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Thermally treated attapulgite from the Ventzia Basin, Western Macedonia, Greece: a promising pozzolanic material

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The environmental impact, caused by cement and cement-based materials' production, has driven the researchers and industry towards to the investigation and development of new supplementary cementitious materials (SCMs) with pozzolanic activity, which are used to replace part of cement, indirectly reducing CO_2 emissions of cement's production. This work investigates the effect of the thermal treatment of attapulgite on its pozzolanic activity. Two representative attapulgite samples from the Ventzia Basin, Western Macedonia, Greece, were thermally treated. Each sample was calcined at constant high temperature for different times. Pozzolanic activity was evaluated on the basis of Chapelle test and was investigated by means of X-ray Diffraction and Differential Thermal Analysis. According to the results, thermal activation increased the grain size of the produced material compared to the mean grain size of the raw material, resulted in attapulgite dehydroxylation, distortion and amorphization and led to a pozzolanic activity which exceeds the minimum pozzolanicity of a metakaolin according to NF P18-513 standard [700 mg Ca(OH)2/g metakaolin]. The results of the Chapelle test also showed rapid increase in pozzolanic activity between raw and thermally treated materials. Time of calcination seems to have no pronounced effect on attapulgite pozzolanicity. X-ray Diffraction and Differential Thermal Analysis of the Chapelle products of the two thermally treated attapulgite samples demonstrated that CSH phases such as tobermorite, which enhance the engineering performance of cement, were formed during the pozzolanic reaction. Furthermore, Differential Thermal Analysis of the Chapelle products provided further evidence of the presence of CSH and of attapulgite activation, based on the amount of bound water into hydrated silicates (total water loss). It is concluded that calcined attapulgite from the Ventzia Basin, Western Macedonia, Greece, exhibits pozzolanic activity highly competitive to that of commercial metakaolin and therefore it could be utilized as a pozzolan in building materials. Further studies need to be performed in order 1) to clarify the effect of impurities on the attapulgite pozzolanic activity 2) to investigate in detail the hydrated calcium silicates formed during the pozzolanic reaction, by means of XRD, SEM and TEM and 3) to study the effect of the specific surface area of attapulgite thermally treated in different conditions (temperature, time) on its pozzolanicity.