



## History and development of the wooden sleeper

### General Information

Over 150 years ago, when iron railways in Europe and the United States were beginning to develop, the material used for contemporary sleepers was wood.

Since then the wooden sleeper has kept, and is regarded, as it was then, as a highly qualitative material in track construction.

Today there are more than 2.5 billion wooden sleepers worldwide which make up the majority of the diverse materials used.



The wooden sleeper is used in the entire field of track construction. Tram and underground tracks, harbour tracks, narrow gauge tracks and track systems at industrial sites belong to this realm.

The wooden sleeper can also be used for fast tracks. However, due to the necessary mass required to stabilise the track system, concrete elements are increasingly utilized for high-speed lines.

### Production

In Europe **beech** and **oak** are employed above all for wooden sleepers. In countries where hardwood trees do not occur **pine** is used as well.

Log wood felled in winter is sorted, cut and stored for at least 6 to 12 months in the open. Crack prevention plates which are attached to the front-side protect the wooden sleeper against the formation of cracks.



After that the surface of the wooden sleeper is treated and holes are pre-drilled for attaching them to the tracks.

In order to guarantee a sufficient durability the wooden sleepers are impregnated at this point. Creosote, which is utilized in this process, meets strict safety requirements and is subject to continuous quality checks.

### Creosote, health damaging?

This wood protector can contain up to 85% polycyclic aromatic hydrocarbons (PAH). In addition, the PAH Benzopyrene contained in creosote can have a carcinogenic effect.

For this reason new regulations for the use of creosote with a strictly limited content of Benzopyrene (max. 50 ppm) were brought into force. Firstly, this regulation was met with the standard WEI type B. This creosote contains less heavy components but many light fractions which are not properly fixed in the wood. Because of this inconvenience, the standard WEI type C was then developed. This creosote is considerably less malodorous and has a lower evaporation rate due to a significantly reduced proportion of volatile components.

The sleepers are impregnated in a large pressure vessel according to the Rüping process, which combines stages of pressure and vacuum. At **Ets Röthlisberger SA**, the main provider of wooden sleepers for the Swiss National Railways (SBB-CFF), the impregnation process is adapted to guarantee an optimal penetration of the solvent-free creosote WEI type C into the wood.

### Energy balance

Energy consumption is more current today than ever. Alongside effective energy costs energy consumption also has an environmental cost.

The energy consumption for manufacturing a wooden sleeper is a quarter lower than that of a concrete sleeper (ca. 4800 KJ to 6300 KJ).

In the recycling process the energy consumption for breaking up concrete sleepers is a lot higher than for the wooden sleepers. Furthermore, recycling of one timber sleeper produces 1000 MJ in the energy capture process. The energy capture for impregnated wooden sleepers is possible and profitable, particularly with combined heat and power generation using the gasification method. This is increasingly used in Scandinavian countries and is regarded as very environmentally friendly.



## Advantages of the wooden sleeper

The big advantage of the wooden sleeper is its **adaptability**. The wooden railway sleeper can be fitted in all types and widths of track. Moreover, it is suitable for heavy loads. It can be used in many different ground conditions and lies well on all standards of ballast (gravel).

The wooden sleeper is successfully used for long tracks, in stations as well as marshalling yards, for tunnels, metal bridges and points systems.



In the case of derailment wooden sleepers don't break despite being struck by metal wheels. If a derailment occurs the track width remains the same and the track system thus remains open to traffic. This is not the case for concrete and metal sleepers; concrete sleepers break and steel sleepers bend.

As time goes by the wooden sleeper entrenches itself into the gravel bed and in this way the resistance to lateral displacement of the track system gets increasingly better.

The wooden sleeper is an **excellent electricity and sound insulator**. The wooden sleeper is recommended for isolated track sections like in tunnels, for, before and after level crossings as well as under points. The wooden sleeper is used in residential areas and on bridges where it absorbs vibrations and therefore also sound emissions. If the wooden sleeper is equipped with absorbent, plastic intermediate plates it meets the highest standards.

If the track's base structure is on difficult terrain the wooden sleeper prevents the track from sinking as it "floats" in the gravel. Movements are thus absorbed in the base structure.

The wooden sleeper is available in different sizes and can be utilized for all rail attachment systems. It is easy to work on even if it's already in the track system. It's easy to handle, needs no complicated assembly equipment and is easy to replace.

## The environment and sleepers

As everybody knows wood is a **native and renewable raw material**. As long as forests are sustainably thinned, the wood comes from necessary clearings. The production of wooden sleepers facilitates a large value creation and makes up an important proportion of forestry turnover.

Regarding the undisputed **climate change** and its grave consequences the use of wood increasingly gains in importance. The reduction of green house gas has become one of the biggest challenges of our time. Wood is not only a CO<sub>2</sub>-neutral raw material but it also stores greenhouse gas. Per kilo of wooden sleeper produced 1.44 kilos of CO<sub>2</sub> are removed from the atmosphere, 1 kilo of O<sub>2</sub> is released into the atmosphere and 18.5 MJ of calorific value (corresponding to 0.4l of fuel oil) is accumulated from solar energy. Therefore forests, and railway sleepers produced from them, are important reducers of greenhouse gas. (Info: <http://www.forst-hamburg.de/oekologischesholz.htm>)

The wooden sleeper also has a suitable weight for transportation and handling, which again has a positive effect on the environment.

## Conclusion

The elasticity of the wooden sleeper protects the upper track and the rolling stock, increases the travelling comfort for passengers, reduces damage in the case of derailment, reduces the dynamic effects on the base structure and minimises noise and vibration.

Due to the modernising of wooden sleeper manufacture and because of great interest in natural and renewable materials, wood remains a modern alternative already with a tradition of more than 150 years in railway construction.

