Reducing phosphorus (P) losses from drained agricultural fields with iron coated sand (-glauconite) filters

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Abstract In north-west Europe, a region characterised by intensive agriculture and a large area (17 - 40 %) of drained agricultural fields, P losses to the environment are a major cause of eutrophication problems. As the Water Framework Directive demands rapid water quality improvements and most of the current P mitigation strategies tend to work on the long run, additional measures are needed. One potential solution is the installation of P filters at the end of tile drains, which remove the leached P immediately. In this study, we present the whole process of developing small scale field filters, starting from one industrial by-product (Iron coated sand (ICS)) and four acid pre-treated natural minerals (Bauxite, Biotite, Glauconite and Olivine) as potential phosphorus sorbing materials (PSM). Initial batch (ad)sorption experiments revealed following order in P sorption capacity and speed: ICS > Bauxite > Glauconite > Olivine = Biotite. As the presence of lead and nickel, two potential harmful elements for the aquatic environment, excluded the use of bauxite (and olivine) as PSM, subsequent laboratory tests in flow through systems were performed with P filters containing mixtures of ICS and glauconite (100/0, 90/10, 80/20, 70/30 and 60/40 % on weight basis). A significant relationship between K_{sat} and the filter mixtures' D_{10}, D_{40} and bulk density was discovered next to a significant effect of the filter mixture composition on P removal efficiency and K_{sat} stability. Finally, three 10 week field trials showed that the pure ICS filters were able to handle all drainage discharges (up to 6 m^3 day^{-1}) and had a P removal efficiency of at least 70 %. The 90/10 ICS/glauconite filters could maximally process discharges of 4 m^3 water day^{-1} with a P removal efficiency of 57 %. As saturated ICS filters can easily be replaced and reused in situations with high P loads and longer retention times, this is a promising technique to reduce P losses on the short term.