Influence of PET wastes on the environment and high strength concrete properties exposed to high temperatures

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The accumulation of polyethylene terephthalate (PET) waste from single use of drinking water bottles and fly ash (FA) generated from power stations has become the main threats to the environment every year. The cement production increases with increasing concrete demand worldwide, thereby increasing pollution caused by emission of CO and CO_2 from manufacturing processes. High-strength concrete (HSC) is brittle and has low tensile strength. Moreover, HSC has low porosity and thus suffers from spalls at high temperatures. The importance of this study is to investigate the effect of PET waste on the hardened properties of HSC, reduce the HSC spalls, measures the CO and CO_2 gases releases from specimens contains PET waste exposed to high temperatures and reduce the cement used in concrete. In this study, 0.25% of coarse aggregate weight was replaced by PET fiber waste and FA was used by 30%, 35%, and 40% instead of cement weight. Nanosilica (NS) material was used by 2.5%, 5%, and 7.5% of cement weight to compensate the expected strength reduction after using FA and PET. A part of the specimens was exposed to 400 _C and 700 _C to investigate the effect of high temperatures on compressive strength, flexural strength, spalling, porosity, CO and CO_2 emissions, and concrete color changes. Results showed that the compressive and flexural strength were improved by the presence of FA and NS but reduced by elevated temperatures. Spalls appeared in specimens containing NS exposed to 700 _C but not in specimens containing PET combined with NS. The porosity of the control specimens increased with increasing temperature, while presence of FA and NS in HSC specimens refined the pores by 50%. The color of the specimen surface changed with increasing temperature. Hence, specimens containing PET waste and exposed to high temperatures released CO gas at concentrations higher than the allowed limitations to human breath in a closed environment.