

NSF STTR Project Summary

Overview: The Permian Basin is an oil-and-gas-producing area, approximately 250 miles wide and 300 miles long, located in West Texas and the southeastern New Mexico area. Over 85,000 drilling permits (for new wells and re-entry) have been issued for the Permian Basin by the TX RRC since 2006. In recent years, oil and gas producers have employed new methods that combine horizontal drilling with enhanced stimulation. These new methods, known as "fracking," have changed oil and gas wastes' profile - both in terms of radioactivity and volumes produced. The geologic formations that contain oil and gas deposits also contain naturally-occurring radionuclides, which are referred to as Naturally Occurring Radioactive Materials (NORM). Oil and gas fracking brings NORM to the surface in a concentrated form, which could pose a radiation safety hazard. In 2011, GTI carried out a Techno-economic Assessment of Water Management Solutions project (2011) supported by 23 companies' consortium. This consortium identified many priority industrial challenges for the pre- and post-crossover stages of a shale gas development area's water-based life cycle and identified NORM removal as one of the highest priority research areas. They also ascertained that there is currently no commercial product on the market to selectively remove NORM from concentrated produced and flowback water. This STTR proposal addresses this problem.

Keywords: NORM removal; fracking; produced water impurities; adsorbents; Computer-aided molecular design.

Subtopic: Chemical Technologies (CT6):

Intellectual Merit: Through the development of theory and computational methods with the Group Contribution method (GCM) and a novel optimization-based Computer-aided molecular design (CAMD) framework, Dr. Diwekar's group generated order-of-magnitude better clay-based adsorbents than currently commercially available or published adsorbents for removal of produced water impurities. However, these modeling results need to be verified experimentally by synthesizing these new adsorbents and comparing their adsorption behavior to the theoretically predicted isotherms before commercializing them. The research will result in efficient and cost-effective adsorbents customized for the type of water contamination encountered using the new CAMD framework and cutting-edge experiments. This is the focus of the current STTR proposal.

Broader/Commercial Impacts: The idea of using CAMD for NORM adsorbents is a novel concept that has never been used before. The proposed research is of considerable fundamental and practical significance to the area of produced water treatment. The proposed approach is expected to remove 99% of NORM from produced waters effectively. This approach also reduces the cost of treatment technology. This is going to have a tremendous impact on the fracking industry. This unique capability provides a competitive edge in the produced water market for stochastic research. We expect to capture at least 5% of the market in the next ten years. The project plans to disseminate results through presentations at SBIR conferences and webinars.