

## *Composition and particle size of mineral trioxide aggregate, portland cement and synthetic geopolymers*

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### Abstract

**Objective:** To describe the composition and particle size of Portland cement (PC) and geopolymers in comparison to mineral trioxide aggregate (MTA).

**Design:** A quantitative, laboratory-based exploratory study.

**Setting:** Schools of Dental Sciences and Physical Sciences, University of Nairobi; World Agroforestry Centre (ICRAF); Ministry of Mining, all in Nairobi, Kenya.

**Study population:** Grey PC clinker, Kaolin, Fly ash (FA) and blast furnace (BF) slag, together with alkaline-activated aluminosilicates (AS) or geopolymers derived from them, were evaluated in comparison to two brands of MTA (MTA Cem and ProRoot MTA).

**Methods:** The materials were characterized by x-ray diffraction (XRD), energy dispersive X-ray fluorescence (EDXRF), graphite furnace atomic absorption spectroscopy (GFAAS) and fluoride ion selective electrode (FISE) for compositional analysis, and laser diffraction for particle size distribution analysis. Continuous data was subjected to analysis of variance (ANOVA) and Tukey's post hoc test for hypothesis testing at  $\alpha$  level of 0.05.

**Results:** While MTA and PC comprised mainly of dicalcium and tricalcium silicate phases, geopolymers contained aluminosilicate phases such as quartz and mullite. Only FA contained fluoride (43.33 $\mu$ g/g, sd 5.77). There was no statistically significant difference in the composition of MTA and PC as determined by EDXRF except in the Bi (F-statistic=44.29, df=2, adjusted p<0.0001, difference=2.47, 95% CI 16.30, 33.14%wt) and Pb content (F-statistic=164.40, df=2, adjusted p=0.000, difference=1.74, 95% CI 1.43, 2.05%wt). There was no statistically significant difference in the mean particle size distribution of MTA, PC and geopolymers (D50 for PC = 12.46 $\mu$ m, sd 3.18, MTA = 7.23 $\mu$ m, sd 3.43, aluminosilicates = 12.74 $\mu$ m, sd 3.79, p>0.05).

**Conclusion:** Composition of PC was similar to MTA while particle size of PC and geopolymers was similar to MTA.