CRITICAL PROCESS FILTRATION, INC.

# Post-Use Filter Analyses

From time to time, filter users experience a mysterious drop in filter life or an unexplained filter failure. Critical Process Filtration can perform tests on the filters in question to try to clear up the questions surrounding these events.

Critical Process laboratory staff will use several techniques to investigate the performance of the filter in question. These include a review of the manufacturing history of the filter, the conditions under which the filter was operating and, of course, analyses of the contaminants captured in the filter media and the filter components themselves.

**Understand the operating conditions and expectations and how they might contribute to filter performance issues**

**Characterize the particles and organisms that have clogged the filter**

**Identify potential contaminant sources and ways to reduce contamination**

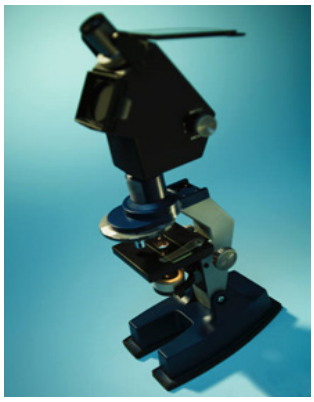
**Test filter components to determine effects of the application on the filter**

**Develop filtration system options that are the most cost-effective**

Technical Services

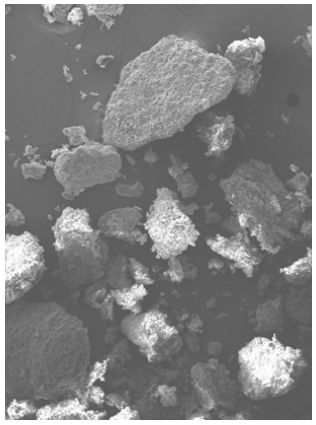
## Determining Operating Conditions

All filter performance investigations start with some questions. Information on the fluid handling system components, system setup, type of fluid, temperature, flow rate, expected contaminants, amount of time in service, and other factors are needed to establish how the filter was being used. If the filtration issue is a recent development in an established application, a history of the filter performance may be requested to see if the issue may have developed over time or be an anomaly.



## Identifying the Contaminants

A detailed examination of the particles and organisms that have clogged or damaged a filter is critical to determining the cause of the filter performance change or failure. As when the Critical Process Filtration staff analyzes a fluid, the particles are gently removed from the filter media and then, using optical imaging technologies, the contaminants are examined for initial identification as inorganic or organic. If bacteria are present, then we may use outside experts to identify the bacteria. That identification may help indicate a source. Identifying inorganic particles or unknown organic substances can be done using advanced chemical analyses at local academic and commercial laboratories.



Once the nature of the contamination captured by the filter is known, the possible sources of that contamination can be learned. Critical Process Filtration staff will work with the user to review the answers to the questions regarding operating conditions and compare those to the contamination for clues as to the source. If appropriate, Critical Process Filtration will suggest changes to the filtration system or its operation that may reduce the contamination.

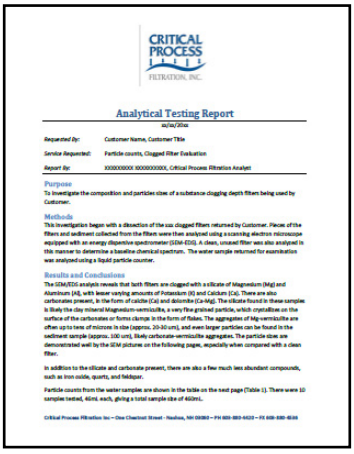
## Evaluating Filter Components

Determining the fluid contaminant levels and learning the operating conditions can help define some of the factors that change filter performance. However, the filter components themselves must be examined and tested to determine how the filter has been adversely affected. Where possible, Critical Process Filtration tests the final filter and then all filter components using the same quality assurance methods used during filter manufacture. Obviously, some test values will be different. Those differences provide information about what filter components are affected by the changes in fluid and operating factors. Changes in the structure of filter media or media supports could indicate chemical attack. Discoloration can also indicate a reaction to operating conditions or the fluid itself. Our laboratory also tests the cartridge or capsule structural components and elastomers for changes in shape, strength and other physical attributes.

All of the information on filter components provides valuable clues about how the filter has failed or what physical changes in the filter components have occurred and affected its performance.

## Analysis and Reporting

After the analyses are complete, the various findings are compiled into a report for the user. The report summarizes the operating conditions and the results of all tests on the contaminant and the filter components.



CRITICAL PROCESS FILTRATION, INC.

Analytical Testing Report

xx/xx/20xx

Requested By: Customer Name, Customer Title

Service Requested: Particle counts, Clogged Filter Evaluation

Report By: XXXXXXXXX XXXXXXXXX, Critical Process Filtration Analyst

Purpose

To investigate the composition and particles sizes of a substance clogging depth filters being used by Customer.

Methods

This investigation began with a dissection of the six clogged filters returned by Customer. Pieces of the filters and sediment collected from the filters were then analyzed using a scanning electron microscope equipped with an energy dispersive spectrometer (SEM-EDS). A clean, unused filter was also analyzed in this manner to determine a baseline chemical spectrum. The water sample returned for examination was analyzed using a liquid particle counter.

Results and Conclusions

The SEM/EDS analysis reveals that both filters are clogged with a silicate of Magnesium (Mg) and Aluminum (Al), with lesser varying amounts of Potassium (K) and Calcium (Ca). There are also carbonates present, in the form of calcite (Ca) and dolomite (Ca-Mg). The silicate found in these samples is likely the clay mineral Magnesium-vermiculite, a very fine grained particle, which crystallizes on the surface of the carbonates or forms clumps in the form of flakes. The aggregates of Mg-vermiculite are often up to tens of microns in size (approx. 20-30 um), and even larger particles can be found in the sediment sample (approx. 100 um), likely carbonate-vermiculite aggregates. The particle sizes are demonstrated well by the SEM pictures on the following page, especially when compared with a clean filter.

In addition to the silicate and carbonate present, there are also a few much less abundant compounds, such as iron oxide, quartz, and feldspar.

Particle counts from the water samples are shown in the table on the next page (Table 1). There were 10 samples tested, 40mL each, giving a total sample size of 400mL.

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The Critical Process Filtration staff and user representatives will jointly implement changes to the filter system that will restore its cost-effective operation.

## Quality Standards

Our goal is to ensure our customers the greatest possible value for their filtration dollar. Our state of the art manufacturing facility and quality management system are certified to meet ISO 9001:2008 standards. Each operation from assembly and test to cleaning, drying, and packaging is done in appropriately rated clean rooms. A sophisticated MRP system collects and processes real time data from manufacturing centers and inspection points. This allows variable and attribute data to be quickly and easily analyzed driving constant improvements in both quality and cost.

## Total Performance

Critical Process Filtration, Inc. is a vertically integrated manufacturer of filtration products for industries in which filtration is considered a critical part of the manufacturing process. We supply a complete line of products and services to help you cost effectively satisfy all your filtration requirements from a single source.

Contact our **Technical Service Department** to learn more about these and other services available from Critical Process Filtration.

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