
PROCESS DATA SHEET – BELT FILTERS PACKAGE

PROCESS DATA SHEET

Belt Filter package

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PROCESS DATA SHEET – BELT FILTERS PACKAGE

1. OBJECT

This document is the process data sheet for vacuum belt filters. The goal of these packages is to separate and wash precipitates of rare earth elements (REE) in aqueous solutions of ammonium nitrate.

These packages are groups of equipment that are purchased from a single supplier responsible for achieving a global process function, based on performance requirements as defined in the present process data sheet. The design and sizing of the equipment, piping, instrumentation, and other components included within the package limits is performed by the supplier under its responsibility.

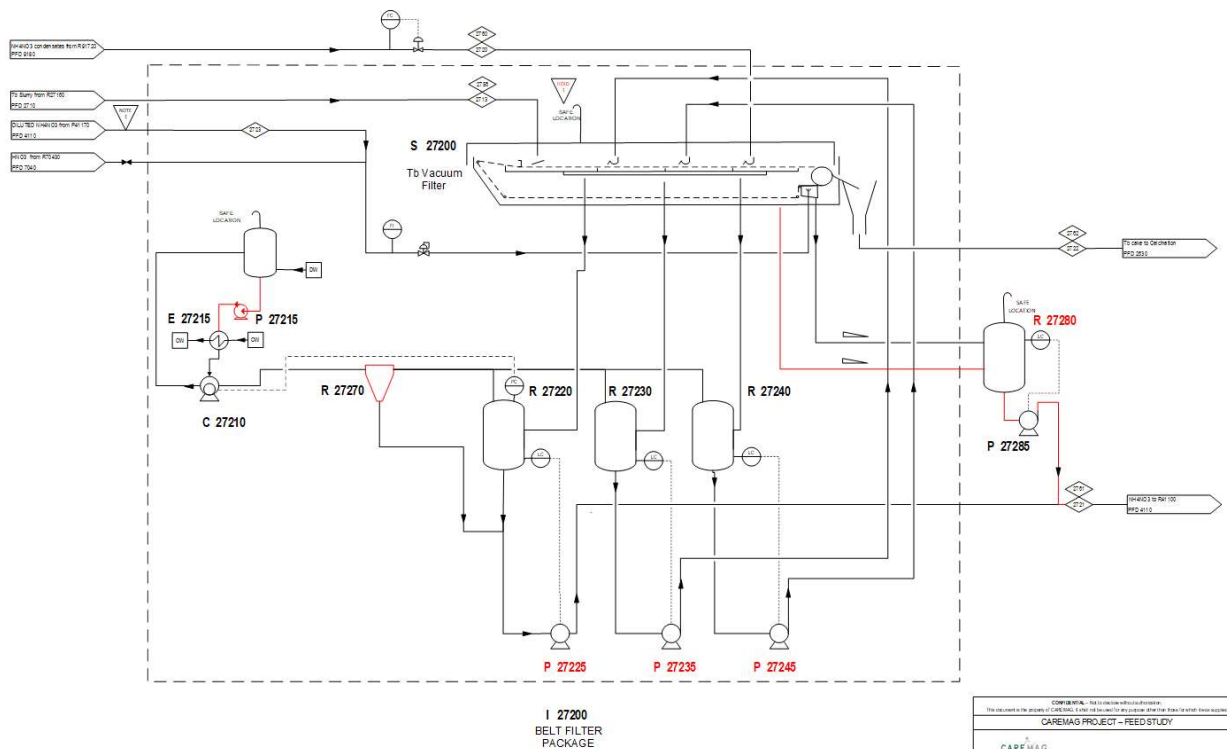
2. PROCESS DESCRIPTION

The process is similar for each package:

- Nd/Dd slurry filtration (in hydroxy nitrate or carbonate form)
- Tb slurry filtration (in hydroxy nitrate or carbonate form)
- Dy slurry filtration (in hydroxy nitrate or carbonate form)
- SEG carbonate filtration
- HoLuY carbonate filtration

Only the process of Tb filtration (package I27200) will be described as reference.

Schematic representation is shown below.



PROCESS DATA SHEET – BELT FILTERS PACKAGE

The precipitate of Tb hydroxy nitrate or carbonate is sent from upstream precipitation reactor (by pump) at one side of the vacuum belt filter S27200 where it is spread out, by means of a slurry feeder, on a filter cloth supported by an endless carrier belt situated above the vacuum box. The slurry is transported by the carrier belt to the other side of the filter where it is scraped from the filter cloth after removal of the mother liquor and a washing with warm condensate. The scraped cake of Tb hydroxy nitrate or carbonate falls by gravity to the downstream kiln.

The mother liquor and wash filtrate are removed from the cake by means of the vacuum applied on the vacuum box.

On the first section, where slurry is fed to the filter, the mother liquor composed of ammonium nitrate in water, passes through the filter cloth, is collected by the vacuum box and is sent under vacuum to the vacuum receiver R27220 where it falls by gravity to the pump P27225.

After this first section, the cake is washed three times in counter current mode in three successive sections.

The warm condensates coming from the NH_4NO_3 concentration process, are sent under flow control, to the last washing section to be spread out on the cake. After passing through the cake and the filter cloth the wash filtrates are collected by the vacuum box and sent to the vacuum receiver R27240. From R27240, the wash filtrates are pumped by P27245, back to the filter to be used as washing water in the second washing section.

In the second washing section, the wash filtrates after passing successively through the cake, the filter cloth, the vacuum box, the vacuum receiver R27230 are sent back, by pump P27235, to the filter to be used as washing water in the first washing section.

Finally, after being used to wash the cake three times, the wash filtrates collected in the first washing section are mixed with the mother liquor and are pumped by P27225 to the NH_4NO_3 concentration unit.

The belt filter also includes a continuous washing of the filter cloth. After scraping of the cake, the filter cloth is washed with diluted NH_4NO_3 solution. The spent diluted NH_4NO_3 solution is collected with the drip-pan to the tank R27280 (CAREMAG furniture) and after is returned to NH_4NO_3 concentration unit. When required, nitric acid could be used to wash the filter cloth instead of the diluted NH_4NO_3 .

The vacuum is created by the vacuum pump, whose suction is connected to the vacuum receiver R27220. A cyclonic separator R27270 is installed between the vacuum pump and R27220 as a security. The vacuum pump discharges to atmosphere at safe location. A water loop including a heat exchanger feed with cooling water is used to cool the water circulating in the pump (P27215).

PROCESS DATA SHEET – BELT FILTERS PACKAGE

3. MASS BALANCES

Slurry		I 22200 PrNd / Nd		I 26200 Dy		I 27200 Tb	
		Hydroxy nitrate	Carbonate	Hydroxy nitrate	Carbonate	Hydroxy nitrate	Carbonate
Nominal flowrate (Note1)	kg/h	645	1448	1039	1968	247	350
Solid content	% wt.	18.2%	11.7%	6.8%	4.5%	6.1%	4.7%
Density	kg/m3	1240	1137	1102	1059	1119	1065
Viscosity	Cp	1.05 @ 20°C					
Temperature	°C	50					

Slurry		I 24200 Ho-LuY	I 25200 SEG
		Carbonate	Carbonate
Nominal flowrate (Note1)	kg/h	8685	4105
Solid content	% wt.	8.4 %	7.4%
Density	kg/m3	1107	1091
Viscosity	Cp	1.05 @ 20°C	
Temperature	°C	50	

Note 1: No additional margin to be added on indicated flowrate.

PROCESS DATA SHEET – BELT FILTERS PACKAGE

4. OPERATING & DESIGN CONDITIONS

Filter package		I 22200 PrNd / Nd	
Mode		Hydroxy nitrate	Carbonate
Operating		Continuous and in campaign	
Location		Indoor	
Number of filters		by supplier	
Number of washings		3	
Washing ratio		0.8 m3 washing condensate / t of dry cake	0.7 m3 washing condensate / t of dry cake
Cake specific resistance	m/kg	6,52 10 ¹⁰	1.3 10 ¹⁰
Apparent density of humid cake	kg/m3	1344	1344
Maximum cake humidity at filter outlet	% mass	60%	40%
Maximum losses of product through the cloth	% mass	0.05	
Vacuum pressure	Barg	Max -0,8 (Note 1)	
Design temperature	°C	100	
Design pressure	barg	by supplier	
Filter sizing			
Selected filter surface with 2cm cake thickness (Note 2)	m2	2	
Average filtration rate for cake formation @ 0,5 barg ΔP	l/h/m2	514	1720
Filtration rate estimated of washing (Note 3) @ 0.5 bar ΔP	l/h/m2	260	860

Filter package		I 26200 Dy		I 27200 Tb	
Mode		Hydroxy nitrate	Carbonate	Hydroxy nitrate	Carbonate
Operating		Continuous and in campaign		Continuous and in campaign	
Location		Indoor		Indoor	
Number of filters		by supplier		by supplier	
Number of washings		3		3	
Washing ratio		0.8 m3 washing condensate / t of dry cake	1,5 m³ washing condensate / t of dry cake	0.8 m3 washing condensate / m3 interstitial water in cake	1,5 m³ washing condensate / t of dry cake
Cake specific resistance m/kg		3,85 10 ¹⁰	3.4 10 ¹⁰	3,85 10 ¹⁰	1.7 10 ¹¹
Apparent density of humid cake kg/m3		1344	1309	1344	1046
Maximum cake humidity at filter outlet % mass		60%	60%	60%	60%
Maximum losses of product through the cloth % mass		0.05		0.05	
Vacuum pressure Barg		Max -0,8 (Note 1)		Max -0,8 (Note 1)	
Design temperature °C		100		100	
Design pressure barg		by supplier		by supplier	
Filter sizing					
Selected filter surface with 2cm cake thickness (Note 2) m2		2.5		2	
Average filtration rate for cake formation @ 0,5 barg ΔP l/h/m2		870	1010	870	250
Filtration rate estimated of washing (Note 3) @ 0,5 bar ΔP l/h/m2		435	780	435	200

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PROCESS DATA SHEET – BELT FILTERS PACKAGE

Filter package		I 24200 Ho-LuY	I 25200 SEG
Mode		Carbonate	Carbonate
Operating		Continuous	Continuous
Location		Indoor	Indoor
Number of filters		by supplier	by supplier
Number of washings		3	3
Washing ratio		1.5 m ³ washing condensate / t of dry cake	1,5 m ³ washing condensate / t of dry cake
Cake specific resistance	m/kg	6 10 ¹⁰	6 10 ¹⁰
Apparent density of humid cake	kg/m ³	1127	1226
Maximum cake humidity at filter outlet	% mass	60%	60%
Maximum losses of product through the cloth	% mass	0.05	0.05
Vacuum pressure	Barg	Max -0.8 (Note 1)	Max -0.8 (Note 1)
Design temperature	°C	100	100
Design pressure	barg	by supplier	by supplier
Filter sizing			
Selected filter surface with 2cm cake thickness (Note 2)	m ²	21	15
Average filtration rate for cake formation @ 0,5 barg ΔP	l/h/m ²	670	610
Filtration rate estimated of washing (Note 3) @ 0,5 bar ΔP	l/h/m ²	330	310

Note 1: Adjustable vacuum down to -0,8barg. Vacuum pressure and pump technology, liquid ring or other, to be confirmed by supplier.

Note 2: Including 20% on overall filter surface for dewatering of the cake after washing.

Note 3: Filterability considered for the sizing of filter surface required for each washing.

Conditions at package limit:

- Feed
 - Operating pressure: Required pressure to be defined by supplier
 - Operating temperature: 50°C
 - Design pressure: 6 barg
 - Design temperature: 100°C
- Hot condensates for washing
 - Operating pressure: Required pressure to be defined by supplier
 - Operating temperature: max 80°C
 - Design pressure: 6 barg
 - Design temperature: 100°C
- Diluted NH₄NO₃ for cloth/ belt washing
 - Operating pressure: Required pressure to be defined by supplier
 - Operating temperature: max 80°C
 - Concentration of NH₄NO₃: 110 g/L
 - Design pressure: 6 barg
 - Design temperature: 100°C

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PROCESS DATA SHEET – BELT FILTERS PACKAGE

- Mother liquor
 - Operating pressure: hold
 - Operating temperature: 50°C
 - Design pressure: 6 barg (to be confirmed by supplier)
 - Design temperature: 100°C

Utilities:

Foreseen utilities:

- Hot condensates,
- Cooling water (CW),
- Demineralized water (DW),
- Industrial water (IW),
- Instrument air (IA),
- Service air (AS),
- Nitric acid (HNO₃),
- Electricity.

The supplier will confirm the utilities required for the belt filter/vacuum pump operation and will provide an estimation of their consumption.

The supplier will indicate the quality of water required for the vacuum pump operation.

The supplier will confirm the possibility or not to use diluted NH₄NO₃ for cloth/belt washing.

5. PACKAGE DESCRIPTION

5.1. Scope of supply

Package will contain the following pieces of equipment (**typical to be completed and confirmed by supplier**)

- Belt filter, including as a minimum:
 - Filter drive motor with gearbox and a speed variator (VSD)
 - Continuous Filter cloth washing system
- Mother liquor vacuum receivers with level detection instrumentation.
- Mother liquor storages (filtrate tank), **if it is not possible to put directly the liquor pumps under the vacuum receivers.**
- Mother liquor pumps
- Vacuum pump with accessories (total water recirculation, cooling with cooling water is preferred).
- Vent cover for filters is proposed in option.
- Drip-pan
- Splash and mechanic protection system
- **Dewatering** : The supplier shall include, in option, an improved dewatering technology for Ho~LuY and SEG filter.

Supplier shall provide all the necessary instruments for correct, safe, and efficient operation of the package based on the following document.

PROCESS DATA SHEET – BELT FILTERS PACKAGE

The Supplier shall supply all security and control system enabling this package to operate safely under all circumstances for the specified operating conditions.

5.2. Package Material

The supplier should define construction materials in accordance with solids and liquids used in the process as for the required pressure and temperature in operating conditions.

All parts in contact with the products:	at least SS 304 L
Scraper knife:	by supplier
Belt:	by supplier
Filter cloth:	by supplier

Proposed materials should be approved by client.

On the commercial offer, the supplier will provide a maintenance plan with separate pieces price list.

5.3. Slurry and washing distribution

Carbonate slurry is a fast-settling product. Particular care is required when introducing it onto the filter to ensure the most homogeneous distribution possible. A presentation of the slurry dispenser and the cake wash distributors is required in the technical offer.

5.4. Dewatering technology

The final humidity of the cake is a crucial parameter for caremag plant's energy consumption. Means of reducing this humidity can be offered as an option and will be considered **as a determining factor in supplier selection**.

5.5. Belt drive speed

Due to Caremag's different sourcing, slurries may vary in filterability and density. To compensate this, the supplier will carefully design the belt speed and its operating range. A calculation note must be provided in the technical offer, and the supplier must confirm that the filter operates correctly over the entire belt speed range (especially at very low belt speeds).

The belt drive speed must ensure the possibility to reach the following cake height range:

Cake height variation:	10 to 20 mm (optimal height is 15mm)
Flow variation:	from 50 to 100 % nominal capacity