research Wood Scientist and Wood Technologist at Kronospan Ltd. in Wrexham, United Kingdom. His responsibilities include the coordination of research and development in the area of process control and development, MDF/particleboard. He is also a consultant for a project at the School of Wood Technology and Furniture Design, Technological Institute of Education in Karditsa, Greece. Previously, he was a Research Assistant at the Forest Research Institute in Athens, Greece. Dr. Goroyias has received several awards and is the author of numerous publications. He received a B.S. degree in Forestry, Forest Manager from the Technological Institute of Education, Karditsa, Greece; and a Ph.D. degree from the School of Agriculture and Forest Science, University of Wales, Bangor, United Kingdom.

J. Kenneth Grace
Professor and Chair
Department of Plant & Environmental Protection Sciences
University of Hawaii
Honolulu, Hawaii, USA

Dr. Kenneth Grace is a Professor and Chair of the Department of Plant and Environmental Protection Sciences at the University of Hawaii, Honolulu. His responsibilities include directing a research program on biology and control of termites and other structural pests, and wood protection from termite attack. Dr. Grace has published over 180 articles and book chapters, and is a frequent speaker at national and international conferences. He is an honorary life member of the Royal Canadian Institute, and has received awards for research excellence from Orkin Pest Control, the University of Hawaii, and Gamma Sigma Delta (the Honor Society of Agriculture). Dr. Grace also teaches at the University of Hawaii, and is Department Chair, supervising the activities of 30 faculty and 60 staff and students. He received a B.A. (Honors) degree in Biology, and Ph.D. degree in Entomology from the University of California at Berkeley.

Michael E. Hedley
Project Leader, Wood Performance Enhancement
Forest Research
Rotorua, New Zealand

Dr. Michael Hedley is Project Leader of Wood Performance Enhancement at the New Zealand Forest Research Institute in Rotorua. He manages a staff of 16 and his responsibilities include the development of a government-funded research program; management of commercial programs; Board member - New Zealand Timber Preservation Council; Chairman - Australasian Wood Preservation Committee. He received a B.S. (Honors) degree in Botany, and a Ph.D. degree from the University of Newcastle Upon Tyne, United Kingdom.

Dave Helmer
Divisional Technical-Commercial Manager
Janssen Pharmaceutica
Titusville, New Jersey, USA

Dave Helmer is the Divisional Technical-Commercial Manager at Janssen Pharmaceutica, Plant and Material Protection Division in Titusville, New Jersey. He has held positions of increasing responsibility within Janssen Pharmaceutica, Plant and Material Protection Division over the past 17 years. His current responsibilities include global responsibility for commercial development of termiticides, and Research and development of wood and material protection products in NAFTA for Janssen Pharmaceutica. He received a B.S. degree in Horticulture, and an M.S. degree in Plant Pathology from Rutgers University, New Brunswick, New Jersey.

Gregg Henderson
Professor and Urban Entomologist
School of Forestry, Wildlife & Fisheries
Louisiana State University Agricultural Center
Baton Rouge, Louisiana, USA

Dr. Gregg Henderson is a Professor and Urban Entomologist in the School of Forestry, Wildlife and Fisheries at Louisiana State University Agricultural Center in Baton Rouge, Louisiana. His responsibilities include teaching and research. His current research focuses on the biology, behavior, and control of Formosan termites. He has received numerous awards and has been published in several book chapters, refereed Journal articles, proceedings, pesticide screening reports, films, and newspaper/magazine articles. He received a B.S.

degree in Biology and Psychology from Rutgers University, New Brunswick, New Jersey; an M.S. degree in Entomology from Washington State University, Pullman; and a Ph.D. degree in Entomology from the University of Wisconsin, Madison.

Joe H. Hope
Manager, Global Projects and Field Technical Center
Aventis Environmental Science
Clayton, North Carolina, USA

Dr. Joe Hope is Manager of Global Projects and Field Technical Center at Aventis Environmental Science in Clayton, North Carolina. He is responsible for providing global technical direction on research and development projects, strategy, and positioning to Global Product Managers; and to manage staff (passive treatment technology managers, scientists, superintendent), operating/research budgets and research at Field Technical Center/global regions. He received a B.S. degree in Biology from Moravian College, Bethlehem, Pennsylvania; and an M.S. degree in Entomology and Ph.D. degree in Plant Physiology from the University of Tennessee, Knoxville.

Alain J. Jermannaud
International Consultant, Termites & Wood Preservation
HEPEX Consulting
Soulac sur Mer, France

Alain Jermannaud is an International Consultant, Termites and Wood Preservation, HEPEX Consulting, Soulac sur Mer, France. His current responsibilities include training and education of staff members of Chemical companies and Termite Control Operators; studies on feasibility of development projects of wood preservatives and termiticides for Chemical companies; market studies; audit of TCO companies; expert witness for Justice Courts; and management of a private experimental field testing site for termites. He received an Ingenieur Agronome degree from the Institut National Agronomique Paris-Grignon.

Jöran Jermer
Project Leader
SP Swedish National Testing & Research Institute
Borås, Sweden

Jöran Jermer is Project Leader, SP Swedish National Testing and Research Institute, Borås, Sweden. His current responsibilities include Project Leader with responsibility for wood durability and wood preservation research at SP, and Secretary-General of the International Research Group on Wood Preservation. His current commitments include Convener of European (CEN) and Swedish (SIS) standardization committees and membership of ISO committee for wood preservation, President of the European Homologation Committee for Wood Preservatives (EHC), and Member of the Nordic Committee for environmental labeling of outdoor furniture. He received an M.S. degree in Chemical Engineering from the Institute of Technology, University of Lund, Lund, Sweden.

Clif Jones
Manager, Business Development
Wood Preservative Group
Osmose, Inc.
Griffin, Georgia, USA

Clif Jones is the Manager of Business Development, Wood Preservative Group at Osmose, Inc. in Griffin, Georgia. His responsibilities include developing markets for expanded use of preservative-treated wood products, specifically borate-treated wood products for use in wood-frame construction. He received a B.S. degree in Business Administration from the University of South Carolina, Columbia.

Glenn M. Larkin
Research Scientist
School of Forestry & Wood Products
Michigan Tech University
Houghton, Michigan, USA

Glenn Larkin is a Research Scientist in the School of Forestry and Wood Products at Michigan Tech University, Houghton, Michigan. He is responsible for the management of the Wood Protection Group. He received a B.S. degree in Chemistry from the University of Denver, an M.S. degree in Chemistry from the University of Idaho, and is currently pursuing a Ph.D. degree from Michigan Tech University.

Stan Lebow
Research Wood Scientist
USDA Forest Service
Forest Products Laboratory
Madison, Wisconsin, USA

Dr. Stan Lebow is a Research Wood Scientist within the Wood Preservation and Fire Research Unit at the USDA Forest Products Laboratory (FPL) in Madison, Wisconsin. He is responsible for conducting research in a range of areas involving wood preservation, including the environmental impacts of preservative-treated wood. He has recently published research on the environmental impact of treated wood used in wetland boardwalks, the rate of release of preservatives from marine piling, and on methods of reducing the leaching of preservative from treated wood. Dr. Lebow also conducts research on the treatability and durability of new wood preservatives and new wood products. He is active within the American Wood Preservers' Association, where he works on the development of standards to improve treated wood products. He is also a member of the Forest Products Society and the Society of Wood Science and Technology. Prior to joining the FPL 8 years ago, Dr. Lebow was employed within the Department of Forest Products at Oregon State University, where he assisted in research on the treatment of western wood species and on the chemistry of wood preservative fixation. He received a Ph.D degree from the Department of Forest Products at Oregon State University in 1992.

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Leo Lindroos is a Process Engineer at Outokumpu Harjavalta Metals Oy in Pori, Finland. His current responsibilities include development work and project work. He has held various positions within Outokumpu Oy since 1967. He received his Engineer degree from Tampereen Teknillinen Opisto, Tampere, Finland.

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Dr. Kurt Mackes is an Assistant Professor in the Department of Forest Sciences at Colorado State University in Fort Collins, Colorado. His current responsibilities include teaching courses on wood products and timber harvesting, and conducting research relevant to wood utilization and marketing, with an emphasis on utilizing wood from small-diameter trees. He received a B.S. degree in Wood Science and an M.S. degree in Wood Science and Technology from Colorado State University; and a Ph.D. degree in Forestry and Forest Products from Virginia Tech.

Kurt Messner
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Dr. Kurt Messner is a Professor and Head of the Department of Mycology at the University of Technology in Vienna, and Director of the company LIGNOCELL Wood-Biotechnology GmbH. He is the author of numerous papers, mainly in international scientific journals. He received a Ph.D. degree in Botany from Vienna University in 1973.

Holger Militz
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Dr. Holger Militz is a Professor and Director of the Institute of Wood Biology and Technology at Göttingen University, Göttingen, Germany. Previously, he was a Professor at Wageningen University, The Netherlands; Director of the SHR Timber Research Institute, The Netherlands; and Head of the Wood Technology Group at the TNO Timber Research Institute, The Netherlands. He received an M.S. degree in Wood Science from the University of Hamburg, Germany; and a Ph.D. degree in Wood Science/Environmental Sciences at the University of Wageningen, The Netherlands.

Paul I. Morris
Group Leader, Durability & Protection
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Dr. Paul Morris is currently Group Leader of Durability and Protection at Forintek Canada Corporation. Forintek is Canada's national wood products research institute. His group of four scientists and four technologists is responsible for meeting client needs for research in short-term protection of wood during harvesting, transport and storage, and long-term durability in service. The latter includes durability by nature, durability by design, and durability by treatment. He has 18 years experience in wood preservation research since obtaining a Ph.D. degree from Imperial College of London University. Dr. Morris has authored or coauthored over 200 papers, technical reports, contract reports, and other publications. As a member of the International Research Group on Wood Preservation, he maintains awareness of new technologies under development throughout the world. He also participates in collaborative research and test method development. Dr. Morris' areas of expertise include international wood preservation standards, treatment of Canadian wood species, and factors affecting the durability of wood products. He is also an Adjunct Professor in the Department of Wood Science at the University of British Columbia. In his spare time, he is a hiker, Telemark skier, and sea kayaker.

Richard J. Murphy
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Dr. Richard Murphy is Senior Lecturer in the Department of Biological Sciences at Imperial College in London, United Kingdom. His responsibilities include teaching and research supervision at undergraduate and postgraduate level in wood structure, wood deterioration, mycology, and wood protection. Previously, he has been a Research Fellow at the University of Canterbury, New Zealand; a Visiting Research Scientist at the New Zealand Forest Research Institute in Rotorua; and a Post-Doctoral Research Associate at Imperial College. He received a B.S. (Honors) degree in Botany with Zoology from King's College, London, and a Ph.D. degree from Imperial College in 1982.

Darrel D. Nicholas
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Dr. Darrel Nicholas is a Professor in the Department of Forest Products at Mississippi State University in Starkville, Mississippi. He teaches courses in Wood Preservation. His research interests include development of new wood preservatives, evaluations of wood preservative systems, non-enzymatic decay mechanisms of brown-rot fungi, bioconversion of lignin, and dimensional stabilization of wood. He received B.S. and M.S. degrees in Forest Products from Oregon State University, and a Ph.D. degree in Wood Science and Technology from North Carolina State University.

Mel H. Pine
Director of Communications & State Government Relations
American Wood Preservers Institute
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Mel Pine joined the American Wood Preservers Institute (AWPI) in 2000 as the Director of Communications and State Government Relations. He is the spokesperson for the treated wood industry in the United States and Chair of the Treated Wood Council's Communications Committee. He coordinates the industry's communications and its relationships with state governments. He oversees stewardship of the industry's enhanced Consumer Awareness Program. Previously, he was President, MHP Communications; Senior Staff Advisor, Senior Editor, and Staff Advisor, Mobil Corporation; Adjunct Professor, New York University Journalism Department; Chief Copy Editor and Copy Editor, New York Daily News; Copy Editor and Telegraph Editor, Philadelphia Daily News.

Jim Renfroe
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As President and CEO of Wood Care Systems, Jim Renfroe's responsibilities include the overall management and development of sales, marketing, production, and administration of this remedial wood preservative business involved in the sale and application of wood preservatives and restoration products. He developed several systems for restoration and preservation of wood using borate-based wood preservatives and epoxy products. He is responsible for hiring and training staff, sales and purchasing, inventory control, accounting, and finance. Major emphasis on growing the business through supplier relationships, web site development, and building strategic alliances. He has published numerous articles and books and is a member of several professional associations. He received a B.S. degree in Business Administration from Valdosta State College, Valdosta, Georgia.

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Dr. Alan Ross is Vice President and Technical Director of Kop-Coat, Inc. in Pittsburgh, Pennsylvania. His responsibilities include directing Kop-Coat's global research and development efforts in wood preservatives and specialty coatings. He is a member of several professional associations including the American Forest and Paper Association (Committee on Research Evaluation, Wood Preservative and Biodegradation Committee), American Wood Preservers' Association (First Vice President), Federation of Societies for Coatings Technology (Joint Coatings - Forest Products Committee), Forest Products Society, and Window and Door Manufacturers Association. He received a B.S. degree in Chemistry from Case Western Reserve University, Cleveland, Ohio; and a Ph.D. degree in Organic Chemistry from Yeshiva University, New York, New York.

John N.R. Ruddick
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Dr. John Ruddick is a Professor in the Department of Wood Science at the University of British Columbia in Vancouver, British Columbia, Canada. His responsibilities include teaching courses in wood preservation and research. His main research interest is in enhancing the durability of wood in service, by using environmentally sensitive approaches. He is the author or coauthor of numerous publications. He received B.S., M.S., and Ph.D. degrees.

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Michael Sanders is a Research Assistant II in the Department of Forest Products at Mississippi State University in Starkville, Mississippi. He received a B.S. degree in Industrial Technology from Mississippi State University. He is currently pursuing an M.S. degree in Forest Products. Professional accomplishments include: Outstanding Young Men of America Award (1989); Certified in Master Standard Data (MSD); Member of the National Association of Industrial Technologist (1989-1990); Certified Commercial Pesticide Applicator; Coauthored technical forums with Drs. Terry L. Amburgey and H. Michael Barnes; Member of the Forest Products Society; Member of the *ALPHA THETA* chapter of *XI SIGMA PI* national forestry honor society; Co-instructor - 1999 Wood Preservation Workshop (Koppers Industries); United States Patent #6,142,198 - Application of Mechanical Stress to Improve Wood Treatability.

Tor P. Schultz
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Dr. Tor Schultz is a Professor in the Department of Forest Products at Mississippi State University in Starkville, Mississippi. He teaches courses in the area of wood technology and products, physical properties of wood, and advanced lignocellulosic chemistry (graduate). His research interests include synergistic wood preservations, natural durability of wood, reactions of lignin, and rapid analysis of wood. He received a B.S. degree in Forestry/Wood Science from the University of Florida, and an M.S. degree in Wood Technology and Ph.D. degree in Wood Chemistry from North Carolina State University.

Robert L. Smith
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Dr. Robert Smith is an Associate Professor and Director of the Center for Forest Products Marketing and Management, Department of Wood Science and Forest Products, Virginia Tech, Blacksburg, Virginia. He holds a Ph.D. degree in Forest Products Marketing from Virginia Tech, an M.B.A. degree from the University of Wisconsin-Oshkosh, and a B.S. degree in Wood Science from Michigan Tech University. He teaches undergraduate and graduate courses in the areas of forest products marketing. Prior to completing his Ph.D., he was a Sales Representative for 8 years in the Midwest for a major supplier of treated wood products, and for 6 years was a Production Manager at a wood treating plant. He has authored over 150 articles in the areas of forest products, marketing, and sales. He teaches forest products marketing and sales workshops throughout the United States.

William B. Smith
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Dr. William Smith is Professor of Wood Products Engineering at the State University of New York College of Environmental Science and Forestry in Syracuse, New York. His teaching and research activities are in the areas of wood drying, preservation, processing, and marketing. Dr. Smith is a member of the Forest Products Society, Society of Wood Science and Technology, New England Kiln Drying Association, and American Wood-Preservers' Association.

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Dr. Helena Solo-Gabriele is an Associate Professor in the Department of Civil, Architectural and Environmental Engineering at the University of Miami in Coral Gables, Florida. She teaches graduate and undergraduate courses in environmental engineering. Her academic interests include environmental transport of metals and microbial contaminants, transport of water and contaminants between surface and groundwater systems, and environmental impacts of metals in pressure-treated wood. She received B.S. and M.S. degrees in Civil Engineering from the University of Miami, Coral Gables, Florida; and a Ph.D. degree in Civil and Environmental Engineering from the Massachusetts Institute of Technology, Cambridge, Massachusetts. She is a licensed Professional Engineer in the State of Florida.

Jeffrey B. Stone
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American Wood Council Division
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Dr. Jeffrey Stone represents the American Wood Council Division of the international forest products industry. His duties include instruction on hurricane-resistive building construction, building code analysis and development, committees on performance standards for dwellings, and consultative services to architects, engineers, contractors, governments, and material suppliers. He is the author or coauthor of numerous publications and presentations. He is a member of several professional associations and has received several awards. He is a Certified Building Official and Certified Building Inspector in the State of Florida. He received a B.A. degree in Political Science and a Master of Public Administration degree from the University of South Florida, and a Ph.D. degree in Public Administration from Florida State University.

Nan-Yao Su
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Ft. Lauderdale Research & Education Center
Institute of Food & Agricultural Sciences
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Dr. Nan-Yao Su is a Professor of Entomology in the Ft. Lauderdale Research and Education Center at the University of Florida, Ft. Lauderdale, Florida. His responsibilities include teaching and research. His research responsibilities include studying insect pests damaging to structures and to develop control measures suitable in urban settings. His accomplishments include: Developed a reduced-risk monitoring/baiting procedure for population management of subterranean termites; received the U.S. Department of Agriculture Secretary's Honor Award (1996); and delineated foraging dynamics of subterranean termites. He is the author or coauthor of numerous publications. He received B.S. and M.S. degrees in Entomology from Kyoto Institute of Technology, and a Ph.D. degree in Entomology from the University of Hawaii.

R.C. Tang
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Dr. R.C. Tang is a Professor in the School of Forestry and Wildlife Sciences at Auburn University in Auburn, Alabama. He received a B.S. degree in Forest Science from the National Chung-Hsing University in Taiwan in 1957, and a Ph.D. degree in Wood Science from North Carolina State University in 1968. He was a Research Associate at the Institute of Theoretical and Applied Mechanics and the Department of Civil Engineering at the University of Kentucky during 1968 and 1970. He also served as Assistant and Associate Professor in the Department of Forestry at the University of Kentucky during 1970 and 1977. He has conducted research on a variety of areas in forest products and utilization, wood mechanics, fiber physics, and timber engineering. Currently, his research activities at Auburn University are concentrated on the areas of composite structural panels and composite structural lumber and environmental effects on the long-term engineering performance of wood composite structural systems. Current teaching responsibilities include undergraduate courses of forest products utilization, primary wood processing technologies, special problems in forest products, and advanced graduate courses of mechanics of wood and wood composites, and physics of wood and wood composites.

Bill Tucker
President
Florida Building Material Association
Mt. Dora, Florida, USA

Bill Tucker is President of the Florida Building Material Association (FBMA) in Mt. Dora, Florida. The strategic goals of the FBMA are: 1) Aggressively represent members' interests in the government policy making processes that affect their business opportunities and options. 2) Facilitate development of codes and technical standards that promote the use of members' products in the Florida marketplace. 3) Promote the use of wood products, related building materials, and services marketed by association members. 4) Provide programs and services that increase members' operating effectiveness and efficiency. 5) Provide opportunities for social interaction and business networking among members. Mr. Tucker received a B.A. degree from Florida State University, Tallahassee.

Steven A. Verhey
Ph.D. Candidate and Instructor
School of Forestry & Wood Products
Michigan Tech University
Houghton, Michigan, USA

Steven Verhey is a Ph.D. Candidate who is finishing a dissertation about the fungal durability of wood fiber/thermoplastic composites. His research has focused on determining suitable methods of evaluating durability and how wood component manufacturing variables affect the durability of model, compression molded composites. He is currently teaching two courses at Michigan Tech University on Wood Anatomy and Properties and Composites II. In addition to his doctoral research, he has participated in a project that studied the suitability of using red maple sawlogs to produce laminated veneer lumber. He is also participating in investigations that may improve the water and slip resistance of oriented strandboard and the dimensional stability of wood fiber/thermoplastic composites. He received a B.S. degree in Chemistry from the University of Wisconsin, Stevens Point; and an M.S. degree in Chemistry in Michigan Tech University, Houghton.

Henry Walthert
Executive Director
Canadian Institute of Treated Wood
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Henry Walthert is Executive Director of the Canadian Institute of Treated Wood (CITW) in Ottawa, Ontario, Canada. The CITW is a non-profit industry association comprising of members from across Canada. Operating under a Federal Charter, the Institute serves as a forum for those involved with the wood preservation industry, from research to production, marketing, and protection of the environment. CITW members cooperate with government departments and other agencies in preparing standards for the industry, and in developing guidelines for the design and operation of wood preservation facilities. It works with Canadian university testing laboratories, faculties, and independent research organizations concerned with the development of treated wood. Mr. Walthert received Bachelor of Forestry and Bachelor of Education degrees from the University of Toronto, Toronto, Ontario, Canada.

Kim Watson
Global Development Manager
FMC Corporation
Philadelphia, Pennsylvania, USA

Kim Watson is the Global Development Manager at the FMC Corporation in Philadelphia, Pennsylvania. He has 10 years experience in research and development with a focus on plant protection in agriculture (legumes, oilseeds, cereals, and vegetables), and 7 years experience in research and development with a focus on insecticides in the non-agricultural markets (e.g. termite control, timber preservation, vector control, turf and amenity, and consumer and urban pest control). He received the following degrees: Bachelor of Applied Science, Graduate Diploma of Applied Science, and Master of Business (Marketing).

Lonnie H. Williams
President
Rich Mountain Wood Protection Services, Inc.
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Lonnie Williams is the Owner and President of Rich Mountain Wood Protection Services, Inc. in Gulfport, Mississippi. He is responsible for all phases of the management and operation of this small consulting firm specializing in laboratory and field testing of preservative-treated wood or rigid foam insulation for resistance to damage by subterranean termites; and consultation, inspection, and expert witness testimony on wood-infesting insect problems for companies and individuals. He retired after 27 years as Principal Research Entomologist at the USDA Forest Service's Wood Products Insect Research Laboratory in Gulfport, Mississippi. His career accomplishments include: Pioneered the resurgence in the United States of research interest about boron-based wood preservatives and pesticides; authored or coauthored over 90 technical and popular publications, primarily on wood-infesting beetles and borates for wood protection; played a major role in the organization and chairing of highly successful international conferences on borates for wood protection. He received a B.S. degree in Forestry and an M.S. degree in Entomology from the University of Missouri in Columbia.

Andrew Zahora
Senior Research Scientist
Chemical Specialties, Inc.
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Dr. Andrew Zahora is a Senior Research Scientist in Wood Technology at Chemical Specialties Inc. (CSI) in Charlotte, North Carolina. His areas of research currently concentrate on the performance testing and treatment aspects of new wood preservative systems as well as the effects of modifications to existing commercial products. Dr. Zahora received a B.S. degree from the State University of New York College of Environmental Science in Syracuse, and a Ph.D. degree in Forest Products from Oregon State University, where he investigated various aspects of fumigant movement and interactions in wood. Prior to joining CSI in 1989, he had been a Post-Doctoral Fellow at the Imperial College of Science and Medicine in London, England, investigating the development and control of decay in air-seasoning wood poles. He is active in the American Wood Preservers' Association and the International Research Group on Wood Preservation.

SESSION ABSTRACTS

MONDAY, FEBRUARY 11

SESSION I: EMERGING ISSUES IN WOOD PROTECTION

Emerging Domestic Markets for Treated Lumber

Robert L. Smith, Associate Professor and Director, Center for Forest Products Marketing & Management, Dept. of Wood Science & Forest Products, Virginia Tech, Blacksburg, Virginia, USA

Probably no single market segment for wood products has endured more scrutiny in recent years than the market for treated wood products. With additional regulations in the 1970s on safer applications of preservatives to wood, and current challenges related to leachability of Chromated Copper Arsenate (CCA), it seems like this market is under constant change. We have historically treated 6 billion board feet of product with CCA since the mid-1980s, and much of this material has been used in the residential construction market. The public concern for the perceived safety of treated wood products will undoubtedly have an impact on all wood preservatives, not only CCA. And there will be increased regulation by authorities to make sure treated wood products are used and disposed of properly. In addition to the increased scrutiny of the industry, new substitute products such as plastic/wood composites have captured market share during the last decade. When discussing emerging markets for treated wood, the future isn't what it used to be. However, the sale of treated wood products has remained fairly constant over the past two decades. This indicates that there remains a strong need for the application of wood in environments that are hostile to its natural durability. As we investigate emerging domestic markets, the industry must look to areas where treated wood has a distinct competitive advantage and it also must address the concerns of the public related to safety issues. Finally, I feel the industry must address how to recycle treated lumber being removed from service. The major markets for treated wood can be divided into industrial markets that include railroad ties and timbers, highway construction, marine construction, and utilities. Many of these products are still treated with oilborne preservatives. There exist opportunities for growth in these markets with the repair and replacement of our nation's infrastructure. The other major market utilizing waterborne preservatives, primarily CCA, is the residential market. Of the two, the residential market now represents nearly 70% of preservative usage. There is an increasing need for the entire framing of homes to be treated to stop infestation by termites and other insects. There is also an increasing concern for indoor air quality, which can be addressed by the treatment of framing lumber to reduce or eliminate mold. The treated wood foundation that has been in existence since the 1950s, still holds opportunities for treated lumber. Another market that holds opportunities is the light-frame commercial building market. This market currently is predominately steel and treated lumber could make inroads here. New "perceived" safer preservatives or adjustments to retention levels could assist manufacturers in promoting the environmental friendliness of wood over steel/concrete. The treatment of engineered wood products also provides an opportunity for the industry. Programs that promote the recyclability of treated lumber will also enhance the image of the wood preserving industry. I believe that the domestic market for treated products is bright for those willing to promote these products as a method of saving our forests and extending the lifespan of wood products in service.

Emerging International Markets for Treated Wood

Christopher Gaston, Director, Markets & Economics, Forintek Canada Corporation, Vancouver, British Columbia, Canada

The vast majority of all treated wood production in North America is used domestically in outdoor applications (which for treated lumber is primarily for residential decking and fencing). The two largest areas of growth are in expanded end-use applications (for example, treated lumber used in residential and non-residential framing), and in expanded geographic markets. This presentation focuses on the latter. The international markets which are shown to have the largest room for expansion or adoption of treated wood products are, in order, Japan, Western Europe, and emerging Pacific Rim economies. These markets are investigated both for both building and outdoor applications of treated wood. This investigation includes competitive and environmental considerations.

Emerging Technologies in Wood Protection

Philip D. Evans, Professor and Director, Centre for Advanced Wood Processing, University of British Columbia, Vancouver, British Columbia, Canada

Technology, broadly defined as the application of knowledge to achieve practical outcomes, has become increasingly important as companies try to compete in a fierce and unforgiving globally competitive environment. In the wood protection industry, emerging technologies promise competitive advantage, reductions in the environmental impact of treated wood products, and the solution to seemingly intractable problems such as the treatment of refractory timbers. More generally, technology is shaping the structure of the industry as developments in other fields open up new markets, provide opportunities for product diversification, or produce substitutes that displace treated timber from its traditional strongholds. While the acquisition of new knowledge is essential to technological advancement in many high-tech fields, the key to future development of the wood protection industry lies with the exploitation of the vast body of information and new instrumentation that has been generated in the last 30 years in the physical, biological, and chemical sciences. For example, the quantum leap in our understanding of how organisms function at the molecular level offers unlimited possibilities for altering tree genomes to engineer new biocides, or wood that possesses inherent resistance to biodeterioration. This presentation reviews the state-of-technology currently employed by the wood protection industry in the industrialized world, the potential impact of emerging technologies on the chemicals, processes and products produced by the industry, and the constraints to the adoption of new technology.

Emerging Materials: What Will Durable Materials Look Like in 2020?

Jerrold E. Winandy, Project Leader, USDA Forest Service, Forest Products Laboratory, Madison, Wisconsin, USA

Forest resource issues will increasingly affect building materials used in North America and worldwide. The use of smaller-diameter, lower-quality, and faster-grown timber, in addition to currently lesser used species of timber, will result in an increased dependence on engineered wood-, wood agro-fiber-, wood cement-, and wood thermoplastic-composites. Over the last 25 years, the use of wood-based composites (by volume) has grown by 3-5 fold and their use is now virtually equal to that of solid-sawn wood. All users, including traditional pressure treaters, will find it increasingly difficult to find solid-sawn commodities in the grades, sizes, and volumes they have traditionally grown to expect. Users and engineers will continue to increasingly demand more reliable and more durable building materials. To meet this long-term change in markets, treaters will need to adapt their business plans to create the knowledge and the infrastructure critical to producing durable building products that meet this inevitable demand for more-durable wood-based composite products. We will all need to facilitate basic research to make more durable composites.

Environmental Issues in Europe

Gérard Deroubaix, Environment Manager, Centre Technique du Bois et de l'Ameublement (CTBA), Bordeaux, France

The development of the environmental sensitivity in the European society generates new constraints for wood preservation. Traditionally expressed as regulations, they are now appearing as market requirements. In the 1970s, industrial accidents led to regulations designed to handle industrial risk. These regulations touched first the wood preservative manufacturers' plants, and 10 years later, the entire wood treatment industry. In the 1980s, health and environment problems led to the ban of or restrictions on some chemicals, and then to the elaboration of an authorization system for products, the "Biocidal Products Directive." The concept of risk assessment then became important in the wood preservation sector, as a way to select substances. As useful and widespread as it may be, in the EU regulations, this approach always expresses a potential negative effect on man and the environment. In opposition, Life Cycle Analysis can be a useful tool to demonstrate some positive environmental aspects of wood preservation, like service life extension. Today, it seems that beyond regulations, the European market is going to impose environmental requirements. Different indicators support this idea, such as the development of eco-marketing (eco-certification of timber, ecolabels), or the "sustainable building" approach and the acknowledgement of forest and wood products as carbon sinks. Indeed, the wood industry in Europe wishes to surf on the ecological sensitivity of the market to promote wood as the ecological material. In that context, if wood preservation can meet the high level of regulatory constraints that it faces in Europe, it may be time for eco-design and eco-marketing.

SESSION IIA: MARKETS AND MARKETING

Florida Building Material Dealers and the Future of Sales and Distribution of CCA-Treated Wood Products

Bill Tucker, President, Florida Building Material Association, Mt. Dora, Florida, USA

Over the past 2 years, CCA-treated lumber has suffered from a relentless attack by the media. From local to the national governments reacting to the media reports, politicians have initiated efforts to curb its use. We decided to survey retail lumber dealers to determine the affect these attacks and government initiatives have had on the market for the product. In our survey, which was mailed to 100 Florida retail lumber dealers, we asked the respondents to rate on a scale, from one to ten - one being minimal and ten being major - the following. 1) Contractor concern over CCA-treated wood products. 2) Contractors switching to alternative treated wood products in hidden applications (furring strips, sole plates, etc.). 3) Contractors switching to alternative wood products when building decks. 4) Contractors switching to composite or non-wood products when building decks. 5) Consumer concern over CCA-treated wood products. 6) Your concern over CCA-treated wood products. 7) Is your company considering stocking and selling treated wood products other than CCA? 8) Are you stocking composite or non-wood alternatives to CCA-treated wood products? With the 47 respondents, the overall results of the survey showed minimal contractor concern about CCA-treated wood, but a perception of greater consumer concern and a willingness to stock and sell non-wood alternatives.

The Incursion of Alternative Building Materials

William B. Smith, Associate Professor, College of Environmental Science & Forestry, State University of New York, Syracuse, New York, USA

A number of materials are being promoted for use as alternatives to traditional pressure-treated preserved wood products. Dominant in the marketplace among these are several types of recycled plastic lumber, timbers, and pilings. These plastic lumber and composite products are manufactured from waste polyethylene and other plastics, often from a recycled waste stream. They are typically championed as being environmentally beneficial because they use materials that would otherwise have to be landfilled, and, because plastic is not seen as being susceptible to biological degradation, have been suggested for use in place of preservative-treated wood as a preferred and sustainable building material. The most important characteristics of any building material, however, are its strength, performance, and cost. As a substitute for preserved wood products, these alternative materials have been marketed using various claims of improved product attributes and performance characteristics over wood. While there is validity to some of these points, many lack the scientific and engineering data to support the marketing claims. This presentation will address these issues relative to the common plastic lumber materials currently on the market, and will present and discuss data on the composition and physical and mechanical properties of both wood and plastic and plastic composite lumber that affect subsequent structural performance, including MOE and MOR bending strength, compression, effect of temperature, duration of load, and engineering design values.

Markets for 'Recycled' Treated Wood Products

Stephen M. Bratkovich, Forest Products Specialist, USDA Forest Service, Northeastern Area State & Private Forestry, St. Paul, Minnesota, USA

This presentation will explore marketing opportunities, strategies, and barriers to successfully recycling treated wood products. Utility poles, railroad ties, decking material, guard rails, and highway sound barriers are examples of treated wood products that will be featured in the presentation. Selected case studies of recycling projects from around the United States will be highlighted. Recommendations will be offered on direct marketing of recycled treated wood products to the general public.

Treated Structural Systems - Promotional and Legislative Status

Clif Jones, Manager, Business Development, Wood Preservative Group, Osmose, Inc., Griffin, Georgia, USA

Wood-frame construction is the dominant building method for single-family residential and much multi-family construction in the United States. This dominance is being eroded by alternative materials such as concrete masonry units (CMU), insulated concrete form (ICF), and steel framing. The suppliers of these alternatives often promote the fact that, unlike wood, their building products are not vulnerable to wood-destroying organisms (WDO) such as termites (Formosan, native subterranean, and drywood), carpenter ants, and decay fungi. As nearly one out of every two new homes built in the United States is in a high termite and decay risk area, the WDO issue threatens the marketability of billions of board feet of lumber and billions of square feet of structural panels. Treated wood structural systems offer a means to address this competitive threat. In particular, borate-based treated structural systems (TSS), utilizing borate pressure-treated lumber and plywood and borate in-line treated OSB sheathing, has seen market recognition. TSS utilizes borate-treated wood products for framing and sheathing applications. The TSS approach typically costs less than converting the structural system from untreated wood to alternative materials. It adds 1½ - 2½% to the price of a home. Additionally, TSS allows builders and homeowners to continue to enjoy the many benefits offered by wood such as ease of use, insulating and energy advantages, and the comfort of knowing that they are using a renewable resource. Rules and regulations that govern construction practices in the United States have long required protection of buildings against WDO. The most common approach involves the treatment of the soil at the foot of the structure with a pesticide as a means of keeping soil-borne termites out of the structure. This approach, however, does not provide lasting or reliable protection as soil termiticides degrade in about 5 years and the pesticide barriers can be broken by simple activities such as gardening by the homeowner. As well, soil barriers don't protect the structure from airborne termites (Formosan and drywood), carpenter ants, and decay. As a result, damage to structures from WDO, currently some $3 billion/year, is increasing at an alarming rate. Forward-looking jurisdictions have gone beyond the simple barrier approach. They see the importance of a multi-faceted approach to: 1) Keep WDO out of the structure through barrier treatments, wood debris removal, and proper drainage and moisture management; and 2) Use durable products for the key part of the building - the structure. This approach has been used with great success in Hawaii. Other jurisdictions such as Louisiana have also investigated mandating a similar approach, but the lack of a political consensus has resulted in the development of public education programs and market-based solutions. The current state of TSS is that in Hawaii, where treated wood is used extensively for structural systems, borate wood preservatives have by far the largest market share. In the continental United States, there is increasing commercial interest in TSS, particularly in the southeast. Custom builders and smaller niche builders see the value and some are now offering TSS as an option. Various tract builders are looking at TSS, but are reluctant to increase costs. Several multi-family builders, who have traditionally built with steel or concrete, are now using TSS because it offers the best combination of affordability, durability, and ease of use.

Relationship Between Codes and Standards

Jeffrey B. Stone, Southeast Regional Manager of Codes & Standards, American Wood Council Division, American Forest & Paper Association, St. Pete Beach, Florida, USA

America's building codes require compliance with a multitude of standards. The requirements provided by the standards are used by architects, engineers, and those engaged in preparing and administering building codes to produce buildings, products, services, and systems that are safe and serviceable. Standards development systems provide a forum for producers, users, and consumers and those having a general interest, such as representatives of government and academia, to meet on common ground and write test methods, specifications, and other documents for materials, systems, and services. Code development systems provide a similar forum to establish minimum, not necessarily optimum, requirements for buildings and structures. Consensus processes develop standards and determine whether the standard will be included in the codes. The establishment of standards and their inclusion in the codes are political acts, in which various interests debate the benefits and limitations of proposed provisions. Just because a standard is adopted by a highly respected nonprofit, professional society, such as ASTM or ASCE, does not guarantee their inclusion in the code. Interests that are different from that of the standards development process influence the code development. This presentation examines differences between standards development and code adoption. Included will be a discussion of some of the variants of the consensus process and variations of the standards writing organizations that are influencing the codes.

SESSION IIB: OVERVIEW OF CURRENT RESEARCH ON WOOD PROTECTION AND DURABILITY

What's Stopping the Recycling of Recovered CCA-Treated Lumber

Robert L. Smith, Associate Professor and Director, Center for Forest Products Marketing & Management, Dept. of Wood Science & Forest Products, Virginia Tech, Blacksburg, Virginia, USA; *Delton Alderman*, Research Scientist, USDA Forest Service, Northeastern Research Station, Princeton, West Virginia, USA; *Philip A. Araman*, Project Leader, USDA Forest Service, Southern Research Station, Blacksburg, Virginia, USA

Awareness and concern regarding the environmental impacts and disposal of copper chromated arsenate (CCA) treated wood products are increasing. Several investigators predict that the quantities of CCA-treated lumber will increase significantly in the upcoming decades. Additionally, with the number of landfills decreasing, landfill tipping fees increasing, and limitations being placed on the types of materials that can be landfilled, it is vital that treated wood currently directed to landfills be recycled. There are wide discrepancies in the estimates of treated wood residue quantities taken out of service. In 1990, Cooper estimated that 350,000 cubic feet of treated lumber were removed from service and in 1993 one million cubic feet were removed. He projects that over 564 million cubic feet of treated lumber will be removed from service in 2020, while Felton and DeGroot estimate nearly 671 million cubic feet will be removed from service. In between those estimates, McQueen and Stevens project that nearly 430 million cubic feet will be removed in 2004. The primary goal of this project is to identify factors which will assist decision-making in the reduction of the quantities of CCA-treated lumber directed to our private and public landfills. Ultimately, this will have an effect in three principal areas: 1) Conservation of both public and private softwood forests; 2) Reduction in the area of public and private land utilized for landfills; and 3) Generation of new economic opportunities via the creation of recycling businesses. The objectives are: 1) Estimate the amount of CCA-treated lumber being removed from service in selected Mid-Atlantic cities; 2) Identify the barriers and incentives towards utilizing recycled treated lumber; and 3) Recommend potential products/markets for recycled CCA lumber. This study will discern the factors influencing the recycling and subsequent utilization of CCA-treated lumber. Additionally, this research will determine the individuals, organizations, barriers, and incentives that influence the recycling and utilization of CCA-treated lumber.

Potential Markets for Double-Diffusion Treated Ponderosa Pine

Kurt H. Mackes, Assistant Professor, and *Christopher M. Jennings*, Research Associate, Dept. of Forest Sciences, Colorado State University, Fort Collins, Colorado, USA; *Tim G. Reader*, Forest Products Specialist, Four Corners Sustainable Forests Partnership, Durango, Colorado, USA

Results from a project funded by the Four Corners Sustainable Forests Partnership has shown that the double-diffusion wood preservation method can be used to treat wood from small-diameter ponderosa pine. A subsequent project being conducted by the Department of Forest Sciences at Colorado State University, the Colorado State Forest Service, the San Juan RC&D, and the Four Corners Sustainable Forests Partnership involves demonstrating the use of wood from small-diameter trees harvested in the Four Corners Region for highway and campground structures. An objective of this project is to investigate the commercial viability of the double-diffusion process. As part of this investigation, potential markets for double-diffusion treated wood have been identified and will be discussed in this presentation. In addition to highway and campground structures, including signposts, guardrails, retaining walls, and sound barriers, other possibilities such as glued-laminated beams, posts, and landscape timbers will be considered.

Remedial Wood Preservation and Restoration

Jim Renfroe, President and CEO, Wood Care Systems, Kirkland, Washington, USA

The biggest enemy of wood is water. Water leads to rot and in many cases rot attracts wood destroying insects like carpenter ants and termites. Once you cut a tree down, its natural defense mechanisms are cut off and rot is nature's way of recycling to return it to the earth. There are chemical and mechanical processes that begin to take place within days to return a magnificent tree into compost in just a few short years. This same process, (although slower) is at work in lumber, timbers, poles, logs, door and window millwork, and historical buildings. This presentation will briefly describe what happens, but its focus is on how to stop these natural processes and reverse the damage. While there are only a few remedial wood preservatives, this presentation will focus on borate-based wood preservatives. Borates are the only preservative that has broad-spectrum control, virtually no toxicity to mammals, ability to diffuse through wood, and can be purchased and used by the end user without a license. After *in-situ* preservation with borates, epoxy-based restoration products can be used to add integrity back to the damaged wood and form a decay and insect resistant repair. A low-viscosity liquid epoxy is applied first to penetrate several cell layers deep and harden to form a waterproof barrier. Then, a high viscosity epoxy paste is applied to fill in the missing wood.

Characterizing the Environmental Response to Pressure-Treated Wood

Kenneth M. Brooks, Senior Scientist, Aquatic Environmental Sciences, Port Townsend, Washington, USA

The U.S. Environmental Protection Agency's registration process does not evaluate the environmental response to the small amounts of active ingredient that are lost from pressure-treated wood. Recognizing this, other federal and state agencies responsible for managing aquatic resources have questioned, and in some cases strongly opposed, the use of all forms of treated wood in aquatic environments. Proponents of the use of pressure-treated wood products have addressed this regulatory opposition in five ways with varying degrees of success. 1) Industry has developed Best Management Practices designed to reduce preservative losses to aquatic environments; 2) Preservative suppliers have undertaken laboratory studies to understand preservative loss rates; 3) The Western Wood Preservers Institute, U.S. Forest Service, and chemical suppliers have sponsored development of computer models predicting the site-specific environmental response to treated wood projects; 4) The United States and Canadian governments have sponsored a series of environmental risk assessments to evaluate the model's predictive capabilities and to determine the environmental response to large projects constructed in worst case environments; and 5) Based on the results of those risk assessments, there is an emerging effort to define additional Best Management Practices for construction and demolition of treated wood projects. This presentation will discuss the history and results of these approaches with specific examples and analytical results. This history will be used to recommend a methodology for developing a rational approach to the use of new and existing wood preservatives in sensitive environments.

Water-Borne Copper Naphthenate: A Potential New Preservative for Softwoods, Hardwoods, and Composites

D. Pascal Kamdem, Associate Professor, Dept. of Forestry, Michigan State University, East Lansing, Michigan, USA; *Mike H. Freeman*, Consulting Wood Scientist, Memphis, Tennessee, USA; *Elmer Schmidt*, Professor, Dept. of Forest Products, University of Minnesota, St. Paul, Minnesota, USA; *Pascal Nzokou*, Graduate Research Assistant, Dept. of Forestry, Michigan State University, East Lansing, Michigan, USA

Copper naphthenate is a well known commercially used wood preservative used for the treatment of wood poles, fence posts, lumber, glulam beams, timbers, and wood shakes/shingles. In recent years, researchers have begun to investigate alternative formulations that transform the typically oil-borne preservative into new, environmentally friendly water-borne systems. Included in the research reported here is the 6-year stake test efficacy data comparing water-borne copper naphthenate in Southern Pine (SYP) at multiple exposure sites in the United States with oil-borne copper naphthenate, ACQ and CCA -Type C. This presentation will also compare some other alternate formulations of water-borne copper naphthenate using alternative coupling systems to make the oil-borne preservative water borne in nature. Additional work indicates that water-borne copper naphthenate may be a good biocide candidate for the protection of wood composites. This emerging preservation technology offers a potential new lumber and composite treatment with benefits to treaters and consumers over that of conventional wood preservatives in performance and environmental matters. Future reports will evaluate the performance of water-borne copper naphthenate (i.e., efficacy) in the lesser-studied softwood species of red pine and ponderosa pine and in maple, oak, beech, and yellow-poplar. Specifically in this study, Water-borne copper naphthenate (WB Cu-N) was used to treat southern yellow pine (*Pinus* spp) 19 mm x 19 mm x 400 mm stakes. The treated stakes were exposed in test sites located in Gainesville, Florida, Augusta, Georgia, East Lansing, Michigan, and Aberdeen, Mississippi. CCA, ACQ, and oil-borne copper naphthenate (CuN) were also used to treat some stakes for comparison. Untreated samples were destroyed by decay fungi and termites within 2 years on all sites. After 3 years exposure in Florida, the rating of stakes with 2.0 kg/m^3 copper retention from WB Cu-N is still equivalent to CCA at 5 kg/m^3 retention, ACQ at 6.4 kg/m^3 retention and oil-borne copper naphthenate at 1.6 kg/m^3 copper retention. After 6 years exposure in Mississippi and 5 years in Michigan, 0.76 ± 0.07 kg/m^3 Cu metal from WB Cu-N offered good protection comparable to CCA and ACQ treatments. This study clearly suggests that WB Cu-N can be used as a wood preservative for both above ground and ground contact applications.

Field Testing Above Ground

Andrew Zahora, Senior Research Scientist, Chemical Specialties, Inc., Charlotte, North Carolina, USA

This presentation provides performance results from internal testing of various preservative systems using different above-ground field-testing protocols at different test sites throughout the United States and world. The benefits and drawbacks for individual field test methods will be discussed. Relative rates of decay and how the different preservative systems perform with the different test methods and at the different locations will be discussed.

Current Research and Perspectives at the SP in Sweden

Jöran Jermer, Project Leader, SP Swedish National Testing & Research Institute, Borås, Sweden

At present, SP's research in wood durability and wood preservation is focused on the following themes: 1) Performance studies (field testing and investigation of technical properties) of treated and untreated wood; and 2) Problems related to waste wood. SP has recently been involved in the following projects: 1) A survey of the amounts of wood preservatives used in Sweden during the 20th Century; 2) Guidelines for the re-use of demolition wood; 3) Inventory and analysis of potential contaminants, e.g. wood preservatives, in waste-wood fuel chips. Current projects are: 1) Field trial of chromium- and arsenic-free wood preservatives; 2) Service test of wood treated with arsenic and chromium free preservatives; 3) Performance study of a number of substitute wood materials to "conventionally" preservative-treated wood; 4) Further studies of waste-wood fuel chips related to the quality of the fuel as well as problems of deposit formation and corrosion in the furnaces; 5) Studies of heat-treated wood - its performance against decay and strength properties; and 6) Wood protection by design. The general situation for research in wood durability and wood preservation in Sweden is rapidly getting worse. This is particularly true for research related to traditional wood preservatives (biocide type) and wood preservation for which only very limited funds are available. With less money available for research it is increasingly difficult to recruit Ph.D. students and to replace retired expertise.

A New Approach to Improving Wood Treatability

Michael G. Sanders, Research Assistant II, and *H. Michael Barnes* and *Terry L. Amburgey*, Professors, Mississippi Forest Products Laboratory, Mississippi State University, Starkville, Mississippi, USA

Although the sapwood of southern yellow pine is readily treatable, the heartwood remains essentially impermeable to preservatives such as chromated copper arsenate (CCA). Concerns expressed by individuals in the treating industry have indicated a problem with the treatment of "transition wood" found in an increasing amount in today's plantation-grown stock. Preliminary tests at the Mississippi Forest Products Laboratory indicate that the treatability of southern pine heartwood can be improved, without having a detrimental effect on the strength properties, by subjecting kiln-dried dimension stock to the MSU "TASK Process"; which incorporates varying levels of compression and/or vibration to mechanically stress lumber. The authors also feel this process should aid with the problem of treating "transition wood."

Termite Infestation in France: New Regulations to Limit the Spread

Alain J. Jermannaud, International Consultant, Termites & Wood Preservation, HEPEX Consulting, Soulac sur Mer, France

In France, termite distribution covers more or less half the national territory. *Reticulitermes* is the only genus described, with five species: *santonensis*, *grassei*, *lucifugus*, *banyulensis*, and *corsicus*. The infestation covers primarily urban areas, and it has been proved that the spectacular extension of the geographical distribution in the last 50 years is basically caused by human activities. The law voted by the french Parliament in 1999 has three main objectives: 1) prevent termite distribution to new territories, 2) reduce the infestation in already contaminated areas, and 3) enforce disclosure in real estate transactions. Any occupant or owner of a building will be fined if he does not declare to the authorities the presence of termites in his building. Any demolition waste material suspected to contain termites has to be burned or treated on site if combustion is not feasible. Prior to any real estate transaction, a certificate establishing the situation of the building regarding termites has to be established by an independent expert. The Mayor of any city has the ability to require from any building owner a termite detection done by an expert, and a treatment at his own expense if termites are detected. The first 2 years of application of the law have shown a spectacular increase in the activity of termite detection experts and termite control operators. A new decree in preparation will modify the construction codes in infested areas.

Properties of Wood Treated With Organic Preservatives

Alan F. Preston, Vice President, Technology, and *Futong Cui*, *Andrew Zahora*, *Lehong Jin*, and *Paul Walcheski*, Senior Research Scientists, Chemical Specialties, Inc., Charlotte, North Carolina, USA

To address the toxicity concerns of metallic preservatives, the wood preservation industry is developing third-generation preservatives. These preservative systems are highly effective, water-based, synthetic organic preservatives. The preservatives examined in this study are colorless and odorless. The gluing properties, corrosivity, and paint adhesion properties of wood pressure-treated with these organic preservatives are similar to those of untreated wood. When a water repellent is incorporated in the preservative system, the treated wood is non-corrosive to a wide range of fasteners in accelerated corrosion tests.

Bifenthrin - A Termiticidal Treatment for Wood and Wood-Based Composites

Jim Creffield, Forest Products Entomologist, CSIRO Forestry & Forest Products, Melbourne, Victoria, Australia; *Kim Watson*, Global Development Manager, FMC Corporation, Philadelphia, Pennsylvania, USA

Bifenthrin is one of the lesser-known synthetic pyrethroids with unique properties that make it suitable for a wide range of applications in the field of timber preservation. In this presentation we detail a series of laboratory and aboveground field trials that demonstrate the effectiveness of bifenthrin when impregnated into solid wood and when applied to either the veneers or adhesive of plywood. Laboratory bioassays conducted on solid *Pinus radiata* revealed protection threshold values of between 10 and 20 g/m^3 of bifenthrin for the voracious subterranean termite *Mastotermes darwiniensis* and less than 2.5 g/m^3 of bifenthrin for the most economically important Australian species, *Coptotermes acinaciformis*. Data from subsequent field trials support these results. In a further laboratory trial, green veneers of *P. radiata* were dipped into emulsions of varying concentrations of bifenthrin, dried, and formed into plywood panels. Protection threshold values obtained for this material were between 10 and 20 g of bifenthrin per m^3 of plywood and less than 10 g of bifenthrin per m^3 of plywood for *M. darwiniensis* and *C. acinaciformis*, respectively. When added to the adhesive of phenolic-bonded *P. radiata* plywood, bifenthrin was relatively stable demonstrating good efficacy against both species of termite. Field trials on particleboard, bonded with urea-formaldehyde adhesive containing bifenthrin, have been instigated. Given that it is relatively stable when exposed to extremes of temperature and pH, is non-corrosive and that it binds strongly to cellulosic materials, bifenthrin appears to offer the potential for long-term protection of wood and wood products.

Treated Parallel Strand Lumber in Marine Tests

Paul Merrick, Manager, Preservation Technology, Trus Joist, A Weyerhaeuser Business, Plymouth, Minnesota, USA; *Barry Goodell*, Professor, Dept. of Forest Management, University of Maine, Orono, Maine, USA; *Jeffrey J. Morrell*, Professor, Dept. of Wood Science & Engineering, Oregon State University, Corvallis, Oregon, USA

Test arrays of parallel strand lumber (PSL) manufactured from southern yellow pine and Douglas-fir veneer have been exposed at three marine exposure sites in North America for 5 years. At two sites only, CCA and ACZA treated specimens were placed in test. At the Florida site, the two waterborne treatments were supplemented with creosote/waterborne duel treatment. Specimens treated at, or above the AWPA recommended retention levels are performing well when visually graded using AWPA Standard E5. Specimens treated below the recommended minimum retentions are experiencing attack relative to activity at the sites. Some ACZA treated specimens are exhibiting a lower level of performance than CCA specimens treated to a similar retention. Overall, the data demonstrate that parallel strand lumber treated in accordance with AWPA Standards can be used in place of traditional solid sawn and round wood products in marine applications.

Enhanced Efficacy From the Combination of Copper and Cu-8: Lab and Field Studies

Tor P. Schultz and *Darrel D. Nicholas*, Professors, Mississippi Forest Products Laboratory, Mississippi State University, Starkville, Mississippi, USA

We have examined a number of biocide mixtures to identify combinations, which are synergistic, using the agar plate test as an initial screen. The combination of Cu(II) and Cu-8 (copper-8-quinolinolate, oxine copper) was found to be highly synergistic. Further agar plate tests with various decay and stain/mold fungi continued to show high synergism. Synergism was also observed with soil- and agar-block decay tests. Outdoor sapstain/mold tests were conducted using southern yellow pine (SYP) sapwood separately dipped in water-soluble Cu-8 (PQ-56) and/or CU(II) sulfate. However, no synergism was observed. We believe this was due to the Cu(II) complexing with the sulfonic acid used to formulate water-soluble Cu-8. Outdoor ground-contact tests were conducted at two locations using SYP sapwood pressure-treated with an oil-soluble Cu-8 (Nytek 10) and/or ammoniacal copper carbonate (ACC). After 3 years of field exposure, wood treated with the combination of 0.75% ACC (about 0.28 pcf CuO) and at least 0.08% Cu-8 (about 0.02 pcf) had decay and termite ratings at or above 9.0 (out of 10) at both locations. Conversely, wood treated with only 1.0% ACC, or 0.30% Cu-8 alone, was inadequately protected against decay fungi and termites at both sites. We believe that the addition of Cu(II) to Cu-8 causes the di-ligand [bis(8-hydroxyquinolinato)Cu(II)] to equilibrate to the mono form. The mono form is more hydrophilic than the bis compound and, consequently, we hypothesize that it has greater fungicidal and insecticidal activity. Thus, the combination of Cu(II) and Cu-8 may result in a “new” compound with greater efficacy than the two starting “reagents,” as opposed to this mixture being literally synergistic. The mono form may also be easier to formulate than the bis-ligand.

Making Refractory Wood Species Treatable by Fungal Pre-treatment

Kurt Messner, Professor and Director, LIGNOCELL Wood-Biotechnology GmbH, Vienna, Austria; *Alan Bruce*, Associate Professor, TRI-PERM Processes Ltd., Dundee, United Kingdom; *Edward Tucker*, Ph.D. Student, Scottish Institute of Wood Technology, School of Science & Engineering, University of Abertay Dundee, Dundee, United Kingdom

Many wood species including Douglas-fir, Norway spruce, Sitka spruce and fir are not fully commercially exploited because it is very difficult to achieve satisfactory penetration of preservative even when using pressure treatment systems. When the timber is seasoned its permeability can be reduced to between 1% to 5% of that of green timber. This is largely due to the aspiration of the pit membranes. A variety of different strategies including oscillating pressure methods, incising, and enzymatic degradation have been adopted with limited efficiencies to overcome this problem. A novel biotechnological method based on the pre-treatment of wood with fungi selected from a wide array of strains improves permeability of refractory wood species considerably. Two types of fungi: Type 1 - either wood colonizing molds like specific strains of *Trichoderma*, or Type 2 - weakly wood degrading fungi, were chosen for permeability enhancement. The pretreatment process includes inoculation of wood having a moisture content above 50% with fungal inoculum containing a nutrient solution and subsequent incubation. When using weakly wood degrading fungi, eradication of the fungi by subsequent heat treatment is needed. After incubation of 3 weeks with *Trichoderma* or of 1 week with Type 2 fungi and subsequent pressure treatment with creosote, full sapwood penetration was achieved. Type 2 fungi also effected heartwood penetration. A patent for EU, USA and Canada is pending for the process.

The Microdistribution of Borate Preservatives in Flake-Based Wood Composites

Glenn M. Larkin, Research Scientist, and *Peter E. Laks*, Professor, School of Forestry & Wood Products, Michigan Tech Univ., Houghton, Michigan, USA; *Matthew P. Nelson*, Principle Scientist, Chemicon, Inc., Pittsburgh, Pennsylvania, USA

Boric acid and its salts are commercially important wood preservatives with both fungicide and insecticide activity. Although it is believed that borate ions hydrogen-bond and/or form ester linkages with wood polymer hydroxyl groups, most borates diffuse easily and tend to leach out of the treated wood composites over time. Composite panels are being used in ever-broader applications, such as exterior sheathing and siding, which inherently include exposure to leaching hazards that may affect their durability. At present, zinc borate is the only widely used preservative for in-process treatment of composite panels in North America. There is little or no literature available on the microscopic behavior of borates in wood and wood-based products. The purpose of this work is to determine the microdistribution of borates in flake-based wood composites. Techniques are being developed to directly elucidate the borate ion microdistribution in the composite panel. The metal counter-ion microdistribution is also being determined. Direct measurement of the borate ion microdistribution is important because it is the biologically active component of borate wood preservatives. The methods being developed for these studies will be adaptable to other preservative systems. A primary objective of this research is to probe the relationship between borate microdistribution and preservative performance in composites, especially OSB. Using a borate treated, all pMDI flakeboard model system, the questions being asked are: 1) Where do the borate ion and its metal counter-ion localize in the composite? 2) Do the borate and metal ions remain a single chemical entity during the manufacture and serviceable lifetime of the composite panel? 3) How and where in the composite panel do the borate and metal ions migrate during exposure to leaching? 4) What is the effect of the metal counter-ion on the behavior of the borate ion? Preliminary work shows that zinc borate appears to remain intact during the press cycle and may localize near the glue line. The results of these studies and how they affect panel durability will be presented and discussed.

Low-Dose Active Ingredients for Decay and Insect Protection of Wood and Wood Products

Dave Helmer, Divisional Technical-Commercial Manager, Janssen Pharmaceutica, Plant & Material Protection Division, Titusville, New Jersey, USA

Agricultural pesticide volumes have decreased over the past 10 years in the U.S. due to the increasing use of low-dose active ingredients. These compounds are highly active with greater specificity for the target pests thereby enabling targeted application and employment of integrated pest management techniques. Wood preservative volumes have been increasing in the United States. Oilborne and creosote preservative use has stabilized in the past 5 years, but waterborne wood preservatives continue to increase at the average annual rate of 5.9% per year (1993-1997). Modern fungicides and termiticides are available to help reduce active ingredient output of wood preservatives. Carbamates, quaternary ammonia compounds and triazoles are available for aboveground wood preservative formulation and have effective use rates that are approximately one tenth the active ingredient used in the metal containing systems. Further reductions in use rate volumes are achieved by improved formulation delivery systems and by combining low-dose organic components to achieve interesting synergistic effects. Termite protection is necessary in the U.S. and insecticides are necessary components of low-dose organic preservative systems. The new neo-nicotinoid class of insecticides are candidate termite control preservatives that show activity at levels as low as 2% of the metal containing systems. By combining the various low-dose decay preservatives with the new insecticides, it may be possible to protect wood from insect and decay in aboveground exposure with 100 to 200 g/m^3 total active ingredient compared to the 4000 to 6000 g/m^3 total active ingredient being used today.

Wood Retification: In France, an Industrial Process of Heat Treatment Producing Lumber With Improved Resistance to Decay

Alain J. Jermannaud, International Consultant, Termites & Wood Preservation, HEPEX Consulting, Soulac sur Mer, France; *Laurent Duchez*, Operating Process Manager, New Option Wood, Bordeaux, France; *René Guyonnet*, Professor, Ecole des Mines, Saint Etienne, France

Retification® is a soft pyrolysis process conducted in specific vessels under inert atmosphere at temperatures ranging from 210º to 240ºC. Compared to natural wood, Retified® wood shows better dimensional stability, a reduction in moisture absorption, and improved resistance to decay. After a Retification® treatment, non-durable or non-impregnable wood species can be placed in higher Use Category Numbers, keeping a low environmental impact as the process does not require any preservation chemical. In France, it is currently used for treating the most common and widely available, generally non-durable, wood species, such as Maritime pine and poplar. The industrialization and the upscaling of the process started in 1995. To date, four industrial platforms are in service, with a total nominal capacity of 15,000 cubic meters of wood per year. Trials conducted by CTBA according to European Standards have demonstrated the aptitude of Maritime pine sapwood treated by Retification® to be used in exterior constructions, not in contact with the ground. The main applications of Retified® wood are cladding, trusses, decking, street furniture, soundproofing walls, aboveground wood gates and fences, and garden furniture.

TUESDAY, FEBRUARY 12

SESSION IIIA: DURABLE ENGINEERED WOOD PRODUCTS

Biodegradation Susceptibility of Engineered Wood Products

Peter E. Laks, Professor, School of Forestry & Wood Products, Michigan Tech University, Houghton, Michigan, USA

Wood-based composites (engineered wood products) are ubiquitous in modern residential and light commercial construction. Common products include oriented strandboard (OSB), plywood, laminated veneer lumber (LVL), medium density fiberboard (MDF), thermoplastic/wood fiber composites, plus a host of other materials. The composition of wood-based composites can vary widely, depending on the manufacturer. Composition variables include wood element size, wood species, water repellent type, and adhesive type, content, and distribution. All these factors can affect the biological resistance of the composite. The mold, decay fungus, and termite resistance of common engineered wood products will be described and discussed.

Wood Protection Processes for Engineered Wood Products

Mark J. Manning, Manager, Technical Development, U.S. Borax, Inc., Valencia, California, USA

The production of engineered wood products in North America has grown dramatically over the last decade. Some of this growth has been fueled by the use of these materials in exterior building applications, end uses which traditionally require the commodity to be protected from wood destroying organisms. Whereas plywood can be pressure treated with aqueous based preservative systems, this is not the case with many other wood composites, leading to the development of new treatment processes to impart the requisite protection. The assemblage of wood composite components during manufacture offers various 'in-process' routes for incorporating the preservative system into the engineered wood product. This presentation will review treatment processes for engineered wood products, describing the current status while highlighting the critical factors important for successful incorporation of the preservative system.

Current Developments at CSI on Durable EWPs

Kevin J. Archer, Product Development Manager, Chemical Specialties, Inc., Charlotte, North Carolina, USA

The production of wood-based composite panel products has increased dramatically in recent years, so much so that in 2000 for the first time, OSB production exceeded that of plywood. For this growth to continue, additional uses for composite panel products beyond traditional applications such as flooring and sheathing in residential housing and commercial buildings will need to be developed. Further expansion of wood particle and wood flake based composites into other traditional construction applications are hindered by limitations in the physical and mechanical properties of the manufactured panels. Excessive water absorption leading to thickness swelling is one serious drawback of wood composites, but susceptibility to attack by biological agents such as decay fungi and termites is becoming an increasingly troublesome problem. While chemical preservatives and water repellent and dimensional stabilizing treatments are readily available for solid lumber and plywood, their application to wood-based composites has been limited. In part, this can be attributed to the fact that conventional vacuum pressure processes used with solid wood products do not lend themselves to composites. The development of economically viable value-added treatments and treatment processes for composites has great potential for both industry and consumers alike. This presentation reports on some recent developments at CSI and some of the methods employed to evaluate the efficacy of those treatments under laboratory and field conditions.

An Alternative Technology for the Production of Dimensionally Stable and Decay Resistant Strandboard

George J. Goroyias, Research Wood Scientist and Wood Technologist, Kronospan Ltd., Wrexham, United Kingdom; *Michael D. Hale*, Lecturer, Wood Pathology, School of Agricultural & Forest Sciences, University of Wales, Bangor, Gwynedd, United Kingdom

The exterior use of OSB is restricted because when it is exposed to wet conditions, swelling, loss of internal bond strength (IB), and decay occur. In this study an alternative process of pressing, which results in the production of dimensionally stable and more decay resistant strandboard, was investigated. Boards were pressed at elevated temperatures for prolonged pressing cycles and their physical properties (thickness swelling and water absorption after 2 and 24 hours soak), mechanical properties (IB, MOR, MOE), and decay resistance were assessed. Regression analysis and analysis of variance (ANOVA, $p=0.005$) between pressing time/temperature and each property tested were used for the assessment of the results. The decay resistance of the boards was tested according to a draft European standard (DD ENV 12038: 1996) with a slight modification to the sample size. Boards were tested against *Coniophora puteana*, *Poria placenta*, *Trametes versicolor*, and *Pleurotus ostreatus*. The results of this study showed that the increase of pressing time and temperature resulted in significant reductions in the thickness swelling and water absorption of the boards. The treatment had little effect on board mechanical properties. The resistance to fungal biodegradation was significantly improved at the higher temperature/pressing time combinations tested. The results of this study show that the production of a dimensionally stable and decay resistant OSB is possible without excessive use of preservative chemicals. If adopted, these findings may lead to the development of new wood-based panel products (non-preserved dimensional stable and decay resistant hazard class 3-OSB) which may replace preservative-treated plywood for exterior construction applications.

Integral and Surface Treatments for the Enhanced Durability of Engineered Wood

Alan S. Ross, Vice President and Technical Director, *Raymond L. Bender*, Senior Scientist, Engineered Wood Chemicals, *Brian M. Marks*, Research Scientist, *Linda L. Smith*, Millwork & Engineered Wood Project Manager, and *Karen L. Waszczak*, Senior Technician, Kop-Coat, Inc., Pittsburgh, Pennsylvania, USA

Engineered wood products made from wood-based composites are widely used construction materials. Although these products offer many advantages to architects and builders, one of their perceived shortcomings is a lower level of durability compared to that of other construction materials when exposed to the elements. Strategies for enhancing the durability of engineered wood products include improved building designs, better attention to proper installation and maintenance, and the use of protective treatments to help resist decay, mold, insects, fire, and water damage. Protective treatments can be combined with the wood furnish or adhesive prior to the fabrication of the engineered wood component. These are referred to as integral treatments. Alternatively, some treatments are applied after the engineered wood component is fabricated. These are considered to be surface treatments. This presentation discusses several integral and surface treatments designed to enhance the durability of engineered wood.

Dimensional Stability of OSB Webbed I-Joists: Effect of Water-Proofing Sealers

R.C. Tang, Professor, School of Forestry & Wildlife Sciences, Auburn University, Auburn, Alabama, USA

A number of well-designed and developed engineered wood composite products have been popularly used in light- and medium-frame building construction in recent years in the United States. Wood composite I-joists are one of these well-developed engineered wood composite products was introduced about 32 years ago. The production of wood composite I-joists was 121.0 million linear m (397 million linear ft.) in 1995 and increased 125.4% in 1999 to 272.8 million linear m (895 million linear ft.) and continued growth is expected in the 21st Century. In general, wood composite I-joists are composed of either finger-jointed solid lumber or composite lumber (e.g. LVL) as top and bottom flanges and wood composite panels, such as plywood, waferboard, flakeboard, or oriented strandboard (OSB) as webs. At present, commercially produced I-joists are available in different depths and long lengths, fabricated to meet the load capacities as needed in various building constructions. Furthermore, they are light weight, as compared with identical size solid-sawn lumber, and can be easily handled at the construction site without the need of special handling equipment. It was found in our previous studies on I-joists that bending load capacities of OSB webbed I-joists with finger-jointed solid southern pine lumber flanges were reduced 28% and 52%, respectively, when the environmental conditions were changed from dry (65% RH at 75ºF) to humid (95% RH at 75ºF) and wet (24-hr. water sprinkled) due to the increase in moisture content. It is well-known that wood-based composite products, like solid wood, are hygroscopic and dimensionally unstable when exposed in humid and/or wet environments. Thus, excessive dimensional changes in the web materials and flange materials in the wood composite I-joists, when left at the construction site without waterproof plastic covers during storage or after they have been framed, can be disastrous. Problems associated with in-service deflection of wood composite I-joists in moist/wet environments have been reported by structural engineering consulting firms in recent years. So far, most research work on wood composite I-joists has been focused on the short-term and/or long-term (e.g. creep and duration of load (DOL)) structural performance under dry or humid environments. Information concerning the dimensional stability and durability of wood composite I-joists, as affected by humid/wet environments, is very limited. However, for the improvement of long-term engineering performance and serviceability of wood composite I-joists, such data are necessary. In this study, the dimensional stability of commercially produced 10-in. deep OSB-webbed I-joists, fabricated with solid-sawn southern pine flanges, under humid (i.e. 1-week and 2-week 95% RH exposures at 75ºF) and wet (i.e. 24-hr. and 48-hr. water-sprinkling) environments was examined. In particular, the effect of industrial waterproofing edge and face sealers on the dimensional changes in I-joists and their components was investigated. Test results indicated that application of one layer of waterproofing edge sealer on the ends of sections cut from the full-size I-joists did not effectively reduce the moisture increase in the I-joists, but two layers of edge coatings applied at the ends substantially prevented the penetration of moisture/water into the I-joists when they were 24-hr. and 48-hr. water-sprinkled. However, additional application of the face sealers on the surfaces of flanges and web improved the effectiveness of the waterproofing sealer for the prevention of moisture increase as well as on the swelling in flanges and web. Furthermore, the effect of waterproofing coatings on the depth change in I-joists was observed.

Properties of Laboratory Made Plywood With Fipronil® Insecticide Added in the Resin Formulation

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With increases in the use of wood composites in a wide range of applications, protection against decay fungi and termites represents one of the criteria for material selection. Fipronil®, an insecticide already used to protect agricultural crops and exclusively used in the public health sector, was added in the formulation of phenol-formaldehyde resin during the laboratory manufacture of 5-ply plywood. Three-point static bending and shear tests were conducted. MOE ranged from 1.1 to 1.2 million psi (7.71 to 8.54 GPa) and MOR from 8000 to 9099 psi (55.2 to 62.7MPa). Shear strength and wood failure varied from 198 to 249 psi (1.36 to 1.71 MPa) and 73% to 92%, respectively. Analyses of variance showed that the addition of 37.5 to 375 ppm of fipronil® did not significantly affect the shear or the bending strength at the 5% level. After 24-month exposure above and ground contact in Gainesville, Florida, 150 to 250 ppm fipronil® loading was sufficient to control termite activity on plywood samples.

Fungal Resistance of Wood Fiber/Thermoplastic Composites

Steven A. Verhey, Ph.D. Candidate and Instructor, and *Peter E. Laks*, Professor, School of Forestry & Wood Products, Michigan Tech University, Houghton, Michigan, USA

Although wood fiber/thermoplastic composites are marketed as highly decay-resistant alternatives to treated wood, evidence in the scientific literature suggests that decay fungi can successfully attack these materials. Our investigation into the durability of wood fiber/thermoplastic composites has dealt with compression molded composites that were produced from maple or ponderosa pine particles and polypropylene. Laboratory decay tests with *Gloeophyllum trabeum* and *Trametes versicolor* have shown that increases in decay susceptibility (weight loss) coincide with increases in wood loading and particle size. Zinc borate (ZB) was found to be an effective preservative at loadings as low as 1% in composites that contained 50% wood. The results of a one-year, ground contact field exposure experiment suggested that moisture absorption and thickness swell were primarily responsible for strength loss, but that fungal decay may also have had an effect. A subsequent laboratory experiment that considered the strength reducing effects of moisture absorption and thickness swell found strength and weight loss differences between decay and sterile control samples. The incorporation of ZB (3% in 60% wood composites) prevented weight and strength loss from the decay samples.

SESSION IIIB: ENVIRONMENTAL ISSUES

What's Ahead on Regulation of Wood Preservatives?

Mel H. Pine, Director of Communications & State Government Relations, American Wood Preservers Institute, Fairfax, Virginia, USA

With the U.S. Environmental Protection Agency (EPA) on an announced course to complete by 2003 its regular reassessment of the use of chromated copper arsenate (CCA) as a wood preservative, a number of factors came together in 2001 to publicize and speed up parts of the process. One factor was a flurry of media attention to the migration of arsenic from CCA-treated wood in playsets, which led to the closing of some playgrounds. Florida was the hub for much of this activity, and Senator Bill Nelson (D-FL) led the successful push for a "sense of the Congress" resolution calling for a report by February 15, 2002, on the safety of CCA-treated wood in playsets. In the meantime, the Consumer Product Safety Commission, in response to a petition, also began a review of the safety of CCA-treated wood in playsets. A Science Advisory Panel convened by the EPA called attention to the need for more data, but the federal agencies have been under pressure to act. Whatever the outcome, the wood preservation industry will continue to meet the need for wood that can be used outdoors safely and with confidence.

Minimizing Health and Environmental Impacts of Treated Wood Through Best Management Practices at the Treating Plant

Henry Walthert, Executive Director, Canadian Institute of Treated Wood, Ottawa, Ontario, Canada

In 1994, the Canadian government declared several substances toxic as defined by the Canadian Environmental Protection Act. Included among those substances were several used by the wood preservation industry in Canada. These were inorganic arsenic compounds, chromium VI, polycyclic aromatic hydrocarbons, dioxins, furans, and hexachlorobenzene. The Act required that some of these substances be scheduled for virtual elimination while others were to be managed to minimize releases into the environment and to protect human health. Environment Canada introduced a series of multi-stakeholder consultations called Strategic Options Processes. In some cases these were convened on a substance basis, in the case of wood preservation and some others there were addressed on an industry sector basis. Several stakeholders from various constituencies were represented at the "Issue Table" for the Strategic Options Process for the Wood Preservation Industry. The federal government was represented by personnel from Environment Canada, Health Canada, the Pest Management Regulatory Agency, Industry Canada, and Natural Resources Canada. Industry was represented by the Canadian Institute of Treated Wood, wood preservative suppliers, and treaters. Users were represented by the Canadian Electricity Association, the major railroads, and Bell Canada. The environmental groups were represented by Great Lakes United and the Sierra Club of Canada. The entire life cycle of treated wood products was reviewed by a number of working groups. Information was gathered and consultants contracted to provide an overview of how the wood preservation industry might better manage our products. In July 1999, a report entitled the Strategic Options Report for the Wood Preservation Industry was published by Environment Canada. A series of recommendations was included for all segments of the life cycle of treated wood products. Those recommendations are now being implemented through two steering committees: the Manufacturer/Treaters Steering Committee and the Industrial Users Steering Committee. Key to the management of these substances at the treating plant level is the implementation of the "Recommendations for the Design and Operation of Wood Preservation Facilities" (TRD's) developed with the assistance of industry experts and published by Environment Canada in March 1999. The industry has introduced with the assistance of the federal government, a voluntary program of implementation that has been subscribed to by all of treaters in Canada.

Minimizing CCA Preservative Emissions by Post Treatment Conditioning and Fixation

Paul A. Cooper, Associate Professor, Faculty of Forestry, University of Toronto, Toronto, Ontario, Canada

Leaching and dislodging of chromated copper arsenate (CCA) components, especially hexavalent chromium, from CCA-treated wood can be minimized by ensuring that all of the chromium is reacted (fixed) before wood is moved from protected storage. It is possible to monitor fixation in several ways, including the chromotropic acid spot test and a boring extraction and analysis method that is easily adapted to plant quality control labs. The fixation process depends on several variables. The fixation rate increases with increasing ambient temperature, ambient humidity, wood density, and decreasing treating solution concentration. It also depends on wood species and location in the tree. For example, dense hardwood species such as oak and maple fix rapidly and other hardwoods such as yellow-poplar and aspen take longer compared to pine; heartwood generally fixes faster than sapwood. There are obvious benefits to controlling the fixation process through higher temperature/high humidity fixation chambers. The implication of releasing incompletely fixed wood is the potential for high leaching and ground water contamination, especially of hexavalent chromium. Copper and arsenic leaching is minimal, even at relatively low levels of chromium fixation. By contrast, dislodging of hexavalent chromium when wood is handled is very low, even when the degree of fixation is relatively low. Arsenic dislodgeability is a greater concern.

Minimizing Preservative Emissions in Amine/Ammonia Preservative-Treated Wood

John N.R. Ruddick, Professor, Dept. of Wood Science, University of British Columbia, Vancouver, British Columbia, Canada

Ammoniacal copper preservatives have been commercialized in North America for more than half a century. With increasing pressure on chromated copper preservatives ammoniacal/amine copper preservatives have been considered the prime alternative. How well do they fix in wood and what factors influence this fixation? Can heating be used to accelerate the fixation? What happens to the ammonia or amine after the fixation has been completed? Do all amine produce similar degrees of fixation? What is the role of co-biocides on the fixation of the copper? These and other questions will be addressed to identify the strategies that may be used to minimize preservative loss from treated wood.

Environmental Impact of Treated Wood in Service

Stan Lebow, Research Wood Scientist, Wood Preservation & Fire Research Work Unit, USDA Forest Service, Forest Products Laboratory, Madison, Wisconsin, USA; *Kenneth M. Brooks*, Senior Scientist, Aquatic Environmental Sciences, Port Townsend, Washington, USA; *John Simonsen*, Associate Professor, Dept. of Wood Science & Engineering, Oregon State University, Corvallis, Oregon, USA

Research is needed to address concerns about the potential environmental impacts of preservative-treated wood used in sensitive environments. This presentation describes recent studies conducted by the Forest Product Laboratory or its collaborators. The leaching and environmental impact of a wetland boardwalk constructed with chromated copper arsenate (CCA), ammoniacal copper zinc arsenate (ACZA), ammoniacal copper quat (ACQ-B), or copper dimethyldithiocarbamate (CDDC) treated wood is under investigation. All four types of treated wood have released detectable amounts of preservative components into the wetland soil and sediments. Levels of preservative components detected in the sediments did not appear to affect either the abundance or diversity of aquatic invertebrates. Bridges treated with CCA, creosote or pentachlorophenol were evaluated to determine if sediments were contaminated and if invertebrate populations were affected. Some samples from sediments below the bridges did contain elevated levels of preservative components. However, these levels did not appear to have any measurable effect on either the diversity or abundance of aquatic invertebrates living in those sediments. In a separate study, soil adjacent to CCA treated stakes that had been in test for 22 years in Mississippi and Wisconsin was analyzed for CCA components. Samples elevated in copper and arsenic were consistently detected within 50 mm laterally and 400 mm directly under the stakes, but were infrequently detected 150 mm laterally from the stakes. Laboratory studies have found that rates of creosote and CCA release are influenced by factors such as preservative retention, amount of water movement around submerged wood, water temperature, and rate of rainfall. Research continues to develop models for these release rates.

Issues With the use and Disposal of CCA-Treated Wood in Florida

Helena Solo-Gabriele, Associate Professor, Dept. of Civil, Architectural & Environmental Engineering, University of Miami, Coral Gables, Florida, USA; *Timothy G. Townsend*, Associate Professor, Dept. of Environmental Engineering Sciences, University of Florida, Gainesville, Florida, USA

Wood treated with chromated copper arsenate (CCA) was identified in 1995 as the cause of elevated arsenic concentrations within wood fuel used for cogeneration within Florida. Since this time a research team from the University of Miami and University of Florida has evaluated the environmental impacts of CCA-treated wood within the State. Research has focused on two distinct areas: 1) in-service leaching of the CCA chemical, and 2) disposal pathways for the discarded product. In-service leaching was evaluated by sampling soils located below CCA-treated decks. Results showed that CCA-treated decks leach chemicals in quantities that will impact soil quality. The average of the soil arsenic concentrations in nearby areas removed from the decks was 1.5 mg/kg. Immediately below the decks, the average soil arsenic concentration was 28.5 mg/kg. Data collected from soil cores indicated that elevated arsenic concentrations below the decks were observed through a depth of 8 inches. Approximately 25,000 acres of Florida land are covered with CCA-treated decks. The top 8 inches of this area corresponds to 60 million tons of soil. A considerable effort has been placed on evaluating the fate of CCA-treated wood upon disposal. The research has shown that the quantities of discarded CCA-treated wood will increase significantly in the future. As of the year 2000, roughly 580 million cubic feet of CCA-treated wood (or 29,000 tons of arsenic associated with CCA) have been sold within Florida. To date, only 7% percent of this quantity has been disposed. A disposal forecast based upon a production statistics and a mass balance model indicate that disposal quantities will increase by a factor of 7 within the next 15 years, and thus problems associated with CCA-treated wood disposal will worsen in the future. Current disposal pathways for CCA-treated wood, and ultimately the arsenic contained within it, include construction and demolition (C&D) landfills, which are generally unlined, or inadvertent mixing within mulch and wood fuel that is produced from recycled C&D wood. Samples collected from 12 C&D facilities located in Florida indicate that on average CCA-treated wood represents roughly 6% of the recycled wood by weight. Research has shown that the CCA chemical is capable of leaching from CCA-treated wood (both in the unburned form and as ash) in quantities that exceed toxicity characteristic limits established by the U.S. Environmental Protection Agency, thereby suggesting that this waste stream should be handled as a hazardous waste. The toxicity characteristic limit is exceeded in ash if CCA-treated wood represents at least 5% of the wood mixture. Leaching from unburned wood was found to be a function of particle size, with smaller particle sizes leaching more chemical. Commercial mulch purchased at retail establishments in Florida also leached arsenic at levels that exceeded the State's Groundwater Guidance Concentrations. The presence of leachable arsenic within the mulch was attributed to the presence of CCA-treated wood. Potential solutions to the CCA-disposal problem have been explored including options for waste minimization and disposal-end management of the treated wood. Waste minimization focuses on the use of alternative wood treatment preservatives that do not contain arsenic. Non-arsenical chemicals evaluated include ACQ, CBA, CC, and CDDC. These alternatives have been standardized by the wood treatment industry to be as effective as CCA for certain applications. Options for disposal-end management explored through this study include sorting technologies to separate CCA-treated wood from other wood types. Sorting technologies explored included the use of a chemical stain and two systems based upon the use of lasers or x-rays. Chemical stains were found to be effective for sorting small quantities of CCA-treated wood. Both the laser and x-ray systems were shown to be very promising technologies for sorting large quantities of wood in a more automated fashion.

The Point of View of Metallurgy to Recycling of Impregnated Timber

Leo Lindroos, Process Engineer, Outokumpu Harjavalta Metals Oy, Pori, Finland

It is clear that this question can be solved in many ways and that we can come to a different solution. An important principle here is that no new storable wastes are born. My principal suggestion for the solution is as follows: Timber is combusted completely. Ash is made use of, for instance, in a copper smelter. At first, arsenic-containing gas is cooled to temperature of 200 to 300ºC. Next, arsenic in gases is nearly completely absorbed in condensate water at low temperatures. The gas is warmed up and the rest of arsenic trioxide is removed with a textile filter or the gas is not warmed up and special filters are used. I can see two main alternatives in making use of arsenic-containing water. 1) Arsenic is precipitated with copper into copper arsenate and the precipitate can be used in manufacturing of CCA. 2) A working solution for treatment plants would be manufactured from the condensate. The condensate would be processed and copper and chromic acid added into the processed condensate. Impregnated wood could be combusted so that all arsenic is mixed with ash and flue dust. In that case, it is difficult to find a treatment plant for such material. Stabilizing and storing of that material is also very difficult.

Options for Recycling Treated Wood in Composites

D. Pascal Kamdem, Associate Professor, Dept. of Forestry, Michigan State University, East Lansing, Michigan, USA

Considerable amounts of preservative-treated wood must be disposed of in the near and distant future. More than 6 million m^3 of CCA, creosote and pentachlorophenol-treated wood are disposed of annually and about 20 million m^3 will be available yearly by 2010. Landfilling and burning alternatives will not be acceptable as disposal methods. Recycling of treated wood into useful composites is the most viable option. Flakeboards, OSB, particleboards, medium density fiberboards, glulam, and thermoplastic composites can be made with preservative-treated wood. Technical problems such as the adhesion and the bonding of preservative-treated wood, sorting of recycled wood products regulatory uncertainties, worker safety, and environmental issues, may limit practical development. Some advantages and disadvantages of composites made of recycled treated wood will be discussed, and some physical and mechanical properties as well.

SESSION IV: NEW PROTECTION TECHNOLOGIES

A Vision for the Future

Paul I. Morris, Group Leader, Durability & Protection, Forintek Canada Corporation, Vancouver, British Columbia, Canada

This presentation focuses on the future of the pressure preservative treatment industry in North America, but also considers the potential role of aspects now considered peripheral. It puts forward the premise that the wood preservation industry risks extinction if it does not evolve. The driving forces for evolution are reviewed and the internal constraints are discussed. A number of alternative strategies are considered and some opportunities are outlined. The merits of specific technologies will not be argued. It is suggested this industry rethink itself as a Wood Improvement industry, relying on diversification to ensure adaptability to an unpredictable future. Key to the future of the wood preservation industry is engaging the wood industry, which is currently suffering from a "Durability Squeeze."

Heat Treatment Technology in Europe: Scientific Background and Technological State-of-Art

Holger Militz, Professor and Director, Institute of Wood Biology & Technology, Göttingen University, Göttingen, Germany

Recent efforts on thermal treatment of wood led to the development of several processes introduced into the European market during the last few years. The total production capacity of heat-treated wood in 2001 is estimated at approximately 200.000 m^3. In this presentation, the different heat processes will be presented. The general technology as well as scientific data on the biological performance and the physical and mechanical properties of the treated wood will be given. Furthermore, the chemical changes at the cellwall level are highlighted.

Vapor Boron Technology

Richard J. Murphy, Senior Lecturer, Dept. of Biology, Imperial College of Science, Technology & Medicine, London, United Kingdom

The technical performance of vapor boron treatment (VBT) and the properties of the treated wood and wood-based materials are reviewed. The technology has attributes that are of particular benefit in the treatment of wood-based composites. It is also capable of delivering shell and even deeper treatment penetrations in solid wood products and can be applied to non-wood ligno-cellulosic materials such as reed, straw and bamboo. There is now a substantial body of technical, regulatory and commercial information on vapor boron technology. Full commercial take-up of VBT remains elusive and the reasons of this are discussed with regard to the overall potential for 'niche-market' treatments in the wood protection industry.

The MPP Process - A One-Stage CCA Treatment and Fixation Process

Michael E. Hedley, Project Leader, Wood Performance Enhancement, *Forest Research*, Rotorua, New Zealand

This presentation describes a new process in which treatment and accelerated fixation of chromated copper arsenate (CCA) preservative is achieved in a single treatment process. The Multiple-Phase Pressure (MPP) Process employs hot (~75ºC) CCA solutions and a combination of hydraulic and pneumatic pressure phases. The hydraulic phase effects preservative impregnation into the wood while CCA fixation occurs during the pneumatic phase, after which a final vacuum is drawn. Kickback solutions collected at the end of pneumatic and final vacuum stages are kept separated from the working solution and are processed to reduce organic carbon and/or metallic ion contaminants to levels which allow safe disposal or recycling. Reverse Osmosis (RO) filtration was shown to be an effective procedure for kickback disposal. Fixation achieved with experimental charges has been between 95% and 98% of the maximum possible. Wood moisture content at the time of treatment and treating solution temperature have most effect on the degree of fixation achieved. At a solution temperature of 75ºC, extending the time at pneumatic pressure beyond 60 minutes does not result in any significant increase in preservative fixation. Results from accelerated Fungus Cellar tests and field tests indicate that in relation to Bethell (Full Cell) treatment, the efficacy of CCA is improved by use of the MPP Process. Although the process was developed for treatment of radiata pine, it has also been successfully used for treatment of Scots pine and *Eucalyptus regnans*, but less successful results have been achieved with Sitka spruce.

Zeroing in on BMPs Through Process Modifications

Randall T. Baileys, Technical Services Manager, J.H. Baxter & Company, Eugene, Oregon, USA

Best Management Practices or BMP's have been gaining a significant amount of attention, particularly in the wood preserving industry where concerns have been raised about any potential effects to the environment associated with chemical losses from treated wood. These chemicals can impact a variety of organisms, but the most critical of these are found in aquatic environments. The risks of aquatic effects from treated wood use were the major impetus for developing BMP's for wood treating. The Western Wood Preservers Institute (WWPI) and Canadian Institute of Treated Wood (CITW) began development of BMP Guidelines for Use of Treated Wood in Aquatic Environments in 1987. These guidelines were developed to ensure adequate fixation of waterborne preservatives, to minimize surface deposits on the finished product and to reduce the potential for over-treatment. These guidelines have allowed continued use of preserved wood products where predictive models demonstrate no negative environmental effects. In addition, BMP's are now being developed for individual states, utilities, ports and harbors with material specifications referencing and including these BMP's as requirements for restoration or new construction involving treated wood products. This presentation will discuss some of the modifications being made with plant equipment and during the conditioning, treating, material handling, and storage of material by treating plants to ensure compliance with BMP's. Treated wood suppliers willing to set their sights and remain focused on these improvements in production procedures may hit the target in more ways than one in the ever-changing treated wood market.

Innovations in Protection Chemistry: New Approaches to Prevent Wood Decay

Tor P. Schultz and *Darrel D. Nicholas*, Professors, Mississippi Forest Products Laboratory, and *William P. Henry*, Associate Professor, Dept. of Chemistry, Mississippi State University, Starkville, Mississippi, USA

The principal United States wood preservatives are chromated copper arsenate, pentachlorophenol and creosote. However, public perceptions about their toxicity to humans and other non-target organisms, leaching into the environment, and questions on the disposal of lumber treated with these first-generation biocides will undoubtedly limit their future use. Second-generation biocides based on copper:organic mixtures are available; however, the long-term use of these biocides may be limited due to concerns with copper. Consequently, it will be necessary to develop third-generation non-metallic biocide systems based on relatively expensive organic compounds. Several organic biocides are available, but most do not have the broad spectrum activity of current wood preservatives and thus biocide combinations will be necessary to ensure that the wood is protected against a wide variety of organisms. Non-biocidal additives such as water repellents, antioxidants and metal chelators can be co-added to enhance the biocides efficacy. Since these additives and biocides are synergistic, reduced levels of the relatively expensive biocide(s) will be required. These biocides/additives will likely require the challenging development of formulations based on oil-in-water emulsions and must be subjected to extensive, long-term testing to ensure that the wood is adequately protected. These preservative systems also must have minimal environmental impact and be amenable to safe and inexpensive disposal. In addition, since composites are being increasingly used, especially in residential construction, improved preservative systems, which do not adversely impact the composite properties, will need to be developed.

WEDNESDAY, FEBRUARY 13

SESSION V: WHOLE-HOUSE PROTECTION AGAINST TERMITES AND DECAY

Comparison of Native Subterranean Termite and Formosan Subterranean Termite Biology, Ecology, and Methods of Control

Gregg Henderson, Professor and Urban Entomologist, School of Forestry, Wildlife & Fisheries, Louisiana State University Agricultural Center, Baton Rouge, Louisiana, USA

Coptotermes formosanus is the most primitive termite species in the family *Rhinotermitidae* that resides in the United States. The biology of this insect makes it more difficult to control and keep from spreading compared to the native subterranean termites (*Genus Reticulitermes*). The primitive features and ecology of this insect are discussed. Alate and neotenic production are profoundly different between the two genera. Aspects of foraging, including protozoans, wood and tree preferences and tunneling behavior are compared and contrasted. Field data suggests the displacement of native subterranean termites by the *Formosan subterranean* termite, but whether their niches truly overlap is questionable.

Transporting Non-Endemic Termite Species in Wood Products Can be Reduced by Understanding Termite Biology

Brian T. Forschler, Associate Professor, Dept. of Entomology, University of Georgia, Athens, Georgia, USA

Subterranean termites are social insects that live in organized groups. Their biology has prepared them to survive catastrophic events such as separation from the main body of their social clique - the colony. Budding is the term used to describe the process of colony foundation through the splitting of termite populations. This aspect of their biology lends itself to dispersal of termites to new habitats. Commercial traffic involving unwitting movement of termite-infested wood products has exacerbated the introduction of subterranean termites into non-endemic areas around the globe. In the United States, spread of the Formosan subterranean termite illustrates the potential role that commerce in wood products play in the distribution of exotic termites. Because termites readily colonize any source of cellulose, under appropriate conditions, even treated-wood railroad crossties are subject to infestation at the end of their useful life. Solutions include development and implementation of protocols aimed at handling, storage, and disposal of wood products from areas known to harbor subterranean termites. This presentation will discuss those aspects of termite biology that pertain to movement of termites to non-endemic regions, examples of the world-wide movement of termites to new habitats, and potential solutions based on exploiting the biological 'weak links.'

The Formosan Subterranean Termites in Florida and an Area-Wide Population Management Program

Nan-Yao Su, Professor of Entomology, Ft. Lauderdale Research & Education Center, Institute of Food & Agricultural Sciences, University of Florida, Ft. Lauderdale, Florida, USA

The FST was first reported in Florida in early 1980s in Hallandale, Broward County. But it was probably introduced there at least 5 to 10 years previously. By 1985, it was found in Orlando and the Pensacola area, and in 1991, well-established infestations were discovered in Tampa, Hillsborough County. In 1996, *C. formosanus* was collected in North Palm Beach of Palm Beach County. Additional infestations have been confirmed in Jensen Beach, Martin County in 1998, Jupiter, Palm Beach County and Crystal River of Citrus County in 1999, and Tallahassee, Leon County in 2000. In urban southeastern Florida where *C. formosanus* was first found, its distribution has expanded to include areas from North Miami Beach, Dade County to Ft. Lauderdale, Broward County. An area-wide population management program was initiated in 2001 in a residential community at the heart of the *C. formosanus* infestation in southeastern Florida. Of the 166 responding to our mail survey 68% indicated that they have and/or still having termite problems. The presence of *C. formosanus* populations in soil and alate catch was spatially analyzed, and the effects of colony elimination on the area-wide *C. formosanus* populations will be assessed.

Effect of Building Design and Construction Techniques on the Colonization of Structures by Subterranean Termites and Fungi

Terry L. Amburgey, Professor, Mississippi Forest Products Laboratory, Mississippi State University, Starkville, Mississippi, USA

The use of treated wood and the application of biocides to soil and/or building components often are used as the primary methods of protecting United States structures from decay fungi and subterranean termites. Little consideration is given to the possibility of minimizing the biodeterioration of structures through appropriate building designs, construction techniques, selection of building materials, and landscaping procedures. Preparing building sites to direct water away from structures on all sides, designing and constructing homes to avoid trapping water within building materials, and landscaping the area surrounding homes to avoid blocking foundation ventilation and trapping water near them will significantly decrease the probability that a structure will be colonized by decay fungi and termites. Prevention of damage to structures by *Coptotermes formosanus* cannot be assured by using any one preventive measure. Rather, in *C. formosanus*-prone regions, several potential preventive techniques must be integrated to comprise an effective system of subterranean termite prevention. Since *C. formosanus* can nest within structures, moisture in building materials may make it unnecessary for these termites to return to the soil, thereby making soil treatments ineffective. Architects and potential homeowners alike must be made aware that, especially in *C. formosanus*-prone regions, structures must be designed to prevent infiltration of moisture into building materials and to assure that rainwater drains away from them.

Enhancing Durability by Building With Treated Wood: Termite Damage and Boron Contents in 12-Year-Old Test Houses in Mississippi

Lonnie H. Williams, President, Rich Mountain Wood Protection Services, Inc., Gulfport, Mississippi, USA; *Terry L. Amburgey*, Professor, Mississippi Forest Products Laboratory, Mississippi State University, Starkville, Mississippi, USA

This study assessed the long-term durability gained from building with boron-treated wood as an alternative to soil termiticide treatments for subterranean termite protection. To do so, 14 test houses, each with 24 square feet of floor space, were built by January 1989 on sites near Gulfport and Starkville, Mississippi. The objectives were to evaluate: 1) the protection from subterranean termites and other insects provided by construction with boron-treated components; and 2) the leaching losses from boron-treated siding with and without additional protection from water repellent treatments. The 14 houses at each site included ten constructed with boron-treated lumber, two with wood treated with an insecticide, and two with untreated wood. Framework and siding materials were processed from southern pine lumber (*Pinus* sp.) treated at a sawmill, then kiln-dried and planed for use. For the 12 houses containing treated wood at each location, supplemental in-place treatments, applied only in 1989 and 1990 to every 5th board of the board and batten siding alternating around the structure, included: none, a fungicide/water repellent, boron/fungicide/ water repellent, boron/glycol/water repellent. For these 12 houses, interior wall coverings were panel sections that were either untreated or boron-treated waferboard and molding with hinges to permit inspection of wall voids. No siding or interior wood was treated on the two control houses of untreated wood at each site. Results are given for the first 6 years of annual inspections for termite damage on the outside of houses as well as inside wall voids and for a final inspection in 2001. Boron contents are given for building frameworks immediately after construction and 12 years later. Increment cores were color tested to show the equilibration of boron in selected stud cross sections. Sampling was done in 1989, 1994, and 2001 of unprotected siding and siding protected by water-repellent coatings only for houses on slab foundations. Results of sampling are presented as initial boron present and percent still remaining after 5 and 12 years. Boron contents also are reported for some boards beneath abandoned termite foraging tubes.

Hawaiian Experience With Treated Building Components

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Both termites and decay are significant problems in the tropical climate of the Hawaiian Islands. The Formosan subterranean termite, *Coptotermes formosanus*, is a severe pest in Hawaii, followed in importance by the drywood termite *Cryptotermes brevis*. Several other important pest termites have also been recently introduced to Hawaii, including *Coptotermes vastator*, a relative of *C. formosanus*. For over two decades, building codes in Hawaii have required use of a soil insecticide treatment or a physical barrier to subterranean termites, and preservative treatment of all structural timbers. "Hawaii Use Only" CCA treatment of Douglas-fir, coupled with soil treatment was the most popular building system for quite a few years. Subsequently, ACZA treatment made small inroads into the Hawaii market. In the past decade, disodium octaborate treatment at 0.42 pcf (Hi-Bor) has become the most commonly used framing treatment. An oil treatment of chlorpyrifos and IPBC (Tribucide) has commonly been used for exposed beams and other decorative timbers. Laboratory and field studies have demonstrated the efficacy of these preservatives when both penetration and an adequate retention are achieved. Although steel framing has taken a large market share in Hawaii, new wood treatments are currently being evaluated, particularly for composite materials. These studies demonstrate that composites require treatment in regions of high termite pressure, and that one cannot assume that inclusion of noncellulosic materials in a product is sufficient to eliminate termite attack.

TECHNICAL FORUM (POSTER) PRESENTATION ABSTRACTS

BOOTH 1

Water-Borne Copper Naphthenate: A Potential New Preservative for Softwoods, Hardwoods, and Composites

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Copper naphthenate is a well known commercially used wood preservative used for the treatment of wood poles, fence posts, lumber, glulam beams, timbers, and wood shakes/shingles. In recent years, researchers have begun to investigate alternative formulations that transform the typically oil-borne preservative into new, environmentally friendly water-borne systems. Included in the research reported here is the 6-year stake test efficacy data comparing water-borne copper naphthenate in Southern Pine (SYP) at multiple exposure sites in the United States with oil-borne copper naphthenate, ACQ and CCA -Type C. This presentation will also compare some other alternate formulations of water-borne copper naphthenate using alternative coupling systems to make the oil-borne preservative water borne in nature. Additional work indicates that water-borne copper naphthenate may be a good biocide candidate for the protection of wood composites. This emerging preservation technology offers a potential new lumber and composite treatment with benefits to treaters and consumers over that of conventional wood preservatives in performance and environmental matters. Future reports will evaluate the performance of water-borne copper naphthenate (i.e., efficacy) in the lesser-studied softwood species of red pine and ponderosa pine and in maple, oak, beech, and yellow-poplar. Specifically in this study, Water-borne copper naphthenate (WB Cu-N) was used to treat southern yellow pine (*Pinus* spp) 19 mm x 19 mm x 400 mm stakes. The treated stakes were exposed in test sites located in Gainesville, Florida, Augusta, Georgia, East Lansing, Michigan, and Aberdeen, Mississippi. CCA, ACQ, and oil-borne copper naphthenate (CuN) were also used to treat some stakes for comparison. Untreated samples were destroyed by decay fungi and termites within 2 years on all sites. After 3 years exposure in Florida, the rating of stakes with 2.0 kg/m^3 copper retention from WB Cu-N is still equivalent to CCA at 5 kg/m^3 retention, ACQ at 6.4 kg/m^3 retention and oil-borne copper naphthenate at 1.6 kg/m^3 copper retention. After 6 years exposure in Mississippi and 5 years in Michigan, 0.76 ± 0.07 kg/m^3 Cu metal from WB Cu-N offered good protection comparable to CCA and ACQ treatments. This study clearly suggests that WB Cu-N can be used as a wood preservative for both above ground and ground contact applications.

BOOTH 2

Louisiana House - Home and Landscape Resource Center

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Building on its environmental, economic development, and consumer education programs, the LSU AgCenter is leading a partnership project to create the Louisiana House - Home and Landscape Resource Center (LaHouse at LSU). It will be a permanent, yet evolving, showcase and hub of educational outreach. The site is several acres near the southeast gateway to the LSU campus, in the shadow of Tiger Stadium. The fully developed site is envisioned to include an exhibit house with a distance education classroom; acres of environmental landscape exhibits with trails; porous "green" parking; an outdoor pavilion; and, in the future second phase, an exhibition hall with changing displays - all with explanatory signage. Each will display a variety of advantageous products, systems, and technologies, not just one way to achieve LaHouse criteria - resource-efficient, durable, healthy, practical and convenient. LaHouse seeks to stimulate change and consumer demand for solutions that address Louisiana's challenges, conditions, and resources. It will combine and balance environmental stewardship with economic benefits and quality of life for the mutual benefit of consumers, industry, and communities - both now and in the future. It will relate to every citizen "where the heart is", their homes. Construction will begin in 2002. As an LSU AgCenter Extension program working with LSU A&M faculty and nationally recognized scientists, LaHouse will uphold the highest standards of credibility and scientific objectivity.

BOOTH 3

The Hollow Veneered Pole: 'Guess Who's Not Coming to Dinner!'

Robert Erickson, Professor Emeritus, and *Rubin Shmulsky*, Assistant Professor, Dept. of Wood & Paper Science, University of Minnesota, St. Paul, Minnesota, USA

The hollow veneered pole (HVP) consists of a wood stave cylinder over-wrapped with high-strength wood veneer. With the use of properly pre-dried material there is no subsequent development of deep seasoning checks to expose untreated wood. Prototype 40-foot long Class-4 HVPs have been made, commercially treated and strength tested. The wall thickness of each pole was 1.75 inches, consisting of the western wood species stave cylinder plus the three concentric layers of 1/6-inch thick Douglas-fir veneer. PRF adhesive was used throughout. Increment core borings yielded 1.4 pounds of penta per cubic foot of veneer and 0.40 pounds of penta per cubic foot of stave material. The heavy and uniform treating of the veneer was attributable to the presence of lathe checks plus fine seasoning checks. Retention variability for the staves was a consequence of the mixture of inherent differences in the permeabilities of the staves. Envisioned is the ability to lastingly protect all of the wood in the critical groundline area. Incising staves on their inner surface would complement the well treated layers of veneer. The HVP is an engineered wood product readily designable to meet long-term performance requirements, not the least of which are resistance to decay and termites. If required, protection against woodpeckers or fire could be provided. This enhanced performance can be realized in the context of using about one-half the amount of wood contained in a comparably sized conventional pole.

BOOTH 4

Soft Rot Decay in Acetylated Wood

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Acetylation of wood with acetic anhydride is known to improve different wood properties; such as dimensional stability, musical tune, light stability (Beckers & Militz, 1994; Rowell et al., 1991; Rowell & Keany, 1991; Yano et al.,1993). Furthermore, research showed an improved resistance of acetylated wood against fungi (Beckers et al., 1994, Takahashi, 1996). In this research, a long-term efficacy of acetylated wood against soil microorganisms was evaluated by microscopy and determination of mass and dynamic MOE loss.

BOOTH 5

Improvement of Dimensional Stability and Fungal Resistance of Wood by Chemical Modification With Methyl Alkenoate Succinic Anhydride (MASA)

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Methyl Alkenoate Succinic Anhydride (MASA), obtained from the reaction of methyl esters of rapeseed oil with maleic anhydride, was used to increase the durability of wood. Scot pine (*Pinus silvestris*) sapwood specimens (68) of dimensions 50 × 25 × 15 (mm) were impregnated with a solution of 30% MASA in methyl ester of rapeseed oil by using partial vacuum (95%) for 15 minutes then atmospheric pressure for 60 minutes. Thermal treatment at 140ºC for 2 hours was used to graft MASA to wood. Twenty-four of the treated specimens were leached for 14 days in water according to EN 84 European standard. Forty-eight specimens (24 leached) were exposed to fungal attack (brown rot: *Coniophora puteana*, *Gloeophyllum trabeum*, *Poria placenta*) for 16 weeks according to EN 113 European standard. The average mass loss was below 3% for all the treated blocs. On the other hand, five of the treated specimens were immerged in water for 72 hours. Water absorption was reduced by 88% compared to untreated samples. Dimensional stability was improved by 23%. Fifteen treated specimens were conditioned in controlled humid atmosphere. Water adsorbed was reduced by 32%.

NOTES

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