BOOK OF ABSTRACTS

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The effect of Co-60 gamma irradiation on coal fly-ash geopolymer set times

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Operations involving grout, mortar and concrete are commonly used in radioactive waste management. Materials based on Portland cement (OPC) have numerous applications, ranging from construction of facilities, radioactive shielding, production of different casings and containers, to waste conditioning procedures (solidification, cementation, grouting). These materials are well known and well standardized, and regulated both internationally and at the national level. OPC is readily available, cost effective and comes in formulations suited for the construction industry. In nuclear and radioactive waste management industries, some challenges with the use of OPC based materials have been recognized (including the durability of concrete under thermal stress, long term stability of OPC binders, and radiolysis of contained water), and have been addressed either by optimizing OPC material formulations, or by using alternative binders. One promising alternative binder is geopolymer, a type of alkali activated binder, solidified by cross linking aluminosilicates into an amorphous matrix. Geopolymer is formed by activation of fine powder with pozzolanic properties with an alkali solution of sodium silicate (water glass). During geopolymerization, water acts primarily as a solvent, unlike the reactions during the setting of OPC, where hydration plays a key role. Various base materials, ranging from metakaolin to byproducts such as fly-ash and blast furnace slag, can be used. Coal fly-ash is an inexpensive raw material with low CO_2 footprint (compared to OPC), with potential applications in radioactive waste conditioning. To our knowledge, the effect of ionizing radiation on geopolymer set time hasn't been explored. We have measured the initial and final set time for fly-ash geopolymer paste, based on the SRPS EN 196-3 standard, irradiated by gamma rays in a Co-60 reference field on position with air kerma rate of 3.42 mGy/s. The binder paste was prepared using fly-ash from TENT B power plant's electrostatic filters without further sieving, activated by water glass with module 1.5 and mixed with distilled water until satisfactory flow was obtained, and poured into sample and control molds. Initial and final set times for irradiated sample and non irradiated control were determined by Vicat apparatus. The irradiated sample demonstrated 11% shorter initial set time, and 16% shorter final set time, compared to control. These set times allow satisfactory working times for geopolymer grouts and mortars. The effect of ionizing radiation on set times and other properties of coal fly-ash based materials must be accounted for in all stages of application, from small scale testing and simulations, to full scale tests and production environments.