Synopsis

Decay Resistance of Siberian Larch Wood

INTRODUCTION

The heartwood of *Larix sibirica* Ledeb. and *L. gmelinii* Rupr. has a high natural resistance to decay. This has been shown in scientific investigations as well as from archaelogical discoveries and practical observations. The level of breakdown depends on the active microorganisms and the environmental conditions. Under similar conditions of breakdown in soil contact, the larch heartwood is 30–50% less destroyed than the heartwood of Scots pine (*Pinus sylvestris* L.). The level of breakdown is strictly correlated to wood density in all the investigated species.

Natural decay resistance is one of several important properties of the heartwood of the two larch species widely grown in Russia, i.e. Siberian (*L. sibirica*) and Dahurican larch (*L. gmelinii*). The relatively high natural decay resistance and good mechanical properties make this wood useful in many fields of practical application. The use and production of wood impregnated with salts of copper, chromium, arsenic or creosote are sources of pollution and environmental concern. From the environmental point of view, it would be an advantage if at least a part of the wood treated with artificial impregnation, could be substituted by wood with a good natural resistance. The wood of the European larch (*L. decidua* Mill.) also has high natural decay resistance, but both the Siberian and Dahurican larch have higher resistance owing to a higher density of the wood (1, 2). Also the heartwood of Scots pine (*Pinus sylvestris*) has a relatively high level of natural decay resistance, which increases with age. However, the proportion of heartwood in larch is approximately twice as large as that in Scots pine of the same age and from similar growing conditions (3, 4).

HISTORICAL DATA ON LARCH-WOOD DECAY RESISTANCE

The Russian academician Pallas (1741–1811) was one of the first scientists who observed the high natural decay and fungus resistance of larch wood. After his Siberian field tours he drew the following conclusion: "Larch wood does not decay, that is why it is used for dams, bridges, piles, pipes for water transport, mills and barrels" (5).

Contemporary literature provides us with many examples of buildings and handmade or manufactured articles produced in the 17th and 18th centuries. These constructions are still well maintained despite very harsh conditions and frequent use. Some examples include the wooden towers in Jakutsk and Ilimsk built in the 17th and 18th centuries; remains of Mangaseisk Defence establishment from 1601; the dam on the Iset river in Ekaterinburg which has been in use for 240 years, and different buildings in Perm, Solikamsk, Cherdyn, Verkhoturie and other cities.

Archival data show that the bulk of the Russian navy fleet in the 18th and 19th centuries was made of larch wood (4, 6). This larch wood was considered better than oak for this purpose. In Russia, some perfectly preserved larch wood products have been found as well as wooden constructions in the Pazyryk barrows located in the Altai mountains, 180 km from Teletskoe lake. These articles belonged to Scythian tribes who lived there in 1000 B.C. (7).

INVESTIGATIONS OF LARCH-WOOD DECAY RESISTANCE

Investigations of natural larch-wood decay resistance were carried out during the 1960s by scientists from the USSR Academy of Science, The Russian Institute of

Forestry and Wood (8, 9), and the Siberian Technological Institute (10). Telegraph poles were used for this research. These investigations showed that the average life-span of natural larch-wood poles was 19–23 years in the Abakan region, and 24 years in the Krasnoyarsk region (8). The first sign of breakdown was seen after 4 years of use. After 4–15 years of use, 10–20% of the telegraph poles demonstrated some decay. However, after 25 years, almost 50% of poles were still functional. The high heartwood content can explain the very low penetration ability for liquids and gas. As a result of these investigations, conclusions were drawn about where this wood could best be put to use for its decay resistance properties, in different soil types (10).

The conclusions and recommendations were based on investigations of several thousand telegraph poles. Physical and mechanical properties and the breakdown of larch wood were investigated (11). Samples of wood taken from a 230-year-old larch-wood building in Krasnoyarsk city were tested. The results showed that the mechanical strength of this wood was only 15–30% less than the average for fresh larch wood from this region.

Data on the resistance of spruce and larch-wood poles were provided by Gorshin (12). His data show that sprucewood poles functioned for 7–8 years, but larch-wood poles functioned for 14–24 years. According to Lomakin (13) the durability of the larch-wood telegraph poles was 12–20 years.

Data on high decay resistance of larch wood has also been provided by Gorchin and Cherntsov (14) and Varfolomeev (15). Field trials to test the relative decay resistance of larch wood were arranged in 1956 by the Senezhskaja laboratory near Moscow. Wood samples of 15 x 15 x 220 mm, respectively, were placed in soil, with half above and half below the surface. The level of breakdown of these samples was determined every year. This breakdown was evaluated on a scale from 0 to 100. The value 100 characterized a sample with no breakdown. Complete breakdown was 0. The results are presented in Figure 1. Data on the relative decay resistance of larch wood, depending on density, are shown in Figure 2. The difference between the heartwood and sapwood of larch is strictly correlated to the wood density.

INVESTIGATIONS *IN VITRO* OF LARCH-WOOD DECAY RESISTANCE

The decay resistance of natural larch wood was investigated in different laboratories in the former USSR (16–18). Petrenkos' (17) results are the most important. Wood samples, 20 x 20 x 10 mm, were used for the test. The experiments were carried out over a period of 4 months at temperatures of 18–20°C and a relative air humidity of 60–70%. The results of this investigation are shown in Table 1.

The published research results as well as archaeological data and practical observations of existing buildings, lead to the conclusion that the heartwoods of *L. sibirica* and *L. gmelinii* have high decay resistance, and the level of decay resistance is strictly correlated to wood density. At similar wood density, the heartwood of Scots pine and the heartwood of larch may have similar levels of decay resistance. However, at the same age the heartwood density of larch is, on an average, at least 30% more than that of Scots pine. The decay resistance of sapwood is at the same level in Scots pine as in larch.

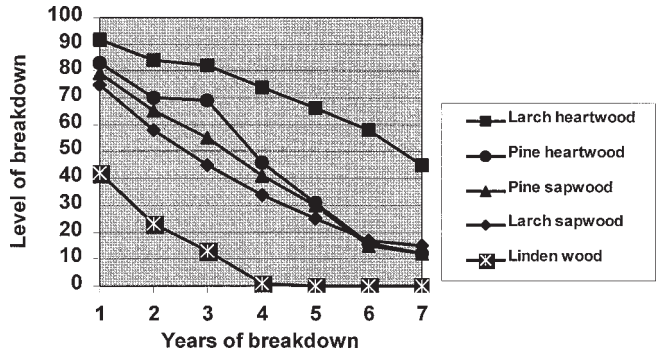

Figure 1. Rate of breakdown of Siberian larch, Scots pine and linden wood in contact with soil (Source: 14).

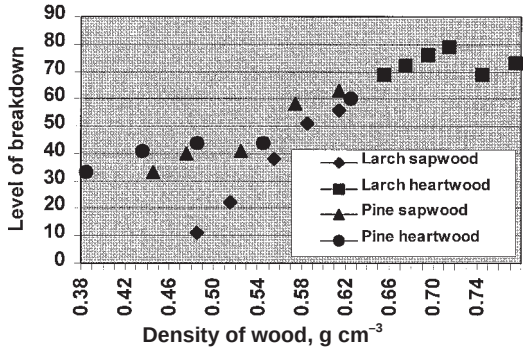

Figure 2. Decay resistance of Siberian larch and Scots pine wood in relation to wood density (Source: 14).

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Professor Oleg I. Polubojarinov
Professor Anatoly N. Chubinsky
St. Petersburg Forest Technical Academy, St. Petersburg, Russia

Associate Professor Owe Martinsson
Swedish University of Agricultural Sciences, SE-901 83 Umeå, Sweden

Table 1. Loss of dry weight of Siberian larch and Scots pine wood after 4 months of breakdown by 2 different fungi in the laboratory (Source 17).

Wood	Species of fungus	Loss of dry weight (%)
Larch, Sapwood	*Coniophora cerebella* Pers.	32.15
	Merulius lacrymans Fr.	14.20
Larch, Heartwood	*Coniophora cerebella* Pers.	23.30
	Merulius lacrymans Fr.	6.00
Pine, Sapwood	*Coniophora cerebella* Pers.	63.80
	Merulius lacrymans Fr.	18.50