DURABILITY OF WOOD

A field study on a traffic noise barrier

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Abstract

At present a rapid-train track is built between downtown Stockholm and the international airport of Arlanda. It is partly passing through densely populated suburbs and therefore noise barriers are built along the track. They are about 3 meters in height and built in sections of 4 meters each and the main part is made of larch */Larix sp/*. These wood species have a high content of heartwood and is therefore expected to have a higher durability than many other commonly used wood species e.g. pine or spruce. However, the applicability of this is disputed and experimental studies are needed for verification.

In order to compare the deterioration of larch with other species nine of the sections have been replaced with other wood materials with and without additional treatment. Four of these use new, arsenic-free, impregnation systems and two use a well established CCA-based system. In the test series untreated pine and spruce as well as the original larch is also included. All materials have been carefully documented, regarding relevant material properties for the wood and the treatment systems. In the paper an overview of the test set-up is given.

The test has been running for approximately three years and no distinct results can or should be seen so far. The deterioration process will be evaluated on the basis of visual inspections as well as microscopical studies. An evaluation based on the environmental conditions is also planned.

The results are expected to give a good base for judging and comparing different treatment systems, and type of wood. Furthermore, to make it possible to model the deterioration process in the view of the modern SLP concept (Service Life Prediction).

Key words: Wood, Durability, Field test, Traffic noise barrier

1 Introduction

At present, a rapid-train track is built between downtown Stockholm and the international airport of Arlanda. It is partly passing through densely populated suburbs and therefore noise barriers are built along the track. They are built in sections of 4 meters each and the main part is made of larch */Larix sp/*. These wood species have a high content of heartwood and are therefore expected to have a higher durability than many other commonly used wood species e.g. pine or spruce. However, the applicability of this is disputed and experimental studies are needed. (Viitanen, 1997).

In order to compare the deterioration of larch with other species, nine of the sections have been replaced with other wood materials, with and without an additional treatment. All materials have been carefully documented regarding, relevant material properties (wood and treatment).

The field test is also an attempt to be a part in a methodological way to predict service life.

2 Principles for service life prediction

A methodological way to predict the service life of building materials and components, is object of standardisation in the ISO draft ”Service Life Planning – Part 2: Service Life Prediction Principles” (ISO, 1998), which is partially based on the RILEM Technical Recommendation ”Systematic Metho-dology for Service Life Prediction of Building Materials and Components”. (Master and Brandt, 1989).

A prediction according to the standard relies on establishing performance-over-time functions that describe how measured values of some chosen performance characteristic of a material are expected to vary over time. With performance-over-time functions established for the range of in-use conditions considered and agreed performance criteria, all essentials elements are known to complete a service life prediction. The methodology includes identification of required information, the selection or development of exposure programs and evaluation methods, exposure and evaluation, interpretation of data, and reporting of results. It employs an iterative approach that permits improved predictions to be made as the base of knowledge grows. (Norén et al, 1998)

The essential steps in a prediction process are shown in Fig 1.

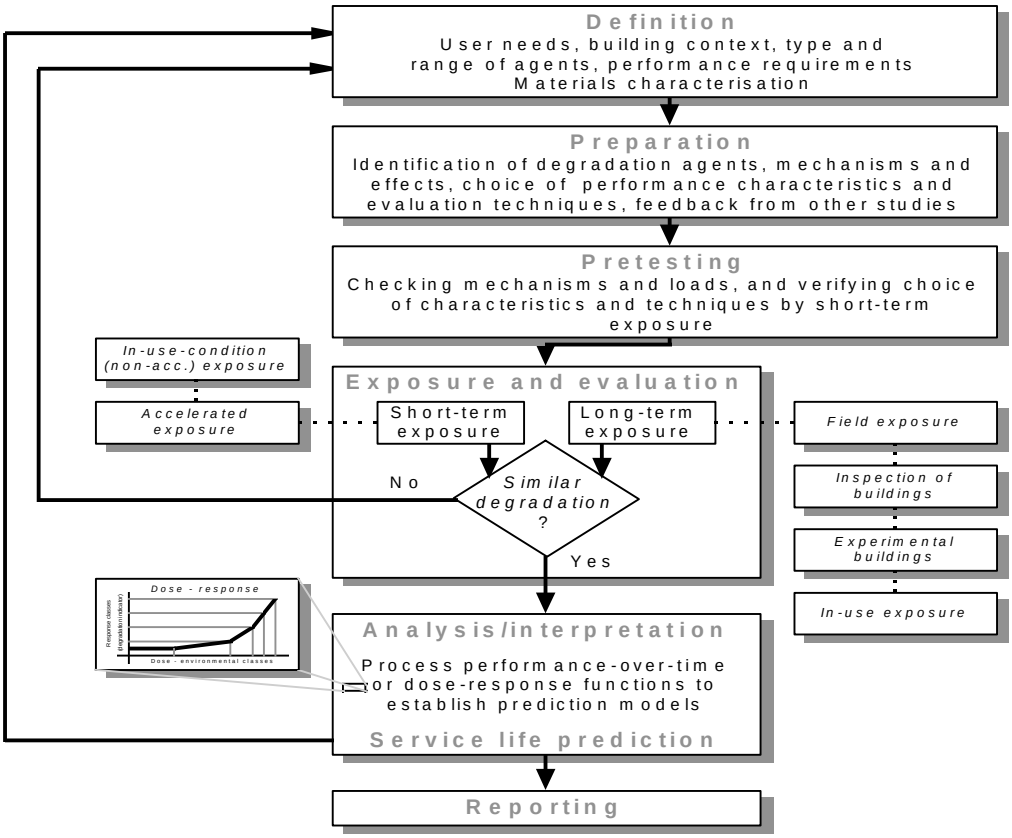

Fig 1: Systematic methodology for Service Life Prediction

3 Description of the noise barrier

The noise barrier is built in sections, each of which has a length of 4 m and a height of about 3 m. The barrier is built with horizontal planks attached by screws to vertical studs. The entire sections are mounted on vertical steel studs with concrete foundations. In order to prevent water from running on and into the structure, horizontal bars with triangular cross section are mounted at a distance of 500-mm. (Paulsen, 1996).

Each section is built in two parts where the lowest part is replaceable. The reason for this is the expected contact with the ground and thus a substantially lower duration compared to the rest of the structure. A sealing strip of EPDM rubber separates the upper and the lower parts. In figure 2, we present a typical cross section of the structure.

Fig. 2: Cross section of the structure

4. Test material

As alternatives to the original larch the following materials are included in the test.

- Pine */pinus sylvestris/* treated with four new products of wood preservatives all in wood preservation class. **NTR/AB*** :
    1. Kemwood ACQ 1900
    2. Kemwood ACQ 1900 with surface treatment
    3. Tanalith MCB
    4. Wolmanit CX-S
    5. Scan IMP
- Pine */pinus sylvestris/* treated with CCA (copper, chromium and arsenic) , wood preservation class. **NTR/A*,** Kemwood K33 C60
- Pine */pinus sylvestris/* treated with CCA (copper, chrome and arsenic) wood preservation class. **NTR/AB*,** Injekta K33 C
- Pine */pinus sylvestris* without additional treatment.
- Spruce */picea abies/* without additional treatment.

The declaration of contents for the products of wood preservatives is shown in Table1.

Table 1: Declaration of content for wood preservatives

Product	Chemical	Content	CAS-number
Kemwood ACQ1900,**AB**	N-alkylbensyldimethylammoniumchloride Tetramincopper	4,8 23	16828-95-8 61789-71-7
Tanalith MCB, **AB**	Tebukonazol Boric acid Copper (II) hydrocxycarbonate	0,5 5,0 22,0	107534-96-3 10043-35-3 12069-69-1
Wolmanit CX-S, **AB**	Copper HDO Copper (II) hydrocxycarbonate Boric acid	6,1 8,1 4,0	---------- 12069-69-1 10043-35-3
Scan Imp KF, **AB**	Propiconazole Cocobenzyldimetylammoniumchloride	5-10 30-60	---------- 61789-71-7
Injekta K33 C, **AB**	Chromiumtrioxide Diarsenicpentoxide Copper (II)oxide	34,0 24,0 14,0	1333-82-0 7778-39-4 1317-39-1
Kemwood K33 C60**, A**	Chromiumtrioxide Diarsenicpentoxide Copper (II)oxide	27,2 19,5 10,6	1333-82-0 7778-39-4 1317-39-1

*Wood preservation Class. **A** and **AB** are 2 of 4 grades in the Swedish standard SS 056110(INSTA 140).

Class. **A:** Full penetration to the heartwood and full retention of preservatives in the sapwood. The field of application is for wood in contact with ground and freshwater and also for wood above ground, which demand extraordinary treatment.

Class **AB:**. Wood used in constructions above ground which mean full penetration to the heartwood and same or less retention as for Class **A**

5 Documentation of the test sections

For all the planks in the ten test sections the following information is documented:

- The content of heart wood
- The width of the annual rings
- The quantity and length of cracks on the end grain
- The moisture content
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All test sections have also been strictly documented by photos.
The content of heartwood and breadth of the annual rings are estimated by visual inspection.

Length and breadth of cracks on the end grain, longer than 5 cm has been documented.

The moisture content is measured in three points, in the middle and at the end grains of the planks, using a protimeter (Gann hydromette HT 85digital).
In laboratory, the retention of additional treatment in the wood is analyzed and the bulk density of the planks has been determined.

Furthermore, 100 screws in the screw union have been weighted, and the average weight, variance and standard deviation are documented.

6 Future measurements and documentation

The test has now been running for approximately three years and no distinct results are given.

The deterioration process will be evaluated based upon visual inspections as well as from microscopical studies.

The visual inspection is divided in two parts:

- Changing in quantity and length of cracks on the end grain.
- The extent of biological degradation

By using microscopical techniques, the type of microorganism attacking the planks can be identified.

The corrosion of screws will be evaluated by measuring the mass loss
Besides measurements and documentation of the test sections, the environment will be documented for an environmental characterization. The data used will be available from a meteorological station close to the noise barrier.

7 Final remarks

The primary aim with the field study is to compare the durability of larch with other sorts of wood e.g. spruce and pine. Secondary is to compare, the efficiency of new arsenic free impregnation systems with well established CCA-systems

Finally is the intention to implicate the study in the service life methodology.

8 References

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