QUARTERLY PROGRESS REPORT

May 26, 2018 to August 30, 2018

PROJECT TITLE: Removal of Heavy Metals from Landfill Leachate using Polyelectrolyte Complex Membranes

PRINCIPAL INVESTIGATOR(S):

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COMPLETION DATE: February 28, 2019

PROJECT WEB SITE: http://www.cece.ucf.edu/sadmani/

Work accomplished during this reporting period:

Fabrication of fibers via electrospinning (Pertinent to Task 1 of research objective – membrane fabrication will be carried out throughout the entire research study)

Nanofiber membranes (NM) were fabricated via electrospinning of a homogeneous polyacrylic acid (PAA)/polyallylamine hydrochloride (PAH) complex solutions by dissolving PAH into 25% PAA aqueous solutions at different molar ratios of 8:1, 4:1, and 2:1. Based on the preliminary metal removal efficiency data, stability, and electrospinning speed, we have selected the ratio of 8:1 (PAA:PAH) for the fibers to be used for the rest of the study.

Characterization of fabricated fibers and evaluation of their stability in metal ion solution (Pertinent to Task 2)

Scanning electron microscopy (SEM) analysis was used for evaluating the fiber size, integrity, and stability. In addition to free standing fibers, ultrafiltration (UF) membranes, laminated with the fibers of optimized PAA:PAH ratio, were examined under SEM. SEM image of the NM-laminated UF membrane surface showed multiple layers of fibers covering the surface of the membrane (Fig.

1 and Fig. 2). The stability of the optimized membranes was investigated by weighing the mass of fabricated fibers before and after mixing in metal ion solutions. It was observed that the fabricated fibers were stable in the metal ion solutions and the weight difference (before and after soaking in the metal ion solution) was less than 6%.

FT-IR analysis of the fibers soaked in solutions containing various metal ions (lead, cadmium, chromium, and arsenic) at the experimental pH was also conducted (Fig. 3). The data are being currently analyzed.

Evaluation of adsorption of heavy metals by fabricated NMs and NM-laminated UF membrane (pertinent to Task 3)

Following the Cu and Pb ions removal tests (please see First and Second Quarterly Reports), the efficiency of the removal of Cd ion using the fabricated fibers was determined using a standard mixture of cadmium. Up to 40% Cd ion removal from DI water was observed when using fibers with PAA:PAH ratio of 8:1. No influence of fiber ratios, however, was observed on Cd removal efficiency when testing the fibers with 4:1 and 2:1 PAA/PAH ratios.

A bench-scale flat-sheet membrane apparatus (Sterlitech CF042) was fully assembled in order to evaluate the efficiency of heavy metals removal by NM-laminated UF membrane (Figure 4). During preliminary run, some leakages were detected in the system and hence the rejection experiments had to be rescheduled. The leakages have been fixed and the metal rejection experiments will resume now.

TAG Meetings:

No TAG meeting was held during this reporting period.

Metrics:

1. List research publications resulting from THIS Hinkley Center project.

None.

2. List research presentations resulting from (or about) THIS Hinkley Center project.

None.

3. List who has referenced or cited your publications from this project.

None.

4. How have the research results from THIS Hinkley Center project been leveraged to secure additional research funding? What additional sources of funding are you seeking

or have you sought?

We will seek additional funding from the Environmental Research and Education Foundation and U.S. EPA.

5. What new collaborations were initiated based on THIS Hinkley Center project?

No change.

6. How have the results from THIS Hinkley Center funded project been used (not will be used) by the FDEP or other stakeholders?

None to date.

Pictures/Figures:

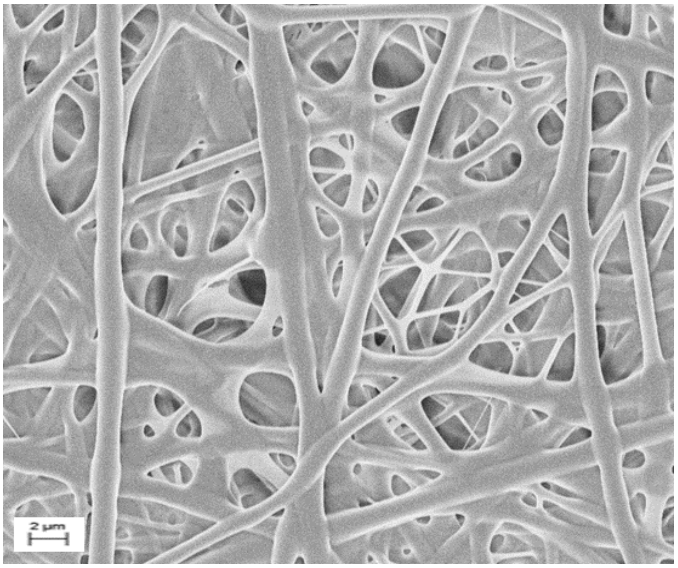

Figure 1. SEM image of the NM-laminated UF membrane surface.

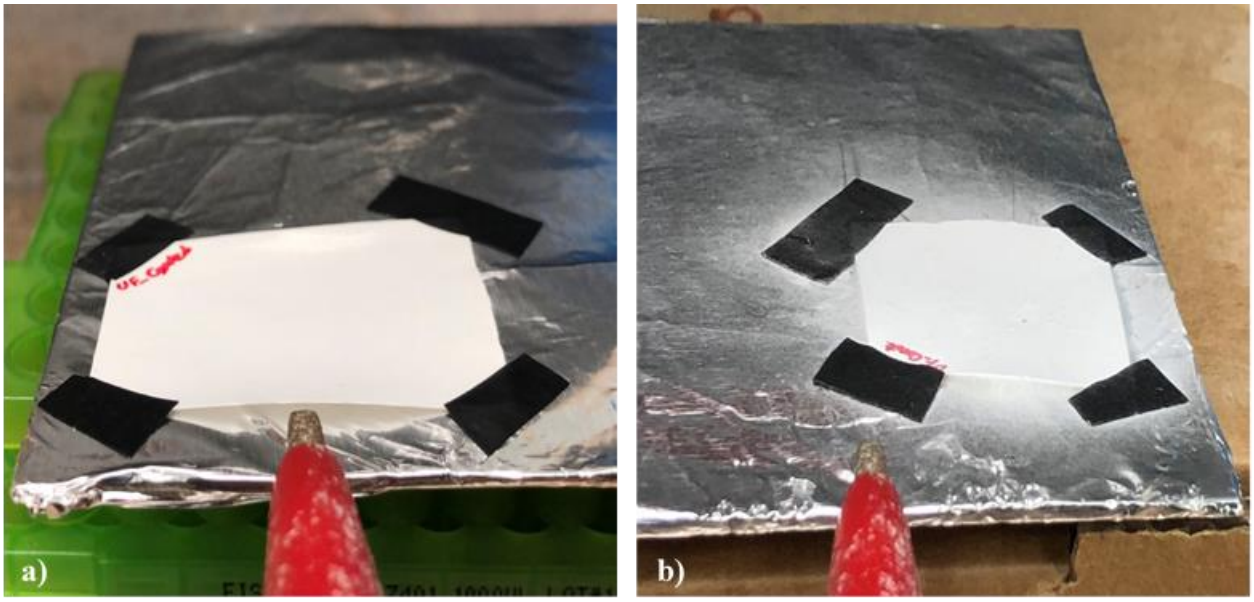

Figure 2. Surface of UF membrane a) before and b) after being coated by fabricated nanofibers/microfibers.

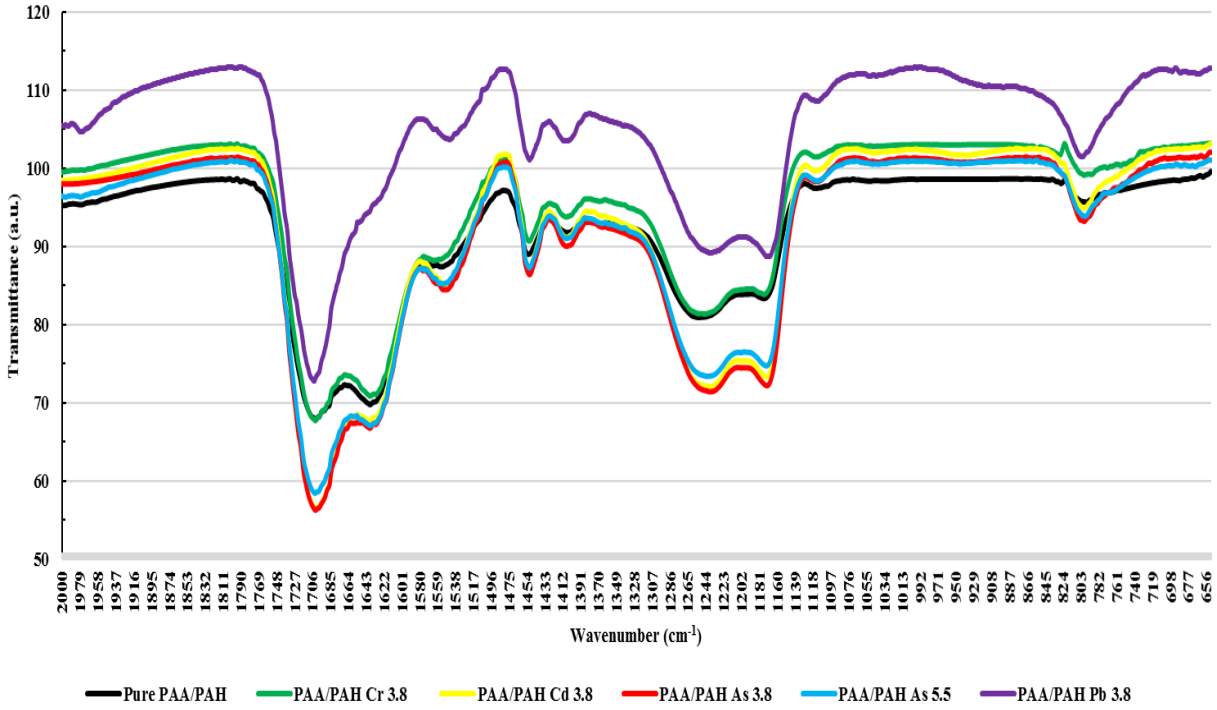

Figure 3. FT-IR spectra of fibers soaked in solutions containing various metal ions.

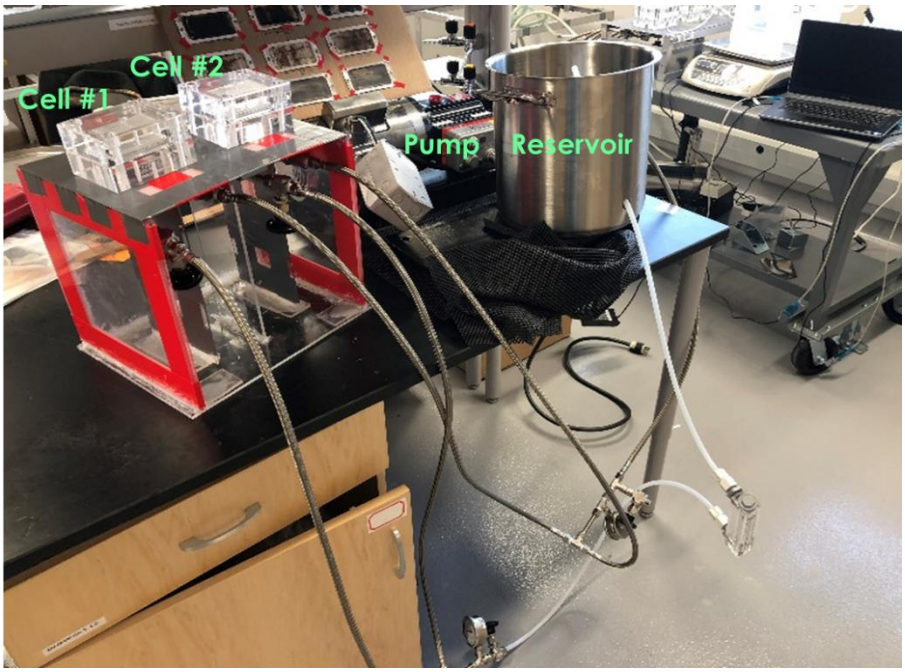

Figure 4. Photograph of Sterlitech CF042 cross-flow membrane setup.