10 Biocides used in wood preservation

L. LEIGHTLEY

10.1 Introduction

Timber may suffer deterioration through the action of fungi, insects and marine boring animals. This deterioration can be prevented if measures are taken to provide conditions unsuitable for the activities of these destructive agents. However, timber preservation refers to the use of chemicals which improve the natural durability of timber, rendering it toxic to fungi, insects and marine borers. The improvement in natural durability of timber not only contributes to forest conservation but offers additional advantages in the utilization of timber.

Timber is a structural material that is obtained from the wood of two general categories of trees termed softwoods and hardwoods. These terms relate to the density of the different types of commercial timbers. In general the two groups can be recognized as: softwoods—conifers, e.g. pine, possessing needle like leaves and hardwoods—broad-leaved, e.g. oak.

Wood forms the bulk of the standing tree and is a complex of many different cells. A tree can be considered to be a mass of millions of vertically and horizontally arranged cells concerned with the upward translocation of water and dissolved minerals from the soil, via the roots, to the active crown of the tree. Wood is the main conductive and supporting tissue of the standing tree. The treatment of wood with preservatives utilizes the fluid pathways used by the living tree.

The conduction of liquid—the sap—through wood is through specialized cells in the sapwood of the living tree. The sapwood also stores sugars and starch. Sapwood is light coloured, always non-durable and is easily treated with wood preservatives. As the tree matures the sapwood ages and becomes the heartwood. The formation of the heartwood occurs as tannins (polyphenolic compounds) are deposited into the sapwood cells and diffuse into the surrounding cells. This imparts a characteristic dark colour to the heartwood in contrast to the paler sapwood. Depending on the species, the deposits in the heartwood may confer resistance to insect attack and fungal degrade. However, this deposition causes occlusions and can dramatically reduce permeability in the heartwood. Because of this impermeability to liquid flow, wood preservation is concerned mainly with treatment of the sapwood with preservatives. The heartwood contains waste products produced during the metabolism of the tree. The dark colour of the heartwood is because the waste products are modified into storage chemicals which often provide natural resistance to biological degradation.
The natural durability of timber is classified according to the resistance of the heartwood to deterioration. The sapwood is always non-durable and will rapidly deteriorate if not protected. The preservative treatment of sapwood has enabled timber containing large amounts of sapwood to enjoy increased and wide use. Timber preservation also allows non-durable species to be utilized for end uses suited to their physical properties. In many situations treated timber has been found to be superior to alternative materials in special end uses, e.g. cooling tower packing and railway sleepers. Another advantage is that timber preservation allows cheap and plentiful non-durable species to be utilized, whilst maintaining more valuable durable timbers for prime end uses. Modern timber preservation techniques are enabling long life construction for a vast array of applications including bridges, wharves, building foundations, electricity poles, marine piling, landscaping and any requirement for timber exposed to the elements.

10.2 The chemical composition of wood

The living tree may be regarded as a manufacturing plant. Through a complex process, photosynthesis, simple sugars are manufactured in the leaves. These sugars are then transported to all the growing parts of the tree. There they are converted to water-insoluble chemicals and incorporated into the cell walls, increasing their thickness and weight.

The most important constituent of wood is cellulose which is formed by the simple sugar, glucose being joined end to end. Cellulose forms 50% of dry wood. Another 25% is contributed by a similar material, hemicellulose.

The cellulose molecules formed by the end to end joining of the sugars are long and thin, like tiny threads. In the cell wall these threads are joined together side by side providing great strength. This three-dimensional structure provides the characteristic strength qualities associated with timber. However, many plants contain cellulose but are not rigid as in trees. The rigidity and hardness of timber is associated with another major constituent, the lignin. Lignin is considered to be a cementing substance since it is deposited amongst the cellulose and hemicellulose molecules within the cell walls.

During active growth of the tree, sugars are produced and stored as starch. When it is required, starch is reconverted to simple sugars and transported to wood cells concerned with the growth of the tree. Wood-attacking insects can use stored starch as a food source.

Other minor constituents of wood include resins, gums, terpenes and oils, fats, waxes and tannins.

10.3 Agents of timber degrade

The growth of wood and its subsequent biological degrade represent essential processes required for the balance of nature. During growth the tree