NTR A – better or less good than other materials

A comparison for choosing building materials considering environment and durability

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Today, a product does not only compete by price, aesthetics and technical performance (durability), but by environmental performance as well. Many consumers prefer to make an environmentally sound choice comparing available alternatives, if they have the option.

IVL Swedish Environmental Research Institute has studied and performed lifecycle analyses, LCA, on poles of several different materials to define pros and cons regarding both environmental aspects and service life. Based on this, different alternative materials have been analysed.

The use of chemicals in building products and minimising of risk are often related to choice of materials. Wood preservatives are used to increase the durability of timber enabling utilisation in applications, which would otherwise not be feasible.

A commonly occurring question concerns the environmental difference between domestic treated timber and timber species with higher natural durability, which are transported over long distances. This study was based on fence poles, which are used in ground contact. To enable the use of pine in such locations it is pressure treated to increase the service life. For use in ground contact treated wood has to satisfy the NTR A criteria. As an alternative to pressure treated pine, timber species with higher natural durability can be used, e.g. larch and robinia (sometimes marketed as acacia). The study has compared these timbers and plastic for use in horse rail fences, which is a common product where several materials are used.

MATERIAL

The following materials have been compared and analysed:

- Plastic
- Siberian larch
- Robinia
- NTR A

PLASTIC

Plastic poles are produced from different polymers. In the current study recycled polyethylene (PE) has been chosen as representative for contemporary plastic fences. Alternative plastics are PP, PVC and ABS. The analysis is based on the plastic being produced from 100 percent recycled production waste material, which seems to be the most common source of raw material for plastic poles and which is a raw material with easily guaranteed quality, compared to plastic from effete products.

There is on the other hand no documented information on service life of plastic poles, but manufacturers can provide examples of fences mounted in 1989/90 and which are still in use. A well-known problem, however, is that the rails may bend over time and that they should be turned each year. Another problem occurring with white plastic rail fences is growth, which causes aesthetic problems.

NTR A TREATED TIMBER AND OTHER CLASSES

Pressure treated pine is according to NTR A, not a precise product. It implies, however, that important conditions referring to a NTR A classification are met:

- *Wood preservatives approved considering environment and protection against rot*
- *Adequately managed production*
- *Quality assurance through neutral control*

All wood preservatives are approved by the Swedish Chemicals Agency according to the New EU Biocidal Products Regulation. Today water-based copper agents are commonly used and pressure treated timber is divided into different classes depending on the intended use. In the Nordic countries the classification is regulated by NTR, the Nordic Wood Preservation Council.

NTR class M treated timber is primarily used where there is a risk of marine pest attacks. NTR class A treated timber is intended for use in ground and fresh water contact or in special cases above ground when a significant risk of rotting in combination with a considerable risk of personal safety is present. NTR class AB is intended for timber used in exposed structures above ground, such as timber decks, fences and wind boards. Joinery products for use above ground e.g. windows, doors and garden furniture are treated with NTR class B.

SIBERIAN LARCH

There are approximately 17 different larch species. Larch wood shows different durability properties depending on where it has grown. Test results show that European larch grown in Sweden provides the lowest durability – similar to untreated sapwood of Swedish pine – among the analysed alternatives. The Siberian larch has a slow growing rate and requires up to 250 years until it is fully grown. Siberian larch has also shown better natural resistance compared to European larch, especially if it has grown in Siberia. Siberian larch has therefore been chosen as pole material in the study.

ROBINIA

Robinia pseudoacacia is classified with natural durability 1-2 according to classification of slow grown timber. When cultivating robinia for use as poles the tree is grown until the heartwood has matured. According to a European supplier robinia is mainly provided by Eastern European countries like Bulgaria, Romania, Moldavia, Hungary and France. Test results from Sweden and Norway have shown that robinia can be classified with durability class 2–3.

SERVICE LIFE ACCORDING TO LCA

The results of the study present service life data and a sensitivity analysis. The first comparison of interest is the environmental impact of manufacturing the poles, without considering the service life, but by regarding their residual environmental impact during the life cycle. The lowest requirement concerning the scope of the LCA in an Environmental Product Declaration, EDP, is from "cradle-to-gate". This means an inventory from extraction of raw materials to the finished product clearing the factory gate. Such a declaration is defined as a declared unit, often expressed as environmental impact per kg or m3.

An Environmental Product Declaration can also be developed to cover an entire life cycle "from cradle to grave". This kind of LCA is based on the so-called declared unit and is not used for comparison of products, unless they are based on the same mutual functional unit.

RESULTS

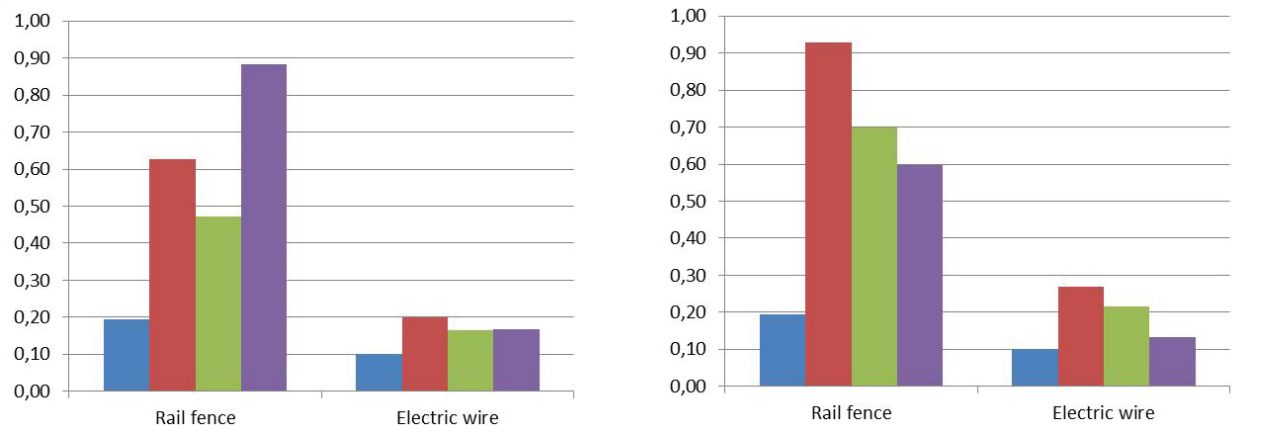
In the results based on the declared unit, differences in service life of the alternatives are not considered. According to the declared unit the climate impact contribution of the two NTR A treated alternatives are low in comparison with the plastic alternative, which shows the highest climate impact contribution of the three alternatives. In the next step the service life prediction was taken into account to facilitate a more accurate comparison and the calculations were based on the functional unit. The service life of electrical wire, which is expected to be replaced regardless of when the poles are replaced, is set to 15 years. A more sophisticated calculation method would be to combine the fixed replacement intervals for fences and electrical wires. This option, however, is considered to result in further errors due to the uncertainties in assumed life expectances and the option is therefore not applied in the study.

The analysis of the climate impact in this study shows that the NTR A alternative is the best both for horse rail fences and for fences. For fence poles larch implies the highest climate impact contribution and plastic and robinia show very similar performance. For horse rail fences NTR A has the lowest climate impact contribution and robinia has the second lowest, followed by larch and plastic as the alternatives with the highest contribution.

The service life of plastic poles is uncertain. The same applies to a certain degree regarding the choice of service life prediction data for larch and robinia. The main scenario for climate impact contribution and the sensitivity analysis result indicate the significance for the comparison, of alternative service life values.

Considering this uncertainty regarding service life prediction data, the NTR class A is the best performing alternative in the comparison. The other alternatives imply further uncertainties and their results rather depend on assumptions about service life. The plastic fence with a service life of 30 years is a comparable alternative to robinia and larch with a life span of 12 years. However, if the robinia service life is restricted to 8 years then plastic becomes the preferred alternative in terms of climate impact contribution. Even for horse rail fences the option of plastic can be considered as superior to robinia and larch when considering an extended service life, but not superior to pine impregnated according to NTR A with copper preservative. See also the graphs below.

Considering different types of fences the following can be generalised based on the results of the study: the more mesh or wire being used, the bigger the effect of the mesh/wire will be on the total environmental impact of the fence, and the impact of the pole choice decreases.



Contributions to climate change, kg CO^2e, during an average life cycle per section and per annum for alternative horse fence materials, where the centre distance between the poles in each section is 2 and 4 m respectively. Data is presented with and without contribution form the electrical wire, enabling the contribution of the wire to be identified. The same amount of material is used with two wires for the horse rail fence and three wires for the fence, regardless of other material choices. The left figure shows the baseline service life scenarios, i.e. NTR A 20 years, plastic 20 years, larch 12 years and robinia 12 years. The right hand figure presents the results from the sensitivity analysis in which the following service life values have been applied: NTR A 20 years, plastic 30 years, larch 8 years and robinia 8 years.

The choice of best performing species is strongly dependent on the nearness and access to the timber source and on durability. The naturally more durable timbers included in the analysis are robinia and Siberian larch. Both these timbers are imported to Sweden, which stresses these options negatively in an environmental comparison, due to big transport distances. In other countries with either naturally durable timbers from domestic production or possibilities to import from adjacent areas these two alternatives would be more competitive.

Another important factor is durability and the lack of empiric data for poles in the field for all alternatives except for NTR A. This becomes especially crucial for the plastic option. If the service life of the plastic alternative is set at 30 years and the naturally durable materials at eight years, plastic poles would become an interesting alternative to the two options above.

When it comes to the durability of timber in ground contact (e.g. based on EN 252), there are currently no methods that allow for generalisation of durability data from various field tests data enabling normalisation. Generalisation would require e.g. corrections for shifting soil conditions, weather and moisture exposure and a natural and physical scale factor between the standard sample and the actual product.

IMPREGNATED TIMBER

95 percent of the production of impregnated timber in the Nordic countries follows NTR standard. According to the Construction Product Regulation construction classified impregnated timber must be CE-marked. In Sweden the manufacturers have introduced a 20 year guarantee for NTR impregnated pine timber in classes NTR A and NTR AB. This warranty guarantees that poles or other products must not be affected by rot to an extent affecting its intended function. Warranty rules are valid for all timber intended for consumer.

In order to rationally assess the technical service life of a pole to be used for a fence or rail fence, a simplification has been made in the report, where a rot index of 75 percent according to EN 252 is regarded to correspond to the technical service life.

The NTR class A treated pine pole and horse rail fences show the best environmental performance regardless the assumed service life values considering the analysed environmental impact categories. The horse rail fences show the greatest difference between competing materials. This comparison applies to the environmental impact categories analysed in accordance with EN 15804. After analysis of all environmental impact categories it can be concluded that the relative differences in contribution do not differ much and show the same pattern as the climate impact of the alternatives included in the study. Thus, the result provides a good representation of all environmental impact categories.

The study has applied and analysed the mandatory environmental categories according to EN 15804, except for the use of resources. i.e. the standard that regulates how an environmental product declaration shall be made for all structural products on the European market according to the Construction Product Directive. At present, we do not know which countries that will implement the requirements regarding reporting and declaration of LCA-performance of products. Even if this will not happen in the nearest future, the environmental classification system for different buildings and structures already comply with EN 15804, and thereby this standard already has impact on how an LCA must be calculated and reported.

For further information, read the entire report *B2102E – LCA for NTR class A timber in ground contact and To be downloaded at www.ivl.se*