

EVALUATION OF TIMBER ADHESION PROMOTION TECHNIQUES FOR SOLID TIMBER SUBSTRATES

J. Custódio¹, H. Cruz¹, J Broughton², A R Hutchinson², P H Winfield²

¹Laboratório Nacional de Engenharia Civil (LNEC), Structures Department, Timber Structures Division. Avenida do Brasil, 101, 1700-066 Lisboa, Portugal

²Joining Technology Research Centre, Oxford Brookes University, Wheatley Campus, Oxford OX33 1HX, United Kingdom.

ABSTRACT

Long-term durability of a structural adhesive joint is an important requirement, as it has to be able to support the required design loads, under service conditions, for the planned life time of the structure. One way of improving bond durability is through the use of surface treatments prior to bonding. In this study, the effects of four surface pre-treatments on three timbers were evaluated quantitatively through contact angle measurements and shear tests. The wettability tests showed that both flame and corona techniques increased the timber's surface free energy, with the corona leading to the greater increase, resting largely in its polar component. This treatment also tended to be less species specific, less susceptible to variation, and tended to last the longest. The shear tests, which are still ongoing, showed nevertheless that, in some cases surface activation, by itself, may not be sufficient to produce durable joints. Thus in such situations, it is also necessary to dimensionally stabilize the bond line, so as to enable it to cope with the timber dimensional variations originating from moisture ingress/egress.

Keywords: surface treatments, adhesion promoters, surface free energy, durability.

INTRODUCTION

Adhesive bonding technology has played an essential role in the development and growth of the rehabilitation and repair of modern and historic timber structures in recent years. The advantages of this method, in comparison to traditional repair techniques, are many but one major remaining concern is the durability of both the adhesive and resultant adhesion to the timber. Although high initial bond strengths are relatively easy to achieve, maintaining good bond durability is comparatively more difficult for the adhesives typically used in these applications (e.g. epoxies). The ability of a joint to maintain satisfactory long-term performance, often in severe environments, is therefore an important requirement of a structural adhesive joint. Additional bonding schemes (e.g. primary and/or physical bonds that are less susceptible to degradation) could be used to improve durability. These include the use of primers, adhesion promoters and other surface treatments. Despite the extra cost associated with them, their use is of particular value where structural bonds may be subjected to repeated wetting and drying. These agents are quite common in the aerospace, automotive, and plastics industries, where they are used to develop highly durable bonds to metals, composites, ceramics, and plastics. However, such treatments are virtually nonexistent in the timber industry [1].