Permanent Oleophobic Surfaces to Mitigate Fouling of Instrumentation

Background

Many of the instrumentation techniques used for monitoring of process variables require direct contact with process fluids. While successfully used in various industries, the bitumen present in the oil sands tailings make the utilization of commercially available instruments challenging. When inserted in the flow, the oil-wetting components of tailings adhere to the surface of the instruments and negatively impact the accuracy of their measurements. Therefore, many of the instruments used in the tailings treatment facilities require frequent maintenance imposing an additional operational burden.

In order to minimize fouling, a few strategies have been developed in the past. One method includes utilization of oleophobic (oil-repellent) products to temporarily create a sacrificing oil-repellent layer on the surface of the instruments (see [1] and the references therein). However, these products only provide a temporary anti-fouling layer. Over time, they tend to get "washed" away in the process so they have to be re-applied on the surface of the instruments. Another method of mitigating fouling involves fabrication of "flow deflectors" in the vicinity of the measurement surfaces in order to change the direction of the flow streams. By reducing the probability of contact between the bitumen droplets and the probe surfaces, deflectors reduce the probability of fouling. However, changing the local flow patterns adjacent to the probe surfaces could impact the accuracy of some of the measurements. In summary, the mitigation strategies developed in the past only provide a partial solution to the issue of fouling in tailings facilities.

Biomimicry may provide another strategy for mitigating fouling of instrumentation in tailings processing. Biomimetic surface engineering utilizes nature-inspired textures in order to fabricate surfaces with superior properties such as self-cleaning [2], super hydrophilicity [3], and super hydrophobicity [4]. It has also been used in the past to manufacture high performance articles for industrial applications (see [5], [6], [7] and the references therein). However, implementation of biomimicry to develop anti-fouling surfaces requires additional research and development. The impact of the size, shape and the pattern of the textures on the accuracy of the measurements should be investigated. Additionally, the endurance of the surfaces structures developed through biomimetic techniques should be evaluated against harsh processing conditions experienced in tailings processing facilities.

Statement of Research Opportunity

Funding opportunities are available for fundamental research focused on the use of biomimicry (or other surface engineering techniques) to develop oleophobic surfaces for instrumentation used in oil sands tailings operations. The research should focus on developing engineered surfaces that would provide "permanent" oleophobic properties that could endure fluid dynamics conditions experienced in tailings processing facilities including high fluid velocities and moving fine and coarse particles in slurries that could contain up to ~4-5 wt% bitumen.

Desired Results

The research project should provide an understanding of whether surface engineering techniques can be utilized to create oleophobic surfaces for instrumentation used in tailings processing. Additionally, the impact of various surface patterns, shapes and dimensions on fouling kinetics under typical processing conditions experienced in the field should be provided as part of the study.

Works Cited

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