TimberSIL®, an Effective Fire Retardant with Reduced Heat Transfer Properties

TimberSIL® is a Class A fire retardant, as determined by ASTM E-84 testing conducted in a standard Steiner tunnel. In addition heat transfer through TimberSIL® more slowly, and weight loss upon exposure to flame is low. Presented below are summaries related to these properties, as well as properties of combinations of materials.

Infrared Thermal Imaging Measurements

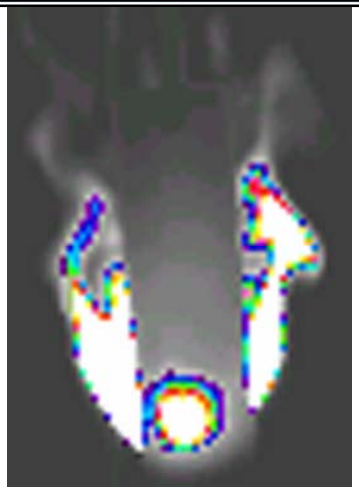
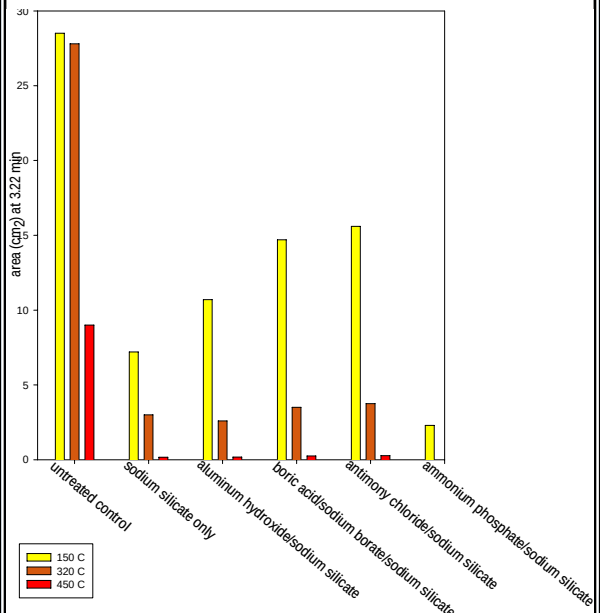


Figure 1. Heat penetration and transfer through a test sample



Area of Sample Measured at or above 150 °C, 320 °C, and 450 °C, Respectively Following Heating of 0.635 cm Pine Cross Section for 200 sec with 1650 °C Flame

Figure 2. Heat transfer in polymerized samples

To more completely describe the benefits and properties of the TimberSIL® polymerization materials, burns tests were conducted utilizing infrared thermal imaging temperature measurements from FLIR Systems Inc.; measurements and analyses were conducted on-site by FLIR Systems. In these tests a 1650 ºC butane flame was placed directly behind a sample, with the apex of the flame directed at a place of direct contact with the sample at approximately 0.75 cm above the lowest part of the sample. The position was chosen to allow maximal flame propagation, if any, while preventing flame snaking beneath the sample and to the other side. Using this method of sample positioning, it was possible to follow the spread of heat horizontally through the thickness of the sample and laterally and vertically as well.

In general, there was an initial period of essentially no change, followed by the beginning of temperature increase, which was indicated by color changes on the monitor. The area of temperature increase typically was a circle as shown in Figure 1. The temperature typically increased laterally and vertically throughout the sample, ultimately reaching a steady state of both temperature and affected area.

The resulting data from thermal transfer measurements are presented. Sample area at three temperature isotherms, 150ºC, 320ºC, and 450ºC, was measured. The 150ºC isotherm was inclusive of the other two isotherms.

These data, especially the heat penetration samples show that the TimberSIL® is evenly distributed throughout the sample. If there were uneven distribution through the sample, this would be seen in an uneven temperature distribution above the heat zone.

Although no advantage of chemical combinations was observed in terms of % weight loss or resistance to leaching, Figure 2 shows that thermal transfer was reduced by approximately a factor of 3 in the polymerized TimberSIL®/ammonium phosphate combination.

In Figure 3 fire retardant properties of TimberSIL® Glass Wood samples are compared to borate-treated wood products.

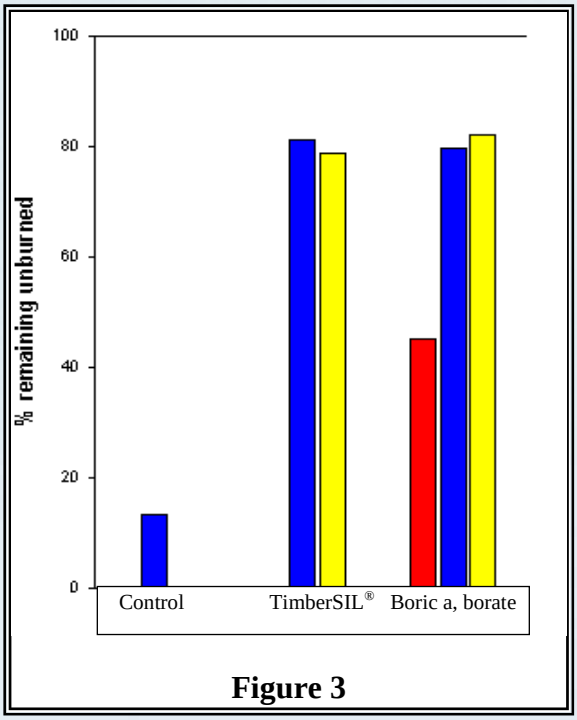


Figure 3

Fire retardant properties were determined by measuring percent weight loss in burn tests. Percent weight loss was measured in yellow pine samples with dimensions of 4.5 cm x 12.5 cm x 6 cm, three replicates each infused with the following: TimberSIL®, 7:3 boric acid/sodium borate saturated solution, TimberSIL®/7:3 boric acid/sodium borate saturated solution and dried. An additional three replicates each were prepared as above and subjected to polymerization. The burn test method was a modification of the standard test method recommended by the American Standards and Testing Methods (ASTM). Standard Method E 69-95 in which the combustible material was placed in an apparatus known as a "fire-tube assembly" and measurements similar to that described above were made.

For the wood only controls (blue, far left), an average 17% of the samples remained unburned. For TimberSIL® samples, the amount remaining unburned was essentially the same (78-80%), for unpolymerized samples (blue, center) and polymerized samples (yellow, center).

For the boric acid/borate sample set, the samples treated with boric acid/borate mixture (red) averaged approximately 45% of sample remaining, an adverse difference of more than 30% when compared to samples containing a combination of boric acid/borate TimberSIL® samples, or samples containing TimberSIL® only. For boric acid/borate/TimberSIL® samples (blue and yellow, far right), the results were essentially the same as for TimberSIL® samples (blue and yellow, center). This shows that TimberSIL® outperforms borate samples, and that should TimberSIL® and borates be combined, the fire retardant benefits of TimberSIL® predominate.

The data show that the results for samples containing TimberSIL® were essentially the same, regardless of whether or not borate/boric acid was present in the samples.