MOVA Panel-Bed Filter Proof-of-Concept Testing
June 11, 2020

EXECUTIVE SUMMARY

MOVA Technologies developed a panel-bed filter prototype based on the concept of filtering particulate matter and gaseous contaminants through a fixed bed of solid sorbents. With a strategic goal to determine the efficacy of the operating concept of the panel-bed, MOVA partnered with Virginia Tech to perform Proof-of-Concept (POC) testing on the prototype. Designed to determine the panel-bed's capture potential through the testing of CO_2, SO_2, NO, and fly ash using a number of solid sorbents, the project included the integration of the prototype in Virginia Tech's Advanced Propulsion and Power Laboratory (APPL), prototype testing, and post-processing of data. The select contaminants intentionally included species relevant to a coal flue gas stream, however, the results can be applied to other industries such as natural gas fired power plants and agriculture.

The prototype utilizes long trays called louvers that are vertically stacked and hold thin beds of solid sorbents which facilitate filtration through chemisorption and physisorption processes. POC testing focused on a single contaminant gas stream with a single solid sorbent to generate the initial operating data needed to continue with the development of the technology. Selected in cooperation with the sorbent subject matter expert (SME), Dr. Stephen Martin, to provide the highest probability of sorption, the commercially available solid sorbents tested included potassium carbonate (CO_2), zeolite 13x (CO_2, NO, SO_2), activated carbon (NO, SO_2), and sand (fly ash).

Another objective of POC testing was to identify and provide recommendations for the design of the panel-bed device and its subsystems. The Virginia Tech team conducted extensive shakedown testing and has suggested design changes to the air delivery components, the sorbent renewal and delivery mechanisms, and sorbent handling components. The puff-back system presented a design challenge that has detailed the difficulties associated with using compressed air in the device, however, the lessons learned from testing will allow MOVA to focus their subsequent design phase to achieve a fully operational system. The design modifications will aid in future testing and scale-up of designs as the technology is moved towards commercialization.

Conclusively, based on the calculated capture efficiency data obtained throughout testing, the Virginia Tech team believes that a successful POC was achieved. Specifically, successful capture was shown for CO_2 with zeolite 13X, NO with both activated carbon and zeolite 13X, and SO_2 with activated carbon and zeolite 13X. The testing results obtained from the integrated test setup demonstrated the ability of the panel-bed filter to reduce gas concentrations for all three contaminant gases. However, post-processing of data uncovered a discrepancy in select NO and SO_2 test iterations between the mass flow and emissions analyzer measurements, likely due to a leak in the sampling or contaminant supply line. As a result, select tests will need to be redone in order to confirm the results, however, this does not affect the conclusion that a POC was successfully achieved.

Additionally, fly ash testing remains as several testing challenges were identified during POC. While the APPL is currently shut down for non-essential research due to COVID-19, the Virginia Tech team is working diligently to identify and implement effective solutions for the remaining tests once the lab reopens. The following testing report fully details the work performed up until the date the lab was closed and details the remaining plan to be completed once testing resumes.