



Eriez StackCell® Flotation Technology for the Coal Industry

Eriez Flotation provides advanced engineering, metallurgical testing and innovative flotation technology for the mining and minerals processing industries. Strengths in process engineering, equipment design and fabrication position Eriez Flotation as a leader in minerals flotation systems around the world. Eriez Flotation has designed, supplied and commissioned more than 1,000 flotation systems worldwide.

Eriez Flotation pioneered column flotation with the introduction of the SlamJet® and CavTube™ sparger technologies into coal beneficiation plants. Building upon the experience gained from decades of design, engineering, and operation of coal flotation circuits, Eriez developed a new high-efficiency flotation technology called the StackCell®. This breakthrough technology, derived from a fundamental understanding of flotation first principles, offers column-like metallurgical performance with an order of magnitude increase in flotation rate.

BACKGROUND

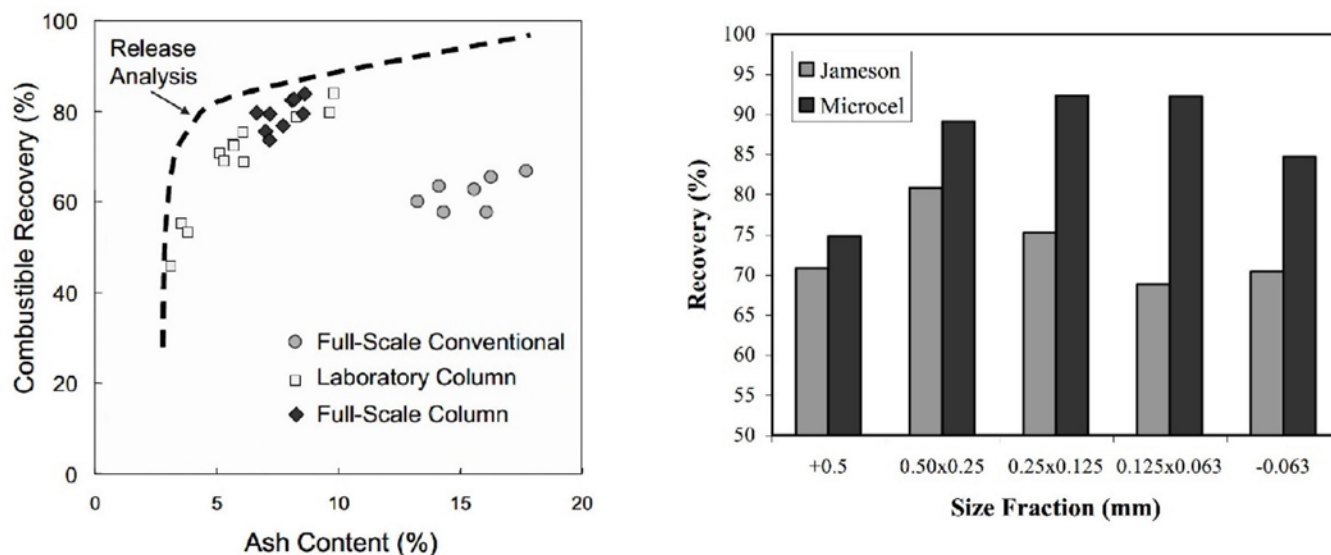
Eriez Flotation – A Proven Leader in Coal Flotation Technology

The economic benefits of Eriez' column flotation technology were quickly realized with consistent increases in plant yield and improved selectivity. The excellent selectivity of Eriez' column cells is due to the addition of froth wash water that practically eliminates the nonselective hydraulic entrainment of ultrafine ash-bearing minerals (clays) into the clean coal product. This point has been proven on numerous occasions by comparison of plant flotation data with the release

analysis separation curve. Several investigations have been published that document bottom-line improvements achieved using Eriez' column cells over mechanical cells and other types of flotation systems.

The superior separation performance compared to conventional cells is illustrated in Figure 1 (below) which compares Eriez' column technology to an existing bank of conventional cells. As shown, the separation results for the column cell are far superior to those achieved using conventional flotation. In fact, the data for column cells tend to fall

Figure 1. Comparison of column and conventional cells (left), and comparison of pilot cell results for the Peak Downs plant (right)



just below the separation curve predicted by release analysis. This suggests that columns provide a level of performance that would be difficult to achieve even after multiple stages of cleaning.

An example of the difference in metallurgical performance between column flotation and the Jameson cell was illustrated in a side by side pilot comparison test of the two technologies. The pilot test campaign was conducted at the Peak Downs preparation plant located in Australia. As shown in Figure 1 (above), the column cell achieved higher size by size recovery when compared to the Jameson cell. Based on these results, Eriez column technology was selected for the expansion projects at Peak Downs and, subsequently, the Saraji preparation plant.

Eriez' Commercial Success with Column Flotation

To date, Eriez Flotation has supplied nearly 1000 flotation columns throughout the world for mineral concentrating applications that include iron ore, base-metals, gold, industrial minerals,

fertilizers (phosphate and potash), energy (coal and oil-sands), and specialty applications such as oil/water separation. Coal applications comprise over 100 of these installations. A partial list of Eriez' column installations in the United States and Australia is included at the end of this paper. Of particular interest is the Arq Corbin facility in the United States, which recently chose Eriez column flotation technology over the Jameson cell for a new tailings pond reclamation plant.

STACKCELL® FLOTATION TECHNOLOGY

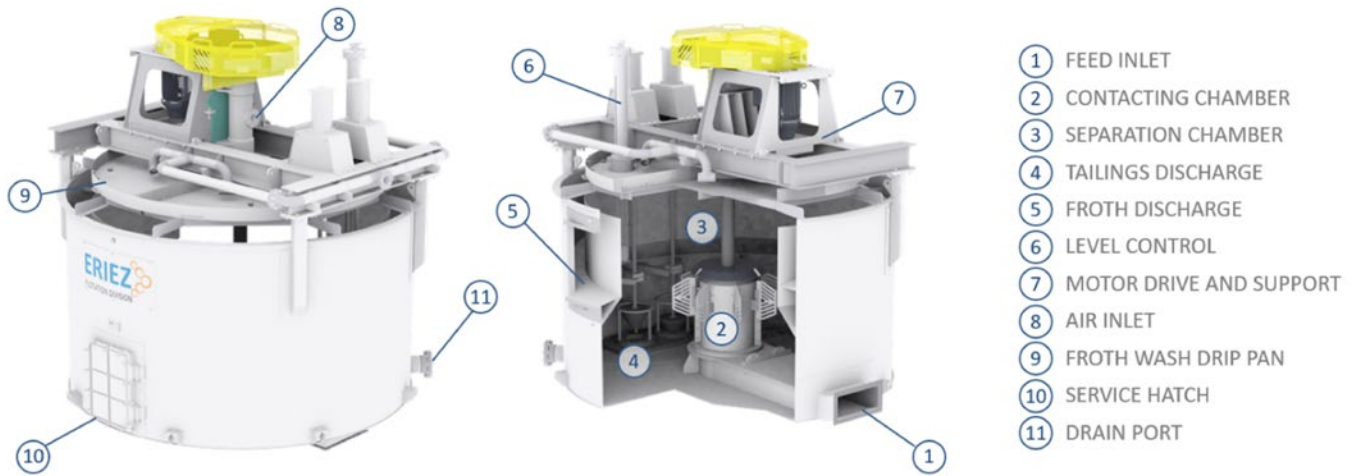
A New Technology for the Next Generation of Coal Processing

While column flotation offers substantially improved performance, there are design matters that must be considered for a properly engineered installation. One such challenge results from the column's large size. Column cells are typically designed to achieve the required residence time and capacity as well as to minimize internal mixing conditions. Due to the large size, fabrication, transportation and erection

can present a challenge. Additionally, column cells present a large foundation load which can drive up costs in some situations. These concerns illustrate the need for the development of a new generation of flotation machine that offers column-like performance, while improving upon the design and operational challenges of traditional flotation circuits.

Building upon the experience gained from decades of design, engineering, and operation of coal flotation circuits, Eriez developed a new high-efficiency flotation technology called the StackCell®. This breakthrough technology, derived from a fundamental understanding of flotation first principles, offers column-like metallurgical performance with an order of magnitude increase in flotation rate. As a result, the StackCell™ provides the same level of performance with reduced cell size, circuit footprint, and installed power. Additionally, a substantial reduction in capital and operating costs compared to other flotation technologies has also been demonstrated.

Figure 2. Illustration of the Eriez StackCell® Flotation Technology



StackCell® Overview

As shown in Figure 2, the StackCell® is a two-stage flotation cell that consists of a contacting chamber that is de-coupled from a quiescent separation zone.

Feed slurry enters the bottom of the contacting chamber which contains a rotor-stator assembly and is capped by a rotating lid. Air is introduced through the shaft at the base of the chamber. The aerated slurry flows upward through the rotor-stator assembly in a high-energy, plug-flow environment that facilitates bubble-particle contacting. This high-efficiency design substantially reduces

the residence time required for bubble-particle collection and eliminates the traditional “contacting zone” required for flotation columns. After contacting, the aerated slurry flows into the outer separation chamber through an annular gap between the contacting chamber and the rotating lid to allow for phase separation of pulp and froth to occur.

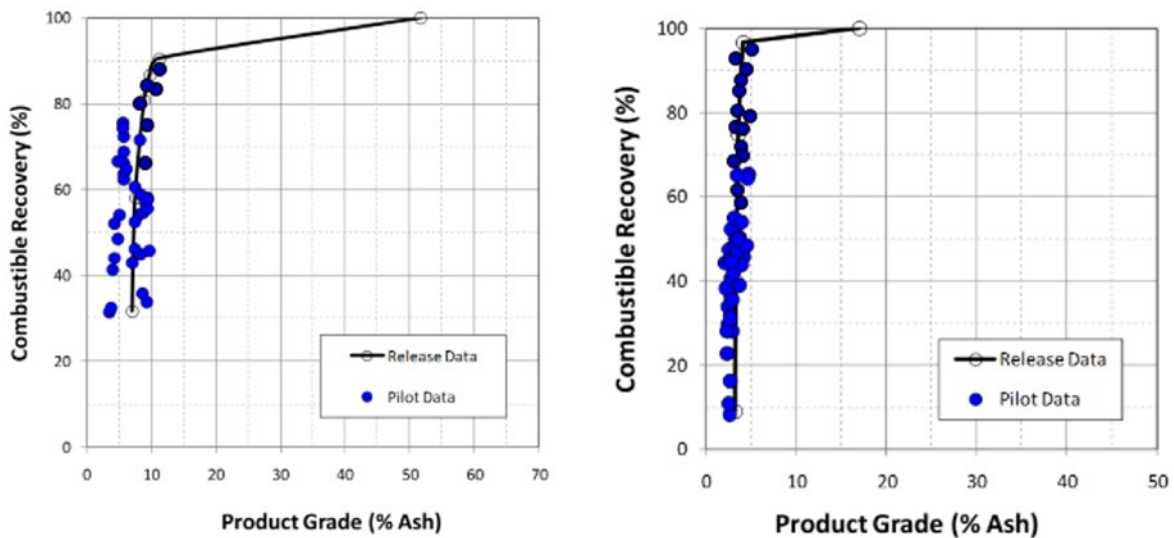
Early Success of StackCell® for Coal Processing

Early work with the StackCell® technology was conducted throughout the eastern U.S. coal fields. The initial pilot testing

was completed using a 1.2-meter diameter StackCell. The flotation response of several thermal and metallurgical coal types was investigated including the Amburgy, Hazard No. 4, Red Ash, Gilbert, and Pocahontas No. 3 seams. These results are shown in Figure 3. As illustrated in both figures, the StackCell® performance was consistent with the ultimate grade versus recovery curve as defined by the release analysis procedure.

To demonstrate the performance capabilities of the StackCell® technology, a 3.7-meter full-scale unit was installed as a rougher unit ahead of two existing

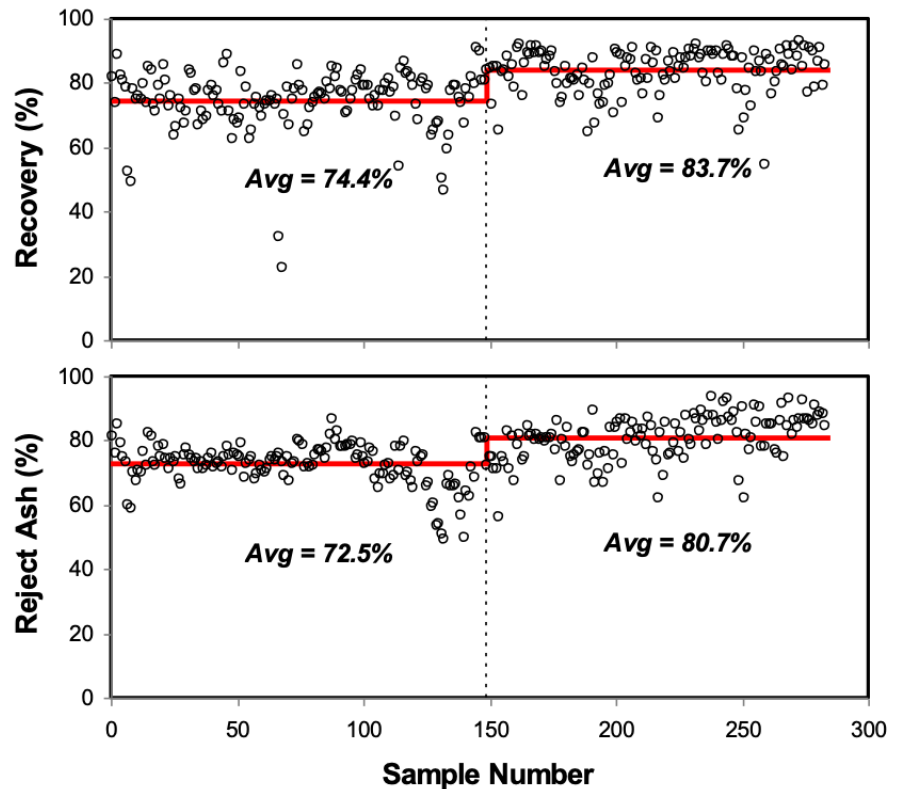
Figure 3. Single-stage StackCell® treatment of Amburgy and Hazard No. 4 Seams (left), and of Red Ash, Gilbert and Pocahontas No. 3 Seams (right)



flotation columns. Historical data suggested that the two column cells were often overloaded due to plant production demands and a recent drop in feed ash content.

Figure 4 shows the impact of the StackCell® installation on the combustible recovery and refuse ash for the entire flotation circuit. For the first 149 production samples taken prior to the installation, the two column cells provided an average recovery of 74.4% and a combined refuse ash of 72.5%. After the installation, the combined recovery for the StackCell® and two column cells improved to 83.7% and the refuse ash increased to 80.7%. The increased recovery is significant considering that less than 10% more cell volume was added to the circuit via the installation of the StackCell® technology. In fact, the contacting chamber provided an additional residence time of less than five seconds to the total flotation circuit.

Figure 4. Combustible recovery and refuse ash improvement with StackCell® installation at Alpha Natural Resources' Roxana Preparation Plant



Sustained Success and Expansion to New Industries

The recent focus of the StackCell technology in coal preparation has been directed toward the recovery of low ash coal from the fines discarded in deslime flotation circuits. Eriez has successfully demonstrated that the StackCell can be incorporated into existing circuits to economically recover and upgrade discarded coal fines, with substantial increases in revenue and profitability. Between 2020 and 2022, twelve (12) StackCells have or will be installed in coal preparation plants in North America and Australia. Through the combination

of StackCell flotation and modern fines dewatering technologies, ultra-fine coal recovery projects offer attractive paybacks as short as a few months.

Furthermore, the StackCell® technology has been proven very successful in several other mining industries including base metals and precious minerals. For more information about Eriez Flotation products, visit www.eriez.com or call (604) 952-2300.



Figure 5. Eriez StackCell® model SC-200 prior to delivery to a North American customer



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Established in 1942, Eriez is a global leader in separation technologies. Our commitment to innovation has positioned us as a driving market force in several key technology areas, including magnetic separation, flotation, metal detection and material handling equipment. The company's 900+ employees are dedicated to providing trusted technical solutions to the mining, food, recycling, packaging, aggregate and other processing industries. Headquartered in Erie, Pennsylvania, USA, Eriez designs, manufactures, and markets on six continents through 12 wholly owned international subsidiaries and an extensive sales representative network. For more information, visit www.eriez.com.

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