Proper Sizing of a Coolant Filtration System

When it comes to selecting coolant filtration systems for grinding applications, one size does **not** fit all. A number of factors need to be considered in order to obtain the best fit. To properly size the filtration system, start by gathering some basic information:

- Wheel width (wheel type)
- Spindle horsepower
- Machining coolant (oil-based, water-based)
- Stock removal (per part, parts per hour, hours per day)
- Material being ground
- Finish requirement
- Tolerance
- Type of grinding (rough, fine, finish, profile, OD, internal, surface, centerless, creepfeed)
- Height and location of the grinder's dirty coolant outlet
- Desired filtration clarity (media-based, media-less)
- Floor space available

Wheel Width / Spindle Horsepower

These two factors dictate the required flow in gallons per minute. Example: 10 HP spindle with 3" wheel width =30 gallons per minute in a water-soluble coolant. This is not a firm calculation, but rather a starting point. Other variables may also need to be considered such as:

- The shape of the machine base and coolant exit points may necessitate higher flow.
- The machine may need to evacuate the coolant with the swarf as quickly as possible.
- The application may require that the pump is placed higher to help clean the grinding wheel or clear swarf from the grinding area.

Grinding Wheels

Some grinding wheels are extremely hard while others are soft and need to be dressed. A high-pressure pump is needed to clean the wheel of grinding fines. If wheels have profiles, it is important to keep these edges sharp to avoid burning or poor finish. Required finishes also play a role in determining which type of grinding wheel is needed.

Machine Coolant

Some coolants cause swarf to clump while swarf is suspended in other coolants. Some coolants foam more than others. If oil is being used as the machining fluid, flows are generally cut in half but the filtration area doubles, based on the coolant's viscosity. Example: For every 10 GPM in water-based coolant, a filter area of 3.5 square feet is needed. But if an oil-based fluid is used, a 7 square foot filter area would be needed to achieve the same GPM.

Coolant Flow
The amount of coolant flow to the grinder helps to determine the coolant reservoir size. We recommend at least 30 gallons holding capacity for every 10 GPM being pumped to the grinder. The following factors are also considered when sizing the coolant reservoir:

- Height of the outlet on the grinder
- Refrigeration needs
- Magnetic separation requirements, if applicable

A reservoir that's too large for the incoming and outgoing flow can cause the reservoir to become a settling tank, creating possible issues with sediment, bacteria, and coolant spoilage.

Stock Removal Rate
High stock removal from *rough grinding* produces larger fines, allowing filter media to be more open. High stock removal from *fine grinding* causes filter media to blind more rapidly, which means more media is required. In either case, a magnetic separator may be necessary to offload some of the fines before they reach the filter media. This will extend the life of the filter media.

Material Being Ground
Lighter materials can be difficult to filter because they float. In these situations, a gravity filter with increased square footage can achieve better filtration. Heavier materials, such as cast iron, can be separated efficiently using cyclones, while a gravity filter might not catch the fine powder produced by cast iron grinding. In this circumstance, adding bag filters or cartridges can help keep the coolant clean.

Finish Requirements
For mirror-like finishes, very fine filtration is necessary in order to avoid scratches or burns on parts. Adding bag filters, cartridges, a centrifuge, or even a pressure filter to the filtration system are some viable ways to achieve the cleanest coolant possible. If finish is not critical, standard 30-micron filtration via a gravity filter is sufficient. Cyclone filter systems are able to produce cleaner coolant. However, because they rely on *specific gravity* of the material for separation efficiency, each application needs to be considered individually, based on its specifications.

Tolerance
It may be necessary to add refrigeration to the filtration system in order to hold tolerance. Refrigeration units vary greatly in size, which also affects the reservoir size. The amount of floor space available is often a deciding factor when choosing between a pass-through chiller and a drop-in style.

Type of Grinding
OD grinding produces fines that are shaped differently than those produced by creepfeed grinding. ID grinding a hard material will not create the same amount of swarf as profile grinding. Some grinding applications produce large volumes of swarf in certain materials, but not as much in other materials.

Dirty Coolant Outlet
The *location* of the dirty coolant outlet(s) and the height above the floor also come into play when sizing a filter system. When the outlets are too low for an effective filtration system, a lift station becomes necessary. When there is more than one outlet on the grinder, the filtration system needs to be built lower than the outlets in order to accommodate a proper coolant drop so the gravity flow is fast enough to evacuate the coolant and swarf from the grinder. Example: The outlets on the Studer S31 are vertical. An inlet pan catches the return flow and returns it to the filter system. If a magnetic separator is needed (based on material being ground and swarf load), a lift station is also needed to catch coolant and swarf from the two vertical outlets. The coolant and swarf are then pumped to the magnetic separator mounted on the gravity filter.

Desired Filtration Clarity
Many companies prefer media-type filters for a very obvious reason: Filter media is generally white, so when the media gets dirty, there is apparent evidence that the coolant is being cleaned. Companies may doubt the effectiveness of a cyclone filter system because there isn't any visible "dirt". But a media-less cyclone filter is often a good solution and has a number of advantages to consider. It will work very well to clean coolant as low as 7 - 10 microns when the material being ground has a high specific gravity. Cyclone systems also keep coolant in constant motion, preventing rancidity and "dead spots" where coolant tends to settle in the reservoir. The amount of floor space needed for the required flow is also substantially less than what is needed for a gravity system. One potential drawback of cyclone filter systems is that the cyclone pump generates heat, so a refrigeration unit may also be needed to maintain proper coolant temperature.

Floor Space
All too often, floor space determines the size of a filtration system. If available floor space is small, the filter system may be undersized and insufficient for the application. Not only will the customer be dissatisfied with such a filter system, but there are also few options available to remediate an undersized system once it's installed.

The success of a grinding application is directly related to the filtration system. While some general guidelines and best practices have been discussed here, determining the proper size of a coolant system is more complicated than it appears – there's no easy formula. Our success over the past 35 years has been the result of using reliable details and application specifications to develop near-custom filtration system solutions.