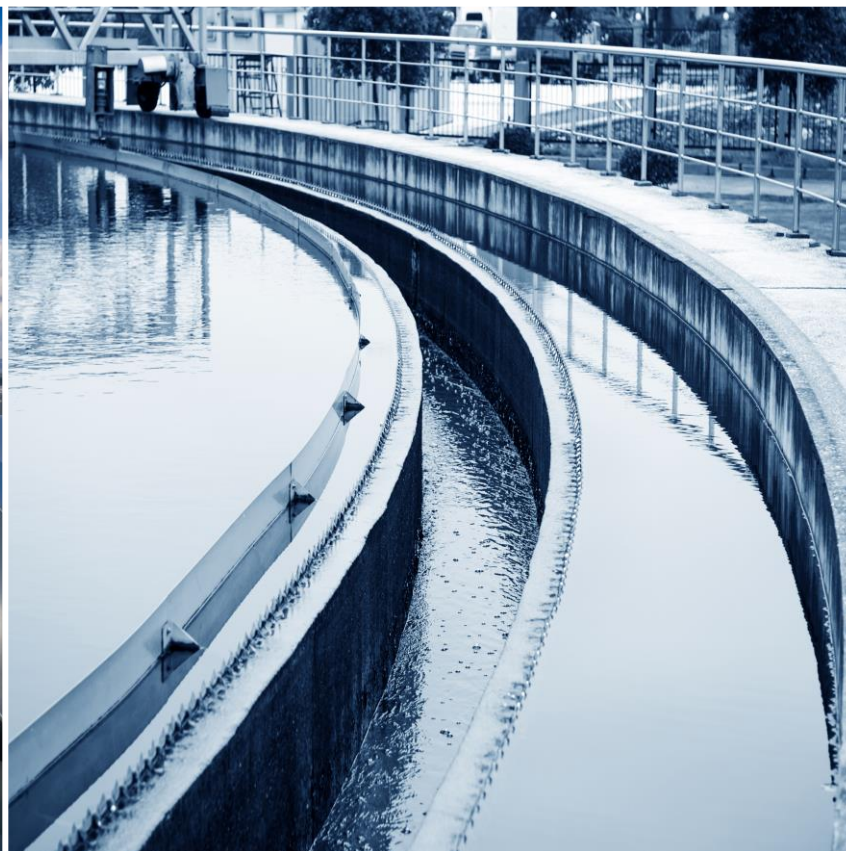


Black Powder Solutions



Water Treatment with Magnetic Separation

February 2020

Black Powder Solutions

Black Powder Solutions (BPS) is a Canadian company that designs and manufactures patented magnetic separator systems as an inline, full-flow solution to removing Black Powder™ contamination from hydrocarbon fluids and gases, refined products, petrochemicals and water.

These systems are the sustainable alternative to conventional filtration; they protect processes and equipment from breakdown or failure at all stages of the hydrocarbon value chain because they effectively remove > 1 micron sized particulate which is detrimental to process system reliability.

Deployment of BPS technology will ultimately elevate system operations, increase production, improve product quality, support safety initiatives and reduce environmental impact.

Black Powder Contamination

Black powder is the industry term for the abrasive, reactive contamination present in all hydrocarbons and hydrocarbon derivatives. Black Powder precipitates from erosion, chemical corrosion and bacterial corrosion of carbon steel pipeline walls and components; moisture, temperature and pressure variance accelerate Black Powder production.

- ❖ Comprised of iron oxides, iron sulfides, chlorides, sodium, calcium and varying dirt such as silica and other particulate.
- ❖ Black Powder originates from producing formations and precipitates throughout the hydrocarbon value chain: during transmission, loading and offloading, fractionation, refinement, processing, petrochemical production and storage.

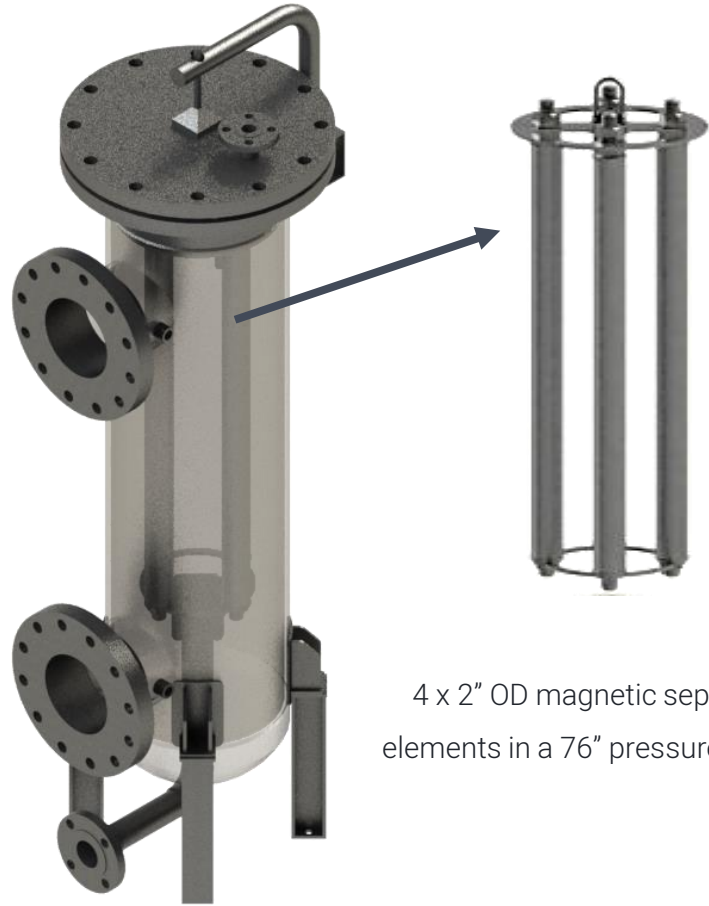


Black powder as a result of catalytic cracking.



Iron oxide rust contamination built up in piping resulting from black powder.

BPS Magnetic Separators



4 x 2" OD magnetic separator elements in a 76" pressure vessel.

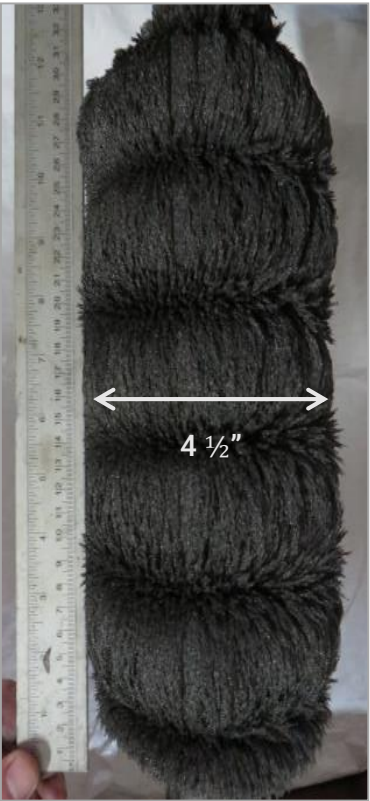
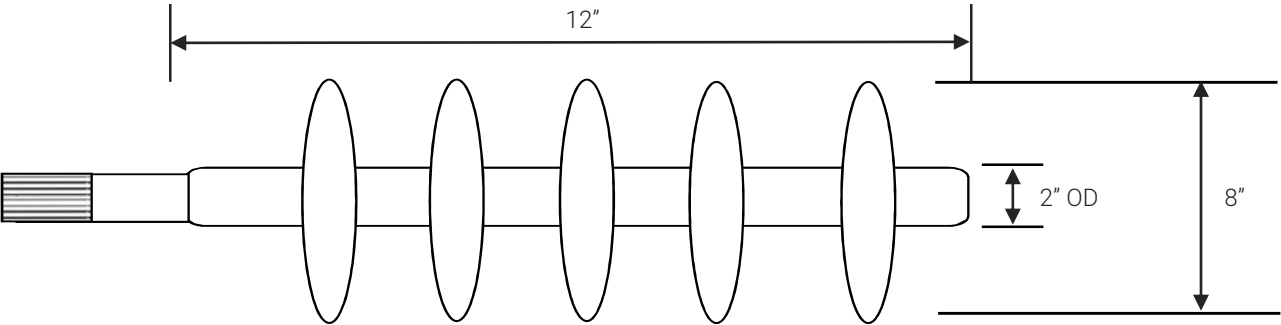
BPS Magnetic Separator are deployable at all stages of the hydrocarbon value chain with application for hydrocarbon fluids and gases, refined products, petrochemicals and water. Systems are cleanable with a 5+ year operating life and require minimal consumables.

- ❖ BPS Magnetic Separator Systems are engineered to achieve 95%+ efficiency of ferrous particulate removal by accounting for design parameters such as pressure, temperature, cleaning mechanisms and specialty alloys.
- ❖ Systems are screenless and operate with minimal flow restriction allowing for full-flow operation with minimal pressure drop (< 0.5 psi in a clean system).
- ❖ Systems employ a magnetic separator element array within a vessel that maximizes dwell time and separation capability.
- ❖ These systems are known to capture non-ferrous material through static charge and entrapment of ferrous particulate.

Magnetic Separator Elements

Magnetic separator elements are constructed with a patented radial-magnetic-field configuration that offers high loading capacity of black powder particulate ranging from sub-micron to 100+ microns in size.

Magnetic Filter Element Length	Number of Fields	Diameter of Field	Holding Strength	Magnetic Surface Area
12"	5	8" OD	630 lbs/lft	989.6 sq/in



BPS 2" OD Magnetic Separator Elements have a holding capacity of 2857.5 grams or 6.30 lbs/lft.

Benefits of Magnetic Separators

BPS Magnetic Separator Systems require cleaning rather than filter disposal; each system offers long life service and utilizes minimal consumables.

The high loading capacity allows for extended maintenance intervals of 6 months to 1 year depending on the application.



Extended life of critical operating systems



Reduction in downtime and lost production based on extended service intervals



Reduction in waste materials, supplies and disposal fees



Improved product quality

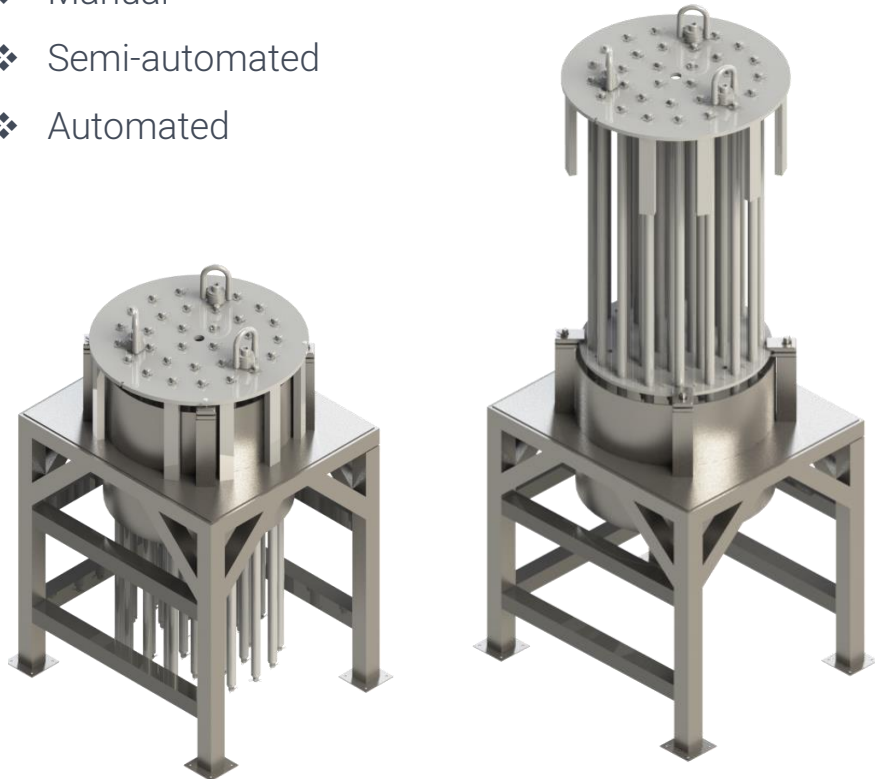


Cleaning and Modular Formatting

Cleaning Systems

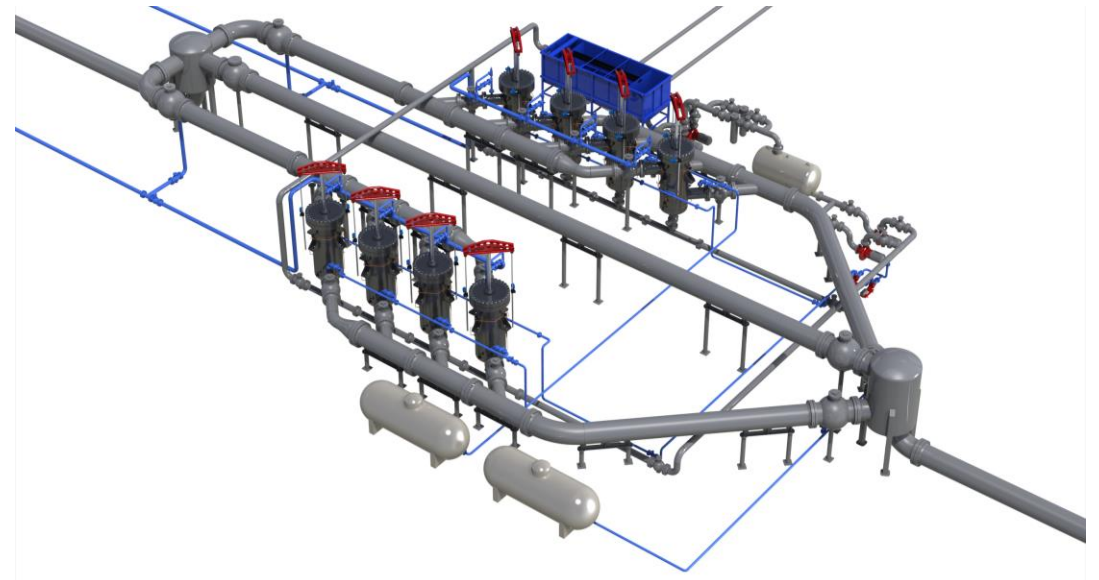
Application dependent

- ❖ Manual
- ❖ Semi-automated
- ❖ Automated



Modular Formatting

Duplex systems with by-pass lines enable constant flow and filtration during the cleaning process.



Installation and Deployment

1. BPS Magnetic Separator Elements are designed for deployment in BPS Stainless Steel Vessels to ensure 95% + black powder removal; each systems accounts for:
 - ❖ Dwell time
 - ❖ Field strength
 - ❖ Magnetic field surface area.
2. For maximum black powder removal, BPS recommends installing magnetic separation systems inline, prior to, or in replacement of conventional filtration; this will also extend conventional filter element life without impeding flow.
3. BPS designs its systems for the specific application. All magnetic separator systems are designed to meet industry standards for pressure applications.
 - ❖ Testing, metal certifications and origin documents are supplied with each system prior to shipping.

Case Study

Power Generation Company, TX USA

Application

6 km long, 0.5" OD Heated Water Line

Solution

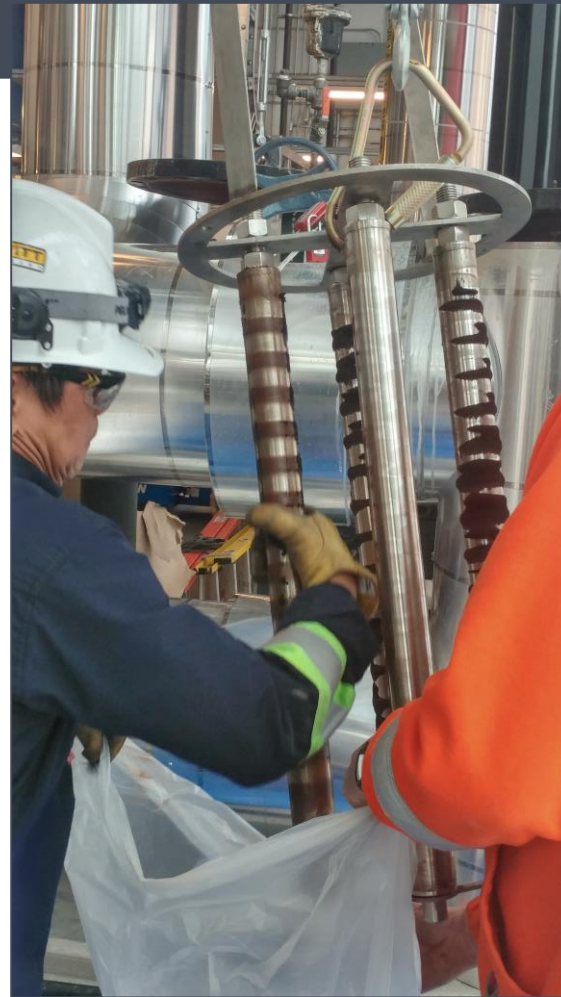
Install BPS Magnetic Separators into existing basket strainer filtration as a proof of concept test.

Results

Contamination shown in the pictures was collected after 3 months of operation.

Results confirmed a larger unit is required for this flow rate.

The unit has been installed for 1.5 years and the customer is looking to install BPS magnetic separation systems on their glycol systems and heat exchangers.



Case Study

Bow Tower, Calgary AB Canada

Purpose

Compare the filtration efficiency of conventional filtration and magnetic separation by the magnetic separator systems upstream and downstream of conventional filters on the Primary Heating Loop, Condenser Water Loop, Lakos and Glycol Systems of the Bow Building.

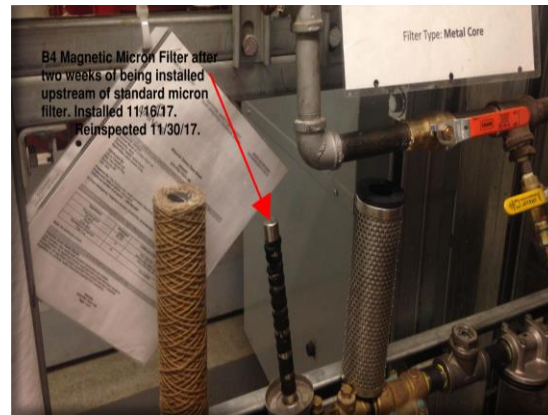
Glycol Filter Station

- ❖ Installed downstream of conventional filter
- ❖ Contamination collected after 27 days.



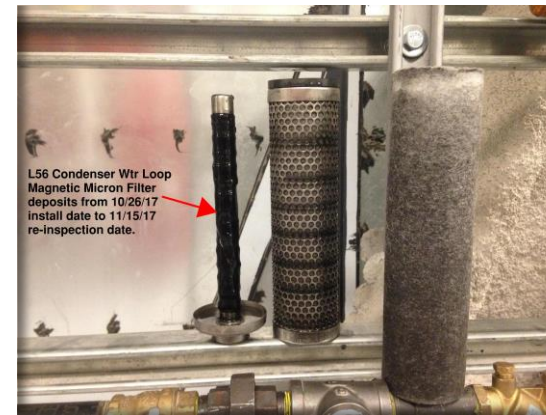
Parkade Glycol Loop

- ❖ Installed upstream of conventional filter
- ❖ Contamination collected after 14 days.



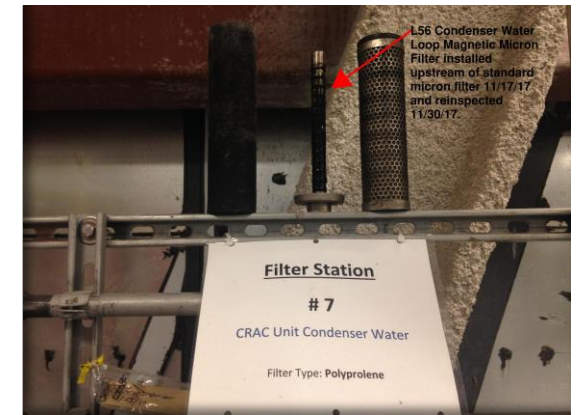
Condenser Water Loop

- ❖ Installed downstream of conventional filter
- ❖ Contamination collected after 20 days.



Condenser Water Loop

- ❖ Installed upstream of conventional filter
- ❖ Contamination collected after 13 days.



Case Study

Bow Tower, Calgary AB Canada

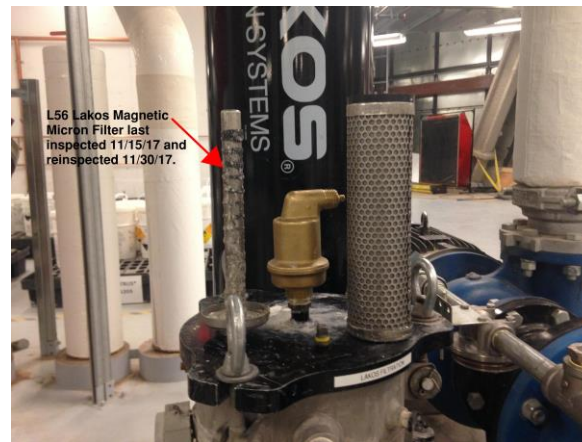
Primary Chilled Water Loop

- ❖ Installed upstream of conventional filter
- ❖ Contamination collected after 13 days.



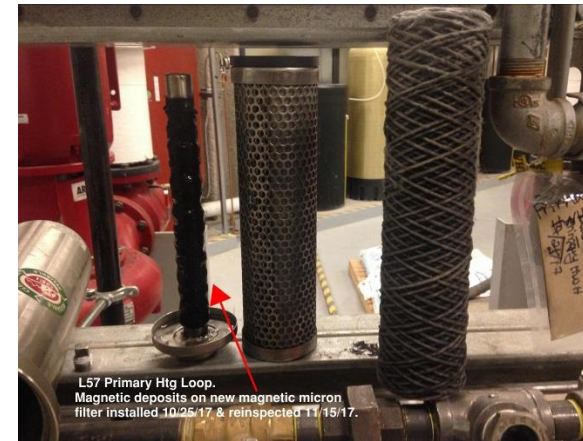
Lakos Sand Filter

- ❖ Installed upstream of conventional filter
- ❖ Contamination collected after 15 days.



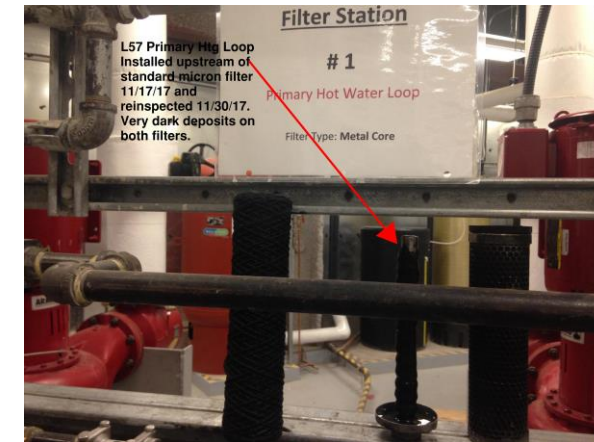
Primary Heating Loop

- ❖ Installed downstream of conventional filter
- ❖ Contamination collected after 21 days.



Primary Hot Water Loop

- ❖ Installed upstream of upstream filter
- ❖ Contamination collected after 13 days.



Case Study

Desalter System, Petromax Refinery, TX USA

Problem

Black powder contamination in the process water prevented the de-salter filtration to purify the water efficiently.

The $<10\mu$ rated Pentair filtration system in place required changeout and disposal every 5 days because of black powder, costing \$13,000/changeout.

The Pentair filter was unable to protect the \$800,000 MycelX salt and oil purifying system.

Transportation of the contaminated process water to a deep well injection site cost \$100,000/month.

Solution

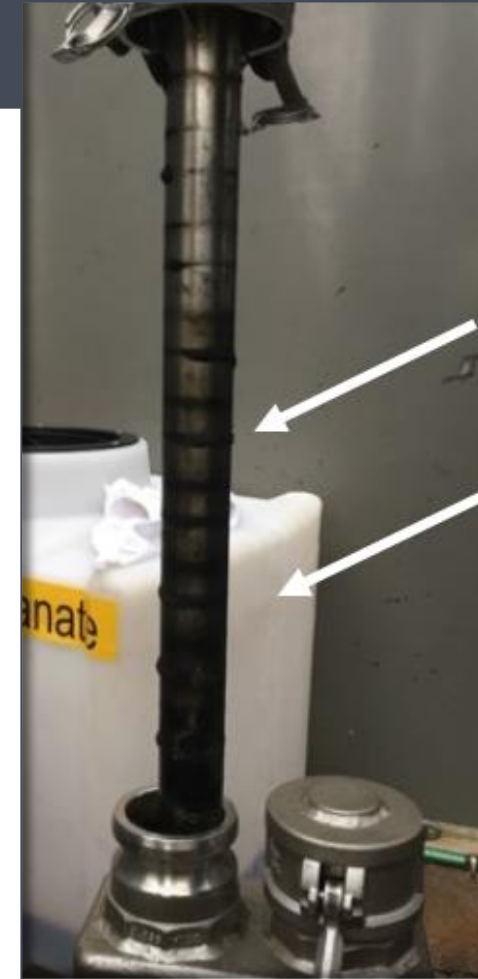
Install 2 BPS Magnetic Separators between the desalter vessel and water tanks, prior to the Pentair system.

Results

Pentair filter element changeout intervals extended to 45 days eliminating 65 changeouts: \$845,000.

No longer disposing of and replacing the process water: \$1,200,000

Protecting the MycelX purification system: \$800,000



BPS Magnetic Separators: \$26,000

Total Annual Equipment Cost Savings: \$2,845,000

Case Study

Mitsubishi Motors, Singapore

Application

Boiler System

Problem

High volumes of iron oxide resulting from corrosion entering the boiler system from the water supply line.

Solution

Install a magnetic y-strainer suction side of the water pump on a 2 week trial.

Results

Photos show the quality of the incoming water as well as the contamination captured after 1 week of operation.



Case Study

Solvay Chemical Plant, Tuscany, Italy

Application

Demineralized Water Injection Cleaning System for Turbine Rotors

Problem

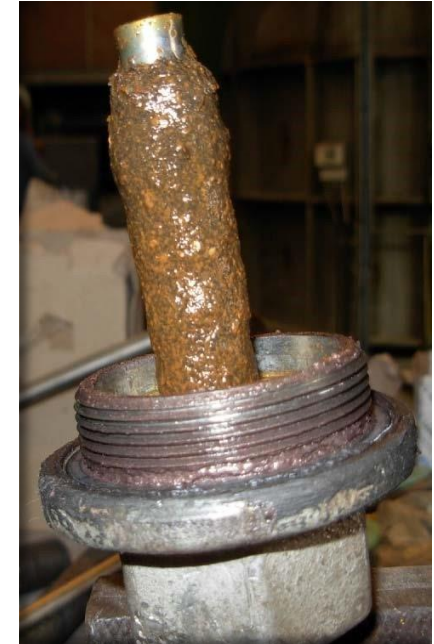
Rust contamination from cast iron piping in process water was damaging system components.

Solution

Install magnetic separator elements into existing y-strainers on the steam turbine to remove rust contamination.

Results

The photos show where the y-strainers were installed on turbine rotors as well as contamination from one magnetic separator elements after 30 days of operation.



Summary

- ❖ Black powder is an industry name for the abrasive, reactive contamination particulate present in hydrocarbon fluids, gas and process fluids such as water or amine.
- ❖ This contamination is pervasive through upstream, midstream and downstream facilities and operations.
- ❖ Conventional filtration is not effective in removing black powder, particularly in the $>10\mu$ range.
- ❖ Black Powder Solutions manufactures magnetic separator systems that are highly effective in removing black powder down to the sub-micron range.
- ❖ These systems are engineered for all oil and gas facility applications; they are sized and designed for your hydrocarbon product, viscosity, flow rate, pressure, temperature, pipe sizing and amount of contamination.



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