Filter Problems, and Why Filters Fail

By Jose M. Sentmanat



Photo 1

hat are the common filter problems and why do they happen? Often the filter is a process equipment component that is ignored until it fails to perform to meet process requirements for clarity, flow rate and cycle time. When performance problems occur, the operators send their distress call to the process or plant engineer and the challenge to solve the problem begins.

If a process can function well without a filter, somebody is ahead of the game. But most likely, if there is a liquid with suspended solids as part of the process, then a filter is essential. Of the problems that can happen with filters, they can be grouped as follows:

Group 1 – Problems with filter

equipment or components.

- Group 2 Problems with filter ancillary equipment. Group 3 - Problems with filter
- operational procedures.

EQUIPMENT AND COMPONENTS

Undersized Filter: Often initial investment cost plays a large role in selecting the filter, so a less expensive or undersized filter is purchased to meet a budget. The undersized filter is not capable of handling the process flow or the total amount of suspended solids overwhelms the filter solids capacity before the cycle is complete. Photos 1 and 2 show the effect of too large a solids load for filter cake space.

Filter cleaning operating instructions should not start with "once the pressure is released, grab a shovel, and start digging to find the filter elements." Overloading the filter cake space with solids, as illustrated above, will cause bridging of the filter cakes between the filter leaves, warping the leaves and causing mechanical damage.

The solids buildup in the filter during filtration is based on the flow volume and the total percent of suspended solids in the feed to avoid overloading situations like shown in Photos 1 and 2.

Sometimes the initial tests performed on a test solution to determine the filter requirements do not represent the actual process feed composition. If a process starts on a production scale with a different feed from what was originally tested, an undersized filter causes production problems.

Internal Support: Sometimes the internal support of the filter leaves affect the filtration flow and the pressure drop through the filter. Photo 3 shows one filter leaf with a solid internal support so that the liquid, as it passes through the filter cloth, flows on top of the solid corrugated sheet. In Photo 4, to prevent the filter cloth from adhering to the solid support, a coarse woven honeycomb support is laid between the solid support and the filter cloth cover, Photo 5. By adding this internal support, filtration flow is improved; the filter cloth is separated from the drainage support with the honeycomb. Field reports have shown an improvement in some cases of a 25% higher flow when the honeycomb internal supports are installed under the filter cloth bags. This drainage support also helps cushion impacts on the filter cloth protecting the cloth from tears when hit against a sharp or blunt object.

Maintenance: Lack of proper maintenance is a major cause of filter



Photo 3: Solid Support

problems. A good preventive maintenance program will maintain the filter system in good condition and problem free. Care in proper cleaning of filter leaves is very important.

Leaves that are dirty cause low filtration flow rates and high differential pressure due to flow restrictions caused by reduced internal drainage in the filter leaves. See Photos 6 and 7. Photo 6 shows very dirty filter leaves with actual damage to the wire mesh. Photo 7 on the right shows a filter leaf that appears to have clean wire mesh. However, process conditions of low flow and high-pressure drop were experienced. A section of the wire mesh was removed and examination showed the internal support was dirty and clogged with solids buildup. This result demonstrates that surface cleaning of the media covering the filter leaf was not sufficient. A good thorough internal cleaning is necessary to keep the internal structure of the leaf clean and free of solids buildup that obstructs internal flow and causes high differential pressure. For cleaning filter leaves, it is recommended that a soaking in a 2% caustic bath at about 150 F for a couple of hours be performed, followed by high pressure hosing to thoroughly dislodge the solids built up in the internals; then wash the leaves well. In the worstcase scenario, ultrasonic cleaning by



Photo 4: Honeycomb Support

a specialized shop is necessary.

In the repair of mesh filter leaves by welding the wire mesh to the filter leaf, care during the welding process is essential to ensure that the welding is good and free of gaps or pinholes



Photo 5: Cloth Bag

that would cause bypassing during filtration. Photos 8 and 9 illustrate some of these problems. Photo 8 shows poor welding of the wire mesh leaving a gap (where the blade of the pocket knife is inserted). This gap at



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Photo 6: Very dirty filter leaves



Photo 7: Dirty Internal





Photo 9: Channeling through Pinhole

Photo 8: Pocket Knife in Welding Gap

the poor weld causes bleed through and prevents the proper buildup of the filter cake during precoating and subsequent filtration. Photo 9 shows channeling in the filter precoat caused by pinholes in the welding of the wire mesh. Bypassing of the flow through holes prevents the filter cake from properly forming on the filter leaf, causing the channeling effect that is shown.

Sometimes operators use im-

proper tools to scrape the filter cake off the leaves to complete discharge of the filter cake. Photo 10 shows some typical improper tools used by operators. These tools, when made of metal and used in a hurry can cause damage to the filter wire mesh as shown in Photo 11 where there is a hole in the wire mesh. This hole will cause bleed through and improper filter cake formation during precoat and filtration. Repair of holes in wire mesh or replacement is required to prevent clarity problems during filtration. Sometimes the wire mesh covering the filter leaf develops holes due to corrosion, wear, or erosion by the abrasiveness of the filter aid passing through the wire mesh during initial buildup of precoat. Protection of mesh from impact with sharp objects when plates are outside the filter is another consideration. Periodic inspection of the leaves is needed to en-



Photo 10: Improper Scraping Tools

Photo 11: Tear in Wire Mesh from Tools

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Photo 12: Wire Mesh Holes from Corrosion

sure that there is no damage to the wire mesh. Photo 12 and 13 illustrate wire mesh holes from damage due to corrosion, photo 14 shows warped and damaged filter leaves and photo 15 shows good filter leaves properly precoated with evenly formed filter cake.

Process Variables: Another filter problem is the selection of improper filter equipment because of inadequate consideration of the flux of the process liquor, inaccurate knowledge



Photo 13: Wire Mesh Hole from Corrosion

of the total suspended solids in the solution, the particle distribution or the nature of the solids. Without a proper analysis of the actual process liquor conditions, trouble looms on the horizon. When consulted about a filter problem, a very common finding is that the filter user has no critical data on the solution to be filtered. Particle analysis is not available with important information such as particle size, nature of the



Photo 14: Warped and Damaged Filter Leaves

solids particles, and if the solids are compressible or not compressible.

Ignoring temperature and pressure fluctuations that affect behavior of the process liquor and its filterability often happens with consequent filter problems. Sudden changes in temperature affect the viscosity of the process liquor and the solubility and amount of solids.

Baffling: Improper baffling of the precoat and feed liquid flowing into the







Photo 15: Good Filter Cake



Photo 17: Cartridges with Missing Springs

Photo 16: Air Bubbles in Spotty Filter Cake



Photo 18: Dirty Vertical Filter Leaves

filter will upset the cake and cause erosion of the filter cake and loss of clarity. Some horizontal filter plates have blank areas to serve as a baffle. However, precise stacking of the plates and correct alignment of the plate bundle with the baffle area opposite the inlet nozzle in the tank is necessary.

Filter Media: Sometimes the filter media is not the right grade for the application whether paper, cloth or wire mesh is used. The right filter media for the application is determined in the bench scale testing of the process liquid and selected to meet the process requirements.

PROBLEMS - ANCILLARY EQUIPMENT

Ancillary filter equipment can cause problems when incorrectly specified or integrated in the system. Lacks of proper instrumentation, incorrect piping, agitators or pumps are factors in filter problems.

Pressure Gauges: Pressure gauges are needed on the inlet feed pipe ahead of the filter and on the discharge outlet line of the filter to calculate the differential pressure across the filter system during operation. Too high a differential pressure will damage filter leaves. Too low a differential pressure causes uneven cake distribution and loss of clarity.

Check Valves: A check valve in the outlet piping of the filter prevents back flow to the filter and premature fall off of the filter cake and loss of clarity. Any back flow to the filter tank not only affects the filter cake, but also can damage the filter leaves and wire mesh media or cloth covers.

Precoat and Bodyfeed: One definite cause of problems with the filter is the lack or improper precoat and/or bodyfeed operations. Bench scale testing of the process liquor determines the proper grade of filter aids for precoating for initial clarity and body-feeding to keep the cake open to meet the process cycle time.

Agitators: Improper agitation in the feed tank causes settling of the solids and instead of a gradual feed of the suspended solids to the filter, lumps of the solids go to the filter that disrupt the filter cycle.

If the agitation of the liquid in the feed tank is too fast, the suspended solids and bodyfeed particles un-

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Photo 19: Sealant Patches (black dots) on Wire Mesh

Photo 20: Sealant on Edges with Leaks

dergo size reduction, due to abrasion, which affects the filterability of solids from the process liquor.

Pumps: The selection of wrong precoat and/or feed pumps is a cause for problems with the filter. For precoating and feeding the filter the most common pump is an open impeller centrifugal pump. For high viscosity liquids a positive displacement pump is better. For bodyfeed a diaphragm type pump is best. Avoid using a pulsating pump that causes a stop and go type flow that affects fil-

ter performance by upsetting the cake. Avoid getting air into the filter feed and use proper venting of tanks to avoid air blocks. Photo 16 shows a spotty filter cake caused by air in the feed to the filter. Air bubbles trapped in the filter cake will burst causing the filter cake to break, leaving bare spots on the media. This condition causes clarity problems and affects the performance of the filter. Bare areas of filter cake are subject to bypassing with no filtration, and the solids become imbedded in the filter media and inside the filter leaf structure. Sometimes the liquid velocity through the filter is so high that the suspended solid particles are forced through the filter cake, which affects the clarity of the filtrate.

PROBLEMS - OPERATIONAL PROCEDURES

When consulted about a filter problem, a very common finding is that the filter operator has no critical data on the process solution for filtration. Data such as the total quantity of suspended solids, the nature



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Photo 21: Cake Drop-off due to Pump Problem



Photo 22: Lumpy Precoat Problem

of the solids, or particle analysis is not available to give important information for particle size, nature of the solids particles, or if the solids are compressible or not compressible.

Common causes of filter problems are inadequate operator training and procedures, not following instructions or simply a disregard for proper operation of the filter. Photo 17 shows filter cartridges where the operators failed to insert the compression springs on some cartridges causing the filter to malfunction. These missing springs were found lying in the bottom of the filter tank. Photo 18 shows the top view of a vertical tank, vertical leaf filter; the leaves are dirty due to lack of good housekeeping practices of cleaning the leaves and the filter internals on a regular basis.

In shift operations, there are instances where operators have inten-

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tionally throttled the filter feed valve to continue running the filter to keep the differential pressure switch and instrumentation from stopping the filter on their shift. Thus, they postpone the work of pulling the filter off production for cleaning to the next shift.

At times operators have dragged the filter leaves on the floor while handling them during installation in the filter, causing tears and wear spots on the filter media. Or simple carelessness with the handling of the filter leaves causes damage to the filter leaves and/or to the filter media (paper, cloth or wire mesh).

Often when wire mesh covered filter leaves develop cracks or wear spots, causing bleed through of solids during filtration affecting clarity and contaminating the filtrate with solids that pass through the holes or cracks, operators try to do quick repairs by using sealants to cover such holes and cracks as shown in Photos 19 and 20.

The time and effort spent in doing these short lived "quick" patching operations on leaves is much better invested by having the leaves repaired by a qualified and experienced shop or simply buying a new set of leaves, if the leaves are old enough to warrant replacement.

Photos 21 and 22 are of the same rotary vacuum pressure filter. Photo 21 shows where the precoat and filter cake has prematurely dropped off due to problems with the vacuum pump. If the pump starts having problems, interrupting the continuous flow, the cake simply drops off the drum. The operator must then stop the filter and thoroughly clean the filter drum to get it ready for the next cycle. This operation is not only time consuming but also a loss in production. Having ancillary equipment in good working condition by good preventive maintenance during plant shut downs avoids production problems.

Photo 22 shows what can happen when the filter is not cleaned thoroughly including the filter trough. If the trough is dirty and not properly cleaned the precoat liquid will pick up the impurities left in the trough. Then the precoat cake is irregular with lumps of unwanted impurities, which definitely affects the filter performance. The operator will have to stop the filter and thoroughly clean the entire filter drum and feed trough. Operator attention and understanding of the process and equipment needs is important.

Based on experience, the filter consultant or troubleshooter is called when filter problems are difficult and not easily resolved by plant personnel. Before calling the consultant and/or troubleshooter, do good homework by having full data on the application. Know the percent of suspended solids, nature of solids, particle analysis, physical data such as specific gravity of liquid, density of the solids, temperature and feed pressure. Have the piping and instrumentation drawing (P&ID) of the process indicating capacities and description of all related ancillaries. Consulting trouble-shooting service is paid by the hour and days on the job trying to resolve the problems.

The person coming to help should not get paid for sitting around waiting for the plant personnel to gather the necessary information required to properly assess the situation to solve the filter problem.

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ACKNOWLEDGEMENTS

The following people contributed to this article with information and photos: Bill Boyd of LEEM/LSS FILTRATION, RAMSEY, NJ, www.leemfiltration.com Jan Hermans, SULPHURNET, CULEMBORG, THE NETHERLANDS, www.sulphurnet.com Alan Greig, GREIG FILTERS, INC., LAFAYETTE, LA, www.greigfilters.com Tom Bevins, FILTER ALL, INC/SEWN WELD IN-DUSTRIES, INC, MAGNOLIA, TX, www.filterallinc.com Julio Mauricio Pineda Marroquin, Consultant, GUATEMALA, jm_pinedamarroquin@yahoo.com

