Industrial Technologies Program

In-Plant Testing of High-Efficiency Hydraulic Separators

Innovative New Generation of Teeter-Bed Hydraulic Separators Offers Enhanced Separation Efficiency and Lower Operating Costs

Conventional hindered-bed separators are used extensively for classification and gravity concentration of minerals such as ore, coal, and titanium-bearing beach sands. The process can be inefficient due to wide variations in the solids content and size distribution of the feed. The poor efficiency has an adverse impact on plant performance (product recovery, concentrate quality and throughput capacity), and on operating costs (power consumption, water usage and reagent consumption).

Design improvements are needed to correct inefficiencies associated with conventional hydraulic separators. Virginia Tech and Eriez will further develop and evaluate new high-efficiency separators that will help to address this issue. Two important novel separators are the "CrossFlow Separator" and "HydroFloat Separator," which are high-tech variations of the conventional teeter-bed separator concept. Compared to a conventional classifier, the CrossFlow design combines the use of an improved feed injection system and simplified water distribution system. This makes it possible to increase both the separation efficiency and throughput capacity, while eliminating mechanical problems associated with existing designs. Operating demands, including power, water and maintenance, are expected to be significantly lower for the CrossFlow design when reporting on a per ton of concentrate basis because of higher throughput capacity. The HydroFloat separator, a novel air-assisted hydraulic concentrator, is an innovative process that combines the flexibility of a flotation process with the high capacity of a density separator. The HydroFloat separator's unique design features will make it ideal for recovering very coarse particles that are too large to be upgraded by existing froth flotation processes.

Fine particle classification is practiced at essentially all mineral and coal processing operations. Therefore, the entire industry is expected to benefit from the industrial research work outlined in this project. The proposed work will initially focus on only phosphate, mineral sands, and coal-related applications. However, the technological improvements for the separator will positively impact many other mining related applications.

Benefits for Our Industry and Our Nation

- *The use of more efficient hydraulic separators will reduce energy usage during fine sizing by up to 42% in the mineral sands industry, 79% in the coal industry and 21% in the phosphate industry.*
- *Power consumption is expected to be reduced by up to 60% due to less pumping of dilution water and by eliminating the energy for the pressuring of cyclones.*
- *The content of valuable minerals in the concentrate of raw feed can be increased to 75-95%.*
- *The classifier's separating efficiency and unique design features can lower operating and maintenance costs, and reduce wear on processing equipment.*

Applications in Our Nation's Industry

This research will directly focus on the phosphate, mineral sands, and coal-related industries; however, it could benefit all mineral ore coal processing operations where fine particles are classified. Other non-mining industries, such as recycling, that incorporate classification and beneficiation circuits for the effective size range will also benefit.

Project Description

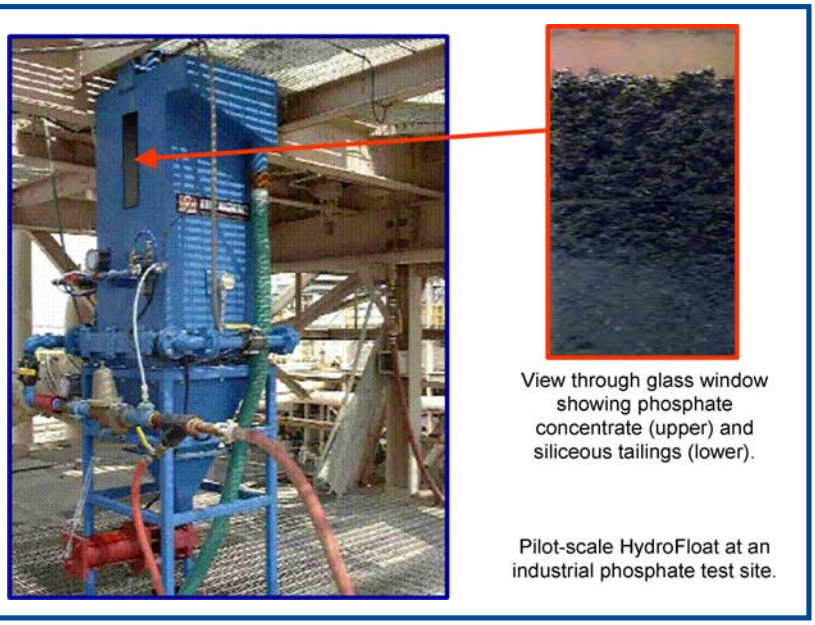
Goal: To demonstrate the enhanced separation efficiencies and lower operation costs for both the CrossFlow and HydroFloat technologies for mineral classification and concentration in the mineral and coal industries.

These goals will be achieved through two phases. In Phase I, these new technologies will be further developed through systematic pilot-scale testing of key design and operating variables at three industrial sites. In Phase II, the technologies will demonstrate improved performance capabilities in field trials conducted at one of the industrial sites, using a production-scale prototype. Data from the pilot-scale and prototype tests will be used to develop simulation programs for process scale-up and to develop optimized high-efficiency flowsheets.

Upon successful completion of Phase I, the industrial team members will evaluate the feasibility of upgrading existing processing circuits and/or installing new processing circuits based on the projected benefits. Virginia Tech and the University of Kentucky will assist with flowsheet design and projected processing performance, utilizing the simulator developed during Phase I of this project. Eriez, the equipment manufacturer, will provide the design and engineering functions to scale up the unit for commercial production. Eriez will also manufacture the production-scale unit. As such, Eriez will take a leading role in the long-term commercialization efforts for these new technologies.

Milestones

- Set up and test continuous pilot-scale test circuits at three dissimilar processing facilities.
- Perform economic analyses to identify the most suitable location among the three industrial test sites for the installation of a production-scale prototype separator.
- Select a prototype test site to perform a wide range of research and engineering activities, including flowsheet design, equipment selection, circuit installation, circuit testing and technical/economic evaluations.
- Develop a database from both phases of work to establish scale-up criteria and to project operating costs for additional installations of the proposed technologies.



View through glass window showing phosphate concentrate (upper) and siliceous tailings (lower).

Pilot-scale HydroFloat at an industrial phosphate test site.

Project Partners

Virginia Tech
Blacksburg, VA

University of Kentucky
Lexington, KY

Eriez Manufacturing, Inc.
Erie, PA

Cargill Fertilizer Co.
Bradley Junction, FL

DuPont Mining Co.
Starke, FL

TECO Coal Corporation
Feds Creek, KY

A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.

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Energy Efficiency and Renewable Energy

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