Microorganisms in sand filters for on-site wastewater treatment

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INTRODUCTION

Sand filters and drain fields with a sand layer are common on-site wastewater treatment techniques in Sweden. In future, their use might increase because they could be used without post-treatment according to the recently suggested regulations for on-site wastewater treatment (Swedish Agency for Marine and Water Management, 2016). The distribution pipes of these systems are buried in a layer of gravel (16-32 mm) which is covered by a layer of soil of varying thickness (Figure 1). For pre-treatment before wastewater infiltration, septic tanks with three chambers are used. Many newly built sand filters have been found to have functional problems due to sludge formation in the distribution chamber, aeration pipes and the filter bed itself (Larsson, Forsberg et al., 2017). This might be problematic because the sludge formation possibly decreases the removal of BOD, pathogens and phosphorus in the filter and can lead to clogging. Soil-based treatment techniques are suitable for on-site wastewater treatment because they are passive, robust and low-cost. Therefore, it is important to increase knowledge about these methods so that a good performance of sand filters and drain fields can be achieved. In this study the performance of sand filters for on-site wastewater treatment was investigated focusing on identifying active microbes and reasons for excess sludge formation. The objective was to explore the correlation between influent wastewater quality and groundwater level below the drain field and the type of bacteria present in the sand layer.

MATERIALS AND METHODS

On-site drain fields with sand layer in the municipality of Kungsbacka, Sweden, were investigated. After visual inspection, six drain fields were selected; three with problematic sludge formation and three that were assessed to be in functional condition. Samples were taken from the sand of the drain fields as well as from the sludge that had formed in the pipes to study the presence and type of bacterial communities. Samples were taken with an auger for coarse sand after drilling and digging through the top soil and gravel layer. Samples were first microscopically examined. Then, DNA was extracted from the samples and analysed with 16S rDNA sequencing.

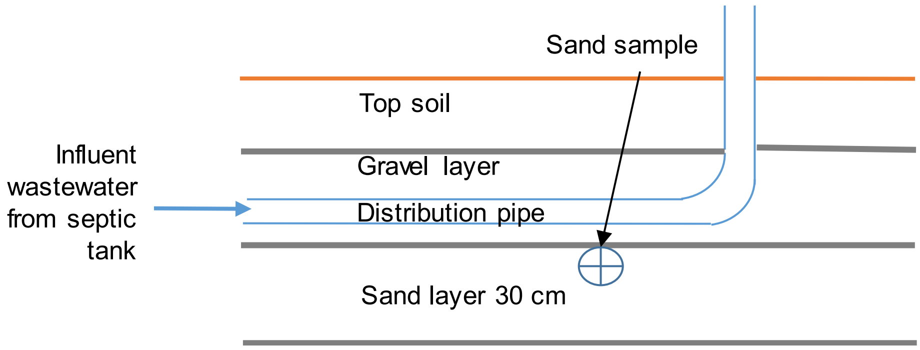

Figure 1 Typical design of a drain field and location where sand was sampled

To assess influent water quality, water was sampled at five occasions from the third chamber of the septic tanks that preceded the drain fields using a Rüttner sampler. The samples were analysed on total suspended solids, pH, total phosphorus and nitrogen, total organic carbon, biological oxygen demand, ether-soluble and emulsified grease. Dissolved oxygen and temperature were measured in the septic tank. The distribution pipes were camera-inspected and the ventilation of the septic tank checked using smoke detection. The drinking water of the households was analysed for concentrations of iron, manganese and alkalinity. The groundwater level was measured in adjacent groundwater wells using a water level sounder.

RESULTS AND DISCUSSION

The project is on-going and the collected samples are currently being analysed.

ACKNOWLEDGEMENT

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