SULPHUR HANDLING & FILTRATION
Twin Process Filtration BV
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The Netherlands

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Fax: +31 344 630 530
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Internet: www.twinprocessfiltration.com
<table>
<thead>
<tr>
<th>Company</th>
<th>Location</th>
<th>Products/Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Twin Process Filtration BV</td>
<td>Tiel</td>
<td>Inorganic Chemistry, Petrochemicals, Specialty Chemicals, Food &amp; Beverages</td>
</tr>
<tr>
<td>Twin Filter BV</td>
<td>Zaandam</td>
<td>Oil &amp; Gas, Air Filtration</td>
</tr>
<tr>
<td>GSF Europe BV</td>
<td>Uitgeest</td>
<td>Production of Filter Plates and Filter Media</td>
</tr>
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... for the brightest result
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Since 1985

Number of Employees ca 75

Annual turn over €25,000,000

World Wide Presence
Twin Process Filtration is providing solid/liquid separation solutions and services for the Chemical Process Industry.

Twin Process Filtration brings together the knowledge of filter media, filtration technology and outstanding skills in mechanical engineering, making hardware and software successfully work together.
People working at Twin Process Filtration

- Process Engineers and Chemical Engineers
- Mechanical Engineers

We understand:

- Processes
- Difficulties in processes
- Optimising the filtration processes
- Bring New ideas
- Provide aid for basic & detailed engineering
Design codes

ASME VIII; PED 97/23EC; AD2000

Certification:

“U”-Stamp ; “CE” Marking

SQLO for China

GOST for Russia, Ukraine and Kazakhstan

Customer specific (ARAMCO)
Range of Self Cleaning Water Filter

**TWIN-O-MATIC**

- Seawater intake filter
- Cooling water filter
- Protection Heat Exchangers
Legend:
1. Electric Motor
2. Brush
3. Fine Screen
4. Inlet
5. Flushing Valve
6. Outlet
Sulphuric Acid Plant
Almost Septic, High Tech

Twin Process Filtration

... for the brightest result
Twin Process Filtration

... for the brightest result
Twin Process Filtration

... for the brightest result
Services & Products for

SULPHUR BURNER PLANT & SULPHUR PROCESSING

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Products

Custom designed systems
  Jacketed Strainers
  Pre Filters
  Polishing Filters
  Self Cleaning Candle Filter

Trading
  Cellulose Filter aid
  Jacketed Valves
  Lined Valves & Fittings
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PROCESS DESIGN

Sulphur source? (Canada, Russia, Refinery)
Sulphuric acid plant, required capacity
Quality of filtered sulphur
Calculations on Sulphur Filter Filtration area

- Based on Cake volume
- Based on Flow rate
- Design Pre coat tank and pumps
MECHANICAL DESIGN

Specification of Filter unit
Design of filter
Design Code and Stamp
Design Calculations and Drawings
Connections Orientation
Hydraulics and PLC Programming
Erection Information
Maintenance Instructions
SULPHUR MELTER SECTION
<table>
<thead>
<tr>
<th>Sulphur specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dark Sulphur</td>
<td>97-98% High content of Carbon</td>
</tr>
<tr>
<td></td>
<td>Carbon deformable particles</td>
</tr>
<tr>
<td>Bright Sulphur</td>
<td>99.5% Mostly from refineries</td>
</tr>
<tr>
<td>Specials</td>
<td></td>
</tr>
<tr>
<td>Sulphide Sulphur</td>
<td>87%</td>
</tr>
<tr>
<td></td>
<td>Metal Sulphides (316 SS Filters!)</td>
</tr>
<tr>
<td>Vulcan Rock Sulphur</td>
<td>85%</td>
</tr>
<tr>
<td>Impurities</td>
<td>Ash</td>
</tr>
<tr>
<td></td>
<td>Carbon ?</td>
</tr>
<tr>
<td></td>
<td>Chlorine ?</td>
</tr>
</tbody>
</table>
For circular reactor
For optimal performance the need Baffling
More Turbulent flow patterns at taper end by acceleration and displacement

Tank shape or liquid level have no effect on homogenisation

... for the brightest result
Sulphur Fires
- Sparks
- Static electricity
- Presence of FeS

Solidifications
- Cold spots
- Bad insulation

Corrosions
- Presence sulphur
- Humidity
- Temperature
Why filtration:

Removal of dirt as ashes and dust

Prevent corrosion caused by sulphur in combination with moister and air

Longer life time of catalyst in converter
IMPURITIES

ASHES General 0.01 – 0.3%
RUST SCALE
FLY ASHES
SAND

(mainly caused by transport)
Difficulties

Viscosity Sulphur

Viscosity

Temperature
Other difficulties:

Blinding of cake due to presence of unsaturated carbons (bitumen)

- Pressure has to be kept low
- Flow has to be kept low
- Pre-coat or body-feed has to be used
Precoating
Precoat filtration
Precoat + Bodyfeed filtration
Type of construction
Support frame type
Overhead frame type
Central Steam inlet
Steam Hose guide / carrier
Two closure systems

WEDGE EDGE TYPE

EXTERNAL PRESSURE
WEDGE EDGE TYPE
EXTERNAL PRESSURE
“Plug and Play”
“Plug and Play”
POLISHING FILTER

Reasons to use a Polishing Filter

- Longer life time of catalyst
- Low pressure drop in converter tower
- Less maintenance & shut down’s
Carbon Candles

+ High efficiency
+ High dirt holding capacity

- Difficult to clean
- Cleaning efficiency
- Expansion deviation with steel
Filter media porous Carbon or SS

Historical reason
Originated from the 40-ties and 50-ties
Available Cotton, SS, Stone

Nowadays
PTFE, PEEK
Pressure clock

separatorplate

SS Candles covered with Teflon Cloth

Oversized drain
Filtration

Backflushing

... for the brightest result
Pulse Discharge Candle Filter

Filtration

Backflushing
Pulse Discharge Candle Filter
FILTER AIDS

- Inorganic
- Diatomite
- Perlite
- Celite

Organic  Cellulose  > 99%

<table>
<thead>
<tr>
<th>Element</th>
<th>Min %</th>
<th>Max %</th>
</tr>
</thead>
<tbody>
<tr>
<td>SiO₂</td>
<td>65.0</td>
<td>80.0</td>
</tr>
<tr>
<td>Al₂O₃</td>
<td>14.0</td>
<td>18.0</td>
</tr>
<tr>
<td>Fe₂O₃</td>
<td>2.5</td>
<td>4.0</td>
</tr>
<tr>
<td>CaO</td>
<td>1.5</td>
<td>2.2</td>
</tr>
<tr>
<td>K₂O</td>
<td>0.9</td>
<td>1.2</td>
</tr>
<tr>
<td>TiO</td>
<td>0.65</td>
<td>0.85</td>
</tr>
<tr>
<td>MnO</td>
<td>0.04</td>
<td>0.06</td>
</tr>
<tr>
<td>P₂O₅</td>
<td>0.04</td>
<td>0.08</td>
</tr>
</tbody>
</table>

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<tr>
<th>Element</th>
<th>PPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fe</td>
<td>&lt;0,01</td>
</tr>
<tr>
<td>Pb</td>
<td>&lt;0,01</td>
</tr>
<tr>
<td>Hg</td>
<td>&lt;0,01</td>
</tr>
<tr>
<td>Cd</td>
<td>&lt;0,01</td>
</tr>
<tr>
<td>As</td>
<td>&lt;0,01</td>
</tr>
<tr>
<td>Sb</td>
<td>&lt;0,01</td>
</tr>
<tr>
<td>V</td>
<td>&lt;0,01</td>
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</table>
FILTER AIDS

Inorganic

Diatomaceous earth

Organic Cellulose

- ash content: max. 0.3 %
- ether extract: max. 0.1 %
- pH: 5.5 - 6.5
- Appr. moisture: 5 - 8 %

Perlite
cellulose + O\textsubscript{2} \rightarrow n\text{CO}_2 + n\text{H}_2\text{O}
Life time of catalyst
Low pressure drop in Converter
Maintenance can be reduced!
Saving cost!
Advantages Cellulose over Inorganic Filter Aid

1) Cellulose burns to $n\text{CO}_2 + n\text{H}_2\text{O}$

2) Better cake release saves filter plates repairs
**Case Study: Sulphur**

Vertical plate filter. T=140-160 °C.

<table>
<thead>
<tr>
<th></th>
<th>Diatomite</th>
<th>Cellulose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumption</td>
<td>200 Kg</td>
<td>150 Kg</td>
</tr>
<tr>
<td>Filter cake Height</td>
<td>5 mm</td>
<td>5 mm</td>
</tr>
<tr>
<td>Filter cycle</td>
<td>8 - 12 hours</td>
<td>20 hours</td>
</tr>
<tr>
<td>Flow rate</td>
<td>20 - 23 m³/hour</td>
<td>26 - 30 m³/hour</td>
</tr>
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</table>
Sinter Metal
5 micron
Efficiency 6.8 micron 98%
Open area 10%

Sintered Felt Metal
5 micron
Efficiency 8.5 micron 100%
Open area 70 – 75%
Advantages Cellulose over Inorganic Filter Aid

1) Cellulose burns to $n\text{CO}_2 + n\text{H}_2\text{O}$
2) Better cake release saves filter plates repairs
3) Less consumption/m$^2$
4) Higher flow rates / m$^2$
Advantages Cellulose over Inorganic Filter Aid

1) Cellulose burns to $n\text{CO}_2 + n\text{H}_2\text{O}$
2) Better cake release saves filter plates repairs
3) Less consumption/m²
4) Higher flow rates / m²
5) Pre coat pump life time
6) Filter cake is Organic/Sulphur/Lime (Roasting?)
ALTERNATIVE SOLUTION

TWO

2

ONE
Pulse Discharge Candle Filter
Self cleaning

- Automatic cake discharge
- Low maintenance
- Custom-made
  - Dimensions
  - Material choice (ss, hastelloy etc.)
  - Welding processes
  - Design codes
Pulse Discharge Candle Filter

How does it work?

Flow direction

Clear filtrate

Cake formation
Pulse Discharge Candle Filter

How does the it work?

Cake discharge

Back pulse
SULPHUR FILTRATION

TWO TO ONE
Advantages Cellulose over Inorganic Filter Aid

1) Cellulose burns to $nCO_2 + nH_2O$
2) Better cake release saves filter plates repairs
3) Less consumption/m$^2$
4) Higher flow rates / m$^2$
5) Pre coat pump life time
6) Filter cake is Organic/Sulphur/Lime (Roasting?)
Advantages Self Cleaning

Candle Filter

1) One Filter for pre filtration and polishing duty
2) Closed system protects operator
3) Higher flow rates / m²
4) Higher filtration efficiency
5) Reduction of maintenance shut downs due longer catalyst cycles
6) Less moving parts
SULPHUR FILTRATION

TWO TO ONE
WHY STILL PRECOAT
With fine filter medium?
Facilitate cake removal
Life time of filter medium
Closed operation
Operators are protected and cleanliness of the sulphur area.

Protection of the catalyst
Less maintenance; instead of a yearly shutdown it can be extended to 3 years.

Less waste material
Reduction of waste cost, possibility for recovering sulphur by roasting process

Less filter aid needed
Reduction of operational cost less waste

1 filter instead of 2
Reduction of investment cost

Spare parts
Less moving part as conventional leaf filter, Teflon media is lower in cost as filter plate bundle exchange
QUESTIONS