**Basic troubleshooting required to maintain disc filter reliability**

Emmerling, Fred A

Disc filters have many applications in pulp and paper mills. The most widespread use is for thickening of slow-draining stocks, such as mechanical pulps. Disc filters are also commonly used in the paper mill as savealls for recovery of fiber and filler and for clarification of whitewater.

One of the first disc filter units installed in paper mills for environmental reasons was a paper machine saveall application. Justification for installation was recovery of valuable fiber and fillers. A side benefit of the application was cleaner effluent discharged to the river. Prior to the introduction of the disc filter, open cylinder deckers, side-hill screens, vacuum drum filters, continuous precoat belt filters, and air flotation separation cells were used as savealls.

The disc filter was introduced to the pulp and paper industry in the early 1950s for use as a paper machine saveall. The disc filter was originally developed for the chemical and mining industries to process slow-filtering materials. Consequently, the disc filter was an ideal machine for use in filtering slow-draining paper machine whitewater. By the mid-1960s, three major equipment suppliers were offering disc filters designed especially for use in the pulp and paper industry. There are now more than six major suppliers in the U.S. and Europe.

In the 1970s, paper machine water closeups became necessary due to environmental pressures. Reuse of paper machine whitewater was necessary for water conservation. A majority of the showers in the wire and press sections that originally used freshwater were designed to use clear filtrate from the saveall.

Disc filter operation. A disc filter unit consists of a series of discs mounted on a hollow center shaft that is equipped with drainage channels terminating at a valve assembly. Each individual disc is made of pie-shaped hollow sectors covered on both sides with filter cloth.

The discs rotate in a vat filled to about the midpoint of the center shaft with a mixture of whitewater and sweetener fiber. The center shaft is rotated by a variable-speed drive. Figure 1 shows the operation of the disc and highlights a single sector as it goes through one rotation.(Figure 1 omitted) The inlet box is shown opposite

the discharge for simplicity. The inlet box is located on the discharge end of the vat on many disc filters.

When the disc enters the vat (1), a mat is formed from the fibers in the vat, first by gravity and then by vacuum. This initial fiber mat, not the filter cloth, is the actual filtering medium. Initially, the filtrate is rich in fines and inorganics.

As the sector rotates further in the vat (2), the mat thickens, and the filtrate becomes clearer as fines and inorganics are retained in the fiber mat. A splitter mechanism in the valve assembly separates the clear and cloudy filtrates, which are carried to appropriate filtrate tanks via droplegs.

As the sector emerges from the vat (3), vacuum is cut off by a valve at the end of the center shaft, and the cake is removed by knock-off showers. The cake discharges into chutes and then to a conveyor that discharges to a stock chest. The knock-off position is sometimes located at the top center position of the disc shaft. Alternatively, the knock-off position may be 150 deg from emergence of the disc from the vat.

As the disc rotates toward the point of entry into the vat (4), the filter cloth faces are cleaned by a wire-cleaning shower. The clear wire-cleaning water is removed from the end of the center shaft in the valve box by a gravity or atmospheric drain.

Operating environment and problems. The saveall is normally located above the paper machine operating floor on a mezzanine. The operating environment is hot, humid, and not conducive to operator supervision. The saveall is normally monitored by a television cam. era from the operating control room. If properly designed and installed, disc savealls are reliable equipment. However, wear on the component parts must be monitored.

When a disc saveall operates well, it receives minimal attention. When the saveall malfunctions, it normally cannot be repaired without outage time. Therefore, a mill will often tolerate a poorly operating unit and use freshwater in the paper machine process when clear whitewater from the saveall should be used.

Common problems encountered in the operation of a disc filter can normally be fixed easily and relatively quickly during a shutdown. The key to minimum downtime is to identify the problem, determine the causes, and have materials and tools to make the repair during a scheduled outage.

Generally, disc filter problems and repairs are similar for all filter manufacturers. It is essential that operating and maintenance personnel become familiar with the manufacturer's manual and the equipment itself to successfully troubleshoot and repair the disc filter.

Common problems encountered include the following:

* Low, no, or oscillating vacuum

*High operating level and rotational speed

* High filtrate solids

* Difficult cake release.

Many operating problems with disc filters are interrelated. Therefore, it is important to comprehensively investigate all operating parameters during troubleshooting efforts.

It is essential to verify that operating conditions are in accordance with the original specifications for the disc filter. Changes in machine furnish, water reuse, sweetener source, and other variables can cause changes in operation that sometimes can be easily resolved by simply removing or adding discs.

Low, no, or oscillating vacuum. Low vacuum cannot be quantitatively defined, since disc filters will operate at different vacuums on different furnishes. Symptoms of inadequate vacuum on a disc filter ate low unit capacity, only partial cake formation on the disc sectors, high solids in the clear filtrate, vat thickening, and high vat level.

The causes for vacuum problems are not always obvious. The following areas must be considered:

Is there an air leak into the saveall? Examine and repair the following areas if leaks are found:

* Seal between the disc filter core and the valve box. This seal is usually a deckle strap between the core and a ring connected to the valve box or a lip-seal arrangement between the core shaft and the valve box. An inspection of these seals is necessary when the machine is not in service.

* Flexible joint between the valve box outlets and the drop legs. Leaks can be detected by moving an open flame around the seal while watching for a drawing force pulling the flame toward the leak.

* All bolts and cap screws on the valve box should be examined and tightened as required.

* All gaskets on the valve box should be checked. Leaks in this area can be checked using the open flame technique.

* Oscillating vacuum is usually the result of loose disc sectors. The bolts holding down the individual disc sectors should be checked. If there are gaskets between the sectors and the core, these should also be checked. The core covers over the openings providing for future discs should be checked for possible leaks.

* Oscillating vacuum may also be caused by improper vat level control. This vacuum problem is usually a cyclic phenomenon caused by the disc running at a fixed speed or a level control that is not properly functioning. Typically, the vat level will decrease to a point where air will be pulled into the vacuum system. Vacuum will be broken, and the level will rise again until vacuum is restored. The cycle will repeat as the vat level drops. The solution to this problem is to either slow down the disc or, preferably, repair or install the disc speed vat-level control loop.

* Oscillating-or low-vacuum problems may be a result of improper dropleg configuration, such as an offset in the leg, a leg that is not vertically plumb, or choking in the leg due to excessive now for the dropleg diameter. Proper design of the dropleg configuration will resolve this problem. The leg should be designed for a velocity of 10 to 16 fps. A good dropleg should be at least 20 ft long from the centerline of the disc to the level in the seal tank, should be vertically plumb, and should have no offsets.

* Oscillating vacuum may also be caused by variations in the seal tank level. This phenomenon usually occurs when the dropleg is sealed in the main tank, not in a separate seal chamber. Proper control of the main seal tank level will resolve this problem.

Is the filtrate system operating properly?

* Is there sufficient flow to the droplegs to create a good, stable vacuum? Flow to the disc filter must be estimated to assure that liquid velocities in the droplegs are in

the range of 10 to 16 fps. If the liquid velocity in the dropleg is low, a smaller-diameter dropleg may be required.

* Are the ends of the dropleg designed properly? Droplegs should be submerged in the seal tank approximately 1 to 1-1/2 pipe dia. If the droplegs ate submerged too deeply, the ends of the legs should be cut off to achieve proper submergence. If the droplegs are not sealed 1 to 1-1/2 dia in the tank level, an extension should be installed to the bottom of the dropleg.

High level and high speeds. If a disc filter has been in service for a long time, operating conditions may have changed since installation. Revisions may be necessary to restore efficient operation.

Verification of the original design specifications should be completed. If original manufacturer specifications are not readily available, the manufacturer should be consulted. If the manufacturer does not have the necessary information, drainage tests (leaf tests) can be performed to determine the operating capacity of the disc filter at various operating speeds.

If the operating conditions, manufacturer specifications, or leaf tests indicate that the disc is properly sized for the application, a check should be completed for the following parameters:

* Is the cake being released properly, or is the cake excessively thin? If the cake is too thin, slowly increase the sweetener stock flow. This action should result in a thicker cake that will release more easily.

*If the cake is not being released properly and is carrying over into submergence, there may be a problem with the valve. Check the condition of the valve segment (the face of the valve nearest the end of the core). The valve face may be worn to a point where the vacuum is not being cut off completely. Consequently, the cake will be held to the disc by residual vacuum. Repair or replacement of the valve face may be necessary.

* Check the wire-cleaning shower nozzles for plugging and clear plugged showers. These shower nozzles should be checked routinely. Even self-purging showers have been known to plug.

* Check the knock-off showers to ensure that the nozzles are open and aimed to hit the upper outer edge of the disc sector. Properly directed showers will start the cake peeling off the disc as required. These shower nozzles should be routinely checked.

* Verify proper venting of the atmospheric port. There should be a flow of air at the port. Unplug the vent if required.

* If the disc filter vacuum is excessively high, installation of a vacuum breaker or air bleed to the droplegs or valve box may be necessary. Proper filter vacuum should be 5-to 8-in. mercury on free pulps and 8-to 12-in. mercury on highly filled or high-wood furnishes. Caution: if the disc is operating at a lower vacuum than indicated above and running well, don't fix it.

High solids in the clear filtrate. One of the more difficult problems to troubleshoot in disc filter operation is high solids in the filtrate. This problem may be caused by operating conditions, physical damage, or disrepair of disc filter components. The following potential problem areas should be checked:

* Center-shaft deckle-strap or lip-seal leakage. Tighten or replace as required.

* Loose disc sector(s). Check by wiggling sectors. If they move an appreciable amount, tighten the holding bolts.

* Bad gasket(s) between the bottom of the disc sector and the core. Replace as required.

* Filtrate separator not set properly, with too little cloudy filtrate. Reset the separator a few degrees at a time and check solids content of clear filtrate. Repeat until desired clarity is reached.

* Leakage in valve box; cloudy and clear separator seals may be worn or missing. If the separator is moved to give less clear filtrate with lower solids content and the solids don't change, this is the problem.

* Hole in filter cloth. This requires careful inspection to find.

* Crack in disc sector body. This also requires careful inspection.

* Ratio of sweetener stock to whitewater may be low. Typically, the vat consistency should be two to three times the consistency of the raw whitewater. This is usually a matter of trial and error and requires testing of the filtrate solids content.

* Cross leakage between clear and cloudy filtrate chests. Occasionally, a loose tile or hole in a baffle occurs and causes the leakage of cloudy filtrate into the clear side of a combination chest.

Difficult cake release. Difficult or incomplete cake release from the disc is normally a result of vacuum leaking past the cutoff point in the valve box. This phenomenon is caused by a worn valve wear segment. The solution is replacement of the valve segment.

A secondary cause of difficult cake release is improper positioning of the knock-off shower nozzle The shower should be positioned so that it starts to peel the sheet off at the upper corner or the sector. The sheer weight of the cake will cause it to drop into the discharge chute and then into the discharge conveyor or stock chest.

Periodic cleaning. Successful operation of a disc saveall requires periodic cleaning. Operating and environmental conditions vary widely from mill to mill. Various chemicals, fillers, and organic compounds can blind the filter cloth, build up on the inner surfaces of the disc segments, and reduce the drainage capacity of the saveall unit.

If there are indications of saveall capacity loss, blinding of the filter cloth, or poor pickup on any of the discs, then an inspection should be made of the disc sectors to determine if buildup of scale, slime, or other foreign materials has occurred.

If severe disc scaling is found, the manufacturer of the disc should be contacted for chemical cleaning recommendations that will not be harmful to the disc filter's materials of construction. A chemical analysis of the scaling material is helpful in making recommendations for the proper chemical cleaning agent.

If cleaning must be performed several times a year, it may be advantageous to install a small, permanently piped chemical cleaning system. The cleaning system may be piped into one of the seal tanks and into the inlet piping to the disc filter.

Showers should be routinely inspected and cleaned.

Fred A. Emmerling is senior pulping and bleaching specialist-PROBEK, BE&K Engineering, Morrisville, N.C.