

Waterborne acrylic varnishes durability on wood surfaces for exterior exposure

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Abstract

The protection performance of varnishes applied to two different wooden substrates (maritime pine and iroko) for outdoor exposure was investigated for eight different varnish systems (with and without colorants and two different light stabilizers). All were subjected to accelerated artificial weathering and natural weathering. Several test methods were used to evaluate the appearance and physical–chemical properties of the coatings during the degradation. The results obtained lead to the selection of the best varnish formulation for the protection of wood for exterior use and provide useful evaluation of the test methods employed.

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1. Introduction

Timber is an organic material used in many construction as well as decorative and aesthetic applications. However, when it is used externally it is exposed to atmospheric agents (mostly solar radiation and rain) that degrade its surface giving it an “stressed” look. In these conditions, changes in the wood’s superficial layer are due mainly to the breakdown of lignin and of other constituents by ultraviolet radiation, and its subsequent removal by the action of rain, associated with the loss of water-soluble products. Extended exposure to atmospheric agents leads to a loss in the timber’s natural colour, the accumulation of dirt and also to the eventual growth of fungi on the wood surface [1,2].

Moreover, the repeated temperature and humidity variations of the ambient air will subject the timber to wet and dry cycles, with the corresponding swelling and retraction creating cracks and fissures. These in turn lead to the exposure of the wood’s subsuperficial layers to atmospheric agents and the progressive degradation of the timber section. Due to these reasons it is important to protect the wood surface with appropriate products, especially, when the timber is exposed outdoor and subjected to prevailing weather conditions [3].

Due to its complex structure, knowledge of the anatomic constitution of this type of substrate is essential so that appropriate techniques for the preparation of wood (drying and eventual preservation) and the correct choice of formulation of the superficial coating are made.

Protected wood relies upon the permeability of the water vapour through the applied products. The use of coatings with UV absorbers (that act as filters) also minimizes the degradation of the wood by ultraviolet radiation [4]. The coatings can also play a role in the resistance to biological agents, if they include added wood preservatives or if a convenient wood preservative is applied before coating. Another requirement of the varnish is its durability. It is therefore necessary that a coating combines properties of tackiness, flexibility, durability, permeability and eventual resistance to fungi. As previously mentioned, the main cause of deterioration of a coating is the atmospheric agents, however, there are more factors that contribute to its premature degradation, such as excessive water content, high humidity during the application of the coating, use of an inadequate system and/or poor application, incompatibility between products, high resin content of the wood, and excessively long intervals between maintenance.

The varnish coating therefore acts as an interface between the material and the environment, which is best evaluated by natural exposure to the environment and/or artificial ageing in the laboratory [5].

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