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Site investigations in the Forsmark area

Control of microorganism content in flushing water used for drilling in KFM01A

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Keywords: Forsmark, bacteria, ultraviolet light, UV, disinfection

Contents

Abstract

A system for disinfection of flushing water and total organic carbon reduction in flushing water has been developed. It comprises a carbon filter and an ultraviolet (UV) radiation unit attached on line in the flushing water system. The reported activity aimed at control of the efficiency of the treatment system with respect to its disinfection capability. The results clearly demonstrated that storage of flushing water over weekends, and bad return flushing of the carbon filters resulted in increased numbers of microorganisms, compared to fresh flushing water from the source. The UV-unit worked as planned, but it is not positioned optimally.

Sammanfattning

Ett system för TOC reduktion och för anti-mikrobiell behandling av spolvatten för borrning har utvecklats. Systemet omfattar ett kolfilter och en UV-enhet ”in line” på spolvattensystemet. Denna aktivitet syftade till att kontrollera effektiviteten hos behandlingssystemet med avseende på avdödning av potentiellt kontaminerande mikrober i spolvatten. Resultaten visar på nödvändigheten av att UV-desinfektion sker så nära borrmaskinen som möjligt. Lagring av borrvatten över dag eller helg i tank samt dålig returspolning av kolfilter gav förhöjda bakteriehalter i spolvattnet. UV-enheten fungerade dock som planerat, men den sitter felplacerad i systemet.

1 Introduction

A system for disinfection of flushing water and total organic carbon reduction in flushing water has been developed. It comprises a carbon filter and an ultraviolet (UV) radiation unit attached on line in the flushing water system. It is known since earlier investigations that flushing water may introduce large number of contaminating microbes into the aquifers (Pedersen et al., 1997). This should be avoided.

2 Objectives

- This activity aimed at controlling the performance of the flushing water treatment system with reference to its ability to kill potentially occurring microbes in the flushing water.
- The results should demonstrate changes in the total number of microbes, the number of cultivable microbes and the possible numbers of sulphate reducing bacteria along the flushing water line, from the flushing water borehole source to the water entering the drilling machine.

3 Equipment and performance

Standard cultivation equipment and procedures were employed as follows:

Total numbers of bacteria were analyzed in triplicates according to Pedersen and Ekendahl, 1990.

Numbers of cultivable bacteria were analyzed in duplicates according to Pedersen et al., 1997.

Most probable numbers of sulphate reducing bacteria were analyzed according to Haveman et al., 1999.

Two sampling occasions were used. Thursday 021010 reflects system status after one week of operation. Monday 021014 reflects system status after a weekend without pumping or drilling.

4 Results

Six measuring points were analyzed. They were:

1. Before the carbon filter (sampling date 021010)
2. After the carbon filter (sampling date 021010)
3. After the UV-unit (sampling date 021010, UV in turned on position)
4. After the UV-unit (sampling date021014, UV in turned on position)
5. Newly filled tank (sampling date 021014)
6. Tank stored over a weekend (sampling date 021014)

4.1 Total number of bacteria

Figure 4-1 shows the total number of bacteria. The lowest numbers were obtained in the flushing water borehole and after UV 021010. After UV 021014 showed very high total numbers, probably due to the de-attachment of debris and microorganisms in the flushing line. Figure 4-2 shows that the UV efficiently killed those microbes. A slight increase in total numbers were observer in the flushing water tanks. During microscopy, indications of algal or cyanobacterial growth were observed.

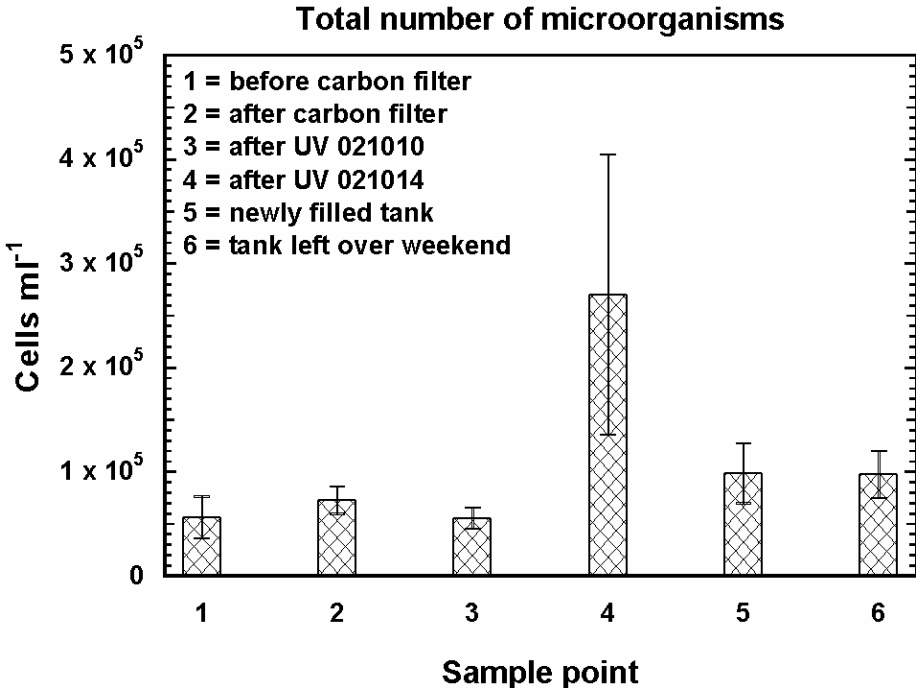

***Figure 4-1**. Total number of microorganisms.*

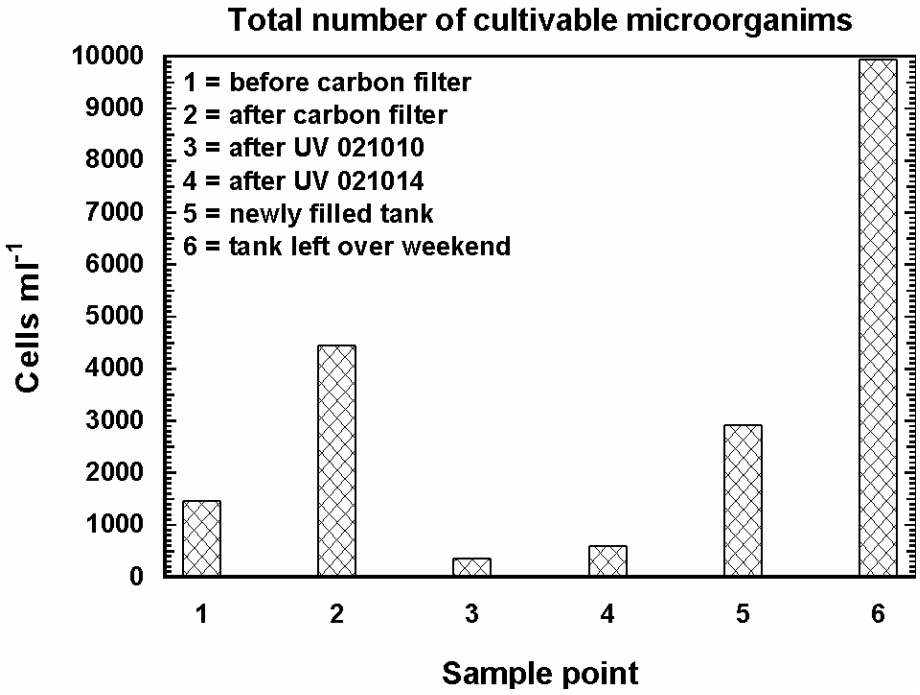

Figure 4-2. *The numbers of cultivable microorganisms.*

4.2 Number of cultivable bacteria

The numbers of cultivable microorganisms were low after the UV-unit both days. The carbon filter increased the numbers as did filling water into flush water tanks. Storage over weekend triggered a significant growth of microbes in the tanks.

4.3 Most probable numbers of sulphate reducing bacteria

The results showed no presence of sulphate reducing bacteria in the system.

5 Conclusions and suggested improvements

It becomes clear that the UV-unit is not mounted optimally in the system. The best position is after the tanks, just before the drilling machine. It also seems as if the back flushing of the carbon filter is too weak. This enables growth of microorganisms in the filter, which in turn will increase numbers of microorganisms downstream the filter. A more vivid back flush procedure is recommended. The tanks should be kept in the dark to avoid growth of algae and cyanobacteria. Those organisms produce oxygen during photosynthesis, which seriously affects the REDOX potential of the groundwater.

6 References

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