Aspects of Rotary Vacuum Filter Design & Performance

Associate Technical Editor’s Comments:
This paper provides a cursory description of the various rotary vacuum filter designs and their applications, enumerates the operating adjustments for each type of discharge, details the optimum performance criteria for precoat filters and examines the basic requirements for the auxiliary equipment. This paper was presented at the 1999 annual meeting of the American Filtration and Separation Society which was held in Boston.

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Abstract
The rotary vacuum filter is very basic in design, application and operation. It is also an extremely effective solid/liquid separation device due to its unique methods of handling (discharging) formed cake solids, relatively low operating labor requirements and its ability to filter continuous or batch process flows.

The rudiments of a rotary vacuum filter installation include (Figure 1):

1. the filter: comprised of the drum, vat, agitator and solids discharge mechanism; and
2. auxiliary package: consisting of a vacuum source [typically a liquid ring vacuum pump], a means of separating the air and liquid discharge from the filter [usually a vacuum receiver] and a filtrate pump [to transport the liquid from the vacuum receiver to the next step in the process].

The filter is rated by the size [filter area] of the drum and its potential output [typically expressed as pounds per hour of dry solids per square foot of filter area; precoat filters are rated by hydraulics instead of by solids]. The sizing of the auxiliary package components is dependent upon the area of the filter and the type of application. Since rotary vacuum filters can handle such a wide range of materials, expected solids output can range from 5# to 200# per hour per square foot and 2 gallons to 40 gallons per hour per square foot [for precoat discharge].

Discharge Designs
The five basic discharge types are:

1. Scraper (Figure 2)
2. Endless Belt (Figure 3)
3. String (Figure 4)
4. Roll, and (Figure 5)
5. Precoat (advancing knife). (Figure 6)

Each is designed to be able to discharge specific types of formed cake solids. In essence, these five mechanisms enable the rotary vacuum filter to efficiently handle [i.e. filter a solid-liquid slurry AND discharge the formed solids] a complete spectrum of process slurries.

The Scraper Discharge, Endless Belt Discharge, String Discharge, and Roll Discharge have in common that:

- the filtered cake solids are formed on a permanent medium, typically a woven synthetic;
- the discharge mechanism must separate the solids from the permanent medium (septum);
- the solids content of the slurries are relatively high;
- the basic designs of the drum, vat and auxiliaries are somewhat “universal”, meaning that one discharge type can be switched out for one of the others. This is not the case for the precoat discharge filter which often requires a totally different filter design.
A precoat filter has the following unique design characteristics:

- well suited for very low solids concentration
- product is typically the “liquid” phase
- designed for “difficult” to filter slurries
- the filter medium is disposable and renewable
- typical filter medium is diatomaceous earth or perlite
- filteraid selection is critical for clarity & economy
- economic operation sensitive to filter adjustments

**Drum Design**

Any RVF utilizing a scraper, endless belt, string or roll discharge must have a drum with (1) filtrate pipes and a (2) valvebody with bridge blocks. A filter with a precoat discharge can use (1) a drum with filtrate pipes, (2) a drum with a valvebody, (3) a valveless drum or (4) a drum without filtrate pipes. For this reason, precoat discharge filters have a wide array of designs, specialty features and varying requirements for successful operation.

The valvebody on universal drum designs allows vacuum and air flow to be controlled to each radial position of the drum, a requirement for all of the discharge designs except precoat. Without a valvebody, the drum can only be used for precoat discharge applications. Universal and valveless drum designs have applied vacuum only to the surface of the drum by means of the filtrate pipes. All liquid and air are contained within the filtrate pipes. The interior of the drum is dry and at atmospheric pressure (Figures 7, 8).

The unique drum design (particular to Italian filters) in Figure 10 changes the design of the auxiliary equipment package. Compare the schematic in Figure 11 with the “typical” schematic for RVF’s in Figure 1.

**Special Designs**

**Cake Wash**

Appropriate wash liquor can be applied to the formed cake solids if the process requires a high degree of mother liquor recovery. As a rule of thumb, 90% of the mother liquor can be recovered with the application of wash liquor equal to 2 displacements of the mother liquor content in the filtered cake solids. It is essential that the wash liquor be applied to the cake solids with uniform distribution. Spray nozzles are preferred, but are a high maintenance item. Drip pipes do not give good distribution unless combined with a wash blanket (another high maintenance item). Weak liquor separation is possible only if the drum is of universal design. An additional vacuum receiver and filtrate pump would be required. Cake wash can be accomplished on all discharge and drum designs (Figure 12).

**Knock-Out Receiver**

Precoat discharge applications are typically high foam generators. Since foam does not easily separate out from the air/liquid stream coming out of the filter drum, there is a high tendency for the foam to be swept through the vacuum receiver, into the vacuum pump and out of the filtration system with the vacuum pump seal water. This can cause environmental problems, vacuum pump operation problems and a loss of filtered product. By adding a second receiver with a diameter sufficient to reduce the air flow velocity to 1 ft/sec (or less), most foam can be dropped out of the air stream. Foam carry-over can also be eliminated by reducing the filter operating vacuum level. However, this will reduce the filter throughput and increase operating costs, especially with a precoat discharge filter (Figure 13).

**Tilting Vat**

One manufacturer offers a “tilting vat” design which provides a means of reducing the “dead” time between the knife blade at point of discharge and the drum as it enters the slurry. The vat is horizontal when filtering at “high” drum submergence and progressively “tilted” as the drum submergence (vat level) decreases. Two other notable design features of this filter are that: the knife is attached to the vat, which moves back and forth, in order to produce knife advance or retraction; as with some other European designs, the filter does not have a vat agitator (Figure 14).
Hydraulic Agitator

Some European filter manufacturers eliminate the “rake” style vat agitator and use the hydraulics of a feed pump to maintain the slurry (filteraid & process) in suspension. The design incorporates a series of nozzles across the back of the vat connected to a common manifold and feed pump. A vat level controller turns the pump on and off so as to maintain a desired vat level. Slurry solids are kept in suspension by [1] the velocity of the multi-stream inlets and [2] the wave motion caused by the cycling of the feed pump. Satisfactory performance is dependent upon the feed pump being sized adequately to ensure that the slurry velocity is sufficient for proper suspension. The process slurry is not usually a major concern. The filteraid slurry, however, can settle out during the precoating mode if the pump is not capable of significant output (Figure 15).

Filter Cloth/Septum Design


- provide desired filtrate clarity,
- have good flow characteristics,
- maintain clarity & flow overtime,
- be durable (good wear), and
- be cost effective.

The [5] precoat discharge filter has different requirements because the septum is NOT the filter medium; the precoat cake [typically diatomaceous earth or perlite] is the filter medium. The filter cloth is basically a support device.

Special Requirements vs. Discharge Design Type

While all of the five design elements presented above are important for all applications [with filtrate clarity usually having the highest priority], the following highlights the critically important septum design elements with the particular filter discharge type.

Endless Belt
- Cake release
- Wear resistance
- Dimensional stability

Scraper
- Wear resistance
- Resistance to solids blinding
- Cake release

Roll
- Cake release
- Resistance to solids blinding

String
- Resistance to solids blinding
- Wear resistance
- Cake release

Precoat
- Resistance to solids blinding
- Flow characteristics

Elements of Cloth Design (Woven Media)

Fiber: the material used to manufacture the strands, e.g. polypropylene, nylon, dacron, etc.


Permeability: indirectly, a measure of the fabric’s ability to retain solids; stated as cfm air flow per square foot area at a pressure differential of 0.5” water column.

Weight:  stated as ounces per square yard; a factor when considering wear, solids blinding and adaptability to the discharge design [belt tracking or cloth caulking].

Thread Count: number of threads per inch in each woven direction; typically determined by the manufacturer.

All of the discharge types, except precoat, require a balancing of the first 5 cloth design parameters in order to optimize filter performance. “Fine tuning” of the belt or cloth design will usually be done with changes to yarn type and fabric permeability. The fabric design for precoat discharge filters, however, must be connected to they type of filter media [filter aid] being used for the process. For this reason, the applicability of the many choices of fabric design is considerably reduced. Sophisticated fabric design offers little or nothing to the efficiency of the operation, except higher costs!

Typical Cloth Design for RVPF
Fiber:  polypropylene [for process compatible fiber]
Yarn:  mono or multifilament; not spun-staple
Weave:  twill
Permeability:  50-150 cfm/ft² range; depends on filteraid
Weight:  6 – 10 oz, typically
Thread Count:  by fabric manufacturer

Micron rated woven fabrics offer no benefit. Non-wovens, needle felts and coated fabrics are not suggested. Stainless steel woven media can be a standard Dutch twill [24 x 110] or bolting cloth [selected by % open area].

Basic RVF Operation
The basic operating adjustments for all RVF discharge designs are: [1] vat level and [2] drum speed. Valvebody settings [if applicable], vacuum control and adjustments to the discharge mechanism are dependent upon the type of discharge design.

Vat Level
Vat level determines the proportion of the filter cycle, i.e. one drum revolution, dedicated to cake formation [filtration] and cake drying. In the absence of any other contradicting factors, vat level should be adjusted to maximum [higher vat level = more filtration]. The two basic reasons for reducing the operating vat level are:

• hard to filter slurries which form thin, gelatinous or slimy cakes; or
• slurries with very high suspended solids content which form very thick cakes.

The effects of varying vat level can be summarized as follows [decreasing from maximum]:

Operating Vat Level Decrease.................↓
 % of drum submergence.................↓
 ratio of form to dry time.................↑
 moisture content of formed solids........↓
 thickness of formed solids..............↓
 flow rate per drum revolution...........↓
 filteraid efficiency [precoat].........↓

For all discharge designs [except precoat], a change in the operating vat level requires an adjustment to the valvebody. [Please see the following discussion on valvebody settings]. Cake solids’ thickness and moisture content can also have an impact on the discharge mechanism operating settings, e.g. amount of air blow back [scraper], discharge roll speed, belt tension and tracking adjustments [endless belt] and knife advance rate [precoat].
Summary of Operating Vat Level Cycles

High Vat Level
- Maximum filtration time
- Maximum solids formation per cycle
- Maximum cake thickness
- Maximum cake moisture content
- Highest filter output

Low Vat Level
- Maximum cake drying/washing time
- Minimum solids formation per cycle
- Minimum cake thickness
- Minimum cake moisture content
- Lowest filter output

Operating vat level is adjusted [reduced from maximum] in order to provide proportionately more cake drying time and/or to form thinner filtered cakes. The penalty for this adjustment is a reduction in filter throughput (Figure 16).

Drum Speed (minutes per drum revolution)
With all other filter operating conditions constant, an increase in drum speed will produce an increase in filter throughput. Drum speed is the “gas pedal” for filter output.

Operating Drum Speed Increase………↑
- filter throughput......................↑
- thickness of formed cake solids......↓
- moisture content of cake solids.......↑
- flow rate per drum revolution.........↓
- filteraid efficiency [precoat]...........↓

The penalty to the process for increasing filter throughput, i.e. increased drum speed, is higher moisture content of the discharged cake solids. This may translate to [1] lost product, i.e. recovery of filtrate or [2] higher disposal costs, i.e. more liquid in the filtered cake solids. With a precoat discharge filter, higher drum speeds also means lower filteraid efficiencies (hence, higher production costs). Drum speed and vat level are usually adjusted “dependently” in order to optimize filter performance.

With all discharge designs, except precoat, another method of controlling cake formation and dryness is with vacuum/air flow regulation. The outlets of the valvebody permit airflow to be preferentially directed from either form or dry zones of the drum. Reducing from zone vacuum results in thinner cake formation, thereby reserving a great amount of air flow to the drying zone for a drier cake.

If all filter operating conditions are held constant, then filter throughput will vary with drum speed in very close approximation to the relationship shown in Figure 17. (Note log/log scale)

Valvebody & Adjustments
The RVF “valvebody” is a device which controls the radial position of application for form and dry zone vacuum blowback pressure (if required) and venting to the various surfaces of the drum as the drum rotates through its cycle. The valvebody is the connection between the filter (at the drum) and the vacuum system (typically the vacuum receiver). Control valves between the valvebody and the receiver may also be used to adjust form and dry zone vacuum levels. Endless belt, scraper, roll and string discharge designs must have a valvebody. Precoat filters do not need a valvebody (most are designed without one) and may just have a rotary union, depending on whether the drum is a universal type or precoat discharge specific.
The "universal drum" has filtrate pipes, requires a valvebody and can be used for any discharge design. Valveless drums with filtrate pipes, valveless without filtrate pipes and drums with internal filtrate pumps are all designs which can only be used for precoat discharge applications. Precoat specific drum designs cannot control the vacuum level at various radial positions on the drum; the entire drum is at the same vacuum level throughout the entire drum cycle [drum revolution] (Figures 18-19).

The filtrate pipes pass through the zones defined by the valvebody and the bridge block settings as the drum rotates through its cycle. (Note that the valvebody does not rotate with the drum, but remains in a fixed position.) Form and dry zone vacuum, blowback pressure and venting are all regulated with control valves external to the valvebody (not shown). This design permits complete control of the surface vacuum level at various radial positions of the drum and also allows for separation of the filtrate from each zone. Bridge blocks must be adjusted for high or low operating vat levels and venting and blowback for each discharge design. The valvebody for a precoat discharge does not have a vent and bridge blocks should be removed for best performance (Figures 20-22).

Note that some manufacturers do not use bridge blocks, but rather a plate with machined openings for form, dry and vent connections. Minor adjustments can be made by rotating the entire valvebody a few degrees in the appropriate direction (same for bridge block valvebodies). Major changes require a new plate or remachining.

**Discharge Mechanism Adjustments**

Detailed instructions for adjusting each of the discharge designs (except precoat) is beyond the scope of this paper. However, there are some typical, and important, settings and conditions which should be mentioned.

**Endless Belt:** Belt tracking, cake release and media cleaning are of major importance for efficient operation. The first task is to ensure that a septum (filter cloth) is selected which provides [1] a smooth surface for good cake release, [2] good wear resistance (suggest a twill weave variation), [3] good dimensional stability (autoclaved material) and a yarn resistant to solids blinding (mono or multifilament). Belt tension, demooning bar height, wash water quantity and discharge roll speed are adjustments which must be carefully selected to maintain tracking and prevent excess wear.

**Scraper:** Filter cloth selection must provide good wear and solids blinding characteristics. Blowback pressure should not be excessive (causes high wear on the fabric and blows out the caulking), blowback should be for the shortest duration possible (just enough to dislodge the cake) and the scraper blade should not be set against the drum (unless the filter is wire wound). Valvebody adjustments are critical for blowback so that excess filtrate is not forced back out of the pipes along with the released cake solids and to minimize wear and media maintenance.

**Roll:** Cloth selection must provide for good cake release and solids blinding resistance. Coated fabrics can be helpful for enhancing both cake release and extending the life of the media because of solids blinding. Valvebody settings for vacuum venting at the point of discharge is critical. Discharge roll speed must be matched to the drum speed and the scraper knife must leave a significant “heal” on the discharge roll so that cake transfer is continuous.

**String:** Besides the usual media selection demands, string tracking and alignment are important. Aligning tines tend to get worn – in grooves from the strings. After a period of time these grooves will jam and cut the strings causing cake discharge and maintenance problems. Careful adjustment of the aligning tine bar to minimize lateral pressure on the strings is essential. Placing a ceramic (glass, or any other suitable material) tube over each tine will act as a bearing surface for the string; the string rotates the tube around the tine as it passes by.

**Precoat:** Filter cloth should be selected in conjunction with the grade and type of filteraid (diatomaceous earth or perlite) being used in the process [please see “Filter Cloth/Septum Design”]. Adjusting the advancing knife for the optimum knife advance rate per drum revolution is absolutely imperative for economic filter performance and filteraid efficiency. This topic is covered in detail below.

**Precoat Filter Operation**

**Filteraid Selection:** Since the filteraid is the actual filtering medium, careful attention must be paid to the single most important selection criteria: process solids penetration. For effective performance, any filteraid must limit the degree of solids penetration into the precoat cake to 0.002” – 0.005”. Greater penetration requires too high of a knife cut to remove the “spent” filteraid resulting in high filteraid and disposal costs. Conversely, if the filter aid is too “tight”, i.e. too fine, solids penetration will be minimized, but flow rate will also be forfeited. Figure 23 illustrates these points.
Using too tight of a filteraid grade not only forfeits available flow (filtration) rates and reduces filteraid efficiency, it may not yield any improved filtrate clarity compared to an optimum grade (in this case, more open). In like manner, there may not be a degradation of filtrate clarity if the filter aid grade is too open, but excessive quantities of filteraid would be required for the same output (flow rate) compared to a tighter (optimum) grade. Note that clarity does not always vary immediately with tighter or more open filteraid grades because of the phenomenon of cake filtration. Once an initial cake of filtered process solids has formed on the precoat, the process solids cake can be the governing factor in filtrate clarity, especially if the suspended solids concentration is high. Clarity can be maintained as the filteraid goes from "optimum" to "more open" as long as the precoat is not so open as to prevent bridging of solids on the precoat cake pores (Table I).

Knife cut analysis must always be based on knife advance rate per drum revolution. Most precoat discharge filters have knife advance drives which are independent of the drum drive. This system design makes it necessary to adjust the knife advance rate whenever the drum speed is changed (assuming that the original knife cut was an optimum one). If the drum speed is reduced, the optimum cut will change to an excessive cut. If the drum speed is increased, the optimum cut will change to an insufficient cut (without a knife advance rate change, the knife will advance at a constant rate per time period, not per drum revolution). Filters which interconnect the drum drive with the knife advance drive are not subject to this condition (Figure 24).

The optimum grade of filteraid (for the process slurry being filtered) will always produce a curve similar to the one shown in Table II, i.e. there will be a decreasing increase in the flow rate, followed by a definite "knee" in the curve, and then finished with a relatively flat flow rate as the knife advance rate increases.

This curve can be duplicated in production by:

1. set the knife to a very low advance rate
2. let the filter flow rate equalize (15 min)
3. measure flow rate and plot
4. increase knife advance rate (100%)
5. let the filter flow rate equalize (15 min)
6. measure flow rate and plot
7. continue process for sufficient points

Note: Do not start with a high knife advance rate and work downwards. The results will be distorted.

The filteraid grade is not optimum if the curve looks like one of those shown in Table I.

Table III provides a useful method for determining the approximate knife advance rate for a given set of filter operating conditions. The numbers in the body of the table indicate how many hours the filter can operate on one [1] inch of precoat cake. Drum speed and knife advance rate must remain constant throughout the measurement period (Figure 25).

This table provides an easy method for checking if the filter is operating within the optimum range. If the advance rate from the table is higher than the "optimum range", then the user can realize cost reduction by:

1. reducing the knife advance rate
2. using a tighter grade of filteraid
3. checking for mechanical problems

If the advance rate from the table is lower than the "optimum range", then the user can increase production and reduce operating costs by:

1. increasing the knife advance rate (for more production)
2. decrease the drum speed (for same production with less filteraid usage)
For Determining Knife Advance Rate:
1. Select appropriate drum speed row
2. Read across for closest operating time recorded for one [1] inch of cake
3. Read up to top row for the effective knife advance rate

For Determining Optimum Operating Time:
1. Select appropriate drum speed row
2. Read across to desired knife advance rate column
3. Intersection of column and row is running time per inch of usable precoat cake

Special Considerations For Precoat Filters
A rotary vacuum precoat filter is a versatile piece of process equipment which can be very economical to operate in terms of both labor and materials [filteraid]. Unfortunately, many users forfeit these benefits because of [1] inadequate knowledge and understanding of how to operate a RVPF and [2] poor design and inflexibility of auxiliary equipment.

Knowledge of Operation: Equipment manufacturers are certainly the prime sources for information concerning the “nuts and bolts” of the filter itself. However, filteraid and septum (filter cloth) selections are typically best resolved by the filteraid producers (remember that the design of the filter cloth is a function of the type and grade of filteraid being used). RVPF users should demand product application information from the vendors of the filteraids.

Auxiliary Equipment Design: The optimum grade (and type) of filteraid has a relatively narrow band of application, i.e. as the process and/or conditions vary, a different grade of filteraid may be required (also impacts filter cloth selection). Flexibility for conveniently handling different grades of filteraid should be designed into the entire filtration system. Precoat slurry mix tanks and transfer pumps, filtrate pumps, vacuum pumps and vacuum receivers are all “culprits” of restricting the available performance of the rotary vacuum precoat filter itself. The most frequent cause of poor filtration performance with RVPFs is inadequate design or maintenance of the above listed auxiliary equipment and poor understanding of RVPF operation. It is not out of the ordinary to observe operating costs and/or loss of production in excess of 30% (off of available potential) because of these two points.

1 – Precoat Slurry Mix System (Figure 26)
A 4” precoat cake can be applied to any RVPF in 45 minutes or less. This implies that:
   1. the mix tank must be large enough to hold the entire charge of filteraid for a full precoat cake at an appropriate slurry concentration (a satisfactory design for small filters); or
   2. the required amount of filteraid can be added so as to maintain the desired slurry concentration during a 30 minute time span.

Note that the desired slurry concentration (wt:wt basis) is typically 5% - 8%. The % concentration should be [1] constant throughout the precoating mode or [2] decrease uniformly to “zero”, as with recirculation systems.

2 – Precoat Slurry Transfer Pump
Given a typical system as shown in Figure 26, the transfer pump needs a capacity of 0.5 to 0.75 GPM per square foot of filter area. Excess precoating time will be the penalty if this pump is too small.

3 – Make-up Water/Recirculation
If a recirculation line is used (as shown in Figure 26), very little make-up water will be needed during precoating. If the precoat slurry is a “once thru” design (not suggested) then make-up water will have to be added at a rate equal to the precoat transfer pump capacity (0.5 to 0.75 GPM per square foot of filter area).
4 – Vacuum Pump Capacity
For the precoating mode, the pump must deliver at least 2.5 to 3.5 CFM per square foot of filter area. During the process mode, 2.0 to 3.0 CFM per square foot is satisfactory. It is usually satisfactory to employ a single vacuum pump for small filters. Power consumption can be reduced by using two pumps for medium to large filters. Vacuum pumps for multiple filters should not be manifolded together into a single vacuum system for all filters. Pumps should be capable of achieving 28” Hg vacuum and sized for the required CFM capacity at 20” Hg operating level.

5 – Filtrate Pump Capacity
Most precoat filter applications will have a process rate of filtration considerably lower than that of the precoating mode. If a single, standard centrifugal pump (ANSI type) is used as the filtrate pump, then one can expect pump application problems, i.e. running off the pump curve for either precoating or process filtration modes. It is common practice to use two differently sized pumps to move filtrate from the vacuum receiver: a large pump for precoating and an appropriately sized pump for process. Centrifugal pumps should not run faster than 1750 RPM and must have a check valve on the discharge side. They must be sized for operating against a vacuum on the suction side and have the TDH capacity appropriate for the process system. Seals must be leak-proof (mechanical or packed).

6 – Vacuum Receiver
The purpose of the vacuum receiver is to separate the two phase mixture coming out of the filter, i.e. the air and liquid (filtrate). If foam is present, the receiver must also be capable of preventing carry over of foam to the vacuum pump (please see previous discussion under “Knock-Out Receiver”). The vessel diameter is the critical dimension for effecting the separation of the two phases; vessel height is to accommodate surges in flow.
Table I. Relative flow rate vs. knife advance rate. (For tight, optimum, open filter aid grades).

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inches per drum revolution
millimeters per drum revolution

Table II. Relative flow rate vs. knife advance rate. (For optimum filter aid grade).

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inches per drum revolution
millimeters per drum revolution
Table 111. Filter aid usage rates.

**Filtration Time (Hours) For 1 Inch of Usable Precoat Cake**

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<td>8.3</td>
<td>6.7</td>
<td>5.6</td>
<td>4.4</td>
</tr>
</tbody>
</table>

**DRUM SPEED** (minutes per revolution)

**Optimum Range**

Figure 1

Typical RVF equipment schematic (for all discharge designs).

Figure 2

Scraper discharge.

- excellent for heavy solids
- typical slurries are easy to filter
- high filtration rates
- simplest discharge design
- "air blow-back" for cake release
- filter cloth is typically a woven synthetic

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Figure 3
Endless belt discharge.
- best for slurries with "moderate" solids content
- filter cloth critical for cake release & filtrate clarity
- most complicated discharge design
- cloth continually cleaned

Figure 4
String discharge.
- for slurries with high solids content
- solids must be fibrous/stringy/pulpy
- filter cloth design is critical

Figure 5
Roll discharge.
- solids must form a sticky, mud-like cake
- slurry solids content usually high
- filtration rates are typically very low
- filter cloth design is critical

Figure 6
Precoat discharge.
- well suited for very low solids concentration
- product is typically the "liquid" phase
- designed for "difficult" to filter slurries
- the filter medium is disposable & renewable
- typical filter medium is Diatomaceous Earth or Perlite
- filter aid selection is critical for clarity & economy
- economic operation sensitive to filter adjustments
Figure 7
Universal drum design schematic.
- filtrate pipes
- valvebody w/bridge blocks
- radial position control of vacuum
- applicable for all discharge designs

Figure 8
Valveless drum schematic.
- filtrate pipes
- no valvebody
- no radial position control of vacuum
- applicable only for precoat discharge design
Figure 9
Drum w/o filtrate pipes schematic.
- entire drum under vacuum
- no radial position control of vacuum
- filtrate is collected in drum interior
- applicable only for precoat discharge design

Figure 10
Drum with internal filtrate pump schematic.
- entire drum under vacuum
- no radial position control of vacuum
- filtrate collected inside of drum
- applicable only for precoat discharge design

Figure 11
Typical RVPF equipment schematic
(for drum with internal filtrate pump).
Figure 12
Typical cake wash schematic (for all discharge designs).

Figure 13
Knock-out receiver schematic.

Figure 14
Tilting vat schematic.
(A) At maximum vat level the vat is horizontal
(B) As the vat level drops [end of run], the vat is tilted so as to keep the slurry level as close to the knife as possible

Figure 15
Tilting vat RVPF schematic w/ hydraulic agitator.
Figure 16
RVF operating cycle (for all discharge designs).

Figure 17
Filter thru-put vs. drum speed.

Figure 18
Universal drum schematic w/ valvebody.
Required for belt / scraper / roll / string discharge
Optional for precoat discharge
Figure 19
Valveless drum schematic w/ rotary union.
Can only be used for precoat discharge

Figure 20
Valvebody schematic
(typical for belt • scraper • roll • string discharge).
View is from inside the valvebody looking out.
(Typical for all schematics of valvebody).
Reference Figure 18.

Figure 21
Bridge block adjustment schematic
(typical for belt • scraper • roll • string discharge).
**Figure 22**
Valvebody schematic (typical for precoat discharge).

**Figure 23**
Relative filter aid grades.

**Figure 24**
Rotary vacuum precoat filter Knife cut analysis.
Figure 25
Optimum knife cut
(required for highest filter efficiency).

Figure 26