Low Entry Vacuum Filters

Polytech's State Of The Art Designs

By Polytech-Filtration

Overview

An automatic vacuum filter is simply a device to create a differential pressure across a barrier filter medium and transport the contaminated filter media and separated solids from the filter as required while providing an uninterrupted supply of filtered liquid. Conventional vacuum filters utilize the suction characteristics of the centrifugal filter pump to provide the differential pressure and supply filtered coolant to the machine tool. Polytech Filtration Systems' state of the art design separates the filter flow and clean supply function and utilizes level sensing to optimize the filtration process.

Advantages

- Highest possible differential pressure capability across the filter media (typically 14-20 in Hg vacuum or 7-10 PSID) to support reasonable flow per square foot of filter area, allow the use of filter media that is restrictive enough to capture fine particles and minimize filter media consumption.
- Able to handle entrained air without risk of cavitation and loss of coolant flow to the machine tool.
- The filter can have a very low contaminated coolant entry height that eliminates the need for expensive and troublesome sump tanks and transfer pumps to return contaminated coolant to the filter from the machine tool.
- The filter works effectively on oil type coolants that exhibit persistent entrained air without such compromises as large transfer tanks and pumps to allow the oil to de-gas or operation at reduced differential pressure.
- Automatic operation with infrequent maintenance required.
- Uses low cost bulk filter roll media
- Simple robust construction with no pressure vessels or tanks.
- Controls adapt to varying flow requirements optimize use of filter media for longest filter cycles and lowest media consumption.
- Conveyor to transport media and solids is suitable for heavy stock removal loads and operates at the bottom of the dirty coolant tank to eliminate settling problems and maintenance.
- Pumps operate in filtered coolant reducing wear and problems with clogging.
- Relatively large clean coolant tanks often allow use of packaged chillers that feature lower cost direct immersion evaporator coils when heat removal is required.
- Relative simplicity and moderate cost compared to automatic pressure and back flushing filters.

Disadvantages

- The use of separate filter and clean coolant pumps may contribute slightly to the heat input to the coolant.

How They Work

Like conventional vacuum filter designs, Polytech's state of the art SL and SLE series filters utilize atmospheric pressure to force liquid through a barrier filter to a lower pressure zone. Vacuum filters used in industry for machine tool coolants are typically flat bed gravity filters where contaminated coolant enters an open top dirty coolant tank with a perforated plate bottom and a lower tank (vacuum chamber). A filter medium sits between the dirty tank and the vacuum chamber to capture solid contaminants as the coolant flows to the vacuum chamber.

In the SL and SLE filters, all filtered coolant is transferred to a clean tank that comprises the bulk of the filter's total coolant holding capacity. Generally this tank is mounted above the contaminated tank and media conveyor conserve floor space; however it has been mounted next to the contaminated coolant tank for packaging entirely beneath a machining or forming line. Separate clean pump(s) supply filtered coolant to the machine tool.

Contaminants are captured by the filter media, as they build up resistance to flow increases, increasing the differential pressure across the filter media. As a contaminant cake builds on the filter media, the trapped particles enhance the particle retention and filtration efficiency improves. As the differential pressure increases, the flow through the filter media decreases until the flow supplied by the clean pumps exceeds the filter flow and the contaminated tank level starts to rise. At this point a regeneration cycle is initiated. Allowing filtration to proceed until it can no longer meet coolant flow requirements automatically provides the greatest possible contaminant loading and lowest media consumption for any operating condition.

During regeneration, the filter pump stops, stopping suction flow, and the suction pipe is vented to equalize the pressure across the filter media. With the pressure balanced, the conveyor feeds new media into the filter, spent media and contaminants are discharged and filtration resumes. Only a short length of filter media is indexed each time so the bulk of the filtration enhancing cake remains providing consistent filtration quality.

The media/sludge conveyor removes solids from the dirty tank eliminate the need to clean out settling tanks. The seal between the dirty tank is a simple but reliable hydraulic pressure seal that requires no maintenance. The open tanks (covers are provided to prevent contact with moving conveyors) are simpler to build and maintain than closed pressure vessels and present none of the swarf packing and removal problems pressure filter vessels experience.

All pumps providing both filtration and clean coolant supply operate in filtered coolant improving pump reliability. The pumps are immersion type pumps and seal less designs are selected wherever possible to reduce maintenance requirements.

Polytech's state of the art vacuum filters are designed to provide reliable filter flow with entrained air present. The centrifugal pumps used in conventional vacuum filter designs have trouble pumping reliably when there is air entrained in the fluid. Entrained air can lead to filter pump cavitation and loss of flow to the machine tool. Conditions which contribute to air entrainment are operating with low coolant levels to accommodate low machine discharge heights, foamy coolant where the surface tension of the coolant is reduced or oil based coolants where the air stays in the oil due to its viscosity. These new designs work effectively under these conditions.

The design permits very low contaminated coolant entry heights so the use of transfer pumps and sump tanks can be eliminated, saving significant cost. Transfer tank and pump problems associated with settling of solids or transfer pump solids handling capacity are eliminated by direct gravity return flow of coolant into the contaminated filter section where the media conveyor can effectively remove even the most "unpumpable" swarf, chips and shards.

Finally, the large clean coolant tanks allow use of packaged chillers that feature lower cost direct immersion evaporator coils when heat removal is required. Mounting the drop in chiller on top of the filter system saves valuable plant floor space.

Prior to Polytech's efforts to design vacuum filters specifically for operation on highly aerated fluids, various pressure and precoat filters were among the few choices available for automatic filtration on machining oils.