# Rotary Drum Vacuum Filters for Production of Wallboard-Grade Gypsum

**Paper #19**

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## ABSTRACT

Conventional wisdom is that production of wallboard-grade FGD gypsum requires the use of horizontal belt vacuum filters for dewatering service, to limit cake moisture to 10% or less. New Brunswick Power initially planned to use HBVFs for gypsum dewatering for the FGD retrofit to its 3 x 350 MW Coleson Cove plant. However, project budget constraints led to cost reduction evaluations which identified potential cost savings if rotary drum filters could be used instead. This paper documents the cost saving considerations that led to the substitution, including improved building arrangement, reduced equipment cost, and reduced power requirements. The operating performance results of the rotary drum vacuum filters at Coleson Cove are presented, proving the capability to produce wallboard quality gypsum filter cake with moisture content as low as 6%. Key aspects of the design and operation of the filters that make rotary drums a viable choice for dewatering are presented.

## INTRODUCTION

This paper will introduce the reader to the idea of using rotary drum vacuum filters (RDVFs) to dewater wallboard grade gypsum produced by FGD facilities. In the past, typical practice was to use RDVFs for disposal grade gypsum only, with horizontal vacuum filters used for dewatering commercial grade gypsum. Today, several FGD systems incorporate new high-rate RDVFs to produce commercial grade gypsum.

Other stations have converted to fully oxidized gypsum production and use existing RDVFs. These include NIPSCO R.M. Schahfer Station and LG&E Mill Creek Station. After converting to a forced oxidation system NIPSCO Schahfer now produces a gypsum filter cake. The gypsum filter cake produced must have a moisture content of less than 15% and a chloride content of less than 100 ppm to meet wallboard manufacturers' requirements. The filters, which were installed in the early 1990's typically operate in the 13% moisture range. Gypsum filter cake travels from the FGD building by conveyor to the wallboard plant next to the power station.

Several stations have specially designed rotary vacuum filters capable of producing wallboard grade gypsum with a filter cake moisture content of less than 10%. The K-S High-Rate FGD Drum Filters operating at CWL&P Dallman, TECO Big Bend, and NB Power Coleson Cove

Stations all produce a wallboard grade gypsum product.  The use of these filters resulted in substantial savings for the utility in installation cost and operating cost.  Space savings were also considerable compared to the space needed for belt filters.

The one thing these stations have in common is the use of RDVFs for producing a wallboard quality gypsum product instead of horizontal belt vacuum filters, even though the RDVF was normally considered to be incapable of meeting the low cake moisture requirement of FGD gypsum filter cake.

The focus here will be to show how the rotary drum vacuum filter can be used to produce a commercial quality gypsum byproduct from an FGD system to meet the wallboard manufacturer's specification.  Also presented is information showing how the utility can save capital and operating cost by using the RDVF compared with the HBVF.

This paper presents an overview of FGD system operating conditions that will produce a saleable wallboard quality gypsum filter cake.  Certain criteria must be met to ensure that the filter cake meets the wallboard manufacturer's requirements.  Among these are particle size distribution, crystal shape, and filter feed characteristics such as feed slurry concentration, feed temperature and cake wash temperature.  Attention must be paid to these issues (whether for RDVF or HBVF) in order to achieve success.  The FGD system at Coleson Cove Station is given as an example of how a system can be designed to save money while at the same time producing the desired product.

# FGD SYSTEM GYPSUM PRODUCTION

Flue Gas Desulfurization systems are meeting a worldwide need to remove sulfur dioxide from power station exhaust gas. Wet scrubbing of the flue gas using limestone slurry is a common means of performing this task. The reaction of the flue gas and limestone produces a slurry composed of water, calcium compounds and other constituents. Forced oxidation of the FGD slurry produces a stream with a high percentage of calcium sulfate (gypsum) suitable for use in wallboard production or cement manufacturing. Slurry that is not fully oxidized produces a disposal grade material suitable for landfill. The processing of these slurries is often accomplished using hydrocyclones as the primary dewatering device and vacuum drum or horizontal belt filters for secondary dewatering. Sale of byproduct gypsum filter cake allows the utility to recoup some of the expense of installing the FGD system.

## Gypsum Filter Cake for Wallboard

For the production of wallboard, the calcium sulfate concentration of the slurry solids must typically be greater than 95%. The gypsum slurry must be dewatered and the solid filter cake must be washed to remove contaminants to meet the wallboard producer's requirements. Filter cakes must typically be dewatered to a maximum moisture content of 10% by weight and with a maximum of 100 ppm of chlorides on a dry weight basis. These criteria vary, however, from one wallboard manufacturer to the next. In some cases, the manufacturer will use a filter cake with higher moisture or with higher chloride concentration. The manufacturer might also allow off-spec material but pay for it at a reduced price to the utility.

The particular needs of the wallboard producer are important considerations when specifying a filter cake solids concentration. If the design calls for a gypsum byproduct of a higher quality than required by the end user, the result is wasted expense by the utility. The utility should also adopt a flexible approach to processing the gypsum slurry to allow for future developments.

## Critical Influences for Effective Dewatering

Certain process variables must be taken into account in order to ensure that the filter (either RDVF or HBVF) will produce a high quality filter cake meeting the requirements noted above. Important characteristics of the slurry are the gypsum particle size distribution, the crystal shape, the feed slurry solids concentration and the feed temperature. Other variables related to the process design are cake wash water temperature and wash rate, vacuum pump sizing, and filter cake drying time, which is a function of filter geometry and operation.

### *Particle Size Distribution*

The particle size distribution of the slurry feed to the filter must be 95% greater than 10 micron. In order to accomplish this, the gypsum slurry must have been classified using a hydrocyclone unit. Today, this is typical practice for FGD primary dewatering, although in past systems the use of settling thickeners was standard practice. Hydrocyclones thicken the slurry to an acceptable filter feed solids concentration while at the same time providing a means to remove excess fines and chlorides from the system. Table 1 shows a particle size distribution for a filter feed slurry having excellent dewatering characteristics. Note the very low percentage of fines being fed to the filter.

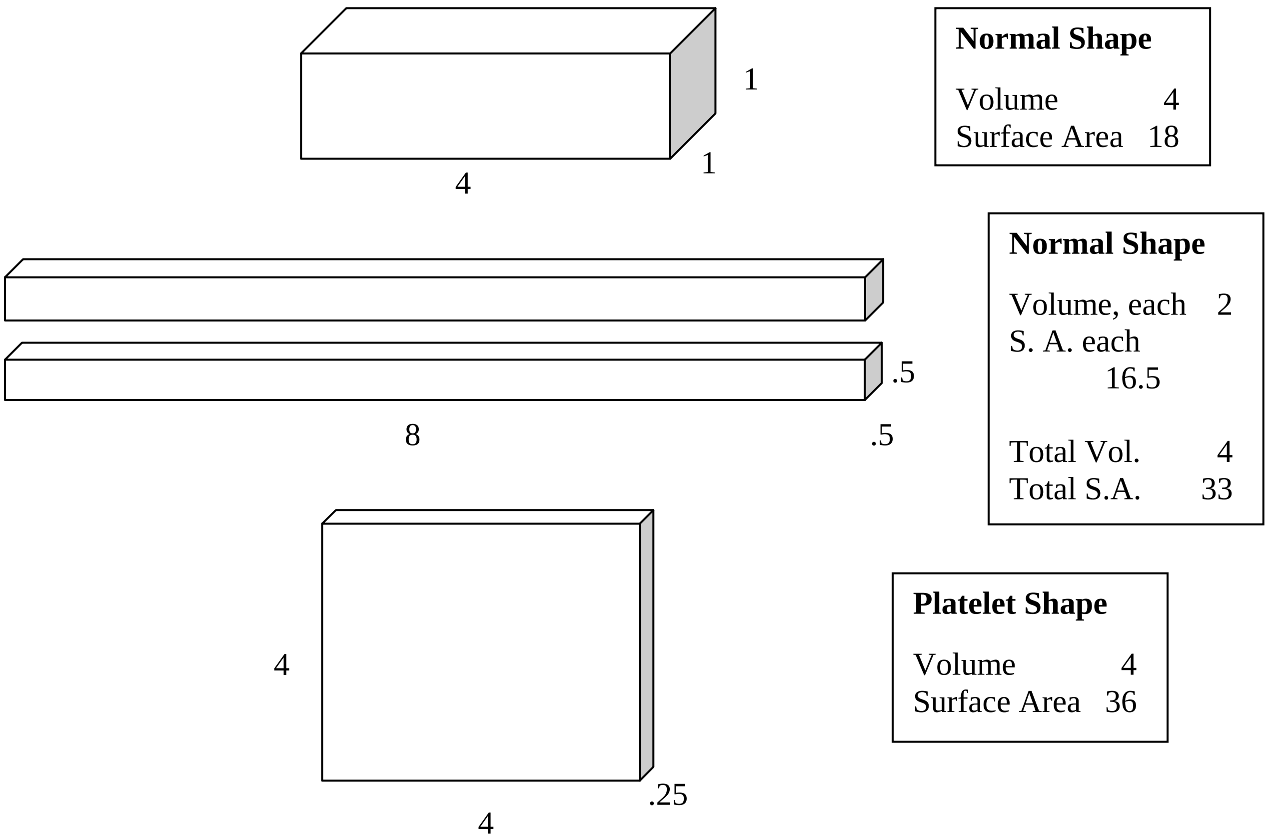
**Table 1. FGD Gypsum Particle Size Distribution**
**Hydroclone Underflow – Coleson Cove Station, NB Power**

| Size | % Pass | % Chng | Size | % Pass | % Chng |
|---|---|---|---|---|---|
| 704.00 | 100.00 | 0.00 | 22.00 | 6.56 | 4.32 |
| 592.00 | 100.00 | 0.00 | 18.50 | 4.10 | 2.46 |
| 497.80 | 100.00 | 0.00 | 15.56 | 2.55 | 1.55 |
| 418.60 | 100.00 | 0.00 | 13.08 | 1.51 | 1.04 |
| 362.00 | 100.00 | 0.00 | 11.00 | 0.82 | 0.69 |
| 296.00 | 100.00 | 0.00 | 9.25 | 0.35 | 0.47 |
| 248.90 | 100.00 | 0.00 | 7.78 | 0.01 | 0.34 |
| 209.30 | 100.00 | 0.00 | 6.54 | 0.01 | 0.00 |
| 176.00 | 100.00 | 0.00 | 5.50 | 0.01 | 0.00 |
| 148.00 | 100.00 | 0.00 | 4.63 | 0.01 | 0.00 |
| 124.50 | 100.00 | 0.00 | 3.89 | 0.01 | 0.00 |
| 104.70 | 99.90 | 0.10 | 3.27 | 0.01 | 0.00 |
| 88.00 | 99.13 | 0.77 | 2.75 | 0.01 | 0.00 |
| 74.00 | 96.95 | 2.18 | 2.31 | 0.01 | 0.00 |
| 62.23 | 90.97 | 5.98 | 1.95 | 0.01 | 0.00 |
| 52.33 | 77.67 | 13.30 | 1.64 | 0.01 | 0.00 |
| 44.00 | 56.68 | 20.99 | 1.38 | 0.01 | 0.00 |
| 37.00 | 34.78 | 21.90 | 1.16 | 0.01 | 0.00 |
| 31.11 | 19.29 | 15.49 | 0.97 | 0.01 | 0.00 |
| 26.16 | 10.88 | 8.41 | 0.82 | 0.01 | 0.00 |

### *Crystal Shape*

The individual particle crystal shape is also an important consideration in order to achieve effective washing and drying of the filter cake. The aspect ratio of the gypsum particles should be no more than 4:1. In relative terms, the following diagram shows three different particles, a normal rhomboid, a needle shaped crystal and a platelet. As can be seen from the diagram in Figure 1, the relative surface area of the normal crystal is much lower than the other two. The greater the surface area a particle has, the more moisture it will hold. As the diagram shows, needle or plate shaped crystals can have close to two times the surface area of rhomboid shapes.

**Figure 1: Effect of Crystal Shape on Particle Surface Area**




***Filter Feed Slurry Concentration***

The percentage of suspended solids in the filter feed slurry is a very important factor affecting the performance of the filter. The main characteristic affected by slurry feed concentration is cake formation time. This is the time it takes for the filter to form a cake on the drum. Typically, 45 to 55% TSS (wt.) gypsum slurry will form a 25 mm filter cake in about 3 to 5 seconds. A lower concentration results in a lower filtration rate and therefore a larger filter to process the same amount of solids.

***Feed Temperature***

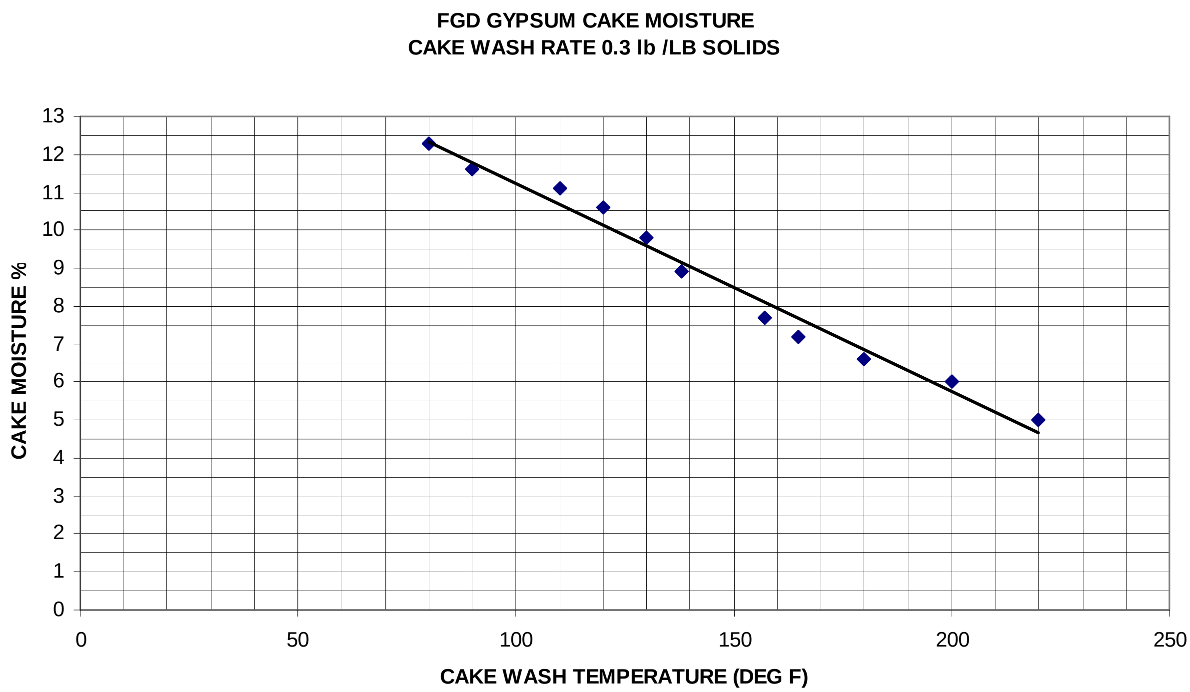
The temperature of the feed slurry is another important factor in producing a high quality filter cake. Increased feed temperature increases the filtration rate (although not as much as increased feed concentration) and also results in a lower moisture filter cake. A secondary benefit of a higher feed temperature is that the vapor that passes to the vacuum pump is also at a higher temperature. The condensation of the vapor acts to heat the vacuum pump seal water, which can subsequently be used as cake wash liquor.

### *Wash Water Temperature*

The filter cake needs to be washed in order to reduce soluble chlorides to a level acceptable to the wallboard manufacturer, in most cases 100 ppm. This washing takes place on the filter after the cake formation step using fresh water to displace the liquor remaining in the filter cake. Typically, the amount of washwater required is about 0.3 to 0.33 pounds of water per pound of dry solid cake. The use of recycled seal water from the liquid ring vacuum pump is a simple means of providing high temperature wash water. This increased temperature of the cake wash also reduces the moisture remaining in the filter cake after washing.

In some cases where warm cake washwater is unavailable, it is necessary to heat the wash water using steam or other means to allow for effective drying of the filter cake. The effect of wash water temperature on cake moisture is displayed in Figure 2.

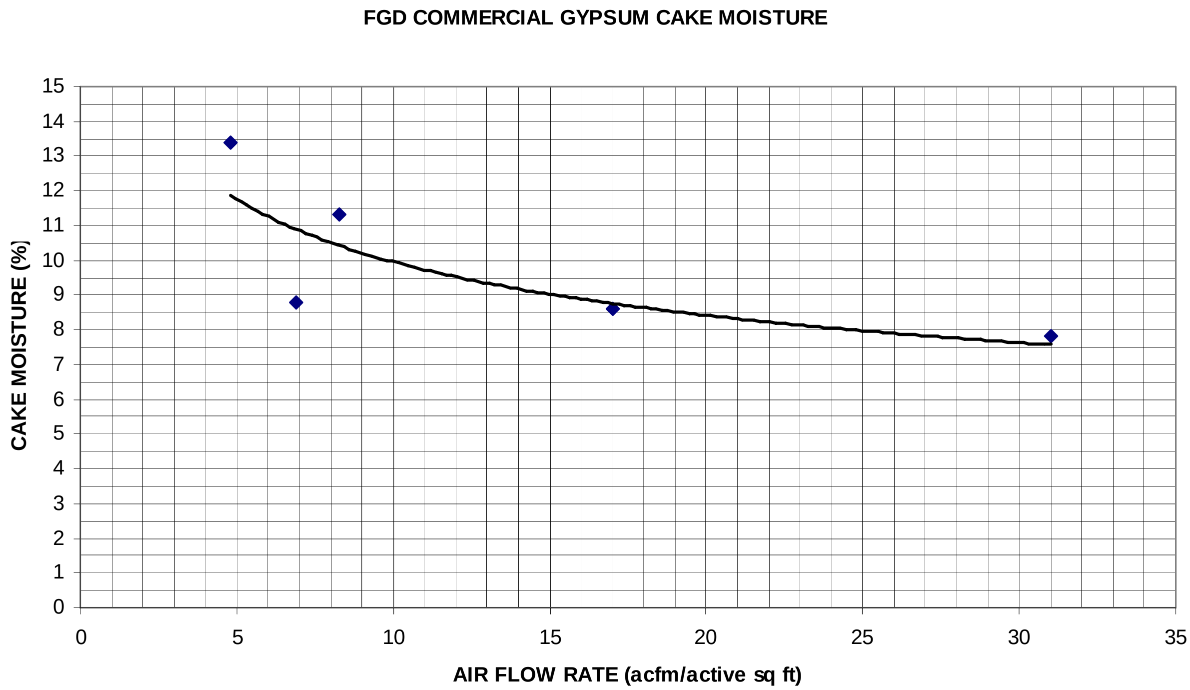
**Figure 2: Effect of Wash Water Temperature on FGD Gypsum Cake Moisture**




### *Air Flow/Vacuum Pump Sizing*

The amount of air passing through the filter cake during the drying stage has a great effect on cake moisture content, up to a point. This relationship is displayed in Figure 3. To guarantee a cake moisture of 10%, an airflow of 15 to 16 acfm/sq.ft. of active area is required.

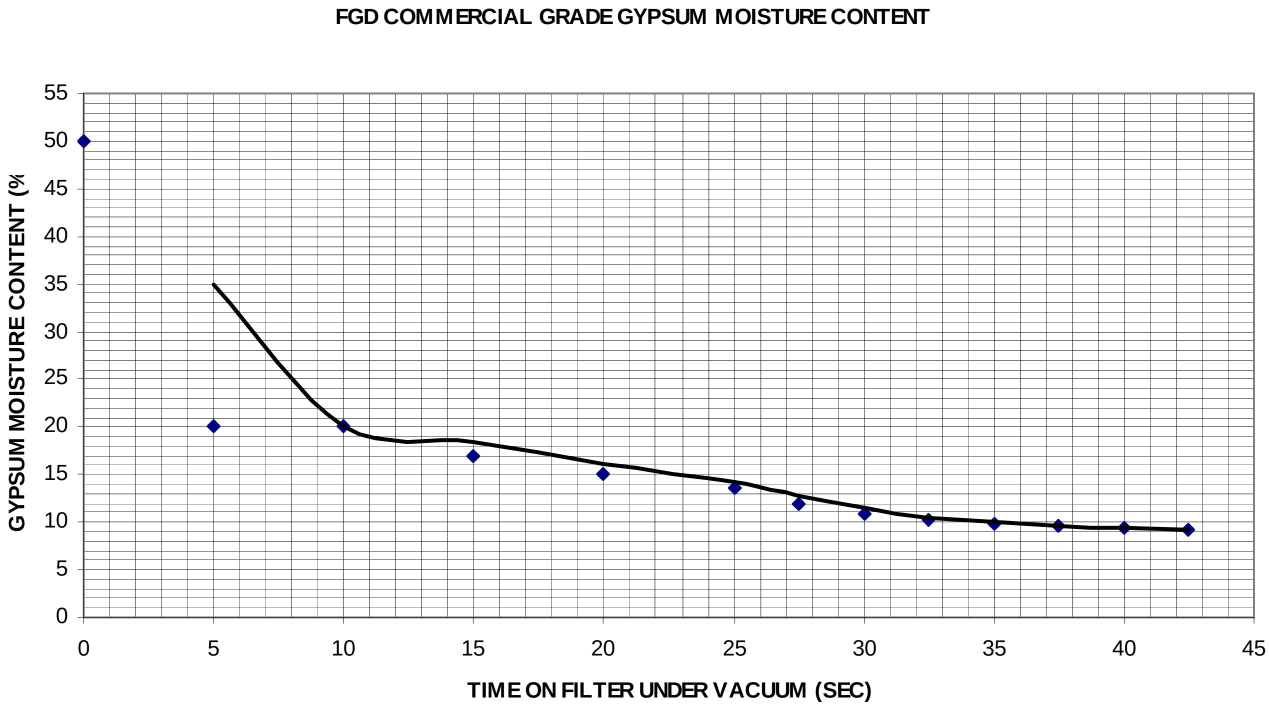
**Figure 3: Effect of Vacuum Pump Air Flow Rate on FGD Gypsum Cake Moisture**




### *Drying Time*

The part of the filtration cycle after cake formation and cake washing is the cake drying stage. Time allowed for cake drying is a function of the filter's geometry as well as the speed at which the drum or belt is moving. As seen in the graph on Figure 4, the greatest reduction in cake moisture occurs at the start of the filtration cycle, which is the cake formation step. After a 5 second cake wash, the moisture remaining in the cake is further reduced by time in the drying zone, but a much slower rate. A point is reached when additional time yields no further reduction in moisture.

**Figure 4: Effect of Drying Time on FGD Gypsum Cake Moisture**




## Horizontal Belt Vacuum Filters as Standard Approach

Why is the HBVF the standard method for dewatering FGD gypsum slurry? The filtration characteristics of typical FGD gypsum slurry are:

- Cake formation is very quick, usually 3-5 seconds to form a 1” thick cake.
- Cake washing is also very quick, usually 3-5 seconds.
- Cake dewatering/drying is, however, quite long due to the requirement for very low cake moisture content. The time for cake drying is a direct function of cake thickness and a 1” thick cake would typically require 50-60 seconds using unheated washwater.

If we look at the elements critical to effective filtration detailed above, we can see that without warm feed slurry and cake wash water, the longer drying time calls for a filter geometry that can provide this. The HBVF design can incorporate short cake formation and wash steps together with a much longer drying step.

Using hot water to wash the filter cake can substantially reduce the dewatering time, however, and this is what makes the use of the RDVF possible.

## NB POWER, COLESON COVE STATION

## Plant Design

New Brunswick Power's Coleson Cove Generating Station in Saint John, NB, Canada includes three 350 MW boiler units. In 2004, the station started up a new flue gas desulfurization unit incorporating two Babcock & Wilcox wet limestone scrubber modules. The initial system design included the use of hydrocyclones followed by horizontal belt vacuum filters to dewater the FGD bleed slurry and to produce a wallboard quality gypsum filter cake.

Budget constraints, however, led to a cost reduction effort. NB Power, along with B&W, saw the potential savings of using rotary drum vacuum filters in lieu of the HBVFs originally specified. The RDVF system required a new design concept to allow hot water for cake wash. The key was to ensure that the filters would perform at the required capacity to produce a high quality filter cake suitable for wallboard production. Results from installations at Tampa Electric and CWL&P indicated that a commercial grade product was achievable.

## RDVFs Considered as an Alternative Approach

The potential for substantial cost savings at Coleson Cove led to the decision to use RDVFs. Specific savings were expected for the following areas:

- Capital Equipment Cost
- Building Cost
- Operating Cost
- Maintenance Cost

### *Capital Equipment Cost*

Savings in the cost of the equipment came mainly from the fact that rotary drum vacuum filter systems are less expensive than horizontal belt filter systems. While the drum filter itself is less costly compared to the belt filter, the ancillary equipment needed for the HBVF also contributes to a higher price tag. The HBVF includes a larger vacuum pump and a higher level of controls and instrumentation that add considerably to the overall capital budget.

### *Building Cost*

The savings in building cost are more notable than equipment cost. In the case of Coleson Cove, the space required for using HBVFs would be nearly three times the space required for RDVFs. The footprint of each of the two RDVFs is about 16' by 22'. This is much less than the footprint of a HBVF sized for similar feed rate, which would be about 12' by 100'. Table 2 shows the difference in required floor area for the drum filter compared to the belt filter. Although actual figures are unavailable, the difference of 3000 square feet of floor space equals a capital budget savings of $300,000 to $600,000.

**Table 2. Footprint Required for Vacuum Filters**

| | Filter Footprint | Floor Space (each) | Floor Area (each) | Floor Area (2 units) |
|---|---|---|---|---|
| RDVF | 16’ by 24’ | 26’ by 34’ | 884 sq.ft. | 1768 sq.ft. |
| HBVF | 12’ by 100’ | 22’ by 110’ | 2420 sq.ft. | 4840 sq.ft. |

***Operating Cost***

The main cost savings opportunity in operation of the drum filter versus the belt filter is the higher power consumption for the vacuum pump with the HBVF, about 600 HP compared to the 400 HP vacuum pump provided for each RDVF. The drum filter resulted in a savings of 200 HP compared to the belt filter.

***Maintenance Cost***

The rotary drum vacuum filter is a less complex machine compared to the horizontal belt filter. Maintenance tasks for the RDVF are minimal and include lubrication of drive and bearings as well as cloth changes. Yearly maintenance includes inspection or changing of the polyethylene wearplate at the filter valve body and the plastic scraper blade should it become worn. There are no filter belt/vacuum box wear parts found on the RDVF. The RDVF also uses normal city line pressure for the cloth wash water thus eliminating the cloth wash pump used with the belt filter. One major item is the filter cloth itself. The RDVF has about 60% less cloth compared to the HBVF at only 15% of the replacement cost.

## Overall System Description

Gypsum slurry is fed from the underflow of the hydrocyclone separators and is directed to one of the two drum filter systems. The filtration system provided by Komline-Sanderson consists of the following major items of equipment:

- K-S 12’ dia. by 16’ face Rotary Drum Vacuum Filter.
- 7’- 6” dia. vacuum receiver with 450 GPM filtrate pump.
- 8200 acfm vacuum pump with 400 HP motor,
- Vacuum pump silencer.
- Cake wash tank and pump.
- Steam injection water heater.

Gypsum slurry is dewatered in the K-S vacuum filters to produce gypsum filter cake. After initial dewatering, the filter cake is sprayed with cake wash water to remove chlorides. The cake wash water heater provides heated cake wash water to produce a lower moisture content gypsum product. Liquid removed from the slurry is recovered as filtrate. It may be returned to the FGD System Absorber Towers as make-up. Utility air is used for cloth blowback to release filter cake from the vacuum filter cloth. The operator manually sets the blowback pressure by adjusting the pressure regulating valve. The gypsum filter cake drops onto conveyors and is stacked either outdoors or inside an enclosed storage building.

Filtrate from the gypsum slurry and air pulled through the filter cake are drawn to the filtrate receiver by vacuum. Air and water vapor are drawn off the top of the vacuum receiver to the vacuum pump. The filtrate pump mounted on the side of the filtrate receiver pumps out the filtrate.

The vacuum pumps are liquid ring type pumps and require seal water for operation. The exhaust from the vacuum pumps is delivered to the top mounted air/water separators where the seal water is separated from the air/water vapor. The air/water vapor is exhausted through a silencer prior to exiting the building to the atmosphere.

The spent seal water from the vacuum pump is expelled into the top mounted separator tank and then drains by gravity to the cake wash tank. A dedicated cake wash pump removes water at a constant design rate of flow (90-100 GPM approx.) for cake washing. This “spent seal water” is pumped to the steam injection cake wash water heater. The temperature can be raised to 170 - 185 ° F and is controlled by the DCS through the temperature control valve (TCV) in the steam injection water heater.

## Operating Results at Coleson Cove

The resulting gypsum byproduct from the drum filters at Coleson Cove has met all expectations. Guarantee points for the drum filters called for a gypsum production rate of 132,682 dry pounds per hour or about 66 tons/hour. Actual performance has shown rates as high as 80 tph dry solids. Cake moisture and chloride content have also met expectations with cake moistures recorded as low as 6% and chloride content well below the 100 ppm guarantee point.

Reports from early 2005 indicated that each filter was producing at a rate of 164,000 pounds/hour with a cake moisture content of 8.9%. Cake thickness was reported as being 1-1/4”. The cake wash temperature was reported to be 138 ° F, which is considerably less than the 185 degrees originally envisioned for the system. This lower wash water temperature alleviates some of the load on the washwater heater.

As shown in Figure 5, recent data (from the month of February, 2006) shows that the drum filter system continues to perform well.

**Figure 5: Gypsum Quality Data for Coleson Cove**

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## Coleson Cove Chemistry Lab
## Daily Gypsum Quality Log

**Note:** All results presented on a dry weight basis
Carbon values in red means organic Carbon result to follow

**February-06**

| Date | Time (hhmm) | Tower | Drum | Moisture (%) | Gypsum (% as $CaSO_4$) | Particle Size (µm AVG) | Sulphite (% as $CaSO_3$) | Carbonate (% as $CO_3$) | Chloride (ppm) | Organic Carbon (% as total C) | Vanadium (ppm) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Limit | <10% | >95% | 35 - 75 µm | | <0.5% | <100 ppm | <0.10% | <200 ppm | |
| 01-Feb-06 | 1700 | 9B1 | 9-1 | 8.20 | 98.3 | n/p | n/p | n/p | n/p | 0.07 | 138.6 | |
| | 2330 | 9B1 | 9-1 | 8.43 | 98.1 | 36.55 | 0.05 | 0.00 | 6.9 | 0.04 | 125.3 | |
| 02-Feb-06 | 0550 | 9B1 | 9-1 | 7.99 | 98.9 | 36.03 | n/p | n/p | n/p | 0.04 | 50.4 | |
| 04-Feb-06 | 1955 | 9B1 | 9-2 | 6.93 | 99.3 | 36.30 | 0.05 | 0.00 | 7.5 | 0.03 | 90.4 | |
| 06-Feb-06 | 0130 | 9B1 | 9-2 | 7.21 | 99.9 | 36.88 | 0.00 | 0.00 | 17.1 | 0.03 | 85.0 | |
| | 2010 | 9A1 | 9-2 | 6.66 | 99.6 | 37.18 | 0.09 | 0.00 | 7.1 | 0.03 | 73.0 | |
| 07-Feb-06 | 0845 | 9A1 | 9-2 | 7.26 | 99.9 | 37.25 | 0.00 | 0.02 | 8.6 | 0.02 | 69.0 | |
| 09-Feb-06 | 0330 | 9A1 | 9-2 | 6.82 | 99.3 | 37.04 | 0.09 | 0.01 | 12.3 | 0.03 | 65.8 | |
| | 1235 | 9A1 | 9-1 | 7.01 | 98.5 | 37.04 | 0.10 | 0.01 | 8.7 | 0.02 | 72.6 | |
| | 1630 | 9B1 | 9-1 | 7.09 | 99.7 | 36.83 | 0.09 | 0.00 | 6.1 | 0.04 | 81.9 | |
| 10-Feb-06 | 1120 | 9A1 | 9-1 | 6.80 | 99.5 | 37.27 | 0.15 | 0.04 | 6.1 | 0.02 | 77.0 | |
| | 2130 | 9B1 | 9-1 | 7.03 | 99.9 | 36.62 | 0.17 | 0.08 | 14.8 | 0.01 | 80.2 | |
| 11-Feb-06 | 0720 | 9B1 | 9-1 | 7.27 | 99.2 | 36.36 | 0.02 | 0.02 | 6.5 | 0.04 | 83.0 | |
| 12-Feb-06 | 1050 | 9B1 | 9-1 | 7.70 | 99.9 | 36.87 | 0.02 | 0.06 | 9.4 | 0.03 | 80.2 | |
| 13-Feb-06 | 0120 | 9B1 | 9-1 | 8.25 | 99.7 | 37.34 | 0.16 | 0.08 | 6.0 | 0.02 | 77.5 | |
| | 0820 | 9B1 | 9-1 | 6.61 | 99.3 | 37.39 | 0.11 | 0.05 | 8.8 | 0.02 | 83.2 | |
| 14-Feb-06 | 0210 | 9B1 | 9-1 | 7.52 | 98.7 | 37.81 | 0.16 | 0.00 | 12.5 | 0.04 | 79.0 | |
| 16-Feb-06 | 0925 | 9A1 | 9-1 | 7.26 | 99.5 | 35.96 | 0.11 | 0.08 | 12.9 | 0.02 | 80.3 | |
| 17-Feb-06 | 2200 | 9A1 | 9-1 | 6.76 | 99.3 | 34.89 | 0.12 | 0.05 | 12.9 | 0.04 | 73.0 | |
| 18-Feb-06 | 1345 | 9A1 | 9-1 | 7.35 | 99.0 | 36.86 | 0.11 | 0.10 | 13.7 | 0.03 | 77.0 | |
| 19-Feb-06 | 1230 | 9B1 | 9-2 | 8.99 | 99.2 | 37.11 | 0.16 | 0.06 | 7.8 | 0.03 | 85.0 | |
| 20-Feb-06 | 1650 | 9B1 | 9-2 | 8.47 | 97.8 | 36.51 | 0.02 | 0.06 | 20.4 | 0.03 | 98.0 | |
| | 2130 | 9A1 | 9-2 | 6.93 | 99.4 | 39.84 | 0.18 | 0.07 | 9.8 | 0.02 | 103.0 | |
| 21-Feb-06 | 1005 | 9B1 | 9-2 | 7.69 | 98.9 | 36.63 | 0.14 | 0.09 | 14.7 | 0.02 | 107.1 | |
| 22-Feb-06 | 0805 | 9A1 | 9-2 | 7.48 | 99.3 | 39.73 | 0.15 | 0.04 | 18.9 | 0.03 | 105.1 | |
| | 1005 | 9B1 | 9-2 | 8.18 | 99.1 | 36.11 | 0.16 | 0.04 | 15.5 | 0.03 | 109.1 | |
| 23-Feb-06 | 0825 | 9B1 | 9-2 | 7.46 | 99.0 | 35.87 | 0.34 | 0.05 | 25.1 | 0.03 | 106.0 | |
| | 1030 | 9A1 | 9-2 | 6.86 | 99.4 | 39.42 | 0.18 | 0.05 | 27.7 | 0.03 | 102.0 | |

## RDVF DESIGN FOR WALLBOARD-GRADE GYPSUM

The use of rotary drum vacuum filters to produce wallboard quality gypsum at Coleson Cove and at the other stations mentioned in the introduction was accomplished through the redesign of various components of the system. In addition to changes to the filter itself, changes to the overall dewatering system design were needed. Many of these changes, however, have already been adopted as standard practice. In particular, the use of hydrocyclones to remove fines from the system upstream of the vacuum filters is common in FGD process designs today..

Specific design changes to the RDVF dewatering system include:

- The feed to the filtration system must be thickened using hydrocyclones, which also scour fines from the system. The thickened feed should be above 45% TSS and the percentage of particles below 10 micron should be less than 5%.
- The filter must be able to handle considerably higher filtrate flow rates and more airflow compared to older RDVF designs for non-oxidized systems.
- Ability to effectively discharge filter cake, including the use of wire winding using stainless steel wire or high strength synthetic cord.
- Continuous or intermittent cloth washing is required. This will depend on the amount of fines in the feed slurry as well as the amount of fly ash present.
- The cake wash temperature must be as high as 150 ° F, depending on the feed slurry temperature. Use of recycled vacuum pump seal water reduces, and in some cases eliminates, the need for heating the cake washwater by other means.
- Material of construction should be C2205 SS for all wetted metal parts. This will vary however, based on individual preference.

## CONCLUSIONS

Although horizontal belt vacuum filters have normally been considered an the preferred selection for dewatering of wallboard-grade FGD gypsum, recent experience at several plants indicates that the use of rotary drum filters should not be overlooked as a potential lower-cost alternative. At Coleson Cove Station, a comparative analysis on a capital cost and operating cost basis led to the substitution of rotary drum filters for the horizontal belt filters that were originally specified for secondary dewatering of the wallboard-grade gypsum produced by the FGD system there.

Consideration of modified design practices, including provisions for the heating of cake wash water, have proven to make rotary drum vacuum filters capable of sustained production of low-moisture gypsum filter cake that rivals, or even betters, that achievable in horizontal belt filters.

## ACKNOWLEDGMENTS

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