Wood corrosion caused by inorganic compounds used as preservatives and fire-retardants

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Abstract Nowadays, many chemicals are often used as preservatives. Influence of boric acid, sodium tetraborate, copper and zinc sulphates on the wood was studied under the conditions of accelerated aging to identify a potential risk for wood during its long-term exposition to the mentioned chemicals. Wooden samples were impregnated under reduced pressure by 5 wt% solutions of the selected chemicals. After that the samples were exposed to accelerated ageing under temperature 70°C and temperature 70°C and relative humidity 80% for 30 days. Changes in the wood structure were studied with electron microscopy, infrared spectroscopy. The results have confirmed that in the long-term perspective copper and zinc sulphates act as catalysts of wood oxidation, with copper being a more effective oxidation catalyst and probably binding itself to wood polymers. Boric acid also acts as a catalyst of the cellulose oxidation, which confirms the chemical mechanism of fire retardance effects of this acid. Sodium tetraborate, as a result of its alkalinity, causes the lignin corrosion.

Keywords wood corrosion, preservatives, sodium tetraborate, boric acid, copper sulphate, zinc sulphate

EXTENDED ABSTRACT

Nowadays, many chemicals are often used as preservatives for wood protection against biological agents and fire. Despite of this fact, the current knowledge of potential wood corrosion caused by preservatives is still not sufficient. However, it is well known that transitive metal cations catalyze

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oxidation of polysaccharides as well as lignin does. Oxidation causes damage of wood polymers, which also projects into the damage of wood anatomical structure. Other inorganic compounds may cause hydrolysis of wood polymers. There is also evidence concerning wood damage caused by fire retardants on the basis of ammonium salts or ammonium chloride. These are the reasons why the influence of boric acid, sodium tetraborate, copper and zinc sulphates on the wood was studied under the conditions of accelerated aging to identify a potential risk for wood during its long-term exposition to the mentioned chemicals. Wooden samples were impregnated three times under reduced pressure by 5 wt% solutions of the selected chemicals. After that the samples were exposed to accelerated ageing under dry (temperature 70 °C) and wet (temperature 70 °C and relative humidity 80 %) conditions for 30 days. Changes in the wood structure were studied with electron microscopy, infrared spectroscopy, and by means of pH value measurement. Observations of the impregnated wood structure showed that wood corrosion occurs under the influence of all studied chemicals after the exposure of wood to the conditions of accelerated ageing. The results have confirmed that in the long-term perspective copper and zinc sulphates act as catalysts of wood oxidation, with copper being a more effective oxidation catalyst and probably binding itself to wood polymers. Boric acid also acts as a catalyst of the cellulose oxidation, which confirms the chemical mechanism of fire retardance effects of this acid. Sodium tetraborate, as a result of its alkalinity, causes the lignin corrosion. The results of the research have confirmed the need to explore the changes of the wood chemical structure treated with inorganic chemicals from the perspective of their long-term influence.