Skysong Innovations
Advancing the Arizona State University Knowledge Enterprise

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MitEmit

Background

Production and use of air-blown bitumen involves blowing heated air onto vacuum bottom (VB) to increase its stiffness to a desired point. The vacuum bottom is made from refining crude oil, and is mostly in the form of a heavy liquid. The mechanism of air blowing mainly relies on the oxidation of light compounds of VB via heated air, which increases the polarity of the molecules. This results in the production process being time-consuming, energy-intensive, and leading to the formation of secondary organic aerosols.

Modifiers and additives such as acidic compounds have been used to promote intermolecular interactions and play a role as an activator for the process. One of these additives, polyphosphoric acid (PPA), is a colorless liquid that has been shown to improve the high-temperature performance of an original bitumen by increasing its viscosity, softening point, and complex shear modulus. However, PPA is not capable of reducing the emission of volatile organic compounds (VOCs) from petroleum-based products to the air. VOCs are emitted to the atmosphere and contaminate the air, and are reported as key ozone precursors. In the air-blowing process in particular, there are high amounts of VOC emissions.

Invention Description

Researchers at Arizona State University have developed MitEmit, a platform technology designed to reduce the emission of hazardous organic volatiles to the air from petroleum-based products such as vacuum bottom, bitumen, and petroleum. MitEmit uses selectively grafted silica with bio-agents or polyphosphoric acids to retain volatile organic compounds (VOCs), which enhances the quality of the hydrocarbon products.

The MitEmit is produced by grafting the active sites of pristine silica nanoparticles with a hybrid bio-oil derived from a mixture of manure and algae bio-oils and/or with polyphosphoric acid. The resulting biopolymer grafted silica disperses well in crude oil, has a stiffening effect, and possesses adsorptive capability for VOCs.

Potential Applications

- Airblowing or asphalt plants (minimization of emissions and carbon footprint)
- Anti-slip coatings & waterproof linings
- Concrete joints

Benefits & Advantages

- Minimizes time of production
- Less energy consumed during the air-blowing process

- Lowers associated emissions while enhancing quality of resulting graded bitumen
- Better performance in stiffening process
- Eco-friendly- made from silica fume treated by bio-oil and/or PPA

Related Publication: Enhancing the Economics and Environmental Sustainability of the Manufacturing Process for Air-Blown bitumen - Journal of Cleaner Production (2021)