Magnetism and Filtration

Augmenting Filtration Efficiency with Magnetism

By: Chris Pasquali, CEO Factory Direct Pipeline Products, Inc.

Many industrial processes use magnetism for sorting and quality control procedures, especially to prevent metal contamination in the food manufacturing and packaging industry. Using magnetism to increase filtration performance is often overlooked and this article will explain options available for pipeline strainers and bag filter housings as well as its effect on equipment sizing.

Magnetic filtration is not going to replace the traditional filtration, just make it much more efficient and less labor intensive.

Pipeline strainers and filters use magnets to remove ferromagnetic particles (mostly iron and steel) from liquids. Whether it is corroded iron and steel piping in HVAC systems, a reclaimed fluid or protection from an upset condition, the addition of magnetic assemblies generally reduces operational costs.

Fluid velocity and viscosity, always an important characteristic to consider for properly sizing strainers and filters, take on an additional importance when using magnetic inserts to maximize efficiency.

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Magnetic Field Strength

Gauss and Tesla units are used to describe magnetic field strength; 1 Tesla unit = 10,000 gauss. Our industrial strainer magnetic inserts are made from an aluminum, nickel and cobalt alloy with magnetic field strength up to 1300 gauss while our industrial bag filter magnetic inserts are made from rare earth elements with magnetic field strength up to 9300 gauss.

To put this into perspective, a typical refrigerator magnet has a field strength of approximately 0.001 Tesla, therefore these industrial filtration magnets are anywhere from 130 to 930 times stronger than refrigerator magnets!

2 bar strainer magnet assembly

The strength of the magnetic field is only part of its "separation strength"; the magnets mass and ratio of thickness to pole distance significantly influences the size or projection of the magnetic field.

Insertion of magnets into the strainer basket or filter bag requires proper positioning to form a uniform magnetic field to attract ferrous particles. Large strainer baskets may require several magnetic columns and smaller strainers only a couple. Bag filter chambers are mostly 7" diameter and in two sizes, 16" and 32" long, therefore the magnet bars for bag filters consist of 1 or 2 bars of the appropriate length per chamber.

The velocity and viscosity of the fluid influences the rate of particle attraction, so if the velocity or viscosity is too high, magnetic particles may bypass the magnetic field.

Velocity

The standard maximum fluid velocity guidelines for filtration applications having a water-like viscosity are ≤5 FPS for non-alloy housings and ≤10 FPS for alloy housings. Reducing the fluid velocity to ≤5 FPM will maximize the magnetic field attraction rate, ensuring retention of most ferrous particles within the magnetic field.

The size of the strainer or filter chamber affects the flow velocity. Placing magnets within the element reduces the flow area, potentially increasing the fluid velocity. Sizing the strainer or filter system for double the flow rate in consideration that the insertion of magnetic assemblies will reduce the flow rate by 40-50% helps address the loss of flow area and flow velocity. "Oversizing" the strainer or filter also helps ensure proper initial differential pressure characteristics (≤ 2 ≤ 5 ΔPSIG).

Since bag filters are typically a fixed size, use multiple filter bag chambers to lower velocity. Increasing the size of a cast strainer requires adapting it to your pipeline or perhaps increasing your pipeline size. Fabricated strainers provide the flexibility of designing the strainer body for the ideal velocity and flow area while enabling use of whatever size nozzle is required to attach to your piping without using adapters.

Viscosity

Fluid viscosity increases flow restriction through a strainer or bag filter and restricts the particles movement towards the magnetic field. Applications involving motor oil and transmission fluid in large engines, machine tool lubricants and coatings are examples of common industrial fluids having a higher viscosity then water. This is another reason to reduce fluid velocity to ≤5 FPM; extremely viscous fluids might benefit from even lower velocities.

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Benefits of Magnetic Filtration

It is possible to attract and retain particles 1 micron and finer with a properly sized magnetic field and low fluid velocity. Pipeline strainers are limited to 400 mesh lined strainer baskets which is approximately equivalent to 25 microns, thus adding them to a simplex or duplex strainer may help them remove finer particles then they could otherwise retain and without fouling the basket surface area.

Bag filter systems provide depth filtration and their performance is significantly improved by preventing ferrous fines from clogging-up the filter bag media. If there is a significant amount of ferrous particles in the fluid, using magnetic inserts can significantly reduce the number of filter bags used annually. The savings associated with fewer filter bags includes reduced labor due to less frequent changes and lower disposal costs because fewer are used.

Fluids such as machine tool coolant contain additives larger than 25 microns designed to extend the life of the coolant, reduce foaming and overall improve performance. Filtering too fine actually strips the coolant of these important additives, however if the particulates are ferrous, using magnetic inserts is a great way to remove them without over-filtering the coolant.

Magnetic Filter Benefits

- Extends:
  - Interval between basket cleaning and filter bag replacement
  - Filter area for non-ferrous particles
- Reduces:
  - Fluid consumption/loss
  - Maintenance time
  - Disposal costs
  - Component wear associated with abrasive fines
  - Damage to filter bags caused by jagged metal
  - Bacterial build-up
  - Filter bag consumption and stocking requirements
- Capture fines with coarser media
- Recycle captured material as a single material

The following picture illustrates the amount of ferrous particles attracted to a pair of magnetic inserts in a standard #2 size bag filter (7"Ø x 32"L); without the magnetic bars how many additional filter bags and/or housings would be required to remove all these fines?

Cleaning Magnetic Inserts

Manually wash or wipe down magnetic inserts in strainer baskets. In bag filter systems the magnet bar positioner has guide rings, which scrape most ferrous particles from the magnetic bars and the particles fall down into the filter bag. After removing the magnet bars, proceed to remove the magnet-positioning cage and filter bag.

A polished stainless steel casing encapsulates each magnet bar with the ends fully welded.

Applications Benefitting from Magnetism

- Automotive Manufacturing
  - Hot pre-rinse water
  - Degreasing
  - Water rinse
  - Surface conditioning
  - Phosphating
  - Final rinse and dip
- Chemical Industry
  - Silicon manufacturing
  - Pigment and paint manufacturing
  - Ceramic glazes
- HVAC pipe corrosion
- Fuel system oil filtration
- Machine tool coolant reclamation

The next time you have a strainer or bag filter application reach out to us using one of our special web based inquiry forms, send an email or call our office; we will put our experience to work for you!

Visit us at https://fdpp.com and let us know how we can assist you with your filtration application!

Chris Pasquali has provided sales and engineering support for industrial filtration applications since 1991

Special thanks to Wim Callaert and Jagdish Chavda of Eaton's Filtration Division for their assistance with this article