Report on the outcomes of a Short-Term Scientific Mission[1]

Action number: CA20130

Grantee name: Eric Deland

Details of the STSM

Title: establishment of a test system for the investigation of MIC by *Desulfovibrio ferrophilus* IS5 under anaerobic industrial flow conditions

Start and end date: 01/09/2022 to 31/10/2022

Description of the work carried out during the STSM

In the laboratory of Dr. Filipe Mergulhão group a flow cell system is used to simulate industrial flow rates. The flow cell contains 21 slides with space for two coupons and was built to work under aerobic conditions. In the first STSM, I was able to readjust the flow system to run under anaerobic conditions. Nevertheless, there were still some incalculable factors, whether the system can run 14 days anaerobically. In this STSM was the goal to run the system three times once as an abiotic control, once with *Delsulfovibrio ferrophilus* IS5 as well as once with *Methanobacterium affiliated* IM1. Unfortunately, we had a delay with the biogon gas bottle delivery, without I could not work anaerobic. Another problem was, that the system was made of Poly(methyl methacrylate) (PMMA) and the system get sterilize by bleach. Bleach will corrosively attack my coupons and can be possible distort my results. For that reason, the system did not contained coupons while sterilization once with 10 % bleach followed by two rounds of 5 % bleach. Afterwards, the system was washed out by sterile water, every step takes 15 min. Meanwhile, the coupons were one side polished, and a number was engraved on the other side. The initial weight was measured with a micro scale to calculate later the corrosion rate. On each slide two coupons were glued on with double side tape, and sterilized under UV light for 20 min. After the washing step the “empty” slides in the flow cell were replaced by the slides with the glued coupons. The system got gassed with biogon gas while performing two washing steps with anoxic, sterile water á 15 min. At the end, the system was filled up with the anoxic artificial seawater medium. For the biological runs, 10 % of the pre-culture of the microorganisms were injected via a syringe to the medium. The experiments run under maximum flow rate for 14 days and was gassed at least every second day with biogon gas for 15 min. At the end of the experiment the pumps were stop, the medium was slowly released, and the coupons were taken out. Three slides with each two coupons were pooled together in order that the flow cell is separated in seven sections. Five of six coupons of each section were used for the corrosion rate measurement and therefore the corrosion layer was removed. Some of the “corrosion rate” coupons

[1] This report is submitted by the grantee to the Action MC for approval and for claiming payment of the awarded grant. The Grant Awarding Coordinator coordinates the evaluation of this report on behalf of the Action MC and instructs the GH for payment of the Grant.

were used for OCT measurements before the corrosion layer was removed. The other coupons were prepared for later surface analyses.

Description of the STSM main achievements and planned follow-up activities

In the application for this STSM I planned to run the system twice under abiotic conditions and twice with *D. ferrophilus* IS5. During my first STMS we notice that we can do three runs if everything works perfectly. For that reason, we decide to run the system first under abiotic condition, then with *D. ferrophilus* IS5 and in the last run with *Methanobacterium affiliated* IM1. The results of the experiments were impressive and coincide what we observe with our flow cell and what the group of Mergulhão observe with their system. We observe much higher corrosion rates as we get with our flow cell, but still is *Methanobacterium-aff*. IM1 under flow conditions more corrosive than *D. ferrophilus* IS5. In contrast to our flow cell the corrosion was evenly distributed over the whole cell. This is something Mergulhão group observe when they look at the thickness of biofilms. The corrosion layer pattern of the different microorganisms and the abiotic control showed macroscopic differences. the abiotic control showed a thin corrosion layer whereas the coupons incubated with IS5 showed a thick corrosion layer, which seems to be loose connected the coupon. The coupons incubated with IM1 showed the interesting corrosion layer patter. The corrosion layer did not cover the whole coupon, it mostly only covers the lower part of the coupon. Here we observed the highest corrosion rates of all three runs, but also the smallest amount of corrosion layer. The analysis of the surfaces will be done in the near future and then we can say more about the corrosion layers. With the flow cell of Mergulhão group we created impressive results and we plan to make a publication out of it.

I would appreciate it if there were future follow-up collaborations with the group of Mergulhão and their flow cell. Next time they can maybe provide us on of their cells because there are very limited in their laboratory in anaerobic work.