Fading and Yellowing of Wood by Sunlight

Visible sunlight represents a blend of various light colours that we see separated from one another, for example, in a rainbow. The spectrum goes from violet to blue, green, yellow and orange to red.

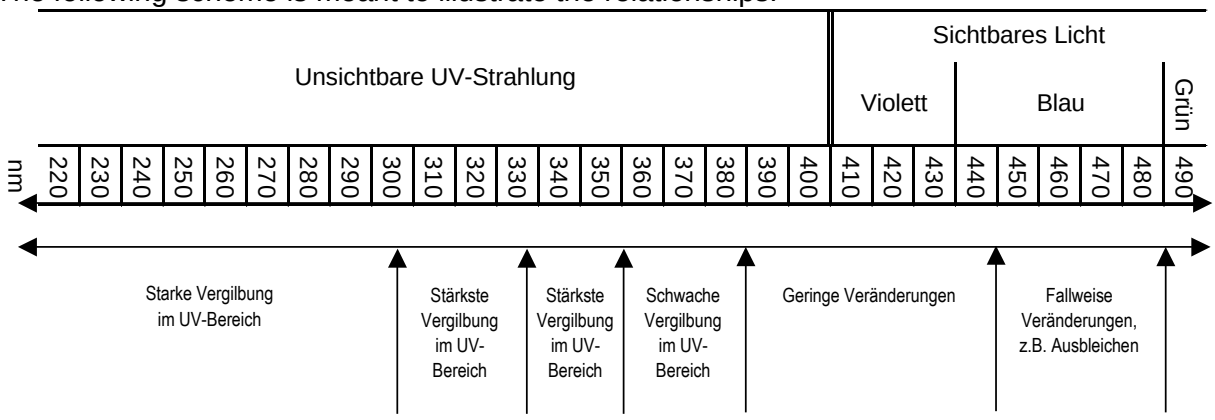
Light consists of electromagnetic waves, whereby the wavelengths of visible light lie between approx. 400 nm and 800 nm (1 nm = 0.000001 mm).

The spectrum includes the invisible UV range below 400 nm up to about 10 nm, and the invisible infrared range of thermal radiation lies above 800.

The shorter the wavelength, the richer in energy is the radiation. Hence, ultraviolet light is richer in energy compared to visible light or infrared light radiation. Thus, it is no wonder that UV radiation not only tans the human skin, but apart from other photo-chemical processes, it also attacks different types of wood and can discolour them.

However, not only invisible UV radiation, but also the visible violet and blue light, that is, the shortwave range of the visible spectrum can lead to discoloration of the wood. Thus, the UV range from 220 nm to 400 nm and the visible range from 400 nm to 480 nm have the greatest impact on the changes to the wood.

The following scheme is meant to illustrate the relationships:



Bleaching occurs as a colour-related change in wood resulting from decomposition of the wood dyestuffs, yellowish (yellowing) or red discoloration as well as darkening is caused by the decomposition of wood extractives and formation of new dyestuffs at the same time.

The range of wavelengths between 220 nm up to almost the boundary of the visible range (380 nm) leads to more or less intense fading. Since normal window glass, too, is permeable to the UV range of 300 nm to 400 nm, changes in the colour of the wood cannot be shielded by window glass. Thus, the colour-related change in wood occurs in residential premises, too.

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Each type of wood has its specific maximum level of absorption, i.e., it gets affected particularly by certain ranges of wavelengths and is changed by these. If you would like to prevent this change, light of these wavelengths must be prevented from impinging on the wood. This can be implemented technically for certain ranges of wavelengths with the help of light preservatives (UV absorbers).

The change of colour in the wood, however, is not triggered only by UV light. Adjacent visible light in the spectrum (VIS) may lead to yellowing or bleaching. In order to protect the wood from these radiation wavelengths, coloured substances with the corresponding complementary colour need to be used; the colour of the wood would get highly distorted as a result.

Various behaviours of wood to the impact of light:

You can classify the various types of wood in the following groups based on their behaviour to the impact of light:

Group A: The wood gets faded only by UV radiation. Protection against light is possible.

Group B: The wood gets faded almost only by visible light. Hence, no protection against light is possible.

Group C: The wood gets faded both by invisible UV light as well as by visible light in the violet-blue range. Protection is possible only for the UV range. The natural yellowing of the wood can be delayed with the help of preservative against light, but it cannot be prevented.

Group D: The wood gets faded by UV light and it also gets bleached by visible light. Under ideal circumstances, the fading and bleaching maintain a balance and the wood shade is maintained. By using coating systems that contain light preservatives, these types of wood take on a bright and unnatural appearance in the course of time as a result of the discoloration.

In general,

	UV/VIS		VIS	
Fading Darkening	⇦	Bright wood	⇨	Darkening Red discoloration
	UV/VIS		VIS	
Yellowing Bleaching	⇦	Dark wood	⇨	Bleaching

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Table of prevalent types of wood and their behaviour to the impact of light:

Type of wood (Wood species)	Yellowing by visible light (without UV light)	Yellowing caused by total radiation (visible and UV light)
Ahorn (Maple)	2	4
Apple	3	4
Balsa	2	4
Pear	3	4
Douglas pine	4	4
Sweet chestnut	2	4
Erle (Alder)	3	4
Oak	2	4
Ash	1	4
Spruce	1	4
Hornbeam	2	4
Pine	2	4
Cherry	2	3
Larch	3	3
Limba	3	3
Lime	3	4
Makassar	1	1
Nut	2	3
Okoume	2	4
Rosewood, East Indian	4	4
Rosewood, Rio	2	3
Ramin	3	3
European beech wood	2	4
Fir	1	4
Elm	3	3
Willow	4 (-)	4 (-)
Wenge	1	1
Zebra wood	3	3

1 No change perceptible

2 Change is barely perceptible

3 Clearly visible change

4 Very clear change

A **successful protection against light** is possible for those types or species of wood listed in the table, for which fading by **visible light** (centre column)
is evaluated as **1** or **2**.

Willow is at the top of the list in the discoloration of all wood types or species listed.

Summary:

Wood reacts differently to the impact of light and shows either yellowing or discoloration. Since not only UV light, but also visible light affects the natural coloration of the wood, you need to reckon with colour changes even in furniture and interior furnishings. With the help of modern preservatives against the impact of light, these colour changes can be diminished and delayed.

Depending on the type or species of wood, light preservatives may provide protection in one case and no protective feature at all in another case or, in fact, even lead to unfavourable effects. Wanting to protect or preserve the wood by increased dosage cannot be implemented since an excess of the preservative may lead to sweating of the preservative or to an unnatural ageing shade of the wood.

It is always the non-coated and raw wood that will change its colour shade under the effect of the light.

Most modern furniture coating systems already contain the optimal quantity of preservatives against light. Please refer to our technical data sheets for the relevant information.
Our staff from the application technology for furniture is at your disposal for technical information and available at +43/5242/6922-301 to attend to you.

Detailed Information:

Appendix 1:
Exposure of furniture surfaces in conservatories and behind large-area glass fronts

Appendix 1 to **"Fading and yellowing of wood by sunlight"**

Exposure of furniture surfaces in conservatories and behind large-area glass fronts

Glass is being used increasingly as a design element in modern architecture. Even in residential constructions, glass fronts and conservatories have become commonplace. Glass is an agent of style in architecture and stands for transparency and brightness.

Glass brings plenty of light into the room. Depending on the glass quality, not only light, but also heat (infrared radiation) and a part of UV radiation can be transported in the region behind it. This is why all items of furniture and furnishing that are located in the light incidence region of a glass element are exposed to more than average stress caused by light and heat. The possible consequences are known: Curtains and carpets get bleached, photos fade and, in fact, plastic parts become discoloured in course of time. The natural material, wood, too, reacts to exposure to light: depending on the wood type or species, there is a slight drift in colour right up to bleaching or yellowing.

Modern coating materials can delay the reaction of the wood: Pigments and light-proof dyestuffs in stains maintain the original colour shade with the customary level of light incidence over a long time period; transparent coating systems are provided with preservatives against light that protect the wood beneath and can delay the onset of natural yellowing. However, similar to a sun cream for the human skin, the preservative against light is only a filter and not an absolute barrier for the light. In case of excessive exposure, the natural reaction of the wood progresses considerably faster – and the wood loses its original colour, gets bleached or becomes yellow.

If coated or varnished wooden furniture is placed in the region of incident light of a large-area glass pane as described above, you inevitably need to reckon with the colour changes as cited above. In order to prevent this, the furniture must be protected against constant incidence of sunlight. Frequently, so-called lamella curtains or vertical Venetian blinds are used as an elegant solution for providing shading. But even pleated jalousies or roller blinds are used as decorative sunshades. Sun blinds, roller blinds or awnings can be mounted outdoors for providing shade.
All measures listed reduce the radiation of light and heat in case of large-area glass surfaces and thus mitigate the harmful consequences mentioned.

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