Prokaryotic communities in drinking water biofilters using alternative filter medium
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INTRODUCTION

Biофильтры являются сердцем систем обработки воды в Европе [1]. Исследования биофильтров способствует оптимизации процесса очистки. Фильтр среднего размера состоит из отмывок, отмытых и просеянных кварца. Другое применение фильтра как основного фильтра для конденсации воды было исследовано в [2-4]. Эти медиа включают карбонатные, керамические, индустриальные отходы и синтетические материалы, такие как пластик, силикаты, песок и металл. Длительность процесса активации также была исследована [5-6]. Однако, эффект, что альтернативные фильтры могут иметь на микрофлору и развитие биофильтра и в конечном итоге в процессе активации получены небольшие результаты.

В целом, целью, что микробные сообщества на фильтре могут активироваться во время процесса активации фильтра.

METHODS

The investigations described in this poster were carried out at Frederbog waterworks near Skanderborg, Denmark. The waterworks treats anaerobic groundwater using a simple process of aeration and filtration (2 filters in series).

Setup

After evaluation of several filter media properties, a filter column of calcium carbonate was selected to remove manganese as an inlet water between the waterworks filters. The water was applied with manganese to achieve a constant concentration of 0.27 mg/L.

Water and Filter media samples

Filter medium properties of quartz sand, calcium carbonate, anthracite and manganese oxide were determined using gravimetric methods and a photometric particle analyzer (Camsizer®E6, Retech Technology GmbH).

Water samples of the setup inlet (water between filters from the waterworks) were taken during the experiment and analyzed for standard parameters.

Water samples (water between the filters and clean water from the waterworks) and filter media samples (second filter of the waterworks and filter column) were collected and analyzed DNA extraction, qPCR with broad range bacterial primers, and amplicon sequencing using 16S rRNA primers. The analysis identified the most abundant amplifiable Phyla and Genera in the samples.

DNA extraction, qPCR and pyrosequencing results

Figure 3 shows that microbial analyses detected the presence of commonly reported prokaryotic groups: Alphaproteobacteria, Betaproteobacteria, Nitrospira, Acidobacteria and Gammaproteobacteria.

Pyrosequencing showed attachment of bacteria present in the inoculant, water between filters of the waterworks, on the filter medium surface (Figure 4).

Alphaproteobacteria (AOB's) were much more abundant (2-3 times) on the calcium carbonate column than in the water between filters (used as inlet).

DISCUSSION

DNA extraction, qPCR and pyrosequencing results

Table 3 – Sample overview and qPCR results.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Ext. DNA</th>
<th>Lib. DNA</th>
<th>qPCR</th>
<th>rRNA</th>
<th>Ext. DNA</th>
<th>Lib. DNA</th>
<th>qPCR</th>
<th>rRNA</th>
</tr>
</thead>
<tbody>
<tr>
<td>7M from Filter 2</td>
<td>1.01</td>
<td>1.79</td>
<td>1.28E+10</td>
<td>1.48E+05</td>
<td>5722</td>
<td>8290</td>
<td>1.2E+03</td>
<td>2.0E+06</td>
</tr>
<tr>
<td>7M from setup</td>
<td>1.73</td>
<td>1.14</td>
<td>2.68E+06</td>
<td>1.2E+15</td>
<td>1.6T32</td>
<td>1.0S32</td>
<td>0.5E+03</td>
<td>2.0E+06</td>
</tr>
</tbody>
</table>

Figure 3 – The 10 most abundant Phyla.

Figure 4 – Comparison of microbial diversity in the inlet (water between filters of the waterworks) and the filter medium coating – after 30 days, 20% of manganese removal (20 minutes of contact time).

• Biologically credited inlet and filter medium samples.

Filter media properties

Table 2 – Properties of different media.

<table>
<thead>
<tr>
<th>Filter media</th>
<th>Shape</th>
<th>Grain Size (mm)</th>
<th>Porosity</th>
<th>Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Quartz</td>
<td>0.99</td>
<td>0.89</td>
<td>0.90</td>
<td>0.96</td>
</tr>
<tr>
<td>B. Manganese</td>
<td>0.99</td>
<td>0.89</td>
<td>0.90</td>
<td>0.96</td>
</tr>
<tr>
<td>C. Anthracite</td>
<td>0.99</td>
<td>0.89</td>
<td>0.90</td>
<td>0.96</td>
</tr>
<tr>
<td>D. Calcium carbonate</td>
<td>0.99</td>
<td>0.89</td>
<td>0.90</td>
<td>0.96</td>
</tr>
</tbody>
</table>

REFERENCES


CONCLUSIONS

• After 30 days of start-up, 20% of the manganese in the inlet was removed (contact time of 20 min). Even with low manganese removal, there was a selection for some taxonomic groups on the filter material relative to the inlet.

• 16S rRNA amplicon sequencing showed attachment of bacteria commonly reported as MnOB's and AOB's on the medium coating. These included bacteria present in the inoculant (water between filters). Further, bacteria undetected in the inoculant suggest that other MnOB's were formed in the coating of the medium, such as: Hyphomicrobiurn and Hyphomicrobiae.

• Further investigations on microbial communities evolving on different filter media can have great importance for start up and management of biofilters for drinking water treatment.

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