Magnetically Capturing Non-ferrous Contamination

Black Powder Solutions' magnetic separator systems capture black powder particulate contamination, which includes both ferrous and non-ferrous particles. It is well known that ferrous materials are attracted by magnetic forces; however, the capture of non-ferrous particles by magnetic forces is less understood.

Non-ferrous particles are magnetically captured due to cross-contamination with ferrous particles. All particulate contamination becomes electrostatically charged due to physical interactions with other particles and surfaces, such as in pipelines or in hydrocarbon processing applications. This electrostatic charge causes negatively and positively charged ferrous particles to adhere to positively and negatively charged non-ferrous particles. The ferrous particle in this particle pair is then drawn to the magnetic element within the magnetic separator system.

There are other forms of adhesion that also cause the pairing of ferrous and non-ferrous particles, including embedding and capillary forces, although static pairing is the largest contributor to this process.

How electro-static charge is induced

Electrostatic charge is generated whenever there is friction between two bodies moving relative to one another. Charge generation occurs on the molecular level at the interface of any two unlike materials, so a static charge will be generated in any moving fluid, with positive or negative charges moving from the fluid onto the bounding surface.

Causes of electrostatic charging:

- Friction caused by fluids and gasses flowing in pipelines
- High fluid velocities
- Passage of fluids or gasses through filter elements or other microporous structures
- Turbulence created by pumping or compression, particularly centrifugal units
- Fluid discharging on to the free surface of a storage tank

Contaminants gaining charge

The amount of charge generated by the flow of a hydrocarbon liquid and filtration is related to several fluid and filter properties. Charge generation typically strengthens with increasing flow, reducing fluid conductivity, with certain additive packages and with increasing viscosity. Charge accumulation increases with lower fluid conductivity, lower temperatures and higher viscosities.