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Development of a penetration test for timber impregnation products for use in old buildings

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ABSTRACT

This paper studies the application of commercial biocides to old maritime pine timber structures (*Pinus pinaster* Ait.) that have previously been impregnated with other products. A method was developed in the laboratory to be used *in situ* to determine the impregnation depth achieved by a new generation biocide product applied to timber from an old building. This timber had once been treated with an unknown product difficult to characterize without extensive analysis. The test was initially developed in laboratory conditions and later tested on elements of the roof structure of an 18th century building. In both cases the results were promising and mutually consistent with penetration depths for some treatments reaching 2.0 cm. The application *in situ* proved the test's viability and simplicity of execution giving a clear indication on the feasibility of possible re-treatments.

1. Introduction

As concerns for the quality and durability of buildings are growing, solutions are needed to increase the likelihood of being able to preserve the physical and mechanical integrity of constructions, and this is more demanding when the building has historical value [1].

Conspicuous among the anomalies currently most observed in buildings' timber structures are those caused by xylotrophic organisms such as rot fungi and subterranean termites, as well as dry-wood termites and woodworms. The first two occur in timber with high moisture content and the second two in dry timber. Keeping timber in a good state of preservation and remediate an infection or infestation both normally require the use of chemical compounds [2]. Treating the wood or using treated wood not only helps homeowners save money but also conserves forests [3,4]. Details of these treatment products should nevertheless be duly noted after application.

Until the early 1990s the use of CCA (chromated copper arsenate) compounds and active substances such as pentachlorophenol, copper, tin or lindane applied in organic solvents (LOSP) was generalized [2–4]. Although some of these formulations were very efficient at extending the life of wood, the health hazard to workers and the risk of environmental impact on the soil and landscape has to be seriously considered [3,4]. In the last few decades severe restrictions were therefore imposed on the use of many of the substances mentioned above in Europe [5], and in the USA where for instance, CCA was phased out of all new residential uses, from January 2004 [6].

Some traditional products based on established practices are also in general use. They include linseed oil, a good water repellent finishing, and used motor oil, which is often applied (particularly in Portugal) in the preventive treatment of wood, though with very arguable effectiveness.

Present day maintenance or rehabilitation interventions in old buildings will necessarily lead to the use of newer and more environmentally benign products on existing timber (Fig. 1). However, the effectiveness of curative/preventive measures is often impaired by the presence of previous treatments or finishes, not always well documented and difficult to characterize.

In this context, there is a need for a penetration test that would allow a swift evaluation whether a particular new wood preservative can be used. The test should also be of minimum disturbance to the structure under rehabilitation.

2. Wood treatment

The industrial preservation of timber started in 1838 when John Bethell registered a patent for timber treatment with creosote in an autoclave, using the so-called Bethell or full-cell process, and even today this is the most frequently used preventive in-depth treatment, even if coupled with other products. Much later the empty-cell impregnation process came along using creosote

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