Phosphate retention/solubilization characteristics of industrially produced Ca–Fe oxide granules

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We studied in laboratory phosphorus (P) retention and solubilization characteristics of industrially produced granules containing calsium (Ca) and iron (Fe). At least 85% retention efficiency was obtained in 5 minute contact with 1 mg P l^{-1} solution, and equally high P retention in leaching tests when granules were placed on the bottom of soil columns.

In a flow-through system fed with 50 mg P l^{-1} solution, the granules showed retention capacity of 7 g P kg^{-1} for a coarse (2–5 mm) size fraction and more than 16 g P kg^{-1} for a fine (< 2 mm) size fraction. About 20% of the P retained by P-saturated granules was solubilised when extracted sequentially with water (twice), with anion and cation exchange resin mixture, and with buffered dithionite solution (pH 6.9, Eh less than –300 mV). During a 6-month anoxic incubation, concentrations of dissolved Fe and P in water increased somewhat, but remained lower than for a soil sample used as control. Solubilization of P was partly pH-dependant, suggesting that phosphate in P-saturated granules was in part precipitated as, or adsorbed to, Ca-associations. Phosphate solubilized at neutral pH but low redox potential suggests that phosphate was also adsorbed by Fe hydroxides.

When P-saturated granules were immersed for 16 days in an oligotrophic lake, 60% of the total granule mass was lost. The mass loss comprised of element losses of > 80% for Ca, but no loss of metal elements, and about 25% loss of the P bound by P-saturated granules. It seems that even though Ca-associations initially played a significant role in P retention by the granules, the metal hydroxide component of the granules had captured P during dissolution of Ca-associations. Field studies are started in 2010 to test the granules as a medium for P retention in wetlands and edge-of-field permeable reactive barriers.