Experimental and computational analysis of the thermal degradation and the loss of strength of engineered wood-based panels

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In the present-day world, there is a large demand for sustainable practices in the construction industry. This mean balancing the needs of the environment, society and economy for both the current and future generations. Timber and timber composites are touted as sustainable construction material. Timber composites have gained interest over natural timber due to reasons such as lower number of defects, higher consistency and higher strength.

The use of timber composites in construction is being blocked due to their low tolerance to fire and high temperatures by organizations governing construction practices. To promote the use of timber composites, it is first needed to understand their behaviour under high thermal conditions. This knowledge can be used to develop methods that can improve the behaviour of timber composites under high temperatures.

In this study, a timber composite panel called Oriented Strand Board (OSB) was studied. OSB is used in construction in various capacity: for walls, floors, roofs, and furniture. The study consisted of several experiments and computer modelling of the material.

The first experiment heated a microscopic amount of OSB in a nitrogen atmosphere at a constant heat to observe the mass loss occurring with temperature. It was observed that until about 225 °C, the mass loss was very small (less than 2%).

The second experiment observed how the thermal conductivity of the material, which is a measure of the material's ability to conduct heat changes with the temperature of the material. It was observed that for a low temperature (less than 85 °C), this thermal property increases linearly with temperature.

The third experiment performed is named cone calorimeter tests. This allowed to subject the OSB material to different levels of heat and observe the time taken to ignite the OSB and the heat released from the fire.

The fourth experiment composed of heating OSB samples at different temperatures (50 °C – 200 °C) for roughly two hours and then bending the samples until they fail. For half of the samples, the bending test was performed immediately after removing from the furnace and for the other half, after allowing 24 hours to cool down the samples. The results showed that increasing temperature increased the loss of strength in OSB and the 24 hours of cooling allowed a change in the strength of the material.

The results from the experiments were compared with results found in previous studies. This comparison showed a degree of similarity between experimental and literature results.

The computer modelling section attempted to simulate the heat transfer occurring inside the OSB material using data from the experimental results and literature study. The results did not fully represent the actual results, meaning that more data and work is needed.