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Evaluation of long-term environmental impacts of building composites containing waste materials by applying different leaching tests

Ocena dolgoročnih okoljskih vplivov gradbenih materialov, ki vsebujejo odpadne snovi, z uporabo različnih izlužitvenih testov

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Abstract

In order to evaluate the long-term environmental impacts caused by the release of contaminants from monolithic building and waste materials, NEN 7375 test is proposed. At each specific points in time over 64 days, leaching solution (demineralised water) is replenished, which enables estimation of the diffusion of inorganic components from composites investigated. In the present work, NEN 7375 test and its modified leaching protocol were compared. In the modified protocol leaching solution was not replenished, simulating the diffusion and dissolution of contaminants. Leaching of selected elements was investigated from compact building composites (98% of mixture from flay ash (80%) and cement (20%) and 2% of electric arc furnace dust) using MilliQ water as leaching solution. Total concentrations of elements in the leachates collected at 0.25, 1, 2.25, 4, 9, 16, 36 and 64 days, were determined by inductively coupled plasma mass spectrometry (ICP-MS). In leachates without replenishing of the leaching solution larger extent of leaching of Cr, Mo and V was observed. These elements were at high pH of leachates (pH 12) predominantly present in the form of soluble oxoanions, On the contrary, other elements were at highly alkaline pH precipitated, so their concentrations in the leachates remained close to respective limits of detection of ICP-MS. The modified leaching protocol simulates better the conditions, when building composite is immersed into the stagnant environmental waters.

Key words: Building composites, leachability tests, diffusion, dissolution.

Povzetek

Dolgoročne vplive na okolje, ki jih povzročijo gradbeni in odpadni materiali, ocenjujemo s pomočjo NEN 7375 testa. Pri točno določenem času v trajanju 64 dni, se izlužitveno sredstvo (demineralizirana voda) zamenja, kar omogoča oceno difuzije anorganskih komponent iz preiskovanih kompozitov. V predstavljenem delu smo primerjali NEN 7375 test ter njegovo

modificirano izpeljanko izlužitvenega testa. V modificiranem testu izlužitvenega sredstva nismo zamenjali, kar je omogočilo, da smo sledili izluževanju onesnažil na osnovi difuzije in raztapljanja. Izluževanje izbranih elementov smo preučevali v gradbenem kompozitu (98% mešanica letečega pepela (80%) in cementa (20%) ter v 2 % dodatek prahu iz elektroobločne peči), pri čemer smo kot izlužitveno sredstvo uporabili MilliQ vodo. Celotne koncentracije izbranih elementov smo določili v izlužkih, ki smo jih vzorčili po 0.25, 1, 2.25, 4, 9, 16, 36 in 64 dneh, z masno spektrometrijo z induktivno sklopljeno plazmo (ICP-MS). V izlužkih, kjer izlužitvene tekočine v času trajanja poskusa nismo zamenjali, je bil obseg izluževanja Cr, Mo in V, ki so pri visokem pH izlužkov (pH 12) prisotni v obliki oksoanionov, večji kot v primeru, ko smo izlužitveno tekočino ob vsakem vzorčenju zamenjali. Nasprotno pa so se ostali elementi zaradi visokega pH oborili in so bile njihove koncentracije v izlužkih blizu mej zaznave z ICP-MS. Modificiran izlužitveni test bolje posnema pogoje v okolju, ko gradbeni kompozit potopimo v mirujoče površinske vode.

Ključne besede: Gradbeni kompoziti, izlužitveni testi, difuzija, raztapljanje.