FUNDABAC®

Filter-drying systems for the Oil & Gas industry

DrM

www.drmgroup.com

FILTRATION

This is DrM

Customized solutions
Each solid-liquid separation system is tailor made to the specific application parameters of our clients. We view every application as a challenge to satisfy our clients, regardless if the application is straight forward or complex.

Application comprehension
Every solid-liquid separation application is unique. DrM's comprehension of all of the applications begins with a discussion with the client and is followed by a request that the client complete an application questionnaire to the best of its ability. Following a review of the information submitted by the client, DrM application specialists may suggest that on-site testing and/or piloting be carried out. This hands-on work ultimately gives both DrM and its clients the confidence that the process is scalable. It also puts DrM in a position to submit a technical/commercial proposal that it will stand behind.

Quality above all
DrM's Quality System is ISO 9001 certified for the design and manufacture plants. We are dedicated to continually improving the efficiency and the effectiveness of our quality management system. All of our products follow a rigid quality control program that employs the most current testing and inspection methods prior to shipment.

Oil & Gas industry specialists

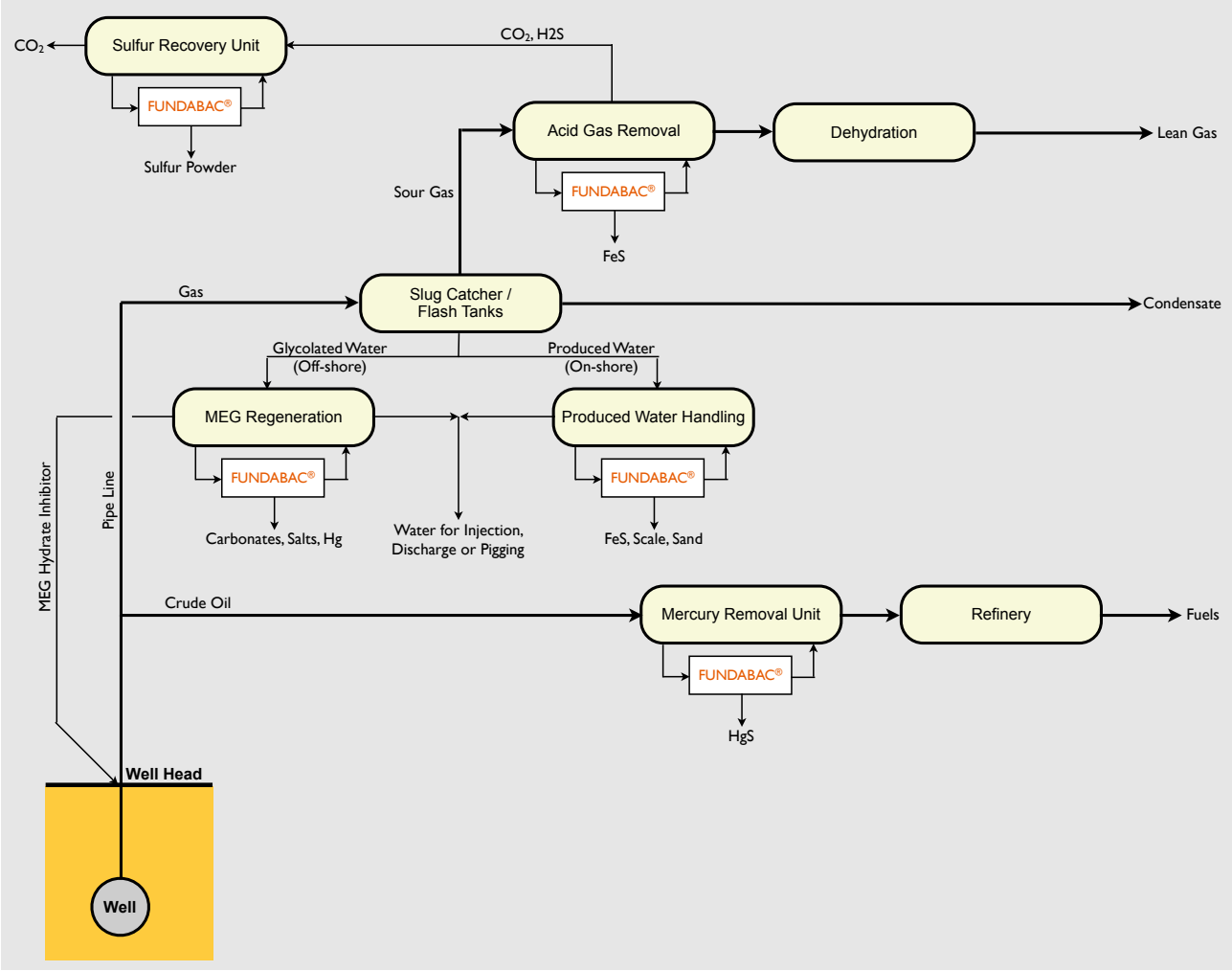
We solve complex liquid clean-up issues

Filtration solutions

The FUNDABAC® Filter has been employed extensively in the Oil & Gas industry for various uses. Its main applications are summarized below:

- Amine filtration in acid gas removal and CO2 sequestration plants
- Removal of low soluble salts in MEG regeneration processes
- Mercury removal from crude oil
- Produced water filtration and pigging water treatment
- Filtration of flue gas scrubbing liquid in FCC
- Sulfur removal in redox sulfur recovery processes

Overview of FUNDABAC® applications and references in the Oil & Gas industry



Key benefits of FUNDABAC®

for the Oil & Gas industry

Waste reduction - solution for environmental issues

The unique dry discharge ability provides major advantages in liquid clean-up systems with relatively high or fluctuating levels of impurities. These systems operate fully automatically and are totally enclosed from the environment. Manual handling is reduced to a minimum and contaminated slurries that require further treatment are avoided completely. The dried cake contains solid filtered impurities, filter aid and approx. 30 - 40% residual moisture. At this dryness, the cake appears as a crumbly powder, free of airborne dust and can be easily handled, disposed of or incinerated.

High flexibility - reduction of process upsets

The FUNDABAC® filter system is regarded by operators as very reliable because once installed, it needs little attention. Filtration requirements may change after selection and installation of the equipment.
A higher solid concentration means a quicker fouling of the filtering element or media. A slurry type discharge system, however, is required to maximize the operating cycle time, otherwise the amount of slurry to be treated is increasing drastically. Thanks to automatic operation and the dry discharge ability, the FUNDABAC® system is not limited in this way.

The FUNDABAC® Filter provides maximum flexibility to adapt to your requirements:

- You face excessive solids contamination?
  …the filter will clean up your system quickly.
- You require a higher filter efficiency?
  …change to a finer filter media or pre-coat grade.
- You are facing foaming problems?
  …apply a multi layer pre-coat and adsorb HC directly in the filter.

Higher filter efficiency

FUNDABAC® Filters provide an unsurpassed filter efficiency down to 1.0 µm particle size and less. Even though the fraction of micron particles in the solvent may not be worrying at first glance, they can accumulate and cause severe problems or reduce the product quality. Plate or leaf type filters and those with circular elements are limited in this instance due to their poor ability to discharge (i.e. detach) the filter cake from the filter surface.

Saving operating and maintenance cost

Thanks to modular construction, no moving parts and high automation, investment and running costs are kept low. Maintenance and disposal costs are cut to almost zero. As the filter element is regenerated after each filter cycle, no fouling of the media occurs. Normally, the filter cloths are replaced during scheduled maintenance shut-downs every 2 - 3 years. This represents a significant contrast to standard cartridge filters, where units have to be taken out of operation frequently and considerable labor and material is required to change the loaded filter elements.

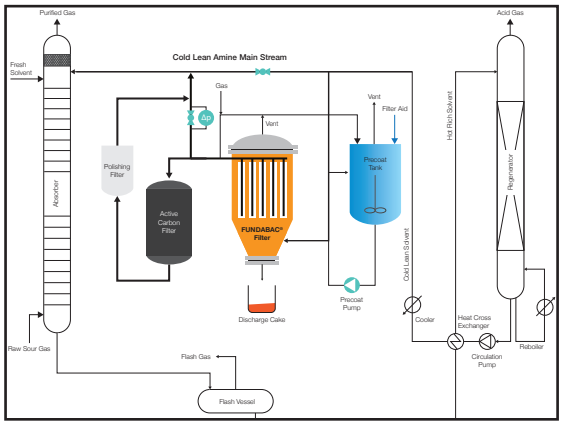
Amine cleanup

for world-scale Acid Gas Treatment plants

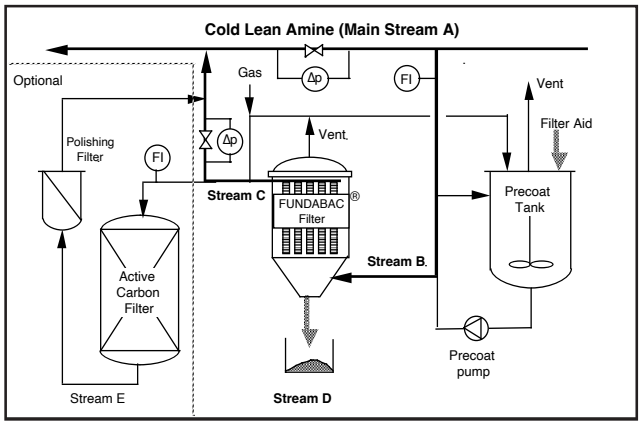
World-scale sour gas treatment plants with multi- billion Nm^3 gas capacity involve the clean-up of large flows of lean amine (MEA, MDEA, DEA, etc.). The clean-up, which is traditionally done in a 10 to 20% slip stream, requires solid/liquid filtration equipment with 100 to 600 m^3/h name plate capacity. The scale of these filters as well as the environmental demands imposed by most of these new gas plants have made static disposable filters economically unattractive. Labor costs and costs for supply and disposal become prohibitive. Self-cleaning, automated pressure candle filters of the FUNDABAC® type have shown reliability since their introduction in 1988. These high efficiency filters provide for excellent removal of suspended solids, which in turn, decrease foaming, corrosion and associated loss of productivity.

The capacity of these FUNDABAC® systems has been successfully scaled-up to in excess of 100 m^2. A significant feature is the dry discharge of the filter cake, which can be readily land filled for disposal or incinerated. The elimination of waste sludges offers significant benefits.

Automatic filters usually run with a filter aid precoat, which is used to remove the very fine contaminants, mainly iron sulfide. The precoat allows a more homogeneous pressure drop over the whole filtration cycle, the filter cloth is protected against clogging and the filter cake can be easily discharged.



Basic configuration for a gas sweetening process utilizing a FUNDABAC® filter for cleanup



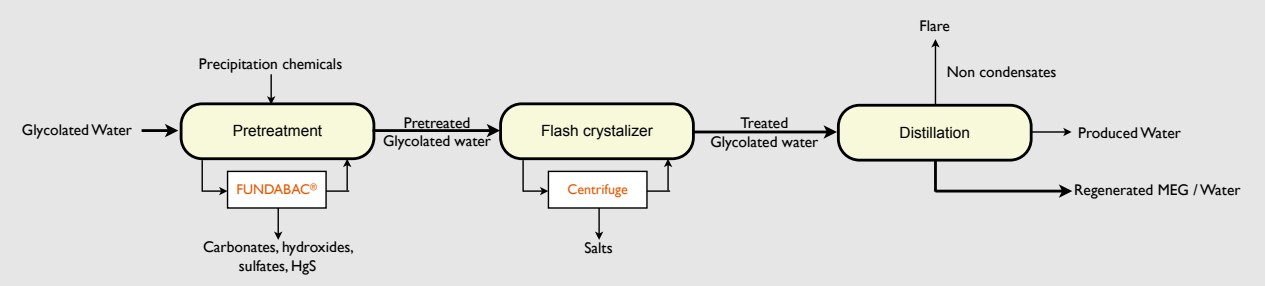
Amine cleanup process scheme including precoat facilities, active carbon adsorption and downstream polishing

MEG regeneration

In off-shore gas fields, MEG is injected into the gas stream as it emerges from the well head to prevent hydrate formation along the pipeline. When the gas reaches the on-shore plant, the glycolated water needs to be separated from the gas stream and the MEG recovered. However, the MEG gets contaminated with calcium, magnesium, mercury and other types of salts and to prevent accumulation, it needs to be purified before it is reused.

Typical consistency of a discharged cake to be packaged in a barrel or another type of container

Various process technologies are applied to treat this glycolated water stream. Solids removal may involve a one or two stage process including sedimentation, centrifugation or filtration.



Typical MEG regeneration process including pretreatment for removal of low soluble salts, flash crystalizer for removal of highly soluble salts and distillation for concentration of MEG

Separation methods which produce a solid slurry with hazardous contaminants can pose a significant risk to the environment if not further treated.

The FUNDABAC® can effectively be applied to dewater such slurries. Waste disposal is reduced to a minimum and MEG recovery is maximized.

Mercury removal

from crude oil

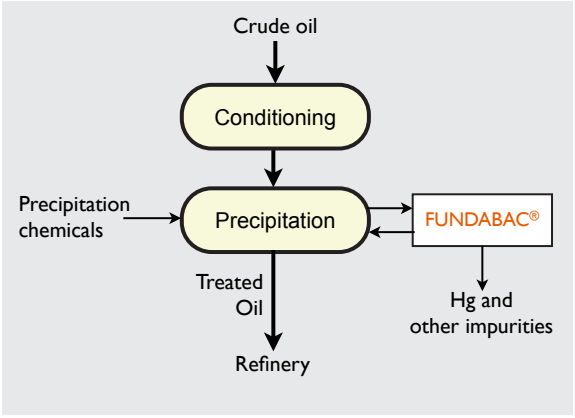
Mercury is a natural trace contaminant and present in fossil fuels. Its compounds are toxic to flora and fauna and represent a risk for health of people who have contact with residues. Additionally, it can cause problems in the production, storage, transportation and refining sector.

As a result, mercury is subject to different types of controls and regulations and fossil fuels containing mercury are sold at discounted prices. The traditional method for the removal of mercury relies on its reaction with elemental sulfur.

However, there are several drawbacks of this method and more modern thinking has moved towards the use of other chemicals as reactants to precipitate Hg from the crude oil stream. One of the first plants implemented along these lines was built by Petrobras in Argentina. The heart of the process is the Hg removal unit which is a FUNDABAC® Filter. The Hg compounds are captured from the crude oil and the solids dried and discharged as dry powder for further processing.

While typical Hg concentrations in the crude are below 10 ppm, the plant was originally designed for a maximum Hg content of 200 ppm. It has been running successfully since 2006 and the FUNDABAC® with its completely automatic operation achieves full expectations. The average Hg content in the oil is around 25 ppb with a removal efficiency above 98%. The filtered Hg is captured on the filter elements of the FUNDABAC® and is gas dried. Then, it is discharged into a re-slurry tank as a solid powder. This keeps oil loss to an absolute minimum. Produced water is added to the re-slurry tank creating a low concentration slurry which is pumped back into the well.

Implementation of such a process adds significant commercial value to the crude when sold to refiners. Thus, the process finances itself while at the same time reduces exposure to the environment. The FUNDABAC® filter has been proven to very effectively remove precipitated mercury compounds from crude oil streams whilst still reducing oil loss to a minimum.



Produced Water and Pigging Water Filtration

Natural gas extraction often involves the production of large quantities of water as a by-product. This needs to be separated from the gas stream. As it also contains impurities, it is classified as a hazardous product which needs treatment.

Additionally, the pipelines used for transportation of the acid gas from the well get corroded due to the aggressive nature of the gas and scale can form along the inner walls of the pipes. This scale needs to be removed on a regular basis. For this, a pigging process is utilized which scrapes off the scale from the internal surface and keeps the pipelines clean.

Finally, the produced water, including the sludge from pigging, is collected and needs to be treated before reuse. With its closed operation, the FUNDABAC® allows completely automated separation of these solids and discharges them as a dry residue from a closed system. As this sour water still contains H_2S as a contaminant, considerable care is taken to protect environment and operators.

The filtration system removes scale and various other contaminants. As the solids content can be high, there is a significant amount of cake to be discharged. This cake still contains some sour water and therefore needs to be handled with care.

A completely enclosed discharge system can be employed for this purpose. The container is docked onto the discharge chute and the exhaust gases are treated. Once filled, this container is taken off-line for disposal at a dedicated disposal site.

So, finally, the complete pigging water treatment only produces some solid waste while the water can be recycled. This is a big step towards of a completely contained treatment system.

Typical installation of off-shore pipelines for gas production

Solid Sulfur separation

in a Sulfur Recovery Unit

There are several process solutions on the market to convert hydrogen sulfide into elemental sulfur. In most of them, the sulfur needs to be separated from an aqueous suspension.

In these cases, it is desirable to produce a cake with a high solids content for two reasons:

- to minimize the loss of catalyst
- to reduce transportation costs

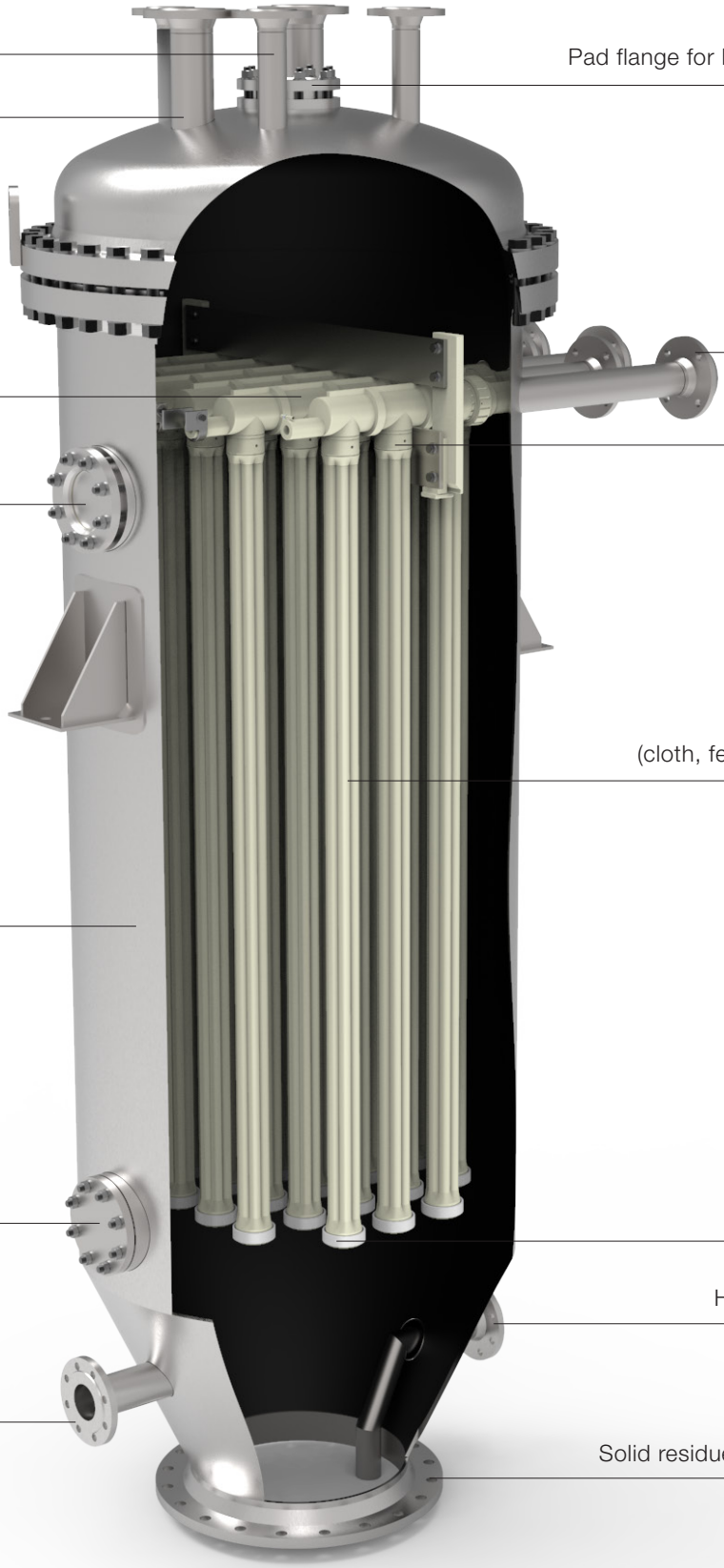
If the sulfur is used as a raw material in another process, it may also need to be washed to reduce contained impurities. The FUNDABAC® is ideally suited to produce dry cakes. Additionally, it can be equipped with a washing system to improve the purity of the solid sulfur powder.

12 m2 FUNDABAC® Filter is used to separate and wash 1300 kg of sulfur per day.

The solids content is approx. 75% and the ash content of 5% is reduced to < 0.2%

FUNDABAC®

A closer look at the filter properties



Four functions, one unit

Understanding the FUNDABAC® Filter

1. Filtration

The uniform distribution of solids throughout the liquid in the filter is achieved by creating an upward flow by means of a controllable overflow. This ensures an even build-up of cake on the filter elements.

2. Cake washing

At the end of the filtration step, heel filtration step, or draining of the filter by gas displacement, the cake can be washed using a suitable wash-phase. The sprayed wash-phase, using the heel filtration method, significantly reduces the volume of the wash liquid compared to conventional washing (fig. 3).

3. Cake drying

The washed cake is dried by blowing a suitable gas phase, e.g. ambient or hot air, nitrogen or steam through the cake on the filter elements, until the required level of residual moisture has been reached.
The cake remains on the filter medium during the entire process due to the unique geometric arrangement of the tubes in the filter elements. At the end of the drying cycle the pressure vessel is vented and the discharge device opened to discharge the solids.

4. In-situ cleaning of the filter media

In-situ cleaning assures longer life of the filter media. Programmed according to need, the filter media are automatically washed in the closed filter to free them from possibly strongly adhering particles.

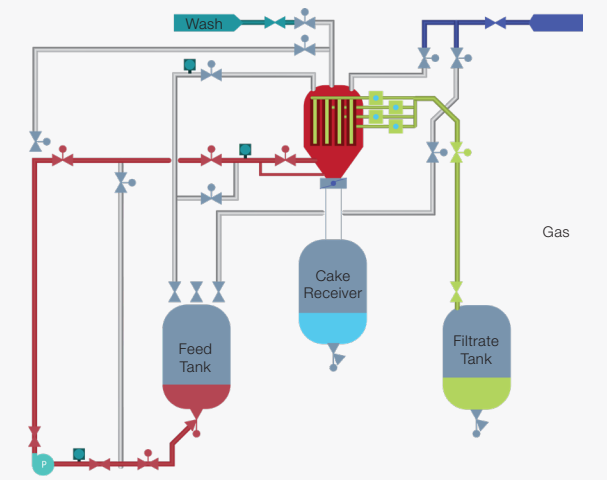


Fig. 2: General Flowsheet of a FUNDABAC® filtration

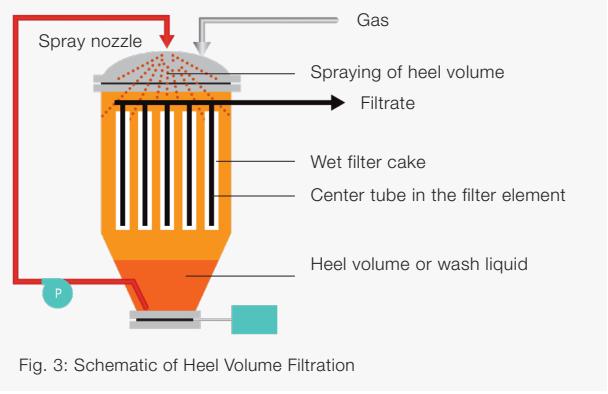


Fig. 3: Schematic of Heel Volume Filtration

Filtrate outlets including sight glass for each outlet. Outlets are grouped into headers with individual pneumatically actuated valves leading into the filtrate collector.

FUNDABAC®

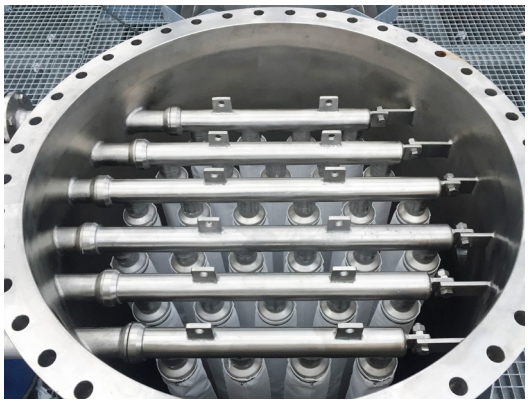
Combination of high tech and efficiency

Personnel and environmental safety
Because of the closed and static system, all contact with product can be avoided and the risk of exposure is significantly reduced. The FUNDABAC® system more than fully meets environmental safety regulations.

Custom design with modular construction
- Static filter elements without rotating parts.
- Distance of filter elements individually adjusted to operate filter at optimal cake thickness.

High operational security
Any breakthrough in a filter media can be isolated by shutting off the corresponding manual valve.

High corrosion resistance
Different alloy steels, coatings, linings and high tech polymers for filter media and internals, used for: Etching acid mixtures of HF, HCl and H_2SO_4. Sulfuric acid regeneration at 92%. All kinds of inorganic and organic acids.



A wide range of process applications and adaptations to process conditions
- Filter media particle retention <1 micron.
- The filter cake can be washed and dried.
- Discharge of filter cake in portions.

Full automation
It is state-of-the-art to operate plants with full automation. Various instruments, such as turbidity meters, sludge density and cake thickness probes, flow controllers, pressure switches and level probes allow the execution of complex filtration processes without operating and supervisory personnel.

Know-how and technical support
We offer forty years of experience in the filtration sector. Our customers may select from a range of more than 50 test filters with a filter area from 0.012 m^2 for laboratory to pilot plants up to 62 m^2.

Plants in operation up to:
250°C
80 barg
3600 m^3/h
20 t/h solids discharge 96% solids content

Additional Applications and industries

Specialty and fine chemicals manufacturing

- Additives
- Adhesives
- Coatings
- Cosmetics
- Decolorization
- Dyestuffs
- Flavors & Fragrances
- Pigments
- Plasticizers
- Plasticizers
- Polymers
- Resins
- Rubber vulcanizer

Mineral and metal processing

- Aluminum recycling
- Bauxite and Alumina filtration
- Catalyst production
- Leaching
- Lithium
- Nickel production
- Non-ferrous metals
- Potassium Nitrate
- Rare Earth
- Steel
- Titanium Dioxide
- Zeolites

Food and Agrochemicals

- Catalyst recovery
- Crop protection chemicals
- Fatty Acids
- Lactose syrup
- Sugars
- Sweeteners
- Vegetable oil

Environmental

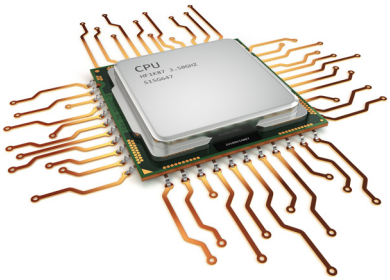
- Biodiesel impurity removal
- Carbon Capture & Storage (CCS)
- Flue Gas Desulphurization (FGD)
- Incineration waste gas treatment
- Quench water
- Recycling
- Solar cell production
- Wastewater

Bulk Chemical and Petrochemical

- Adipic Acid thickening
- Aniline recovery
- Aromatics and resins
- Butane Diol catalyst recovery
- Precious metal catalyst recovery
- Chlor Alkali
- Glycol production
- High purity epoxy production
- Removal of Hypochlorites
- Lubricant wax removal
- Olefins byproduct filtration
- Catalyst removal in oil additives
- Polyols salt removal
- Impurities removal in PPS production
- Purified Terephthalic Acid recovery
- Rubber chemicals catalyst recovery
- Synthesis Gas
- Toluene Diamine preparation and recovery

Oil and Gas Processing

- Mercury removal from crude oil
- FCC Catalyst fines
- Gas Sweetening
- MEG Regeneration
- Pigging Water treatment
- Produced Water filtration
- Sulfur recovery



Electronics

- Copper foil production
- Graphite Oxide (GO)
- High Purity Alumina (HPA)
- LCD production
- Lithium battery production
- Lighting
- Silane
- Photoresist
- Silicon ingot and wafer slicing
- Silicon wafer shaping

Pharma and Nutraceuticals

- Active Pharmaceutical Ingredients
- Antibiotics
- Catalyst recovery
- Cell harvesting
- Decolorization
- Decolorization
- Vitamins
- X-Ray contrast agents

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