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A geochemical and agronomic evaluation of technosols made from construction and demolition fines mixed with green waste compost

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Increasing efforts are being made to create functional soil-like substrates from waste materials, prompted by the need to replace degraded or sealed soils in urban environments, create bulk soils for the restoration of old capped landfill and mine site areas, and to re-utilise value-laden materials otherwise disposed of to landfill. Construction and demolition fines (C&D-fines) and green waste compost (GWC) are two such commonly generated urban waste materials that represent repositories of geochemical value. Here technosols were produced from volumetric mixtures of these wastes ranging from 0-100% C&D-fines, with the remaining proportion comprised of GWC. Agronomic assessment was carried out by way of pot and rhizobox plant growth experiments with ryegrass (*Lolium perenne*), barley (*Hordeum vulgare* L. cv. Optic) and pea (*Pisum sativum* L. cv. Corus) to determine germination, plant mass and rooting behaviors. Geochemical and mineralogical evaluation was achieved by soil solution measurements combined with X-ray powder diffraction analyses to characterise the technosols and their distinct deviations from a reference agricultural geogenic old-red sandtone derived podzol (soil).

Germination and growth of ryegrass was up to 80-fold greater after 30-days in the technosol composed of equal volumes of the two waste materials (50 % C&D-fines: 50% GWC) compared to the soil. Likewise, in the rhizobox experiment, root surface areas of barley and pea were increased from 130-200 cm^2 in this technosol, compared to < 30 cm^2 in the geogenic soil. High concentrations of Ca and Mg in pore waters (550-800 mg l^{-1}) were dominant features of the technosols produced, in contrast to the gegenic soil (< 50 mg l^{-1}), resulting from gypsum and calcite enrichment of the C&D-fines. In contrast, the GWC represented a source of soluble K (450-1000 mg l^{-1}). Highly elevated Ca concentrations in extended leaching tests of the technosols reflected ongoing gypsum dissolution, whereas soluble Mg and K were rapidly depleted.

In summary, the short-term performance of the technosols tested here as plant growth substrates was strong despite their evident geochemical and mineralogical distinction from soil. Optimising the technosol recipe will require balancing the geochemical qualities of each material that forms it to gleaning maximum value and longevity from urban wastes in this way.