A Comparison of DE and Crossflow Filtration: *Just the Facts, Ma'am*

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Summary: *This article intends to provide an objective comparison of diatomaceous earth (DE) filtration with crossflow (membrane) filtration to allow informed decisions on use of these technologies for municipal, commercial and some industrial applications.*

Over the past several years, filtration continues to evolve. Diatomaceous earth (DE) and crossflow filtration, also referred to as membrane separation, could perhaps be considered two extremes of that evolution. As membrane technology becomes more accessible, the question of which technology to use continues to be debated. The following discussion includes advantages and disadvantages of both technologies, a review of areas where each is currently in use, and a comparison of capital and operating costs.

DE filtration

Also known as precoat filtration or diatomite filtration, DE filtration has been used in food and beverage applications for over 70 years. Two types of filters exist: 1) pressure filters, which have a pump or high pressure source on the influent side, and 2) vacuum filters (leaf and rotary), which have a pump on the effluent side and are open to the atmosphere. The leaf or "filter element" is a screen or cloth septum on which a precoat is applied. The precoat is a layer of fresh DE that's applied to the septum by recirculating a dilute DE slurry through the filter leaves. The rotary vacuum filter is a drum rotating on its

axis, partially submerged in the liquid to be filtered, and coated with a thick precoat (often 4-inches or more) of DE.

This technology offers plant operators considerable flexibility in tailoring their operation to specific needs, i.e., when there are changes in the quantity, quality and size of the solids entering the system, operators can either switch to another, more appropriate grade of filter aid, or change the rate of DE addition (body feed). The filters are simple to operate and highly effective in removing solid impurities including cysts, algae and asbestos. Moderate changes in pressure or flow rate usually won't compromise the filtration. These changes may vary depending on system condition. This is why it continues to be a method of choice for many of the world's clarification needs for foods, beverages and chemicals.

Diatomaceous earth is a sedimentary rock comprised of the skeletal remains of microscopic water plants called diatoms. These single-cell organisms have the unique ability to extract silica from water they live in and construct exoskeletons having a highly intricate, microporous structure. Diatoms range in size from under 5 microns (um) to over 100 um and are characterized by a porous structure with openings as small as 0.1 um in diameter. When the life cycle is completed, the diatom organic matter decomposes and washes away leaving a rigid amorphous silica shell. The siliceous skeletons become an inorganic mineral and form a sedimentary repository capable of filtering waterborne contaminants of very minute sizes.

The use of diatomite in filtration applications is based on this unique microscopic structure that's able to trap submicron particles while maintaining a permeable filter cake. Normally, use of diatomite in filtration is a two-step operation. First, a thin layer of clean filter aid is coated on the filter element (cloth or wire screen) by recirculating a dilute slurry of filter aid through the filter. This is referred to as "precoating" the filter. The precoat serves two purposes; it protects the filter element and also producesalmost instant clarity when the filter goes on line. On a rotary vacuum filter, the precoat also provides a disposable and renewable media exposing a fresh surface for filtration. Coagulants generally aren't used or necessary.

Following precoating operation, a small amount of filter aid ("body feed" or "admix") is continuously added to the liquid being filtered. As the filter cycle progresses, the body feed produces a fresh new filtering surface, reducing cake resistance and facilitating entrapment of particles. This provides additional microscopic channels through which clarified fluid can flow, thus keeping permeability and porosity high. Diatomite filtration, with body feed, can thus be considered dynamic filtration, i.e., the filtering surface is constantly rejuvenating itself. Figure 1 is a graphic representation of how the precoat and body feed interact to produce exceptionally clear filtrates associated with DE filtration.