Electronic Supplementary Material (ESI) for Environmental Science: Water Research & Technology.

Pee Power Urinal – Microbial Fuel Cell Technology Field Trials In The Context Of Sanitation

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Supplementary Information

Oxfam trial

Chemical analysis of the inlet, outlet and catholyte is included in figure S1. It shows the gradual increase of pH in time in the inlet tank which is natural in urine, however the outlet tank shown gradual decrease in pH, which could be associated with MFC activity and electrochemical treatment. This includes pH splitting that results in generation of catholyte with a pH range of 9.1-9.4, whilst the outlet anolyte was shown to be 8.5-8.9. The conductivity and dry mass of the processed feedstock (S1 b,c) showed a decrease in conductivity due to the MFC treatment process both in the outlet and in the catholyte. However dry mass analysed in the catholyte showed an increase in the concentration of salts and solids in comparison to the inlet feedstock, from 10 up to 20 g/L. Chromatographic analysis included anion measurement in the inlet and outlet and it suggests that up to 20% of the phosphates and sulphates are being actively removed from the inlet stream whilst the chloride concentration stays in the same level or slightly increases. This might be due to the evaporation losses of water in the long term stationary system.

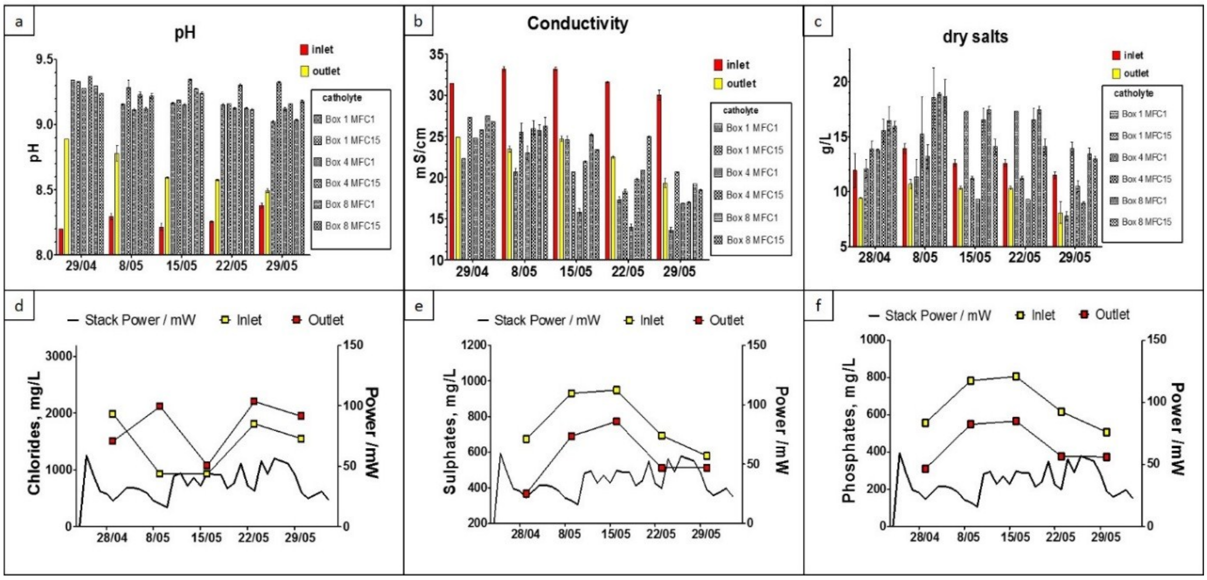

Figure S1 a, b, c) Comparison of the pH, conductivity and dry salts levels of the samples collected from the inlet and outlet tanks and from the synthesised catholyte collected from two MFCs (1 and 15) in three boxes of the stack (Box 1, Box 4 and Box 8). Graphs d, e, f - Average concentration of chlorides, sulphates and phosphates (mg/L) measured for the inlet and outlet.

Glastonbury trial

In the field trial analysis performed in Glastonbury Pee Power over the 6 days, pH levels (Figure S2a) measured in the first (Box 1), middle (Box 6) and last (Box 12) module of the stack showed that anolyte pH from initial 9.2 was gradually decreasing, while the collected catholyte showed an increasing pH trend, reaching 9.7 during the trial. Again, this suggests that MFC electrochemical operation induced pH splitting and ion separation. Conductivity and dry salts measurement show that catholyte increased in dry salt concentration and decreased in conductivity both in comparison to inlet and to anolyte. Whilst the active MFC treatment (COD and TN reduction rate) depends on power performance and on flow rate, the ion separation show similar trends both in low (Oxfam Pee Power) and high (Glastonbury Pee Power) feedstock flow conditions. The concentration increase of chlorides detected in the catholyte samples might be due to improved power and more efficient extraction of this element by MFC activity. Sulphates and phosphates were extracted most efficiently in the last module (Box 12) of the stack suggesting cascade treatment. Rapid flow rate and large quantities of feedstock in that trial might be affecting the consistent data output, however chemical extraction trends still can be visible. It is important to monitor in real time the MFC output, even when implemented in real world applications, since this would allow the operator to decide when it is appropriate to possibly discharge safely to the environment as fertiliser, the treated effluent (anolyte), and in addition extract high salt content, actively processed (catholyte), which could be used as a disinfectant. These initial results show great promise for further trials and analysis of MFC activated treatment.

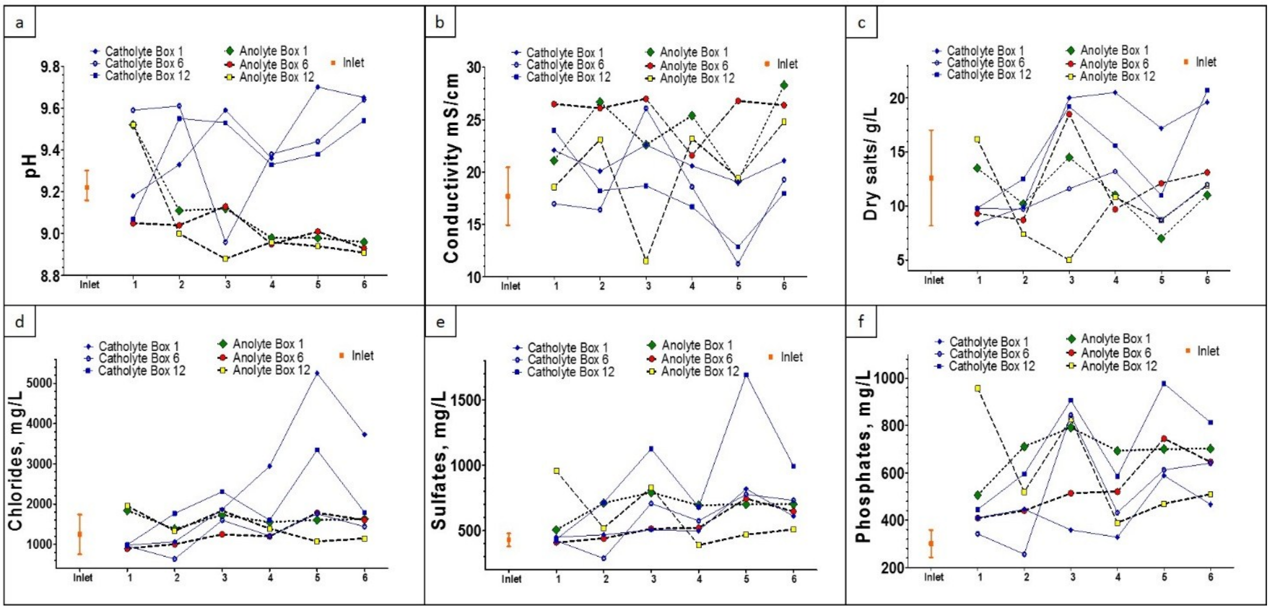

Figure S2. a) Results of pH, b) conductivity and c) dry mass of the anolyte and synthesised catholyte samples collected from MFCs in three boxes of the stack (Box 1, Box 6 and Box 12). Graphs d, e, f: Anions analysis in the anolyte and synthesised catholyte collected from MFCs in three boxes of the stack (Box 1, Box 6 and Box 12).