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Boiler Ash as a Reducer of Formaldehyde Emission in Medium-Density Fiberboard

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Abstract : In the production of fiberboards, an adhesive based on urea-formaldehyde resin is used, which has the advantages of low cost, homogeneity of distribution, solubility in water, high reactivity in an acid medium, and high adhesion to wood. On the other hand, as a disadvantage, there is low resistance to humidity and the release of formaldehyde. The objective of the study was to determine the viability of adding industrial boiler ash to the urea formaldehyde-based adhesive for the production of medium-density fiberboard. The raw material used was composed of Pinus spp fibers, urea-formaldehyde resin, paraffin emulsion, ammonium sulfate, and boiler ash. The experimental plan, consisting of 8 treatments, was completely randomized with a factorial arrangement, with 0%, 1%, 3%, and 5% ash added to the adhesive, with and without the application of a catalyst. In each treatment, 4 panels were produced with density of 750 kg.m^{-3}, dimensions of 40 x 40 x 1,5 cm, 12% urea formaldehyde resin, 1% paraffin emulsion and hot pressing at a temperature of 180ºC, the pressure of 40 kgf/cm^{-2} for a time of 10 minutes. The different compositions of the adhesive were characterized in terms of viscosity, pH, gel time and solids, and the panels by physical and mechanical properties, in addition to evaluation using the IMAL DPX300 X-ray densitometer and formaldehyde emission by the perforator method. The results showed a significant reduction of all adhesive properties with the use of the catalyst, regardless of the treatment; while the percentage increase of ashes provided an increase in the average values of viscosity, gel time, and solids and a reduction in pH for the panels with a catalyst; for panels without catalyst, the behavior was the opposite, with the exception of solids. For the physical properties, the results of the variables of density, compaction ratio, and thickness were equivalent and in accordance with the standard, while the moisture content was significantly reduced with the use of the catalyst but without the influence of the percentage of ash. The density profile for all treatments was characteristic of medium-density fiberboard, with more compacted and dense surfaces when compared to the central layer. For thickness, the swelling was not influenced by the catalyst and the use of ash, presenting average values within the normalized parameters. For mechanical properties, the influence of ashes on the adhesive was negatively observed in the modulus of rupture from 1% and in the traction test from 3%; however, only this last property, in the percentages of 3% and 5%, were below the minimum limit of the norm. The use of catalyst and ashes with percentages of 3% and 5% reduced the formaldehyde emission of the panels; however, only the panels that used adhesive with catalyst presented emissions below 8mg of formaldehyde / 100g of the panel. In this way, it can be said that boiler ash can be added to the adhesive with a catalyst without impairing the technological properties by up to 1%.

Keywords : reconstituted wood panels, formaldehyde emission, technological properties of panels, perforator
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