

Temporal evolution of chromium leachability in compost, a case study in New-Caledonia

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Compost produced from municipal wastewater sludges and green wastes (MWSC) is a promising way for recycling wastewater sludges and for improving agricultural production. During the composting, organic matter is submitted to important changes leading to modifications on physico-chemical parameters. Little is known about the fate of chromium during composting process, while some changes in its speciation and leachability may be expected. This question is especially relevant in New-Caledonia, a French Archipelago, where the geochemical background highlights naturally high level of trace metal. Total chromium in soils can reach 30,000 mg kg⁻¹ and MWSC can contain up to 1,200 mg kg⁻¹, exceeding ten times the authorized contents in compost by the French regulation. In this work, we studied windrows MWSC composting at the initial (t_{-0}) and final phases ($t_{-6\text{months}}$) of composting. The total chromium content (Q_{tot}) was measured, and the leachability of chromium in compost was assessed with kinetic extractions using EDTA 0.05 M over 24h. Extraction curves were modeled as the sum of two first-order reactions to distinguish two mobile fractions from the total pool: one “labile” fraction (Q_1), quickly extractable, with a rate constant k_1 , and one “moderately labile” (Q_2), less extractable with a rate constant k_2 . The remaining fraction is the EDTA non-extractable pool. MWSC contained 327 ± 5.9 mg kg_{dry mass (DM)}⁻¹ and 426 ± 8.1 mg kg_{DM}⁻¹ of chromium at t_{-0} and $t_{-6\text{months}}$, respectively. For both maturity stages, the total mobilizable pool ($Q_1 + Q_2$) represented less than 3% of Q_{tot} . After 6 months of composting process, Q_{tot} increased by 1.3-fold due to loss of water and of volatile compounds. Nevertheless, the mobilizable pools varied differently. The Q_1 pool strongly increased with the composting process, being multiplied by 2.55 whereas the Q_2 pool decreased, *i.e.* it was divided by 1.33. These results indicated that the composting process increases the most labile fraction of chromium. The total mobilizable fraction of chromium represents a relative low fraction of Q_{tot} . However, long term risks related to repeated compost application in agriculture must be considered as chromium could be potentially transferred to groundwater or cultivated plants, affecting agriculture production and human health.