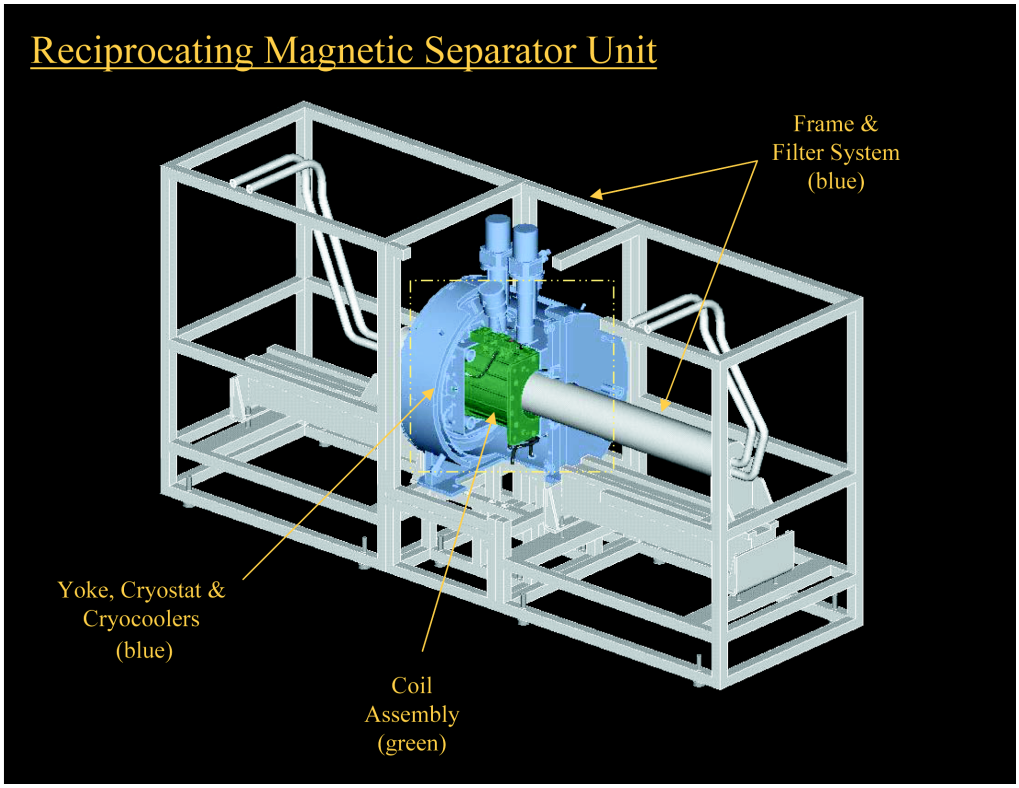
# Reciprocating Magnetic Separator

P R O J E C T • F A C T • S H E E T

SPI Projects are Co-Funded by the U.S. Department of Energy
Superconductivity for Electric Systems Program and Industry Partners

*Superconductivity Partnership with Industry*




*Design concept for the new commercial scale HTS reciprocating magnetic separator. (DuPont)*

## What are its Primary Applications?

HTS magnetic separators have a variety of industrial applications, most notably in the mineral separation, environmental, and chemical processing fields. They can be used to process ores, waste solids, and waste gases, as well as perform isotope separations and water treatment. They can also be used effectively in environmental remediation applications. Magnetic separation is currently used to purify kaolin clay, a material used in high-quality paper.

## What are the Benefits to Utilities?

An HTS magnetic separator consumes little electric power beyond that required for refrigeration. Replacing conventional resistive copper coils with HTS has the potential to reduce the energy cost of operating the magnet by more than 90 percent. The HTS magnetic separator is conduction-cooled and has no liquefying system to maintain. The unit will also be smaller and lighter than its conventional counterparts. As a result, the HTS magnetic separator will be substantially more efficient and will cost less to operate than a conventional magnetic separator. Although electric utilities do not use magnetic separators, they will benefit from the deployment of HTS magnetic separators through reduced demand on power transmission systems.

## What is the Market Potential?

Many industries would benefit from the extremely efficient separations made possible by HTS technology. The technology could have a revolutionary effect on the chemical processing industry. Chemical Processors in the U.S. account for over 750 billion pounds per year of the 50 most widely used chemicals. Processors in remote mining locations, such as the Amazon jungle, would derive particular benefit by being able to operate on less electricity in places where electricity may be expensive or not readily available. The growing environmental remediation

## Goal:

To build a commercial scale, pre-production high-temperature superconducting (HTS) conduction-cooled reciprocating magnetic separator.

## Team:

DuPont Superconductivity (team leader)

American Supercondutor (coil manufacturing)

Outokumpu Physical Separation Division (mineral processing equipment)

J.M. Huber Corporation (field testing)

## Period of Performance:

January 2002 - December 2005

## Cumulative Project Funding:

Private $4.4 million (52%)

DOE $4.1 million (48%)

Total $8.5 million

## What is it?

A magnetic separator uses magnetic force to separate materials of various compositions on the basis of their magnetic properties.

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industry could also capitalize on the device's ability to separate dilute solutions of hazardous materials.

Magnetic separation technology is also frequently used to separate tramp iron from coal at mines and processing plants.

## WHAT ARE THE PROJECT ACCOMPLISHMENTS TO DATE?

The current project was awarded in January 2002, and design and fabrication of individual components of the Magnetic Separator are underway. In an earlier project, a one-quarter scale HTS reciprocating magnetic separator was built and tested. Because the HTS can generate a higher magnetic field than a conventional resistive separator, it performed at a greater throughput rate than a conventional resistive separator, while using less power.

### HOW DOES A RECIPROCATING MAGNETIC SEPARATOR WORK?

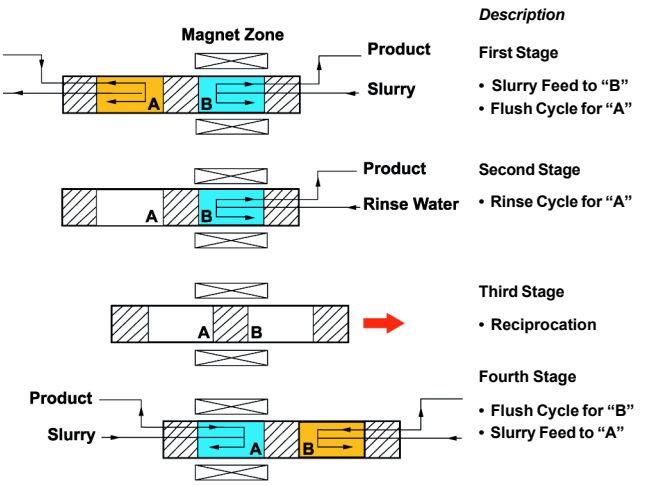


*Diagram of the operating cycle of a reciprocating magnetic separator. (Outokumpu PSD)*

*DuPont's laboratory facility where the HTS magnetic separator technology is being developed. (DuPont)*

## HOW DOES IT WORK?

HTS magnetic separators operate on the same principle as conventional magnetic separators, but because the magnets are coils of HTS wire, they can generate potentially stronger magnetic fields which translates to greater processing capacity. This improved performance enables the separation of larger amounts of material in a shorter time span, or separation of more dilute materials.

A "reciprocating" magnetic separator consists of a pipe-like channel through which raw slurry is passed. The magnetic field generated across the channel causes certain materials to be separated and capture in a canister. The canister is then "reciprocated" out of the magnetic field, and the separated materials are retrieved. This eliminates the need to turn the magnet on and off with each cycle, and lessens AC losses which heat the superconductor and cause loss of conductivity. It also enables essentially continuous operation.

The new magnetic separator will incorporate improved conduction cooling methods, eliminating the need for liquid helium cryogenic systems.

*1/4-scale HTS reciprocating magnetic separator ready for laboratory testing. The new project will build on the knowledge gained in the development of this smaller scale device. (DuPont)*

## WHAT IS THE STATUS OF THE PROJECT?

*The current project, for development of a pre-production HTS reciprocating magnetic separator, was awarded in January 2002 and will end in December 2005. Preliminary component design and fabrication has begun. An earlier project yielded a 1/4-scale unit that was successfully demonstrated in December 2001 for processing kaolin clay.*


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