ENGELMANN SPRUCE AND ITS PRESERVATIVE TREATMENT

FOR TIES AND MINE TIMBERS

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The availability of Engelmann spruce makes it a useful species for railway ties and mine timbers in the western Mountain States. This is in spite of the fact that its strength properties and natural durability are not so favorable as those of many species. A 1944 survey indicated a production for that year of about 20 million lineal feet of mine timbers and a million crossties in Colorado and Wyoming. Such use is the best testimony to the suitability of Engelmann spruce for these purposes.

Ties

Strength properties important in railway ties are bending strength, compressive strength, and hardness. The following tabulation is a composite rating based on these strength properties in Engelmann spruce from Colorado, Montana, and Idaho, and some other western mountain species. Red oak, the most important wood used for crossties, is shown as a basis for comparison.

Species	Rating
Cottonwood, black	45
Fir, commercial white	58
Hemlock, western	64
Oak, red	100
Pine, lodgepole	56
Pine, ponderosa	54
Redcedar, western	52
Spruce, Engelmann	47
Spruce, white and Sitka	57

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[1] Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

Though not a species of high natural durability, Engelmann spruce, when carefully treated with an effective preservative, has a service life of approximately 25 years or more in railway ties (table 1). A survey of western mountain railroads indicated occasional but not excessive breakage of Engelmann spruce ties. Ties should be placed on good ballast and should be protected by tie plates under the rails. With these precautions, treated Engelmann spruce ties give good service.

Mine Timbers

Bending and compressive strength and resistance to decay are also important in mine timbers. Strength, however, is related fully as much to grade and presence of defects as to the species. Tests of Rocky Mountain mine timbers showed that the grade factor often over-shadowed the effect of species, so that little difference in strength was observed between Engelmann spruce and other species.

Mine timbers may be round or sawed. Strength tests show that a round timber has the same bending and compressive strength as a square timber of the same cross-sectional area. Where there is appreciable taper, the diameter of a round timber should be taken at a point one-third of the length from the small end.

Deep season checks may be present in beetle-killed logs. These may substantially reduce the bending strength of a short, deep beam, but they have little effect on the strength of a column or post.

Requirements for decay resistance in mine timbers vary widely with the presence of moisture, ventilation, and permanence of the installation. Untreated Engelmann spruce may be used where long life is not required. Treated Engelmann spruce can be used for more permanent installations. Decay problems in mine timbers are reduced by early removal of the bark and by open piling of timbers to afford as much air seasoning as possible before they are placed in the mine.

Preservative Treatment

Engelmann spruce is a wood of rather low decay resistance and therefore will not give long service as crossties and mine timbers unless treated with wood preservatives. Service records on treated crossties of Engelmann spruce are presented in table 1. These records are limited but show that, in the region in which they have been installed, Engelmann spruce crossties, carefully pressure-treated with creosote or creosote solutions, have an estimated average service life of from 25 to 29 years.

This species is resistant to treatment, especially in the heartwood, and therefore requires properly controlled treating conditions to obtain satisfactory results. Treating temperatures of 190° to 200° F. have been found essential for effective results when impregnating with creosote or creosote solutions. Air seasoning seems preferable to heating in oil or steaming as a means of conditioning prior to treatment, on the basis of the experience thus far in treating Engelmann spruce crossties. Antichecking irons help to reduce objectionable checking during air seasoning. Experiments have also shown that penetration in both the sapwood and heartwood is considerably improved when the timbers are incised.

Since Engelmann spruce is susceptible to checking and collapse if the treating pressure is not kept within a moderate range, the maximum pressure per square inch should generally be under 140 to 150 pounds, and when the full-cell treatment is used, it should not exceed 130 pounds.

Table 1.--Service records on treated Engelmann spruce crossties

Location and date of installation	Railroad	Preservative and treatment	Number in test	Condition of estimated average life
				Years
Missoula, Mont., 1910	No. Pac.	Creosote-coal-tar solution (80-20), 6-3/4 lb./cu.ft.	18	25.4
Kingman, Ariz., 1922	Santa Fe	Zinc chloride 0.5 lb./cu.ft. Petroleum 5 lb./cu.ft.	401	21.8
Kingman, Ariz., 1922	Santa Fe	Zinc chloride 0.5 lb./cu.ft. Creosote-petroleum solution (30-70)	200	18.1
Pinta, Ariz., 1928	Santa Fe	Creosote	878 (hewn)	3 percent removed in 8 years
			1,023 (sawn)	14 percent removed in 8 years
Pinta, Ariz., 1928	Santa Fe	Creosote-petroleum solution (45-55) 8 lb./cu.ft.	906 (hewn)	0.2 percent removed in 8 years
			1,202 (sawn)	4 percent removed in 8 years
Madison, Wis., 1929	C. M. St. P.& Pac.	Zinc chloride 1.07 lb./cu.ft.	75	22
Madison, Wis., 1929	C. M. St. P.& Pac.	Zinc chloride 0.61 lb./cu.ft. Creosote 8.36 lb./cu.ft.	83	29
Madison, Wis., 1929	C. M. St. P.& Pac.	Creosote 6.67 lb./cu.ft.	48	26
Laramie, Wyo., 1927	U. Pac.	Zinc chloride 0.41 lb./cu.ft.	100	16.8