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Apparatus and Method for In-rheometer Automated Chemical Dosing and Reaction Monitoring of Fluid and Semi-solid Materials

Accessory automates additive dosing in rheometers for real-time reaction monitoring.

Researchers at Purdue University have developed an automated laboratory rheometer accessory designed to complement existing rheometers. Presently, there are no commercially available methods for controlled additive dosing inside the measurement chamber of scientific laboratory rheometers. The only way to test the effects of additive dosing on a mixture is to prepare multiple samples, which involves time-consuming cleaning and testing procedures. Moreover, in the case of fast-occurring chemical reactions, mixing the additives outside the rheometer means valuable data on the reaction will be missed between the time of mixing and the placement of the mixture inside the rheometer measurement chamber. Efforts have been made to design automatic sample reloading arms, but these solutions can only hold a select number of samples at a time and are unable to perform real-time dosing of chemicals into the rheometer cup. This shortcoming prevents continuous sampling and hinders real-time collection of rheological data during and after additive dosing.

The technology developed by Purdue University researchers helps laboratory rheometer manufacturers and scientists execute controlled chemical dosage injections in laboratory rheometers. The system is designed to fit a variety of laboratory rheometers. With adjustable feeding and dosing protocols, this technology performs continuous, real-time reaction monitoring absent in commercially available methods. The apparatus significantly reduces the time and manual labor required for dosing, as instead of preparing multiple samples with different doses of additives, a single sample can be used.

Technology Validation:

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Category
GreenTech/Water & Resource Management
Chemicals & Advanced Materials/Materials Processing & Manufacturing Technologies

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The apparatus and testing methodology were validated by monitoring the effects of increasing doses of a polymeric flocculant on the mechanical and chemical properties of fluid fine tailings (FFTs), a soft waste by-product produced by the mining industry. Results corroborated the accessory's use as a process control tool for a broad range of applications in different industries, notably for food, pharmaceuticals, and environmental industries.

Advantages:

-Enables bulk sample placement and evacuation for repeated quality control of the material

-Eliminates issues associated with sample-to-sample variability

-Enables continuous collection of rheological data during a process (e.g., a chemical process resulting from the introduction of an additive into a paste or liquid), allowing continuous reaction monitoring

Applications:

-Advanced modular rheometers

-Soft matter research and manufacturing

-Material science

-Food science

-Biotechnology

-Pharmaceuticals

-Wastewater treatment

-Environmental analysis and clean-up

TRL: 4

Intellectual Property:

Provisional-Patent, 2023-12-19, United States

Utility Patent, 2024-12-12, United States

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manufacturing, soft matter