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Iron coated sand/glauconite filters for phosphorus removal from artificially drained agricultural fields

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Flanders (Belgium) is confronted with reactive phosphorus concentrations in streams and lakes which are three to four times higher than the 0.1 ppm P limit set by the Water Framework Directive. Much of the excessive P input in surface waters is derived from agriculture. Direct P input from artificially drained fields (short-circuiting the buffering capacity of the subsoil) is suspected to be one of the major sources. We aim to develop simple and cheap filters that can be directly installed in the field to reduce P concentration from the drain water. Here we report on the performance of such filters tested at lab scale. As starting materials for the P filter, iron coated sand and acid pre-treated glauconite were used. These materials, both rich in Fe, were mixed in ratios of 75/25, 65/35, 50/50 and 0/100 (iron coated sand/glauconite ratio based on weight basis) and filled in plastic tubes. A screening experiment using the constant head method with a 0.01 M CaCl2 solution containing 1 ppm P showed that all four types of mixtures reduced the P concentration in the outflowing water to almost zero, and that the 75/25, 65/35 and 0/100 mixtures had a sufficiently large hydraulic conductivity of 0.9 to 6.0 cm/min, while the hydraulic conductivity of the 50/50 mixture was too low (< 0.4 cm/min). In a second experiment the iron coated sand and acid pre-treated glauconite were mixed in ratios of 75/25, 65/35 and 0/100 and filled in the same plastic tubes as in the first experiment. Subsequently a 0.01 M CaCl2 solution containing 1 ppm P was passed through the filters over several days, in amounts equivalent to half of the yearly water volume passing through the drains. This experiment firstly showed that in all cases the hydraulic conductivity fluctuated strongly: it decreased from 4.0-6.0 cm/min to 2.0-1.5 cm/min for the 75/25 filter, and to values < 0.4 cm/min for the 65/35 filter, whereas it increased from 0.8 to 1.4 cm/min for the 0/100 filter. Secondly, we observed a decrease in the P removal efficiency with time on each day for all filters: from 90% removal to 80% removal for the 75/25 and 65/35 filters, while for the 0/100 filter the P removal almost reduced to 0%. Based on these results the 75/25 (iron coated sand/glauconite) filter will be tested at field level, and additional research will be directed towards prediction of the evolution of hydraulic conductivity of the filter materials.