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DEPARTMENT OF AGRICULTURE

Forest Service

Commonality of the Chemistries Involved in Moisture, Biological, Ultraviolet, and Thermal Degradations of Wood; Notice of Intent To Enter Into Cooperative Research and Development Agreements

Program Description—Purpose

The USDA, Forest Service, Forest Products Laboratory (FPL) is seeking industrial partners to enter into Cooperative Research and Development Agreements (CRADAs) dedicated to understanding the commonality of the chemistries involved in moisture, biological, ultraviolet, and thermal degradations of wood, and developing basic approaches to protecting wood from degradation without loss of other basic properties, under the authority of the Federal Technology Transfer Act of 1986 (15 U.S.C. 3710a).

An industrial partner may be a Federal Agency, university, private business, nonprofit organization, research or engineering entity, or combination of the above.

A summary of the current status of preventing wood degradation is as follows:

(a) Wood is a three-dimensional, polymeric composite made up primarily of cellulose, hemicelluloses, and lignin. These polymers, along with extractives and inorganics, and the matrix they are in, make up the cell wall and are responsible for the characteristics, properties and performance of wood.

When considering wood as a long term engineering material it must be remembered that wood is a hygroscopic resource that was designed to perform, in nature, in a wet environment and that nature is programmed to recycle wood in a timely way through biological, thermal, aqueous, photochemical, chemical, and mechanical degradations.

There are four basic chemical reactions involved in all the degradation reactions of wood: oxidation, hydrolysis, reduction, and dehydration. Because of the similarities in degradation chemistry, all these degradation reactions will be studied together.

Cell wall polymers and responsible for the properties of wood. Wood changes dimension with changing moisture content because the cell wall polymers contain hydroxyl and other oxygen-containing groups that attract moisture through hydrogen bonding. The hemicelluloses are mainly responsible for moisture sorption, but the accessible cellulose, noncrystalline cellulose, lignin, and surface of crystalline cellulose also play minor parts to major roles. Moisture swells the cell wall and the wood expands until the cell wall is saturated with water (fiber saturation point (FSP)). Beyond this saturation point, moisture exists as free water in the void structure and does not contribute to further expansion. The process is reversible and the wood shrinks as it loses moisture below the FSP.

Wood exposed to moisture frequently is not at equilibrium and has wet areas and drier areas. This exacerbates the moisture problem resulting in differential swelling followed by cracking and/or compression set. Over the long term, wood undergoes cyclic swelling and shrinking as moisture levels change resulting in more severe moisture effects than those encountered under steady moisture conditions.

Wood is degraded biologically because organisms recognize the carbohydrate polymers (mainly the hemicelluloses) in the cell wall and have both specific and non-specific chemical and specific enzyme systems capable of hydrolyzing these polymers into digestible units. Biodegradation of both the matrix and the high molecular weight cellulose weakens the fiber cell wall. Strength is lost as the matrix and cellulose polymer undergo degradation through oxidation, hydrolysis, and dehydration reactions. As degradation continues, removal of cell wall content results in weight loss.

Wood exposed outdoors undergoes photochemical degradation caused by ultraviolet radiation. This degradation takes place primarily in the lignin component, which is responsible for the

characteristic color changes. The surface becomes richer in cellulose content as the lignin degrades. In comparison to lignin, cellulose is much less susceptible to ultraviolet radiation degradation. After the lignin has been degraded, the poorly bonded carbohydrate-rich fibers erode easily from the surface, which exposes new lignin to further degradative reactions. In time, the "weathering" process causes the surface of the composite to become rough and can account for a significant loss in surface fibers.

Wood burns because the cell wall polymers undergo pyrolysis reactions with increasing temperature to give off volatile, flammable gasses. The hemicelluloses and cellulose polymers are degraded by heat much before the lignin. The lignin and carbohydrate components contribute to char formation, and the charred layer helps insulate the composite from further thermal degradation.

The idea of protecting wood in adverse environments dates back to early human history. Perhaps the earliest reference is in the Old Testament (Genesis 6:14) when God instructed Noah to build an ark of gopher wood (a naturally durable and hard wood) and cover it inside and outside with pitch (for both water repellency and decay protection).

Ancient civilization in Burma, China, Greece, and Italy used various animal, vegetable and mineral oils, tars, pitches or charring to preserve wood. Sometime during the second half of the eighteenth century, the science of wood preservation started with a search for toxic chemicals that could be used to treat wood to stop decay. The time line might include: Mercuric chloride first used in 1705, patented in 1832; copper sulfate first introduced in 1767, patented in 1839; zinc chloride first used in 1815; creosote first used in 1836; copper, chromium and arsenic salts introduced in the early 1900's; and pentachlorophenol first introduced in the 1930's. All of these treatments were based on broad spectra toxicity with little concern for environmental implications.

The earliest references to treating wood for fire retardancy dates back to the first century AD when the Romans used alum and vinegar to protect boats against fire. The science of fire retardancy started in the first half of the

nineteenth century. In 1820 Gay-Lussac used ammonium phosphates and borax as fire retardants. Most of the inorganic fire retardants used today were developed between 1800 and 1870.

Protecting wood from moisture damage also dates back into antiquity. Waxes, oils, resins, paints, and coatings have been used to help exclude moisture since shortly after wood was first used by humans.

Protecting wood from damage caused by weathering also dates from the early use of wood. Stains and coatings have been used to cover wood from the degradation caused both by water and ultraviolet radiation.

The process of protecting wood from one type of degradation can cause another type of degradation to take place. For example, in fire retardant formulations involving free phosphoric acid, treated wood has been shown to lose strength. While the wood is very effectively treated for fire retardancy, service life is shortened by the loss in strength. Similarly, wood decking treated with chromated-copper-arsenate (CCA), while having excellent anti-fungal properties, is being replaced after a few years due to cracking and splitting caused by moisture damage.

Since there are only four basic chemistries involved in the degradation mechanisms of wood (hydrolysis, oxidation, dehydration, and reduction), there are many similarities in the degradation pathways regardless of the source of the degradation. Through a better understanding of these common degradation chemistries, it should be possible to protect wood in a more holistic way. That is, controlling one degradation chemistry can lead to the protection of another degradation mechanism. This leads to the idea of combined treatments to control several degradation pathways.

The Forest Products Laboratory is requesting support for this project. The support is in the form of funding in the amount of \$15,000.00 per year for the two-year proposed duration of the study.

An informational and organizational meeting of the Consortium will be held beginning November 18, 1997, 1:00 P.M. and ending November 19, 1997, at 12:00 Noon, at the USDA, Forest Service, Forest Products Laboratory, One Gifford Pinchot Drive, Madison, Wisconsin 53705-2398.

Technical questions may be directed to Roger M. Rowell at the above address, by fax at (608) 231-9262, or by phone at (608) 231-9416.

Questions of a business or legal nature may be directed to John G. Bachhuber at the above address, by fax at (608)

231-9585, or by phone at (608) 231-9282.

A copy of the proposed Cooperative Research and Development Agreement to be executed by consortium members may be obtained by writing Joanne M. Bosch at the above address, by faxing her at (608) 231-9585, or by phoning her at (608) 231-9205.

Done at Madison, WI, on October 10, 1997.

Thomas E. Hamilton,

Director.

[FR Doc. 97-27649 Filed 10-17-97; 8:45 am]

BILLING CODE 3410-11-M

COMMODITY FUTURES TRADING COMMISSION

Sunshine Act Meeting

"FEDERAL REGISTER" CITATION OF PREVIOUS ANNOUNCEMENT: 62 FR 52325.

PREVIOUSLY ANNOUNCED TIME AND DATE OF MEETING: 10 a.m., Thursday, October 23, 1997.

CHANGES IN THE DATE: The Commodity Futures Trading Commission has cancelled the meeting to discuss program objectives.

CONTACT PERSON FOR MORE INFORMATION: Jean A. Webb, 418-5100.

Jean A. Webb,

Secretary of the Commission.

[FR Doc. 97-27802 Filed 10-16-97; 1:43 pm]

BILLING CODE 6351-01-M

COMMODITY FUTURES TRADING COMMISSION

Sunshine Act Meeting

AGENCY HOLDING THE MEETING: Commodity Futures Trading Commission.

TIME AND DATE: 11:00 a.m., Friday, November 28, 1997.

PLACE: 1155 21st St. N.W., Washington, D.C. 9th Floor Conference Room.

STATUS: Closed.

MATTERS TO BE CONSIDERED: Surveillance Matters.

CONTACT PERSON FOR MORE INFORMATION: Jean A. Webb, 202-418-5100.

Jean A. Webb,

Secretary of the Commission.

[FR Doc. 97-27803 Filed 10-16-97; 1:13 pm]

BILLING CODE 6351-01-M

COMMODITY FUTURES TRADING COMMISSION

Sunshine Act Meeting

AGENCY HOLDING THE MEETING: Commodity Futures Trading Commission.

TIME AND DATE: 11 a.m., Friday, November 21, 1997.

PLACE: 1155 21st St. NW., Washington, DC, 9th Floor Conference Room.

STATUS: Closed.

MATTERS TO BE CONSIDERED: Surveillance Matters.

CONTACT PERSON FOR MORE INFORMATION: Jean A. Webb, 202-418-5100.

Jean A. Webb,

Secretary of the Commission.

[FR Doc. 97-27804 Filed 10-16-97; 1:31 pm]

BILLING CODE 6351-01-M

COMMODITY FUTURES TRADING COMMISSION

Sunshine Act Meeting

AGENCY HOLDING THE MEETING: Commodity Futures Trading Commission.

TIME AND DATE: 11:00 a.m., Friday, November 14, 1997.

PLACE: 1155 21st St. N.W., Washington, D.C. 9th Floor Conference Room.

STATUS: Closed.

MATTERS TO BE CONSIDERED: Surveillance Matters.

CONTACT PERSON FOR MORE INFORMATION: Jean A. Webb, 202-418-5100.

Jean A. Webb,

Secretary of the Commission.

[FR Doc. 97-27805 Filed 10-16-97; 1:45 pm]

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COMMODITY FUTURES TRADING COMMISSION

Sunshine Act Meeting

AGENCY HOLDING THE MEETING: Commodity Futures Trading Commission.

TIME AND DATE: 11:00 a.m., Friday, November 7, 1997.

PLACE: 1155 21st St. N.W., Washington, D.C. 9th Floor Conference Room.

STATUS: Closed.

MATTERS TO BE CONSIDERED: Surveillance Matters.

CONTACT PERSON FOR MORE INFORMATION: Jean A. Webb, 202-418-5100.

Jean A. Webb,

Secretary of the Commission.

[FR Doc. 97-27806 Filed 10-16-97; 1:36 pm]

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