WOOD PRESERVATION: 3000 B.C.--1976 A.D.

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The mummies of ancient Egypt represent mankind's early and successful attempts at preservation. Bodies of people, animals, and birds apparently were dried in kilns, covered with natural water-soluble salts for complete dehydration, rubbed with a mixture of cedar oil, wax, and spices, and coated with molten resin. The Egyptian efforts to preserve wood by daubing with natural oils seem feeble by comparison. Later, the early Greeks chose durable woods as pillars for their temples and practiced construction methods designed to keep wood dry. Pillars were placed on stones, and stones were placed on top of the pillars to shed water. The Romans recognized that timber did not suffer from maggots or decay when well smeared with cedar oil, and they daubed wooden towers with alum so they would not take fire while under seige. But not until wood preservation became a matter of national survival in the 18th century was a serious effort made to find better ways of preserving wood.

By 1700, damage to wooden piles in the earth-filled dikes of Holland became so extensive that inundation of the country threatened. Meanwhile, the Royal Navy of Great Britain, continuously at war with nations on the continent, was faced with a timber shortage aggravated by marine borers and decay. As Boulton eloquently described the situation, "During the colossal struggles of Great Britain with hosts of adversaries, the very existence of the nation appeared to be staked upon her fleets. The great prevalence of dry-rot in timbers of the British men-of-war assumed the proportions of a national scandal."

Albion, writing about this critical period in English history, noted that copper sheathing for ships put an end to the marine borer problems, but that the Navy hit upon no simple remedy for the internal ravages of dry rot that "sometimes pulverized whole fleets and remained unmastered to the end." He also wrote, "The timber problem was prominent among the causes of delay which helped the cause of American independence."

Bethell's patent in 1838 for "Rendering wood, cork and other articles more durable" by impregnating them with creosote under vacuum pressure climaxed the frantic search for solutions to the timber-preservation problem and laid the foundation for our present wood-preserving industry. In 1884, Boulton described a method for drying wood by heating it in creosote under a vacuum to prepare it for impregnation with creosote. The Boulton drying method became, and remains, a rapid way to season poles and piles in the western United States.

The Bethell or full-cell process later was modified to use atmospheric or higher air pressures rather than a vacuum before impregnation of provide better control of the amount of preservative forced into the wood. All poles now are treated by the empty-cell processes, although piles for marine use are treated by the full-cell process.

To facilitate penetration of preservatives into Douglas-fir ties that were predominantly heartwood, a method was tried near Portland, Oregon in about 1920 in which numerous small holes were punched into the wood. By exposing end-grain for longitudinal flow of preservatives, the holes permitted heartwood to be penetrated to depths up to 3/4 inch. The Greenlee inciser, two vertical and two horizontal drums with chisel-like teeth extending about 1 inch, made a staggered incising pattern in sawn timbers and soon became standard equipment at western plants.

Incising equipment was developed in the early 1900's to improve penetration of preservative in the sapwood of cedar poles treated by the hot-cold bath or thermal process. By the late 1950's, Douglas-fir poles were being incised full length to a depth of about 3/4 inch.

As the use of electricity increased throughout the United States, 70 to 125-foot poles were required from the Pacific Northwest. Because the 1 1/2- to 2-inch average depth of sapwood of Pacific Coast Douglas-fir poles left a large central core of untreated heartwood, utility companies in the 1960's required 2 1/2-inch deep incisions or rows of 7/16-inch diameter perforations (Figure 1) to obtain deep preservative treatment of the critical groundline zone of poles. Other utility companies required a kerf to the center of the pole from butt to 5 feet above the groundline (Figure 2). The kerf relieves drying stresses and prevents exposure of untreated heartwood in checks to attack by decay fungi and insects.

To extend the service life of untreated cedar poles and, later, of treated cedar and pine poles, various preservatives and preservative "bandages" were applied at the groundline zone to stop external decay. These treatments were of little or no value for controlling decay beyond a depth of about one inch. Decay pockets in poles were flooded with preservatives, but there is no evidence that such treatments stopped the spread of internal decay.

Not until the middle 1960's, when personnel of Bonneville Power Administration poured agricultural fumigants into holes in the groundline zone of pressure-treated Douglas-fir poles was a breakthrough achieved in control of internal decay.

Subsequent research, still in progress at Oregon State University in cooperation with the Electric Power Research Institute and utility companies, shows that Vapam, Vorlex, and chloropicrin can control internal decay of Douglas-fir poles for at least 7 years (Figure 3). The continued presence of fungitoxic concentrations of the fumigants 8 feet above and below the groundline of these poles indicates that the retreating cycle will approach 10 years. From 1 to 2 pints of fumigant are poured from squeeze bottles into from four to eight plugged holes 3/4 inch in diameter. The holes are downward sloping and made in a spiral pattern from groundline to about 4 feet above groundline. The fumigants vaporize, move as gases through the wood, and kill decay fungi and insects. Fumigants are being applied to a steadily increasing number of poles. Vapam has received a label from the Environmental Protection Agency for use in poles and chloropicrin may receive such a label soon.

Other research has been initiated on the use of fumigants in cedar and pine, which have different decay problems than Douglas-fir but in which we expect fumigants to be equally effective. Fumigants have been applied to decaying laminated beams, and to bulkhead piles to control decay resulting from inadequate protection of the cutoff tops. We also are testing the ability of fumigants to stop or slow attack on wood by marine borers. This is a "long shot," but so was the control of internal decay in poles. A combination of laboratory and field studies is laying a scientific basis for the use of fumigants to control internal decay of wood products in service.

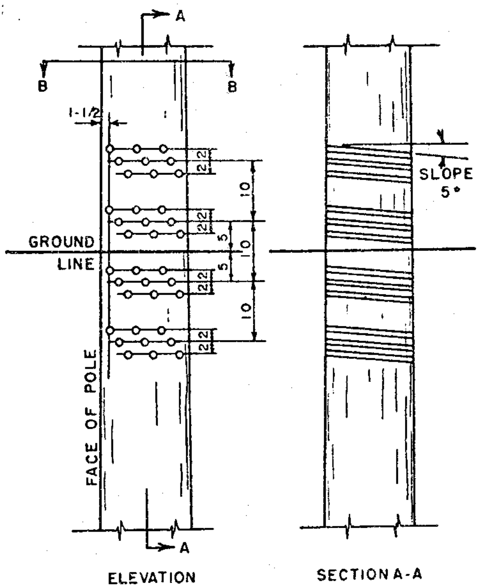

Figure 1. Performations at the groundline of large Pacific coast Douglas-fir poles result in nearly complete preservative treatment of this critical zone with little effect on their load-bearing capacity.

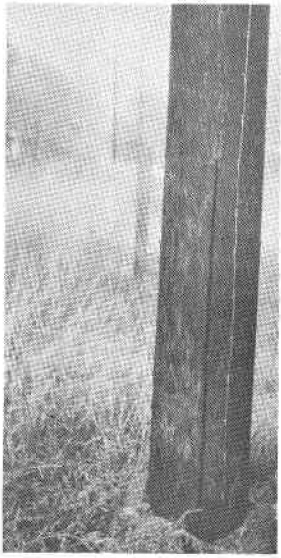

Figure 2. A saw kerf to the center from the butt to 5 feet above the groundline of Douglas-fir poles prevents checking beyond the preservative-treated shell.

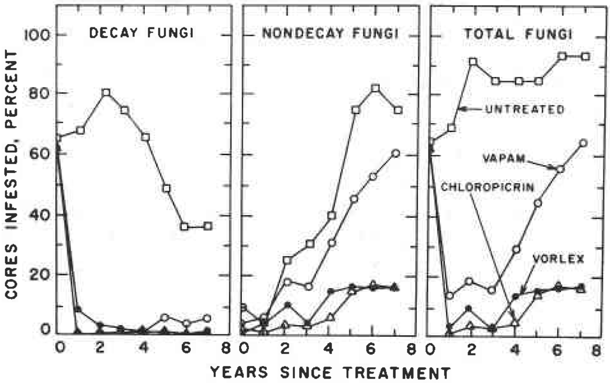

Figure 3. Fumigants placed in Douglas-fir poles with internal decay have controlled the population of decay fungi for 7 years. Through year 5, each point represents 96 cores, 12 from each of 8 poles, removed from 1 foot below to 4 feet above the groundline. Year 6 and 7 values are based on six poles for chloropicrin, seven poles for Vorlex, 14 poles for Vapam and five untreated poles. Missing fumigant-treated poles were inadvertently removed from service.