

Can T_g be used as a service temperature indicator for the selection of a structural adhesive?

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Summary

In order to contribute to the ongoing discussion on the reliability of epoxy (EP) and polyurethane (PUR) adhesives for load bearing structures, a study was conducted at LNEC where several structural adhesives were subjected to several temperature regimes and subsequently assessed, namely to compare their glass transition temperature (T_g) with strength and stiffness decrease with increasing service temperature. The results showed that the PUR and EP adhesives display significantly different viscoelastic responses over the temperature ranges attained normally in service. Thus temperature-induced creep is a risk factor that needs to be considered cautiously when approving novel adhesive types for structural applications. The study of the specific components and formulations of the various adhesives studied, showed that the resultant strength and temperature stability varied greatly. Because of that, careful adhesive selection, considering its glass transition temperature, thermal performance and possibly a post-cure procedure, should be made.

1. Introduction

Adhesives have been used for many years in the wood products industry, and due to the need of a sustainable use of wood in construction their use is still increasing. Apart from the established phenolics, resorcinolics, and aminoplastic adhesives, novel formaldehyde-free adhesive systems, such as EP and PUR adhesives are gaining popularity in special applications (*e.g.* on-site repair or strengthening of timber structures), where the adhesives have to fulfil special requirements, such as, cure at room temperature without significant pressures applied, be tolerant to bond line thickness variations, good gap-filling properties, and strong adhesion to several non-wood materials.

Experimental and modelling work developed by the authors in previous studies [1-4] clearly showed that the service temperature to which the timber structures are exposed dictates the temperature reached at the glue lines placed inside the bonded elements, despite the insulation provided by the timber cover. Because of this, although the service temperature, even in extreme conditions, is unlikely to lead to degradation of the timber structural elements or reinforcing elements, it may limit the performance and durability of bonded structural joints through temperature induced creep if adhesives exhibiting low glass transition temperatures, like the EP and PUR, are used. Although the heating effects on the long-term performance of glued joints are still