



Thermogravimetric analyses and decay resistance of wood-cement composites with silica fume and different chemical additives

Hüsnü Yel^{1,*}, Hülya Kalaycıoğlu², Uğur Aras³

¹ Dept. of Material and Material Processing Technologies, Artvin Vocational School, Artvin Coruh University, Artvin, Turkey

² Dept. of Forest Industrial Engineering, Faculty of Forestry, Karadeniz Technical University, Trabzon, Turkey

³ Dept. of Material and Material Processing Technologies, Arsin Vocational School, Karadeniz Technical University, Trabzon, Turkey

* Corresponding author: yel33@artvin.edu.tr

Abstract. Pozzolan materials can partially substitute Portland cement in order to enhance the properties of wood-cement composites such as durability and mechanical properties. The interaction between additions and cement can be investigated by various techniques such as thermal analysis, X ray diffraction, cement calorimeter and physico-mechanical tests ect. Thermogravimetry (TGA) and derivative thermogravimetry (DTG) are considered important tools to evaluate the hydrated products of cement according to different stages of cement hydration, in addition to quantifying the different phases. The purpose of this paper is to investigate the effects of silica fume and different chemical additives on TGA/DTG and decay resistance of cement bonded particleboards from Douglas fir wood. For this purpose, the three-layer cement bonded particleboards with a target density of 1200 kg/m³ and a dimension of 45*45*1 cm were produced by using 1/2 -1/3 wood-cement ratio, 10%, 15%, 20% silica fume as cement replacement materials and three different chemical additives [Al₂(SO₄)₃, CaCl₂, FeCl₃] to improve the compatibility between wood and cement. All the boards were pressed using a pressure of 18-20 kg/cm³ for 24 hrs. In the first 8 hours of the pressing process, a temperature of 60 °C was applied and then pressing was continued for 16 hrs in ambient temperature. TGA/DTA analyses was done on a DTA-TG apparatus, Shimadzu DTG -60 simultaneous with samples heated over the temperature range of 30 °C – 900 °C at a constant rate of 10 °C/min under nitrogen atmosphere. Decay resistance was performed using brown-rot fungi according to EN 113 standards. The results demonstrated that, the decay test specimens had weight gains in contrast to the loss of weight due to carbonation reaction of cement. Silica fume and CaCl₂ led to decrease the weight gain compared to the reference sample. According to the results of TGA/DTA, the most weight loss was obtained from the boards with 15% silica fume while the least weight loss was obtained from the reference board with %0 silica fume. This means that there were more hydration products [C-S-H gel and Ca(OH)₂] of cement at the board with %15 silica fume than the reference boards with %0 silica fume and the boards with %15 silica fume had more mechanical and physical properties than the reference board.

Keywords: Silica fume, Chemical additives, Thermogravimetric analyses, Decay resistance, Cement bonded particleboards