HTI FILTRATION

HOW IT WORKS. . . . FAQ's About Our Products

- **HYDRA-SUPREME AXIAL FLOW CARTRIDGE FILTERS**
- **HYDRO-FIL BAG TYPE WATER REMOVAL FILTERS**
- **TECHNICAL BULLETINS**

Hydra-Supreme filter elements have gained wide acceptance where high filtration efficiency is required for proper machine operation, and where both liquid and solid contaminants need to be removed. This high efficiency is acquired by combining the proven filtration ability of creped cellulose tissue with HTI Filtration patented construction techniques to overcome traditional barriers and produce the finest "axial flow" filtration products in the world.

Overview

What is "axial flow"?
How does it physically work?
Why use creped tissue?
Why is pressure important?
Why is flow volume important?
How does the filter clean the oil?
What makes the oil go through the filter instead of around it?
What is a "boot" seal?
Isn't this just stacked toilet paper? (The "three C's of filter paper)
How do I know if it is working?
When I test my oil, what do I look for?

Drawings

Cut-Away Filter Design
Seal Comparison and Area

Technical Bulletins

#03-01 – ISO Classification Explanation
#03-02 - Oil Analysis Terminology Explanation

What is "axial flow"?

The Hydra-Supreme filter series uses especially creped and crafted paper to remove contaminants from oil as it passes between and through the layers of paper. Because the oil flows parallel to the center or "axis" of the filter, this is known as "axial flow" filtration. In contrast, most conventional filters pleat their paper in a single layer around a core and drive the oil directly through the paper (perpendicular to the core) toward the middle of the filter.
Axial flow allows the oil to be filtered many times along the flow path and provides multiple avenues for the oil to reach the return ports in the center core.

How does it physically work?

To make paper remove debris, you need to force the oil into contact with the tissue. By pressurizing the oil, it is pushed against, alongside and through the paper to the exit ports. The traditional design problem has always been to avoid having the oil move around the paper or force a hole through it. When the oil is moving through the paper walls, the relatively small pores of the paper stop the larger particles from passing through and any moisture is absorbed on contact with the media. The "fuzzy" sides of the paper tissue also snag very small particles and hold them in place as long as the pump has not produced too much flow velocity. As the oils passes through the tissue, dissolved contaminants like oxidized oil are also removed.

For a cut-away view and explanation see the Filter Construction drawing in this section.

Why use creped tissue?

For this type of filtration to work properly, the cellulose tissue must be allowed sufficient opportunity to absorb contaminants and there must be room for the filter to absorb debris without becoming clogged. This is known as blinding off. Creped tissue provides several advantages over other media and paper types. By creping the tissue, the paper is physically opened up presenting more surface area to the oil and reduces the density of the surface. If you want to clean up a spill, do you use writing paper (high surface density) or paper towels (low surface density) to do the job? Lower density does a better job, but it is also weaker and requires support to operate under pressure.

The creping also provides more surface area throughout the filter. The many thousands of small creased areas created by the creping process provide this expanded surface area. These areas provide multiple entry areas at the surface of the filter so that the initial dirt load deposited on it does not plug it. Imagine the oil flow as a lightning bolt striking from the sky. As it comes down, it branches again and again until it strikes the ground. The path of oil through a creped tissue media is similar to that lightning bolt. Once the oil penetrates the media surface, it moves laterally and vertically, splitting and rejoining itself as it passes through the channels and walls of the creped media.

The creped media also provide room for the paper to expand as it absorbs debris. As we all know, paper swells when it soaks up water. The multitude of tiny pockets in creped tissue provides this expansion room so that the filter can continue cleaning the oil without passing the contaminants on through, or prematurely clogging. This expansion action is also why the sealing design is so critical to the proper function of the filter.

Why is pressure important?

Pressure is both the friend and the enemy of the cellulose filter. To function properly, there must be sufficient pressure to force the oil into contact with the paper and to push the oil into new filtration paths through the filter as previous ones clog up. But too much pressure strips away previously trapped contaminants, collapses the tissue at weak points, and literally blows pathways through the weakened filter allowing the oil to return to the reservoir without being cleaned.

The amount of pressure exerted on a filter is determined by a combination of factors - the viscosity of the fluid, the amount of open surface available, and the volume of oil being pushed by the pump. That is why **all** Hydra-Supreme filters are designed for use as a system. HTI's filtration systems are built to have low initial start-up pressures and then operate up to 90 PSI without collapsing or rupturing the filter. The initial low pressure allows the filter system to operate more efficiently. It enables the filter media to absorb very small debris particles that are blown off by higher pressure systems and allows the filter media to gently expand and expose alternative flow paths as it absorbs debris. Other manufacturers will start their filters at 50 PSI and higher which places immense stress on the paper tissue. Not only does this prevent the filter from doing its job properly, but also frequently proves fatal to the filtration process.

Why is flow volume important?

Paper needs time to fully absorb moisture. This period of time changes with the type of oil involved, the viscosity of the oil, the pressure on the filter, and the surface of the paper being used. When we design a system, we test the paper for absorbency and then design the filter elements to achieve optimum exposure time for each filter segment. HTI strives to create a balance between filter capacity, complete oil cleaning during each pass through the filter, and strength of the segment. By designing the filter flow to accommodate the filter media we achieve higher first pass filtration efficiency and avoid overwhelming the media. Excess flow is not only wasteful in terms of energy requirements, it is actually counterproductive and hurts filtration efficiency and longevity.

How does the filter clean the oil?

There are actually four different filtration processes taking place inside the filter element. These are Barrier, Adsorption, Chromatographic Separation and Absorption.

Barrier Filtration – This is the traditional filtration method where a porous layer traps particles larger than the pore size of the paper while passing through smaller particles. The outer sock of the filter, the ends of the rolled paper, and the multiple layers of the interior paper create three layers of increasingly finer barriers that trap solid debris in our filters.

Adsorption – This is where the walls of the filtration media attract and hold very small particles of debris to the filter surface as they pass by. This attraction is relatively weak though, and these particles can be stripped off if the fluid velocity is too high or the pump creates pulse waves in the fluid.

Chromatographic Separation – This type of filtration occurs as fluids pass through the walls of the filter media and the media removes the color bearing portions of the liquid. In this case, it is the semi-solid, sticky, oxidized oil (varnish) that is removed as the oil passes through the cellulose media. This is very important in hydraulic functions as varnish is what tends to build up in the spools of servo valves if not removed.

Absorption – This is why paper towels work so well! The filter media actually absorbs contaminants into their structure, trapping and retaining them. In this process, the more open the surface there is, the faster the contaminants can be taken in, and the more exposed surface you have, the more contaminant you can trap.

What makes the oil go through the filter instead of around it?

Axial flow (or stacked media) filtration systems require an effective seal at the filter segment junctions to make sure the oil flows through the filter media and not around it through the junction area. This has traditionally been the weak point of this filtration design. Previous attempts all used either bulky outer-wraps of media, globs of hot-melt glue or short, rigid blades placed between the segments to try to maintain the oil to flow through the filtration media. Without a strong flexible seal, the increasing pressure will soon push the relatively soft paper away from the seal and allow unfiltered oil to pass directly back to the machine it is supposed to be protecting. In addition to being prone to failure, these other types of sealing methods also take up space inside the element that otherwise could be used as filtration media.

When the filter is first placed in service, the tissue contracts inward as the oil pressure pushes in around it. Then the filter expands outward as the internal pockets fill with water and debris. Without the ability to move, any seal soon becomes detached from the tissue and the oil pushes around it directly to the exit ports.

Only the patented Hydra-Supreme “boot” seal provides both a flexible, verifiable seal. Its unique design allows it to move with the filter and allows full utilization of the media for filtration. This provides up to 30% greater filter area than competing designs.

For a comparison of seal types and filter area, see the Seal Comparison Drawing in this section.

What is a “boot” seal?

A “boot” seal is a precision cut piece of high flexibility rubber placed firmly around the junction of the filter segments. This effectively closes off the area to external flow while allowing the full use of the segment for internal flow and filtration. Just as importantly, this type of seal moves with the filter as it contracts and expands.

Isn’t this just stacked toilet paper?

There are enough similarities to make this comparison both actual and humorous as the same time. Yes, it is rolled paper, but no, you can’t use Charmin for this job. The paper used in the filter construction is quite special and needs to be manufactured and converted in precise ways to achieve good results.

HTI Filtration refers to “The Three C’s “when talking about paper:
Content-Crepe-Consistency

Paper Content- When making paper, there are many types of cellulose fiber that can be used to obtain different levels of strength, bulk, stiffness, absorption speed and capacity. By blending hardwood fibers, softwood fibers, new and recycled pulp, wet strength additives and different amounts of refining energy, paper can be tailored to needs. There are always tradeoffs and you tend to get what you pay for. HTI uses a special high quality filtration grade paper to provide a filter medium that is strong, effective and designed for the job it’s applied to.

Crepe – This is what creates the open surface, debris holding pockets and absorptive power of the filter paper. Too little crepe, and you have no capacity, too much crepe and you have no strength. The amount of crepe also affects how you can handle, slit and roll the paper. It is far less expensive to roll crepe material at high speeds, but this pulls out the pockets and results in filters with minimized holding capacity albeit at a “lower” filter price.

Consistency – No matter what the crepe or content of the paper, there will be problems turning big rolls from the paper mills into effective filter rolls unless it is done correctly. The problem comes from the fact that the creping function makes paper want to stretch when it is pulled on. With traditional rolling techniques, this stretch makes the roll want to slip internally while being formed, and results in alternating dense and loose areas in the filter roll. This lack of consistency creates the soft spots where the fluid pressure pushes through directly to the collector plates, effectively short cutting the filtration process. HTI produces their filter rolls on specially made machinery that avoids this problem by surface rolling the paper, effectively eliminating the internal stress problems and producing consistent filter density and product consistency.

How do I know if it is working?

HTI conducts extensive testing on new and current products to both prove new concepts and to ensure consistent quality control. We do this extensive testing so that you will not have to. When you buy an HTI filtration system for a particular application you can be assured that it has been rigorously tested and refined to provide the highest efficiency of operation and the best operating value. However, we do recommend that our clients perform normal periodic oil testing to monitor the functional health of the machine being protected. Oil analysis, also known as tribological testing, is typically done by an outside laboratory. For details on oil analysis see our Technical Bulletins #03-01 and 03-02 in this website.

When I test my oil, what do I look for?

In most applications, you will be looking for water content and particulate debris concentrations. However, you may choose to also look for “wear” metals that indicate that a particular surface is wearing inside the machine. For more details on oil testing and contamination ratings, please see our Technical Bulletins #03-01 and 03-02 in this website.

HYDRO-FIL

HYDRO-FIL BAG TYPE WATER REMOVAL FILTERS-

Hydro-Fil bag type filter elements have gained wide acceptance where high water absorption capacities are required for proper machine operation, and where both liquid and solid contaminants need to be removed. This high capacity is acquired by combining the high absorption ability of polymer materials with traditional bag filter construction techniques.

Overview

- **What is a polymer?**
- **How does it physically work?**
- **Why use this instead of a conventional filter?**
- **Why is it a low-pressure system?**
- **Why is the flow volume so low?**
- **How does the filter remove particulate?**

What is a polymer?

Polymers are essentially chemical materials joined together into chains to affect their size and functions. In this case, the polymers were created to absorb water and resist oils.

How does it physically work?

In the Hydro-Fil filter, polymer material is encased inside porous sheets and suspended in a patented helix design formation inside a bag filter. The oil passes through the multiple layers of the helix and is stripped of the entrained water by the polymer. The water is then converted into a solid inside the polymer and cannot be stripped away by any following oil.

Why use this instead of a conventional filter?

The material used in manufacturing Hydro-Fil elements offers significant advantages over conventional filters. The absorptive capacity is typically many times greater due to the increased surface area and polymer content. The filters will drain free of oil after use, an important point when using synthetic oils that cost up to $50.00 per gallon. The filtration media is safe to handle and use. This is an important consideration when packaging food or beverages.

Why is it a low-pressure system?

Polymers require low pressure to force the oil into close contact with the absorptive media. This allows the polymer to “wrestle” the water molecules away from the oil without the higher pressure typically needed to force oil through a barrier.

Why is the flow volume so low?

Unlike barrier type filters where the removal of water is a physical function, the stripping of water with polymers is a chemical function. This process works more efficiently, but also needs more time in contact with the moisture. This is why you will typically find single filter Hydro-Fil systems in use on systems with less than 100 gallon oil capacity.

How does the filter remove particulate?

The bag liner of the Hydro-Fil will trap and retain solid debris down to 10 microns in size. Where semi-solid debris, partially dissolved solids, and very fine particulate are also present in the oil stream, we recommend using a Hydra-Supreme filter following the Hydro-Fil for your system.

HTI Filtration
7716 Gary Watson Pt
Colorado Springs, Co 80915
(719) 490-8800
WWW.HTIFILTRATION.COM