

Report on the outcomes of a Short-Term Scientific Mission¹

Action number: CA20130

Grantee name: Tugce Tuccar

Details of the STSM

Title: Achieving standardization in MIC

Start and end date: 14/09/2023 to 29/09/2023

(My STSM period was 04/09/2023 to 18/09/2023. However, my stay took place 14/09/2023 to 29/09/2023 due to visa approval delay).

During this STSM visit, the purpose of the mission was to gain new knowledge about available technologies for MIC characterization, have a hands-on experience in the process of collecting data for MIC detection by using different laboratory devices and performing wet-lab techniques, and thus make preparations for the round robin MIC test procedure, a study carried out by EUROMIC WG5.

Description of the work carried out during the STSM

For two weeks, I attended the STSM at VIA University College Campus Horsens, Denmark, in the laboratory of Dr Torben Lund Skovhus. During my STSM, the work that was carried out, as described in the work plan.

During the first week of my stay, I got to know the laboratory facilities and learned the analyses used for MIC diagnosis. At the same time, Dr Skovhus organized a general meeting about the project. During this meeting, Dr. Skovhus, I and other participants in the round robin project discussed the test procedure for the pilot study in detail and decided the techniques that can be applied for obtaining reliable results. In addition, I attended technical field trips. I was informed about innovative water technologies during my visit to the Truelsbjerg Water Works (<https://www.aarhusvand.com/showcases/smart-cities/modern-waterworks-in-aarhus/>), both serving as a research waterworks and supplying Aarhus citizens with drinking water. I also had the opportunity to visit the modern molecular laboratories of the DNA Sense Company (<https://dnasense.com/>) at the University of Aalborg, and learn current high-throughput molecular microbiological methods (MMM) for detecting MIC. Finally, I met with Dr Edna Yamasaki Patrikiou, a STSM grantee, in the laboratory of Dr Skovhus, and had the opportunity to engage in scientific and training discussions with her.

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.

During the second week of my stay, I conducted wet-lab practices used for MIC diagnosis by using different methods and devices in the host's laboratory. The analyses that I performed were:

- The detection and measurement of Total-Iron (Fe) in drinking water samples was performed using colorimetric reagents paired with HACH DR6000 ultraviolet/visible light (UV/Vis) spectrophotometer.
- For quantification of total (active) microorganisms in drinking water samples, ATP content of the samples was determined by using two different kits, Quench-Gone Aqueous (QGA) kit used with LuminUltra PhotonMaster and Hygiena Biomass Kit used with EnSURE Touch Luminometer.
- The surface topography of the corroded metal coupons was scanned by a Keyence VR-3200 Wide-Area 3D Measurement System. Surface roughness and wear depth/peaks were measured by 3D scanning.
- The surface topography of the corroded metal coupons was examined and imaged by a stereo zoom microscopy (NIKON SMZ800N).
- Different metal materials were analyzed by Thermo Scientific™ Niton™ Handheld XRF Analyzer to determine the elemental composition of each material.

After each wet-lab work, Dr Skovhus organized meetings, in which we discussed and interpreted the significance of the findings.

Apart from lab practices at the second week, I also visited the materials laboratory of the Danish company Grundfos (<https://www.grundfos.com/>), one of the world's largest pump manufacturers, and learned about material corrosion testing methods. At the same time, I had the opportunity to conduct a MIC failure analysis case study. At this investigation study, my aim was to investigate MIC phenomenon by "Multiple Line Of Evidence" approach. In addition, I attended a webinar on Biofouling and Microbiologically Influenced Corrosion (<https://atv-semapp.dk/free-webinar-on-biofouling-and-microbiologically-influenced-corrosion/>). In this webinar, I gained more knowledge about a new approach to MIC Failure Analysis (Root Cause Analysis).

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

During my two weeks stay, I gained new knowledge to MIC diagnosis techniques and devices. For the first time, I performed ATP testing for detection of active microorganisms and 3D surface scanning for the analysis of corrosion pits, used stereomicroscope for corrosion image analysis and X-Ray machine for the elemental composition of metal, and also, I used the industry's most advanced laboratory spectrophotometer for water testing. Overall, I learned how to use the devices, conduct the analyses and interpret the results of the analyses.

During my STSM stay in Denmark, I visited different industrial plants. The visit to the Truelsbjerg Water Works gave me the opportunity to observe the set up that Dr Skovhus have there to perform a longitudinal evaluation of the biofilms since 2016 and their potential beneficial effects to the water quality (https://www.ucviden.dk/ws/portalfiles/portal/167550487/IWA_Poster_TOLS.pdf). At the DNA Sense, I was able to follow the different steps that are done from the receipt of the biofilm sample to the final analysis and interpretation of the sequence data. During the visit of the materials lab of Grundfos, I was informed about the chemical, mechanical and metallurgical (corrosion analyses especially) tests applied to different pipe material.

During meetings with Dr Skovhus, I was informed about a new multidisciplinary approach for diagnosing MIC, called "Multiple Lines Of Evidence" (MLEO) approach, and how to conduct a MIC failure analysis case study. Moreover, for the first time, I had to the opportunity to conduct a real MIC failure investigation in the corroded water pipe system in the company like a "Sherlock Homes". At this case study, I aimed to investigate root causes of MIC phenomenon by MLEO approach. This industrial experience enabled me to broaden my understanding of MIC problem.

Additionally, one more positive outcome from this STSM, I had the chance to meet members of the EUROMIC community, become a member of WG1 and selected as WG4-Vice Leader.

During this short term stay, I learned different MIC techniques and performed different analyses at the laboratory within the scope of the pilot study of a round robin MIC test procedure. The overall aim of this pilot study is to develop and establish a relatively simple test protocol to reproduce and characterize MIC in the laboratory using common environmental samples and analytical methods. Within this context, Dr Skovhus and I discussed the results of the analyses, I learned during this short time stay, and decided to conduct all of them for the future method development experiments.

Dr Skovhus, Dr Yamasaki Patrikiou and I discussed the possibility of a joint publication on the MLOE to investigate MIC in Materials Performance (AMPP magazine).