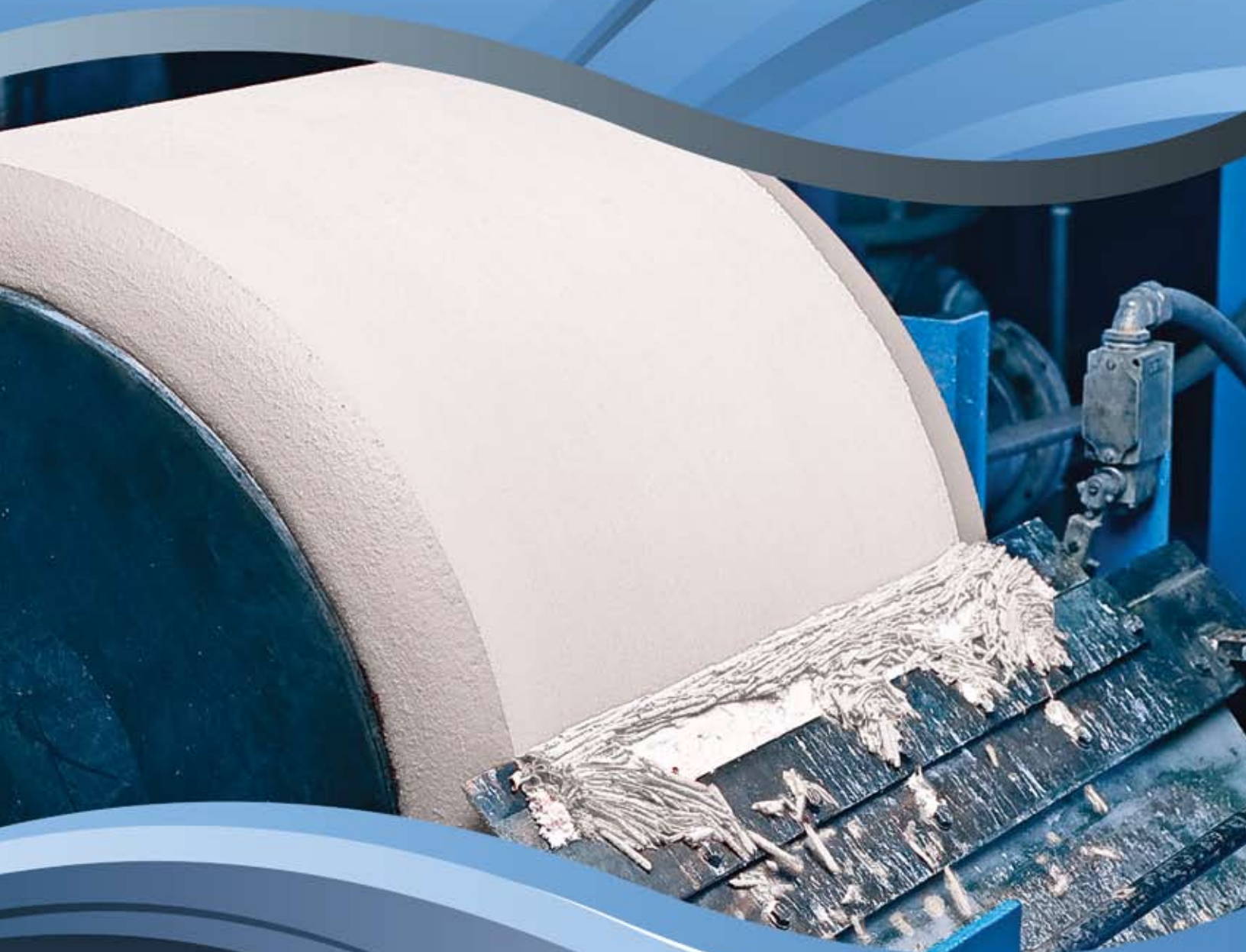


Rotary Vacuum Precoat Filter

A Simple Guide for Efficient Filter Operation



Celatom[®]
Filter Aids

STABLE PRECOAT • EXTENDED CAKE LIFE • HIGH FILTER FLOW RATES • CLEAR FILTRATE

Introduction

Rotary Vacuum Precoat Filters (RVPF) are designed to filter a wide variety of high solid liquids that would otherwise blind or block other types of filters. RVPF's can maintain high filtration rates while removing slimy, sticky, oily and blinding solids. Applications range from process liquids like pharmaceutical and food products to waste water sludges. The information in this Guide will provide helpful information to operate your RVPF optimally with your application.

Precoat Application

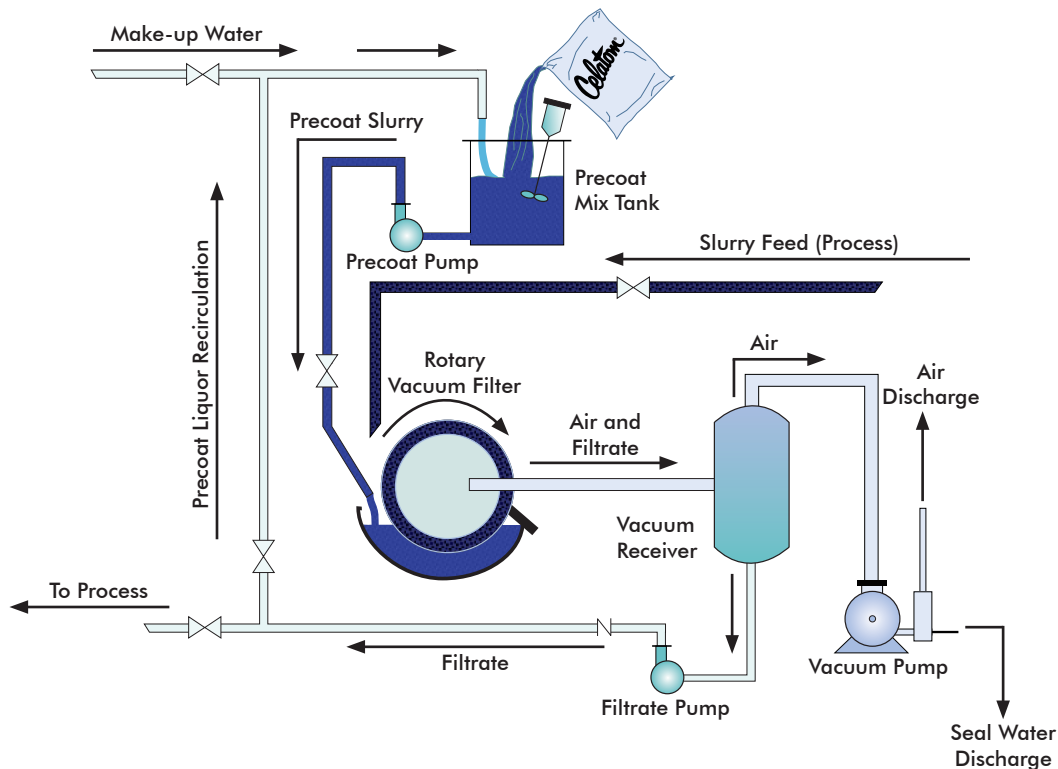
To assure a stable and firm precoat it is recommended the precoat be applied in thin layers. To achieve this the precoat should be applied with a fast drum speed (2-3 rpm) and low vat level (10-20%).

Precoat Slurry Concentration

The most practical slurry concentration range for diatomaceous earth filter aid is 5-10% by weight (3-5% for Perlite). Too high a slurry concentration can produce a soft cake which may crack during process filtration. A low concentration requires too much time to apply.

Precoat Liquor

Filtration rates during precoating are usually very high. This means that a great deal of water (precoat liquor) must be available to maintain the process. The most efficient method of supplying an adequate amount of precoat liquor is to recirculate the precoating filtrate back to the precoat slurry mix tank. This will minimize the amount of make-up water required.



Precoat Addition

The quality of the precoat cake is greatly improved if the slurry concentration remains relatively constant for as much of the precoating cycle as possible. After the initial concentration has been established and the precoating cycle has started, any remaining filter aid should be added at a uniform rate over a period of 15-20 minutes.

Precoat Time

If all of the associated pumps are sized and operating well, a 4" thick precoat cake can be applied in less than 60 minutes. A 10-15 minute curing cycle at the end of precoating is suggested (recirculation of precoat liquor or process slurry without knife advance) in order to firm-up the precoat for a more efficient knife cut during process filtration.

OPERATING CYCLE SCHEMATIC

The following is a brief discussion of suggested operating adjustments and procedures for attaining maximum filter efficiency and through-put while minimizing filter aid usage.

There are essentially only two (2) active operating adjustments which should be made to a rotary vacuum precoat filter:

1. The level of the process slurry in the vat.
2. Filter drum, i.e., the time required for a drum revolution.

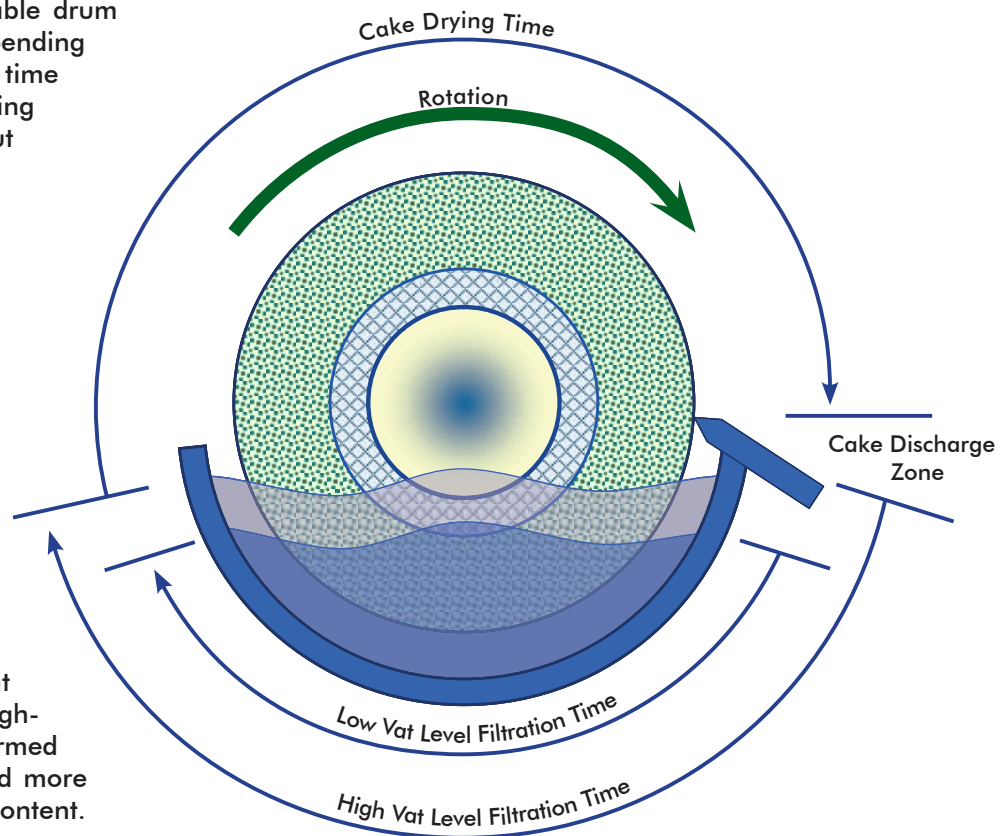
The optimum knife advance rate [per drum revolution] is a given condition determined by the interaction of the process slurry solids and the grade of filter aid being used for the precoat.

VAT LEVEL

During Precoat Filtration:

The filter should normally be operated at the highest vat level design point. At maximum available drum submergence (typically 30-40%, depending upon filter design), the ratio of filtration time to dry time is the greatest. This setting provides for maximum filter through-put for any given drum speed. The vat level should be reduced only if:

1. Formed cake solids are thin and gelatinous/slimy in nature. For this type of slurry, lowering the operating vat level will not reduce the filter through-put and/or the thickness of the formed cake, but will assist in producing drier discharged solids.
2. The slurry has a high solids concentration and forms an excessively thick cake. For this type of slurry, lowering the operating vat level will reduce the filter through-put and the thickness of the formed cake. The solids will be discharged more efficiently and at a lower moisture content.



DRUM SPEED

The primary reason for regulating the filter drum speed is to control the amount of process slurry filtered in a given time period, e.g., gallons per minute.

NOTE: Filter through-put increases as drum speed increases if, and only if, all filtered cake solids and solids which have penetrated the precoat cake are completely removed with every revolution of the drum.

A secondary function of drum speed regulation is to affect the moisture in the formed cake solids. Cake moisture increases as drum speed increases.

Filter aid consumption decreases as drum speed (filter through-put) increases. Therefore, in order to minimize operating costs, the filter should be operated at the lowest drum speed possible for the given process requirements.

Drum Speed Parameters:

An increase in drum speed will typically produce the following results:

- **FILTER THROUGH-PUT (GPM)** ↑
- **% MOISTURE OF FORMED CAKE SOLIDS** ↑
- **THICKNESS OF FORMED CAKE SOLIDS** ↓
- **FLOW RATE PER DRUM REVOLUTION** ↓
- **FILTER AID CONSUMPTION** ↑

A decrease in drum speed will reverse all of the trends listed above.

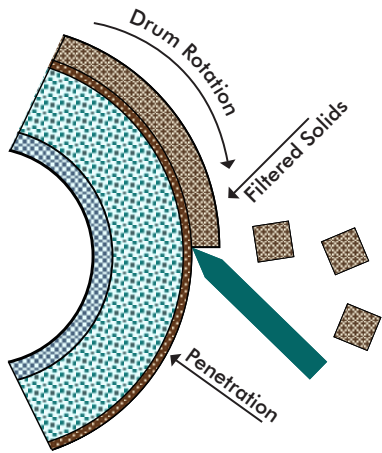


CONTROLLED KNIFE ADVANCE RATE

A complete cycle for a rotary vacuum precoat filter consists of one revolution of the filter drum. The knife must advance at a sufficient rate (typically 0.003" - 0.005") FOR EACH DRUM REVOLUTION so that all penetration of solids are removed. Maximum filter aid efficiency, i.e., gallons filtered per pound of filter aid, is achieved when all residual penetration is removed and a clean precoat surface is prepared for the next cycle (drum revolution) of filtration.

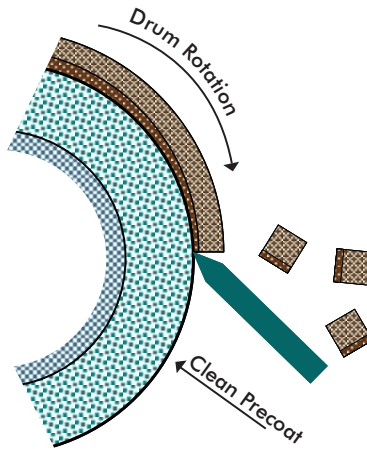
It is essential that all filter cake solids and any significant amount of solids which have penetrated the cake are totally removed from the entire drum surface during each cycle. Any cake solids which are not discharged will reduce the filter through-put of the following cycle. Both "Low" and "Excessive" knife advance rates reduce filter aid efficiency and increase filtration costs.

Cross Section View - Rotary Vacuum Pressure Filter Cake



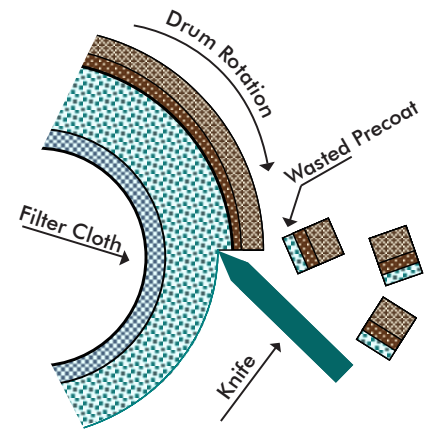
Low Advance Rate

- Residual Penetration
- Low Flow Rates



Optimum Advance Rate

- No Penetration
- Maximum Flow Rates
- Optimal Filter Aid Usage



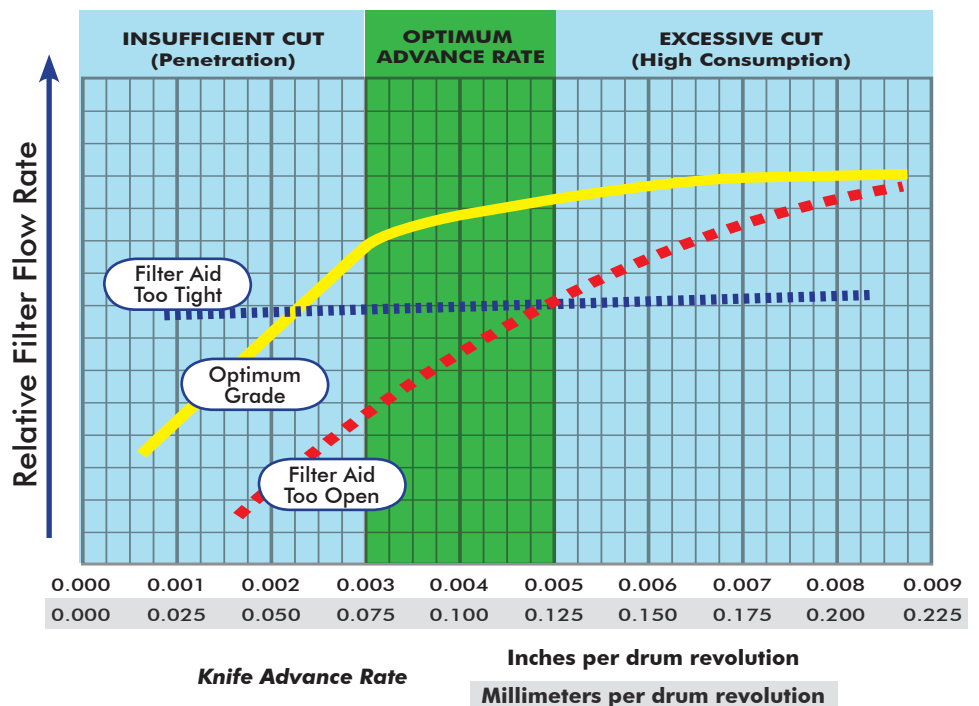
Excessive Advance Rate

- No Increase in Flow Rates
- High Filter Aid Usage

Filter Aid Grade and Knife Advance Rate

The optimum grade of filter aid for an application provides an acceptable compromise between flow rate and clarity. Filter aid that is more "open" may yield higher flow rates, but precoat consumption (costs) will also be higher. A "tight" grade will reduce the required knife advance rate, but filter through-put will be lower. In some cases, clarity requirements may take precedence over flow rate advantages.

Filter Flow Rate vs. Knife Advance Rate



FILTER AID CONSUMPTION

Filtration Time (Hours)
Per inch of usable precoat cake

This table is useful for determining what the approximate knife advance rate is 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 usable precoat cake. Note that the drum speed and knife advance rates must remain constant throughout the measurement period.

	Knife Advance Rate (0.000 inches per drum revolution)								
	2	3	4	5	6	8	10	12	15
0.5	4.2	2.7	2.1	1.7	1.4	1.0	0.8	0.7	0.6
0.75	6.3	4.2	3.1	2.5	2.1	1.6	1.3	1.0	0.8
1	8.3	5.6	4.2	3.3	2.8	2.1	1.7	1.4	1.1
1.5	12.5	8.3	6.3	5.0	4.2	3.1	2.5	2.1	1.7
2	16.7	11.1	8.3	6.7	5.6	4.2	3.3	2.8	2.2
2.5	20.8	13.9	10.4	8.3	6.9	5.2	4.2	3.5	2.8
3	25.0	16.7	12.5	10.0	8.3	6.3	5.0	4.2	3.3
3.5	29.2	19.4	14.6	11.7	9.7	7.3	5.8	4.9	3.9
4	33.3	22.2	16.7	13.3	11.1	8.3	6.7	5.6	4.4

Drum Speed
(Minutes per revolution)



How to use the Table

For Determining Knife Advance Rate:

1. Select appropriate drum speed row
2. Read across for closest operating time for one inch of precoat
3. Read up to top row for the effective knife advance rate

For Determining Operating Time:

1. Select appropriate drum speed row
2. Read across to the desired knife advance rate column
3. The intersection is the time one inch of precoat will operate

FILTER CLOTH SELECTION

The function of the filter cloth is to support the precoat cake during formation and throughout process filtration. Except for the initial formation of the precoat cake, the filter cloth should not perform or affect any filtration function. In order to apply an efficient and high quality precoat cake, it is important to maintain a thoroughly clean filter cloth (or

screen). Process solids can blind the pores of a cloth and cause a dramatic decrease in its permeability. The filter aid cannot form a uniform cake under such conditions and the precoat may crack and fall. The higher resistance of the cloth will also decrease the operating filter flow rates. Typical filter cloth design specifications are shown below.

Typical Design Availability

Fiber Polypropylene, Nylon, Polyester, Cotton
Yarn Monofilament, Multifilament, Spun-Staple¹
Weave Plain, Twill, Satin
Permeability 15 cfm ↔ 200 cfm (air flow)²

¹ Spun-staple yarn should not be used for any application

² It is not suggested to use anything less than 50 cfm, except for special applications

General Selection

Polypropylene: Good general chemical resistance
Multifilament: For "slow" (fine) filter aid grades
Monofilament: For "fast" (coarse) filter aid grades
Twill: Good flow, durability and cleaning characteristics

Permeability Application By Celatom® Grade		Diatomaceous Earth Grades		Perlite Grades	
Very Low	20 cfm	FW-6 ↔ FW-12	CP1200 ↔ CP1200		
Low	50 cfm	FW-6 ↔ FW-40	CP1200 ↔ CP4000		
Medium	100 cfm	FW-14 ↔ FW-60	CP1400 ↔ CP6000		
High	150+ cfm	FW-40 ↔ FW-80	CP4000 ↔ CP6000		

Note: Permeability and yarn are typically modified to account for blinding, cleaning and solids retention requirements of the application.

FILTER AID GRADE SELECTION

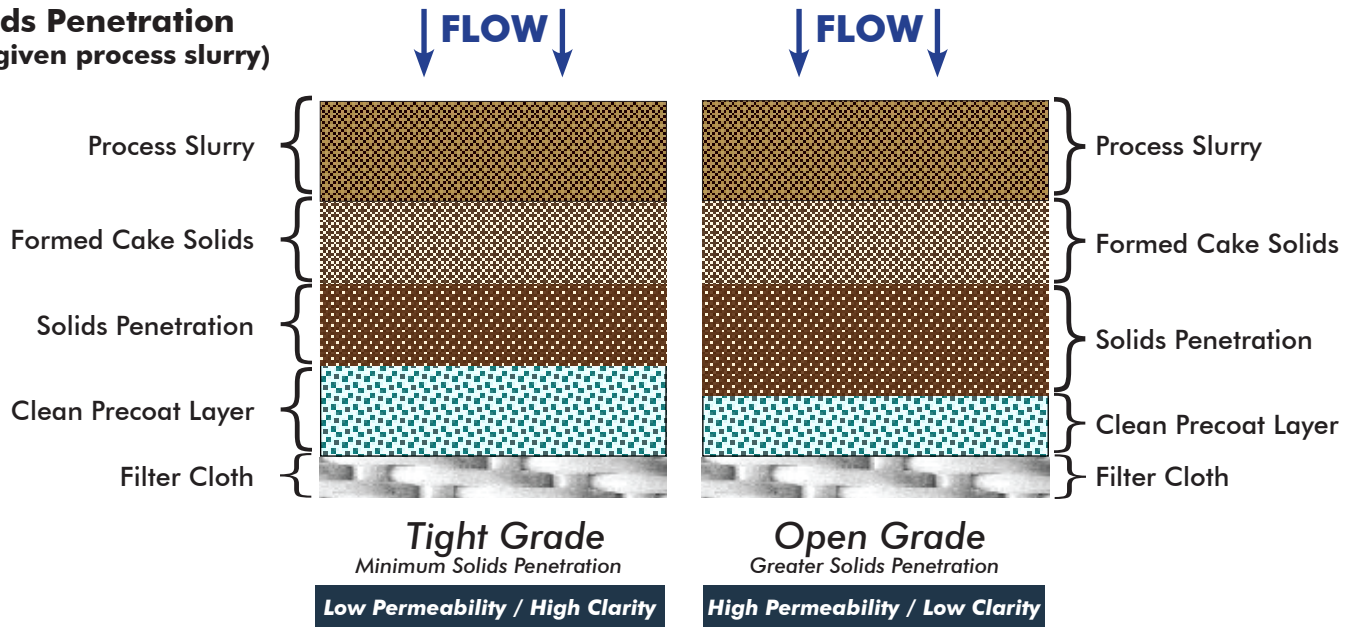
RELATIVE PERMEABILITY VS. SOLIDS PENETRATION

The most efficient grade of filter aid prevents process slurry solids penetration from exceeding 0.003" - 0.005" into the precoat cake. A more permeable precoat grade does not usually produce higher filter flow rates, but

increases what is required for an optimum knife advance rate because of more extensive solids penetration. Filtrate turbidity may also increase.

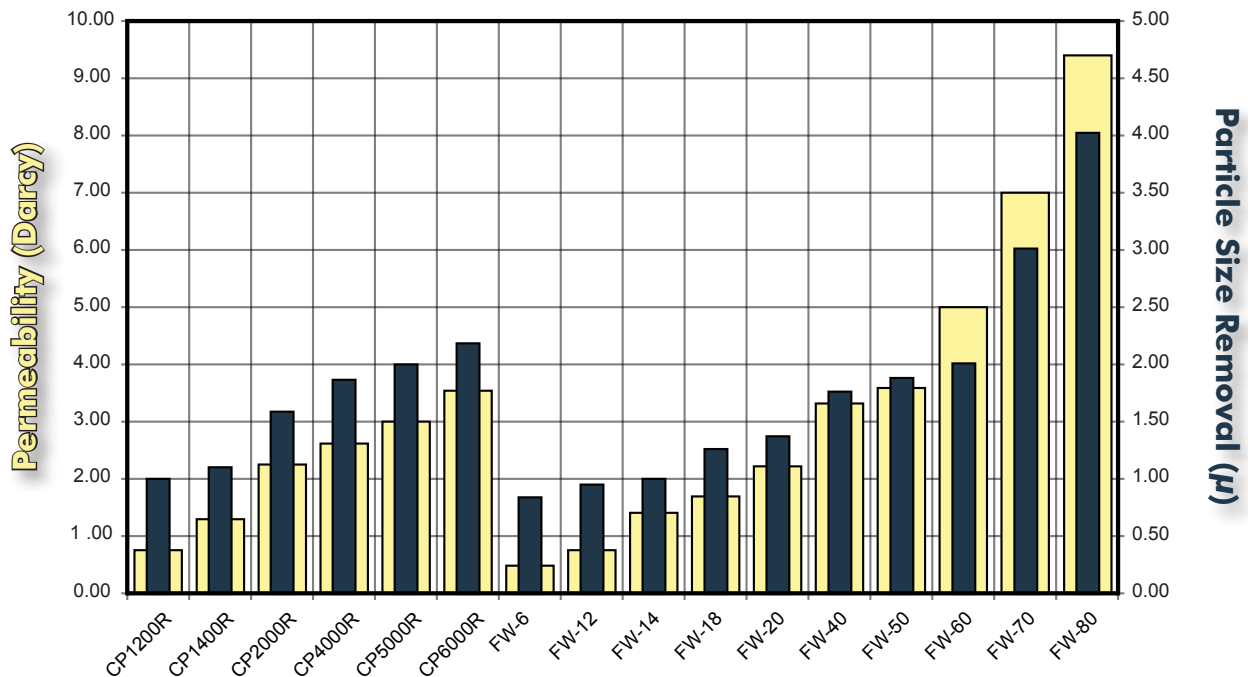
Relative Degree of Solids Penetration
(For a given process slurry)

Cross Section View - Filter Cake*



* Above Cross Section View is not to scale and is for illustration purposes only.

Celatom® Diatomaceous Earth Filter Aids Comparative Permeability and Particle Size Removal





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Filter Aids

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