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Wood reinforced slag matrix composites activated by carbon dioxide

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Steel slag is the by-product of steel making process. Because of its chemical composition, steel slag is carbon dioxide reactive. This property can be utilized to develop steel slag binder to replace Portland cement in making environment-friendly building products. Since steel slag is heavier than Portland cement, wood is considered as reinforcement in slag matrix composites to enhance the flexural strength and reduce the density of the final products. This paper summarizes a recent study on the carbonation activation of steel slag for making wood reinforced slag matrix composites for particleboard application. Five different types of steel slags are examined for their capacity to develop strength. They include two EAF slags, one BOF slag, and two ladle slags. The slags are ground to a size close to cement powder and compaction formed into a precast product. The slag compacts are then carbonated in a pressure chamber at ambient temperature with a gas pressure of 1-2 bar for different duration. It was found that BOF slag is more carbon reactive than EAF slag. The former can develop a strength of 40-50 MPa in two hours reaction while the latter can reach 20 MPa. The dominant parameter for carbon-activated strength gain is the calcium silicate phases with any polymorphs. The strength gain is attributed to the formation of calcium-silicate-hydrates coupled with calcium carbonates. The ladle slag cannot be activated to gain strength due to free lime content. Wood reinforced BOF slag composites are successfully used in making particleboards which are comparable with cement boards and oriented strand boards. It is promising to use activated steel slag to replace Portland cement in making wood slag composite building products. Carbonation activation is a CO₂ uptake process, gaseous carbon dioxide can be converted into solid carbonates and stored in building products. The final composites can be made carbon-negative since it preserves natural resources, recycles industry wastes and serves as carbon sinks for emission reduction.

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