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Report

Quantitative environmental Life cycle analysis

Teak – Esthec

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Introduction
A life cycle analysis has been carried out for laying a deck of 1 square meter. This analysis examined the impact on the environment of both a traditional teak deck and an Esthec deck.

In order to compare the environmental impact of both decks, the following starting points were used:

- Both teak decks and Esthec decks have a life of 20 years.
- The thickness of a teak deck is 12 mm, that of an Esthec deck is 6 mm.

Life cycle analysis of Teak
Teak which is suitable for the shipbuilding industry is cut down in Asian countries like Burma and Thailand. These are the only countries that can supply suitable wood, because the climatic conditions here are right for producing high-quality teak. Teak is also grown in plantations, but this wood often contains spider mites and is much less durable, which is why it is not suitable for use in shipbuilding. The lifecycle of high-quality teak for ship decks is described below.

The teak grows very fast in its first 25 years and reaches a length of 40 meters at most. After having reached this height, the tree gets 2-4 mm thicker every year. During the tree's growth process, it extracts CO^2 from the atmosphere and converts it into oxygen and carbon. The carbon is stored inside the growing tree and the oxygen is emitted into the environment. After 80 years, the teak is ready for felling. The trees are felled with a chainsaw and large trunks are then transported to a saw mill by trucks. At the saw mill, the wood is cut into beams. Of the original tree, 40% is left in the form of beams. The remaining 60% (sawing waste with knots, spider mites etc.) is burned or is left behind in the woods. When the waste is burned, the stored carbon together with the oxygen required for burning is released in the form of CO^2. If any sawing waste is left behind in the woods, it can serve as food for new plantings. As we cannot always be certain that new teaks will be planted, this is not included in the analysis.

The 40% of teak is taken to a port by truck, where it is shipped to wherever required.

The sawing process, transport by truck and transport by freighter all produce emissions: petrol combustion, diesel combustion and electricity consumption.

Then the beams are sawn into planks in the specific country. At a shipyard, the planks are processed into a deck. During this process, the wood is also worked (sawing, drilling, sanding). Finally, wood plugs are inserted into the screw holes and all seams are sealed with glue such as Sikaflex. The transport of the teak deck to the end customer was not included in the analysis, as most likely this will not be very different from the transport of the Esthec deck.

The maintenance of the teak deck generally consists of scrubbing the deck and replacing mastic seals and wood plugs. Although the teak deck requires more maintenance than the Esthec deck, only the replacement of seals has a substantial impact on the environment. Algal growth is usually removed from the deck by means of green soap and salt water. As a rule, chemical agents are not used on account of the possible damage to the mastic seals. However, as we cannot be certain about the cleaning products used, this was kept out of the analysis.

Disposal of the teak deck involves removing the deck from the yacht in question. Because mastic seals and glue residues are attached to the wood, the wood is incinerated in a waste incineration plant. In addition to an emission of greenhouse gases due to the carbon in the wood, the sealed joints and glued joints also produce a significant emission during this incineration.

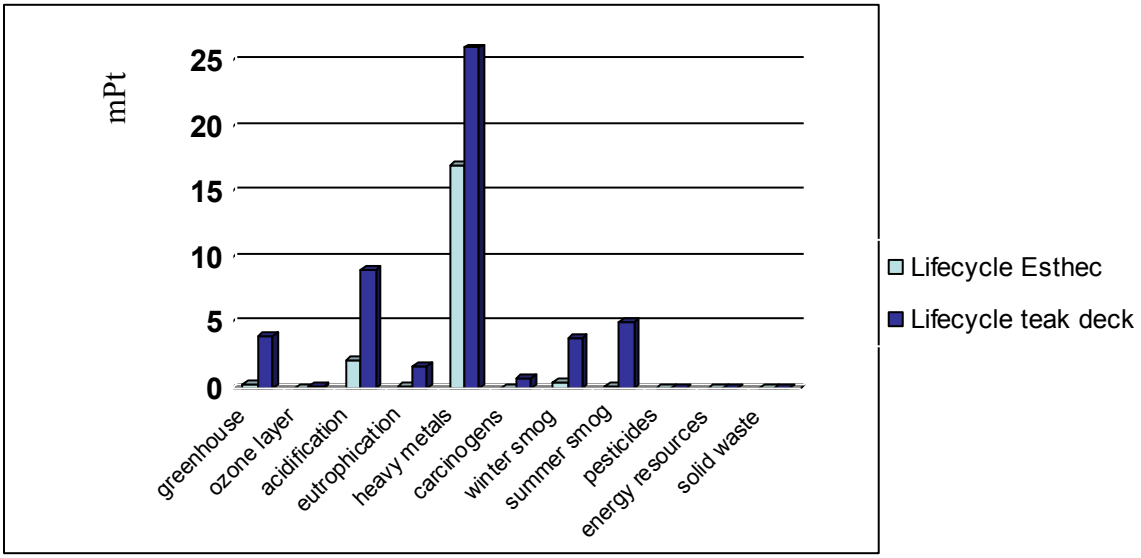
Life cycle analysis of Esthec
The basis of Esthec consists of various raw material and hardeners. These materials are manufactured in Western Europe. All processes carried out to produce the materials for Esthec were included in the analysis. Also the emissions involved in this, are part of the analysis. After production of the materials for Esthec, these are transported by truck to Hendrik-Ido-Ambacht,

where these are mixed with own produced components. Some materials are even composed partly of recycled cutting waste from former decks. Also sanding dust and shreddered waste is being re-used. The decks are tailor-made, by casting them in wooden moulds. After deaeration in a vacuum container, the Esthec compound is poured out onto a pecolit sheet, which is a glass fiber reinforced polyester. This sheet (transported by truck) serves as a base course for the compound and is attached to the deck. After the Esthec deck has hardened, a pattern is molded into it using a CNC machine. After this treatment the pattern is filled with an Esthec pattern filler. Finally, the texture is sanded into the Esthec deck. As with the teak deck, the transport of the deck to the end customer was not included in the analysis.

During use of the Esthec deck, little maintenance is required. It may have to be scrubbed from time to time, but this will take less time and less cleaning products, since there is no algal growth. Nor is it necessary to replace the mastic seals, as with the teak deck. This makes a difference in the emission of the product.

When the deck is due for replacement after 20 years, the top layer of Esthec is sanded from the pecolit sheet. 90% of the top layer will be re-used: the sanding waste is used as well in new Estheck decks. The remaining 10% is incinerated in a waste incineration plant. The pecolit sheet is reused as a base course: the new Esthec compound is poured onto it. Because of this recycling, the emission of greenhouse gases is minimal; only the use of electricity for the various processes produces a small emission.

All facts were fed into the life cycle program Simapro®. The program contains all kinds of data on the impact of operations carried out during the product life cycle (production, use, disposal). The program output is, among other things, a diagram containing a number of emissions.



The diagram shows histograms representing the outputs of both products per effect.
The analysis included 11 effects. Some of the main outputs are explained hereunder.

Greenhouse: there is a marked difference in the “greenhouse” effect. The teak deck contributes greatly to this, since in the case of teak, incineration is involved both during the building process and during the disposal process. Large amounts of CO^2 are released, which contributes to the greenhouse effect.

Acidification: The “acidification” effect is also considerable. This is partly caused by the emission of gases during the felling of the teak. The transport of the teak to the requested port by ship also greatly contributes. The transport of the Esthec materials was included in the analysis. As the distance to be covered is smaller (e.g. Western Europe), the emission of gases is lower and therefore the effect is smaller.

Heavy metals: if we look at the emission of heavy metals, we see that both the emission of the Esthec deck and that of the teak deck are considerable. We see the highest value with the teak deck, which is due to the incineration of the deck after use. This emission is substantial, because wood is incinerated as well as sealant and glue residues and indicates a high emission at disposal.
The emission of heavy metals with Esthec is relatively high, because few chemical components are used. However, this is compensated again, as a result of which the emission is not as high as that of the teak deck. This compensation is achieved by re-using the Esthec deck for the greater part at disposal instead of being incinerated.

Winter smog and summer smog: both are caused by the emissions of machines like chain saws, trucks and sawing and sanding machines. As the number of workings required for a teak deck is far greater than the number of workings required for an Esthec deck, the emission contributing to these two effects is much higher with the teak deck.

Considering the result of the analysis, it should be noted that the difference between the Esthec deck and the teak deck will be even greater in practice, as the analysis assumed an equal life span of the decks (20 years). In general, a teak deck of 12 mm. will not last for 20 years but most

probably maximum 14 years and therefore it will have to be replaced sooner. As a result, the impact of a teak deck will be even 30% greater than the figures shows.

In conclusion and on the basis of this quantitative environmental life cycle analysis, we can say that the environmental impact of an Esthec deck is much smaller than the environmental impact of a teak deck.

In addition to this conclusion, which is mostly about the ecological impact, there are numerous other considerations to be taken into account. For instance, the effects of purchasing teak on the military regime in Burma could be considered. Also social issues like working conditions, child labour and human rights can be of importance in a comparison. Possible consequences for people living in the neighborhood of primeval forests can also be included in a consideration, as well as the loss of primeval forests for the future (deforestation).