



# Centrifugal Separators are *not* Filters!

## Position Paper on the Difference Between Centrifugal Separation and Sand Filtration

**fil-ter** (fil' ter) *n.* 1.A porous substance through which a liquid or gas is passed in order to remove unwanted components, esp. suspended material (*American Heritage Dictionary, Second Edition*).

**fil-ter** \ fil' ter \ *n.* 1.a porous article or mass through which a gas or liquid is passed to separate out matter in suspension (*Webster's Seventh New Collegiate Dictionary*).

### Centrifugal Separation

Centrifugal separators are not filters. Centrifugal separation relies on the velocity of a vortex to exert enough force upon particles suspended in fluid to move those particles to the outside of the vortex to areas of lower velocity where they can fall out of the fluid. The effectiveness of centrifugal separation is a function of the difference between the size and density (measured in specific gravity) of the particle relative to the density and viscosity of the fluid. The smaller and less dense (lower specific gravity) the particle, the more force (velocity) is required to accelerate the particle sufficiently to produce separation.

Distilled water, absent any contribution from dissolved constituents such as minerals (calcium) and metals (magnesium, iron, copper), has a specific gravity of 1.0. The specific gravity of all other substances (except gases) is stated as the ratio of the mass of that substance to the mass of an equal volume of distilled water at 4°C.

Earth, silt and soil – the most typical constituents of air born dust and debris being “washed” into cooling water – have specific gravities ranging from 1.2 - 2.0. A review of literature of centrifugal separator manufacturers shows 75% removal of 74 micron and larger particles with a specific gravity of 1.7. In order for a centrifugal separator to achieve even 65% removal of 20 - 40 micron size particles, the centrifugal separator literature indicates the specific gravity of those particles must be 7.5; the specific gravity of pure iron (Fe) is 7.8. Additionally, according to the majority of studies of solids in cooling tower water that we have seen, particles greater than 25 microns in size as a percentage of all particles greater than 1 micron is less than 0.001%!

### Sand Filtration

Particle retention by a sand filter, such as a Tower-Flo®, is a function of size only; the specific gravity of the particle is not an issue for retention (however, it can be an issue for backwash). The filter media supplied with Tower-Flo® filter systems is consistent with American Water Works Association (AWWA) standards for fine filter sand for potable water (NSF discontinued media certification several years ago). That standard states, “...quartzite or silica in nature, hard, not smooth, with a uniformity coefficient of 1.7, a relative size of .45 to .55 mm, and containing no more than 5% flat particles, or more than 1% clay, loam dust, or other foreign material”.

Filter media conforming to the AWWA standard is generally accepted as retaining 20 micron size particles and larger when clean. Particulate entering the tortuous pathways created by the deep bed of sand will become trapped in the interstitial spaces between the individual grains of sand (that space is defined by the uniformity coefficient criteria of the standard). As these spaces become increasingly clogged by the retained particulate, progressively finer particles will be trapped over the course of a filter run (from backwash to backwash). At a 10 psi pressure drop across the media bed – the point at which backwash will be initiated by differential pressure – it is generally accepted that the media bed, “loaded” with particulate, will retain approximately 99% of 10 micron particles and 90% of 5 micron particles.



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# Centrifugal Separators are *not* Filters!

## Separator Marketing Strategy

Centrifugal separator manufacturers position their product against sand filters in application to cooling tower water based on two primary points: lower maintenance requirement of separators (“no moving parts”); and reduced backwash water volume. On the maintenance point, we concede that a separator – especially one without an automatic blowdown valve – requires little or no maintenance. However, little or no maintenance in exchange for little or no particle removal doesn’t seem like much of a bargain!

On the second point of water loss, separators “purge” typically based on time by use of a timer. Water lost to purging depends entirely on the frequency and duration of the purge. Purge recommendations by separator manufacturers vary greatly with frequency recommendations ranging from once every 15 minutes to once every 4 hours at durations ranging from 12 to 100 seconds. Tower-Flo® filters with standard automatic controls will backwash for a factory pre-set duration of 3 minutes at their maximum flow rate. Frequency will be determined by either: differential pressure which can be expected, in typical circumstances, to occur once every 3-4 days; or the 100 hour “resetting” timer. Which system - separator or filter - uses more water is highly debatable.

## Summary

Centrifugal separators and sand filters are designed to address different particle removal challenges. There are applications where a sand filter is not the best selection. When the material being filtered is heavier than the sand (as measured by specific gravity), the sand filter will trap the material but the material is too heavy to be flushed out by the backwash. Applications such as metal milling and machining, metal quenching, glass grinding, and even well water with sand or heavy clays may not be the best applications for sand filters. On the other hand, there are applications where separators should not be used. When the material being separated is small (generally, less than 40 microns for earth, soil, dirt, pollen, algae, bacteria, etc.) or has a specific gravity near to that of the water or fluid, the material will simply not be removed by a centrifugal separator. It must always be recognized that separators and filters have different particle removal capabilities, therefore, different roles to play in control of suspended solids. Knowledge of the size and nature of the solids to be removed from a fluid is critical to selection of the solids removal equipment best suited to the job.

Separators and sand filters can be complimentary. There can be applications – usually industrial process water application as opposed to cooling tower water applications – where a separator followed by a filter offers the best solution for removal of a combination of large, heavy particles and small, light particles. Neither the separator nor the filter is capable of managing the unwanted components, in their entirety, by itself. In combination, each contributing its respective strengths, removal of a broad range of unwanted components can be successfully accomplished.

Bottom line, it is completely misleading to suggest that a centrifugal separator is a filter and to let a customer think that they can be used interchangeably. Centrifugal separators cost less because they do less – ***they are not filters!***



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