Filtration Options for Gelatinous Particle Retention

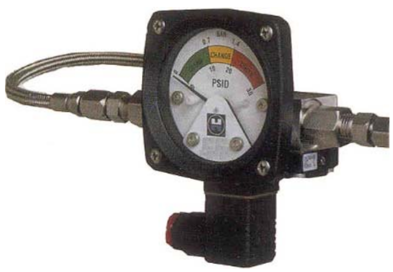
By: Chris Pasquali, CEO Factory Direct Pipeline Products, Inc.

Efficient filtration of deformable particles requires special consideration of differential pressure and the medium used for retention. This article describes the critical design criteria for proper vessel sizing and the specialized filter elements and filter bags designed specifically for filtration of gelatinous particles.

Examples of Gelatinous Particles

Solid-like particles consisting of interconnected microscopic structures which are easily deformable are generally referred to as gelatinous. Polymers, grease, organic material, ink and paint are examples of gel-like particles which are difficult to retain with ordinary filter mesh because the particle is easily deformed and extruded through mesh-like structures.

Role of Differential Pressure



A starting differential pressure across a clean filter element of 2 to 3 PSI is acceptable for most filtration applications because when the element is about 75% clogged the differential pressure will have increased to about 8-12 PSI which is when it should be cleaned or replaced. Assuming a consistent particle load, the differential pressure increases exponentially as the free area of the element is reduced from particles entrained within the filter media.

Monitoring your differential pressure is especially important for retention of gel-like particles as they are more likely to deform and pass through your filter media at higher differential pressures. Thus, a consequence of gelatinous particle filtration is increased frequency of element cleaning or replacement.

Increasing the size of the filter element will both reduce the initial clean differential pressure across the element and provide extra retention area to reduce the frequency of maintenance required. The trade-off is an initially more expensive (larger) filter than the flowrate alone necessitates for the benefit of less down time, personnel exposure to the fluid and reduced media replacement during the years that follow.

Types of Filters for Gelatinous Particle Filtration

We offer three types of specialized media:

1) Filter Cartridges
2) Filter Bags
3) Automatic strainers with permanent SS elements

Filter Cartridges

The LOFPLEAT GG is a pleated filter cartridge made from borosilicate micro fiberglass, a firm substrate forming a torturous path providing both depth and surface filtration. These cartridges are about 90% efficient for retention of particles as fine as 1 micron and support a flow rate of approximately 1 GPM per inch length of the cartridge, which can be up to 40 inches long. High flow rate applications require a cartridge filter housing designed to hold multiple filter cartridges.

The LOFPLEAT HF-G is a higher efficiency version in support of higher flow rates; approximately 8 GPM per inch length of filter cartridge with cartridge lengths up to 60" in length.

LOFMET porous alloy filter cartridges are another example of a rigid torturous path substrate filter cartridge suitable for deformable, gel-like solids retention.

Filter Bags

As compared to filter cartridges, filter bags generally have a larger surface area and the housing design significantly reduces the chance of particle bypass during filter media changes. While it might be possible to re-use rigid design filter cartridges if they can be chemically cleaned, filter bags are designed to be disposed after use due to the intricate microfiber design which makes cleaning them almost impossible without reducing their efficiency.

Filter bags designed to retain gelatinous particles are made from multiple layers of meltblown polypropylene fibers to form increasingly complex pathways through the media, thus provide very efficient depth filtration.

The LOFCLEAR 500 filter bags have a pleated outer layer to pre-filter larger particles and when the differential pressure is low, gelatinous particles will be retained on this outer layer also. The pleated design of the pre-filter layer equates to 32 ft^2 of surface area, about 6 times the 5.2 ft^2 of surface area of the underlying #2 sized filter bag.

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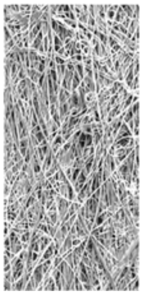
To increase the particle retention capacity and retain gelatinous/deformable solids the LOFCLEAR 500 has multiple layers, each increasingly complex to retain finer and finer particles. This torturous pathway also entraps deformable particles as the differential pressure would need to be quite high to extrude such particles through multiple layers of melt-blown polypropylene fibers that are increasingly dense.



The LOFCLEAR 500 has a fully welded design to maintain flow path integrity as well as ensuring the strength of the filter bag to reduce the chance of rupture as it can hold just over 2 lbs. of particles. The outer layer consists of a fine mesh to prevent fiber migration of the meltblown fibers of which the filter bag is constructed. The polypropylene fibers used in the melt blown process do not contain silicone or other crater-forming substances and thus LOFCLEAR 500 filter bags are often used for filtration of automotive coatings and other critical coating processes. A more thorough description of the melt-blown design with microscopic pictures illustrating the fiber web is online in our filter bag materials article.

Automatic Filters

Most automatic filter designs rely upon the filtered liquid to backwash the element, which is often problematic for the kinds of liquids containing deformable solids such as paint, ink and lubrication fluids because the backwash volume is significant and its also "product". Most backwashing automatic filters involve water or other non-hazardous fluids because sending the backwash to drain isn't problematic. The types of elements used in backwashing filters do not employ a "torturous path", rather a perforated or wedgewire structure which deformable particles could extrude through.

DCF style automatic filters employ a different approach to cleaning the element. Rather than backwashing the element, a cleaning disc cycles through the element. Often referred to as a scraping filter, the internal disc consists of 4 spring loaded sections to evenly distribute force across the element surface and to account for eventual wear of the non-alloy cleaning disc. The frequency of the cleaning stroke is user adjustable.

When sized to have a low initial differential pressure and high frequency stroke, particles, including deformable ones, have a short residence time on the surface of the element before being swept away. The upwards and downwards force of the cleaning disc does a great job of maintaining the low differential pressure and the action is not so harsh against the element as to result in extrusion of deformable particles.

The particles swept from the element reside within the lower section of the filter body referred to as the "purge chamber". The shape of the purge chamber supports easy flow out of the filter during the purge cycle. The purge cycle frequency is another user-programmable characteristic which can be fine-tuned as needed.

The systems differential pressure purges the retained concentrated particle slurry when its drain valve is briefly opened. When the differential pressure is low, the cycle time or frequency of purging can be extended. Alternately it is possible to attach a pump to the drain port to vacuum-out the particle slurry if the differential pressure is not sufficient for thorough purging.

Cartridge, Bag or Automatic Filter?

If your application is to remove as much gelatinous particles as possible, filter cartridges and filter bags will work best. When the loading is very high and its cost prohibitive to use disposable filter media, the DCF style automatic filter is a good choice as a pre-filter, perhaps with a filter cartridge or bag filter installed downstream to retain any remaining particles.

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

Chris Pasquali has provided sales and engineering support for Hayward/Eaton since 2001