WATER & ENERGY

IV Lviv Ecological Forum

GEA Environmental Technology

UWE KUENZL, 13.09.2018

engineering for
a better world

Overview presentation

- General Information GEA
- General Information Centrifuges
- Thickening process
- Dewatering process
- Automation concept
- Decanter in THP process
- References

General Information GEA

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GEA – “engineering for a better world”

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GEA is one of the largest suppliers of process technology to the food industry and to a wide range of other industries.

17,863
employees (FTEs)

4,605
million revenue (EUR)

The company is listed on the German MDAX stock index (G1A, WKN 660 200) and included in the STOXX® Europe 600 Index.

In addition, the company is listed in selected MSCI Global Sustainability Indexes.

4,751
million order intake (EUR)

The international technology group focuses on process technology, components and sustainable energy solutions for sophisticated production processes in diverse end-user markets.

564
million operating EBITDA (EUR)

12.2
% operating EBITDA margin

1.31
earnings per share (EUR)

Our applications – in touch with GEA every day

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Dairy Farming and Processing

Approx. one quarter of processed milk comes from GEA production systems

Food

Every third chicken nugget is produced by GEA technology

Around every third process line for instant coffee was installed by GEA

Beverages

Approx. every second liter of beer is brewed with the aid of systems and process solutions from GEA

Pharma

Every fourth liter of human blood is handled by GEA equipment

Chemical

More than one third of all polymer producer are using GEA Drying technology

Environmental Technology

Around **one quarter** of **wastewater sludge is processed** with **GEA equipment**.

Marine

Every second container ship in the world sails with GEA marine equipment on board

Seven Product Groups, Seven Application Centers, Six Regions (776)

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BA Equipment
SEVEN Product Groups


Automated Milking & Feeding


Conventional Milking & Farming


Separation


Homogenization Equipment


Flow Components


Compression


Food Processing/ Packaging Equipment

BA Solutions
SEVEN Applications


Dairy

Dairy Farming


Beverage


Food


Chemical


Pharma


Utilities

SIX Regions

R-LAM
R-WE&MEA
R-APC
R-NAM
R-NCE
R-DACH&EE

Entrance Area – Welcome to Oelde, Germany
Product Group Separation

Core Products of GEA Separation

Separator centrifuges

with bowl diameters from 200 mm up to 1050 mm

Throughput capacity up to 500,000 l/h
Particle size from 0,5 µm

Taking care to produce fresh milk, starch, mango juice, antibiotics, etc.

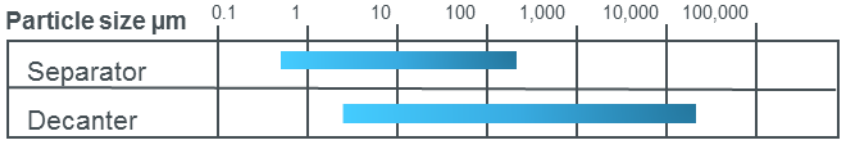
Decanter centrifuges

with bowl diameters from 200 mm up to 1030 mm

Throughput capacity up to 350,000 l/h
Particle size from 5 µm

Taking care of clean water, waste water, rendering, etc.

World's largest decanter centrifuge in operation in Singapore, New York and Los Angeles



General Information
Decanter

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Production in Niederahr (Germany)

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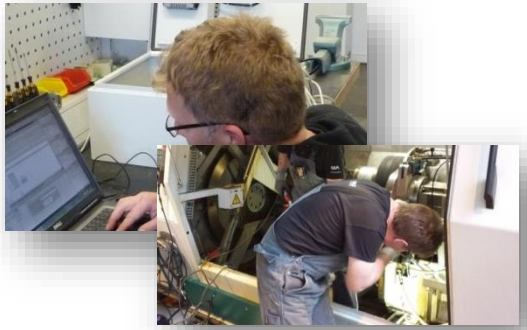
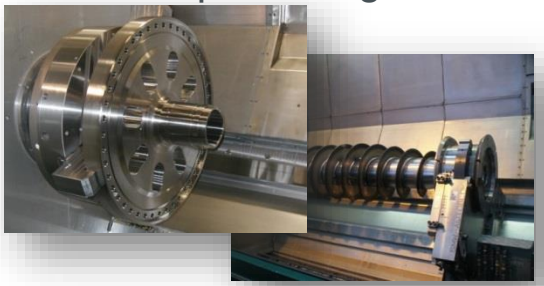
FB4 – Maintenance



FB1 - Shape cutting



FB3 –Handling end product

FB2 – Non-cutting shaping

Current GEA decanters for dewatering / thickening in WRP´s

- Capacity range

- Capacity: 1 – 350 m^3/h
- Feed DS load: 50 – 5000 kg/h
- Bowl diam.: 200 – 1000 mm
- # of machines types: 15

- Features and benefits of GEA decanters

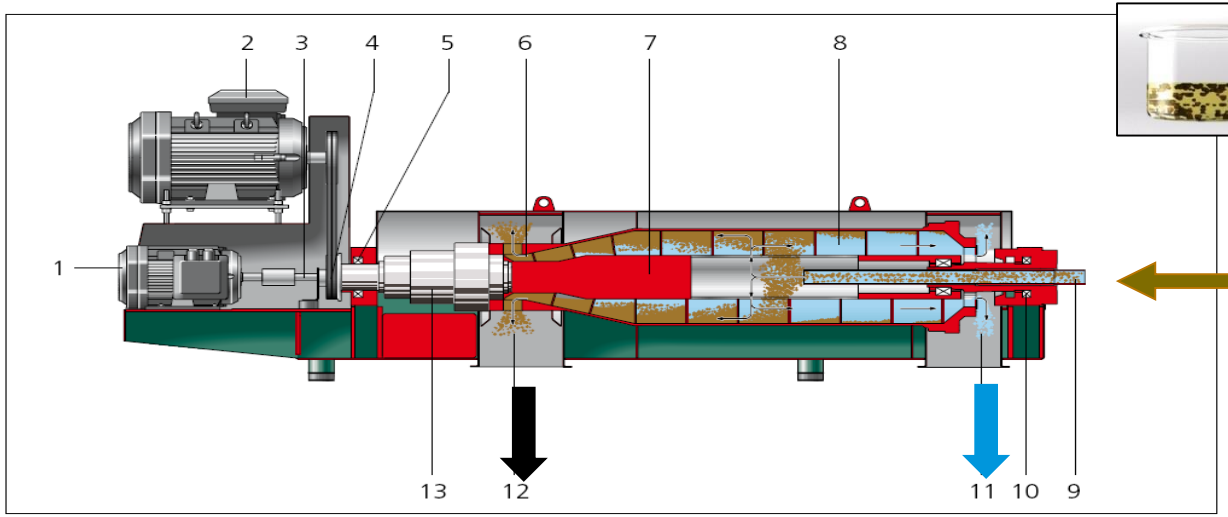
- Vast company experience and know-how with environmental processes and various types of sludge's worldwide.
- Strong commitment and high investments to R&D – improvements, patents and high speed of innovations
- Different decanter types – to cover the whole capacity range with maximum reliability, efficiency and latest technical features
- High level of standardization and modularity
- Best results for Cake DS, polymer and energy consumption
- Best materials, highest quality production, ISO certifications, very competitive prices

GEA separation decanter

Solid-Liquid-Separation (with free liquid discharge)

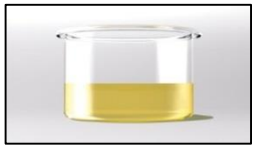
For all wastewater / sewage applications

sludge



1 Secondary motor
2 Main motor
3 Scroll drive
4 Bowl drive
5 Bowl bearing
6 Bowl
7 Scroll
8 Separation chamber
9 Feed
10 Main bearing
11 Free discharge of the clarified liquid
12 Free solids discharge
13 Gear

cake / solids



Clear liquid

How does a decanter works?

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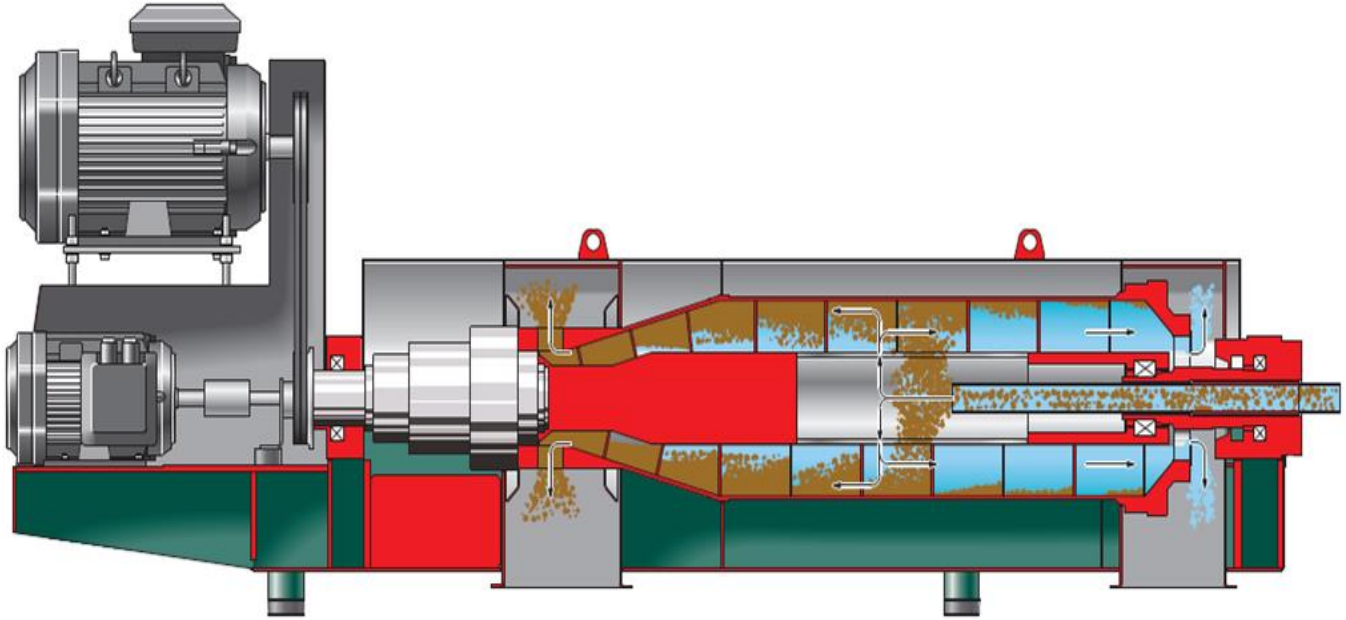
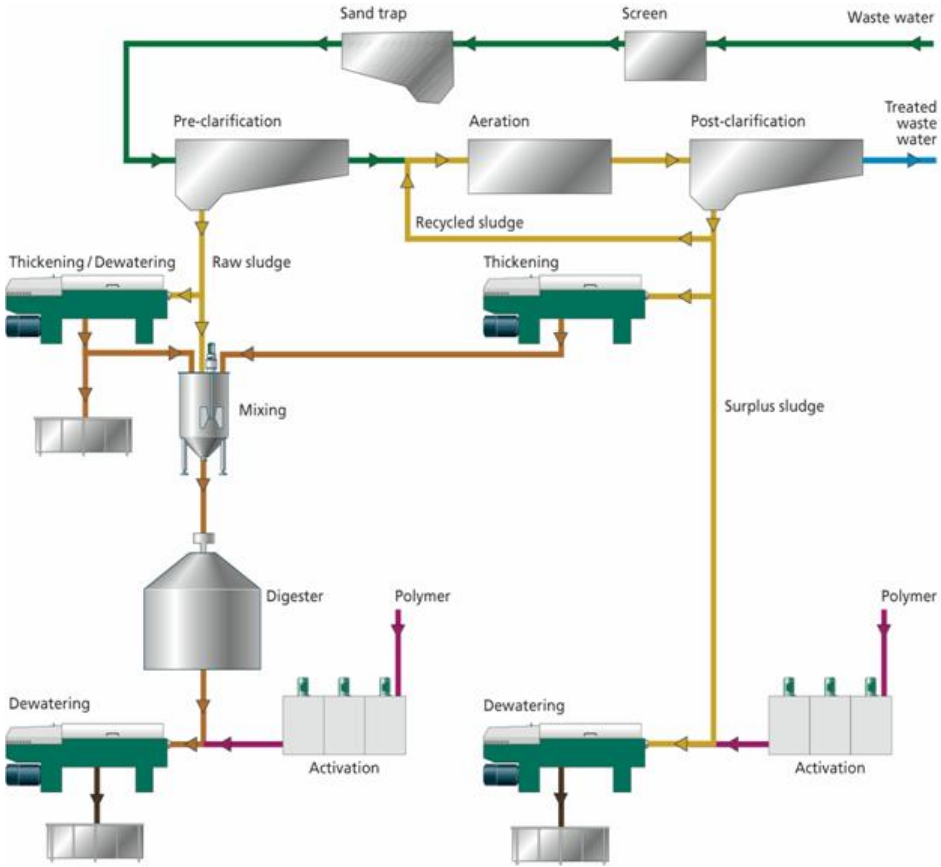
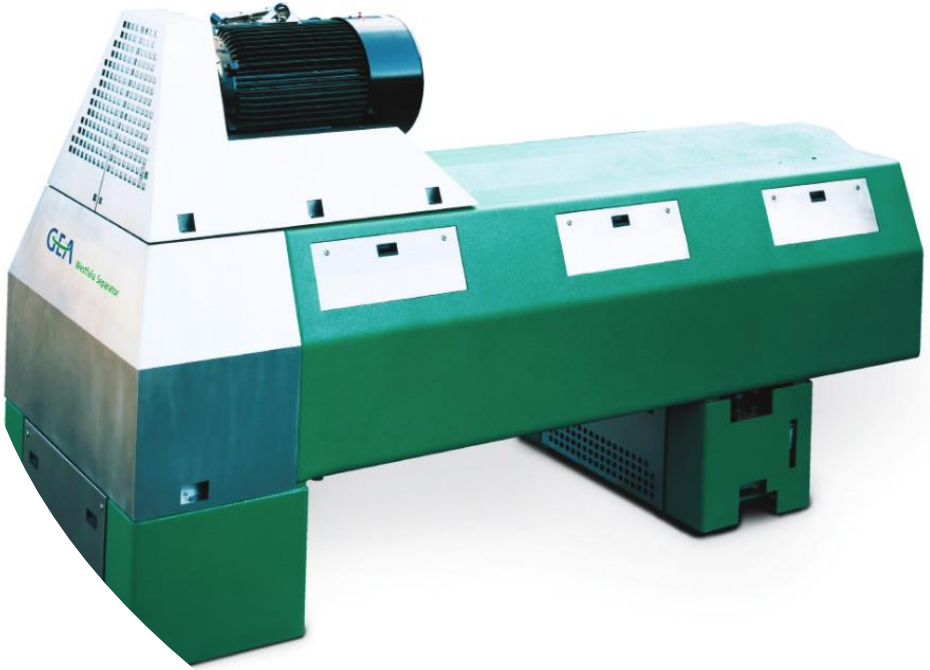
CF466 Video.mp4



Sludge Thickening and Dewatering



Thickening



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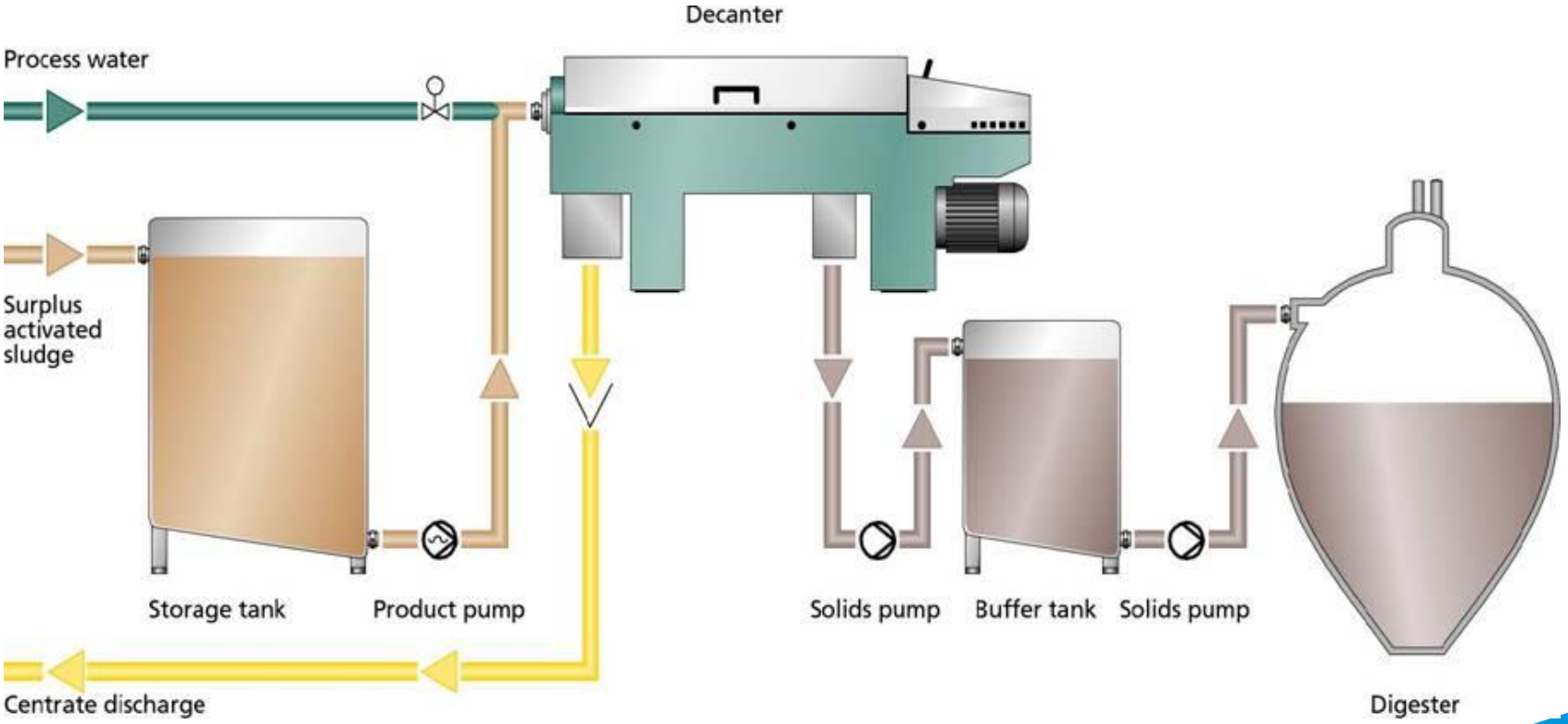
Main processes Environmental Technology

Thickening



Thickening

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Important Requirements in Sludge Thickening

1. Accuracy of pond depth (liquid level in the decanter)
2. High G-force capacity
3. High length to diameter ratio
4. Enough differential speed

GEA's Solution

1. Patented VariPond-System
2. Maximum G-force, up to 3,500 x G
3. High length to diameter ratio, 4:1 or more
4. Enough differential speed

Thickening

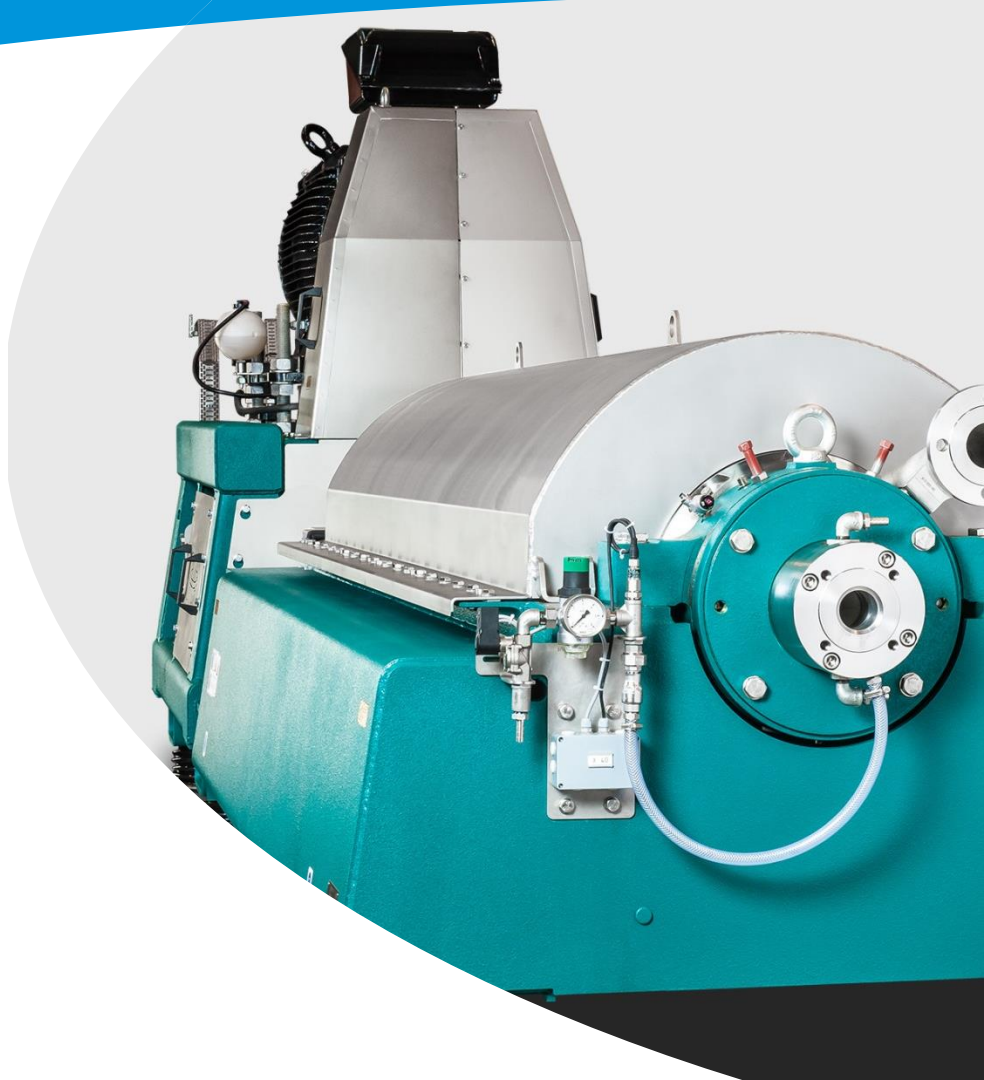
- **Feed concentration:** 0,5% - 1,0% DS
- **Thickened sludge concentration:** 5% - 7% DS
- **Polymer consumption:** 0,5 - 2,5 g/kg DS
- **Liquid phase:** < 0,1% DS
- **Separation degree:** > 90% (bei SVI < 150 ml/g)

without polymer dosage and SVi < 120 ml/g) !!!

- **Thickened sludge concentration** 5% - 7% DS
- **Liquid phase:** 0,1% - 0,2% DS
- **Abscheidung:** > 80%

GEA varipond® - Automatic Pond Depth Adjustment for Centrifuges

Fully automated control system optimizes sludge thickening and (pre-) dewatering



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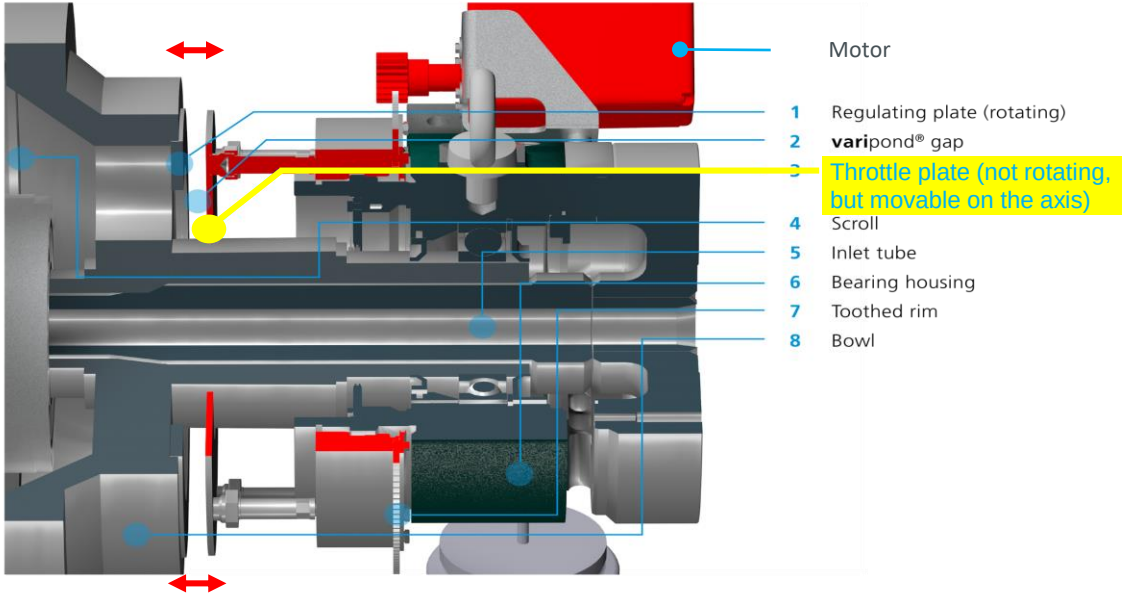
The Solution: GEA **vari**pond®

Patented control and regulating system simplifies infrastructure, guarantees a stable discharge concentration and optimizes energy consumption.

Varipond - The Principle

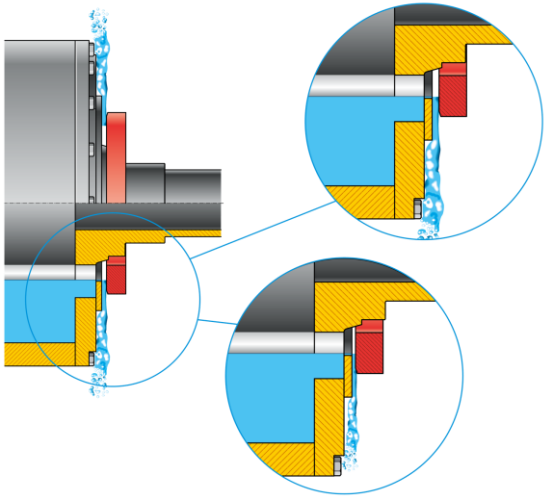
- How does GEA varipond® works?

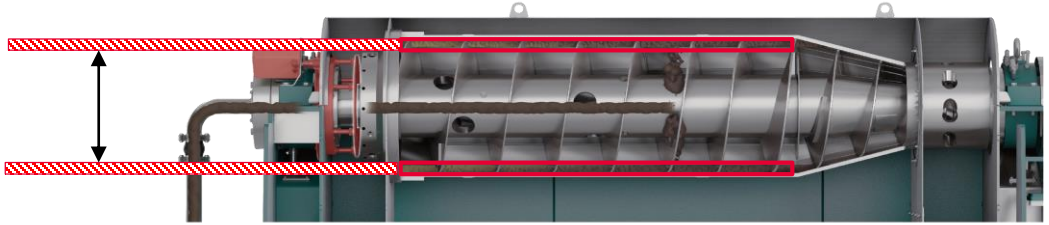
A throttle plate, which can be shifted axially by a small electrical motor, is changing the liquid sludge level inside the bowl towards its optimum position, while the machine is running.



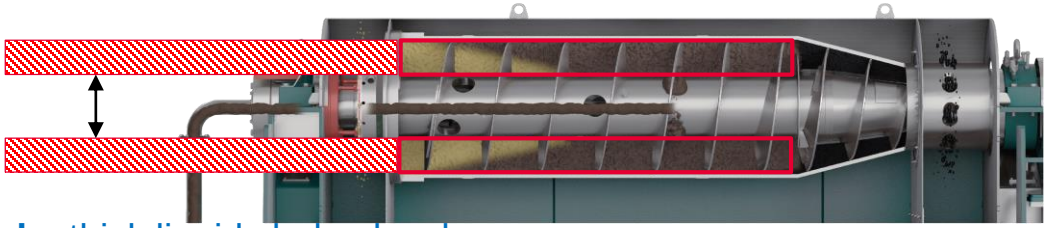
Varipond - The Principle

- Changing liquid sludge levels with a running machine without changing weir plates.





Open = thin liquid sludge level

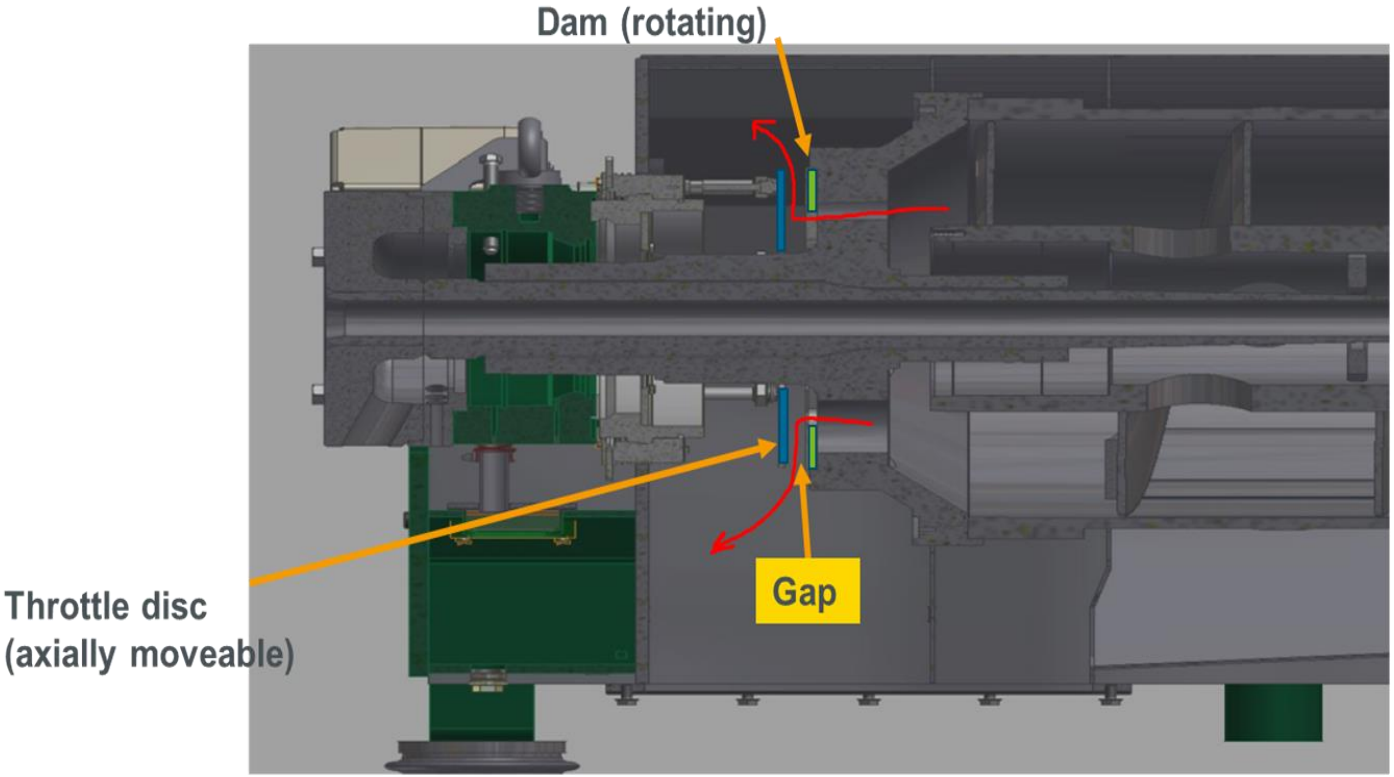


Closed = thick liquid sludge level

- Maximum flexibility for dealing with changed feed conditions
- With maximized performance
- Without any loss of uptime

GEA Separation Varipond®

GEA_Animation_varipond.mp4



Dewatering

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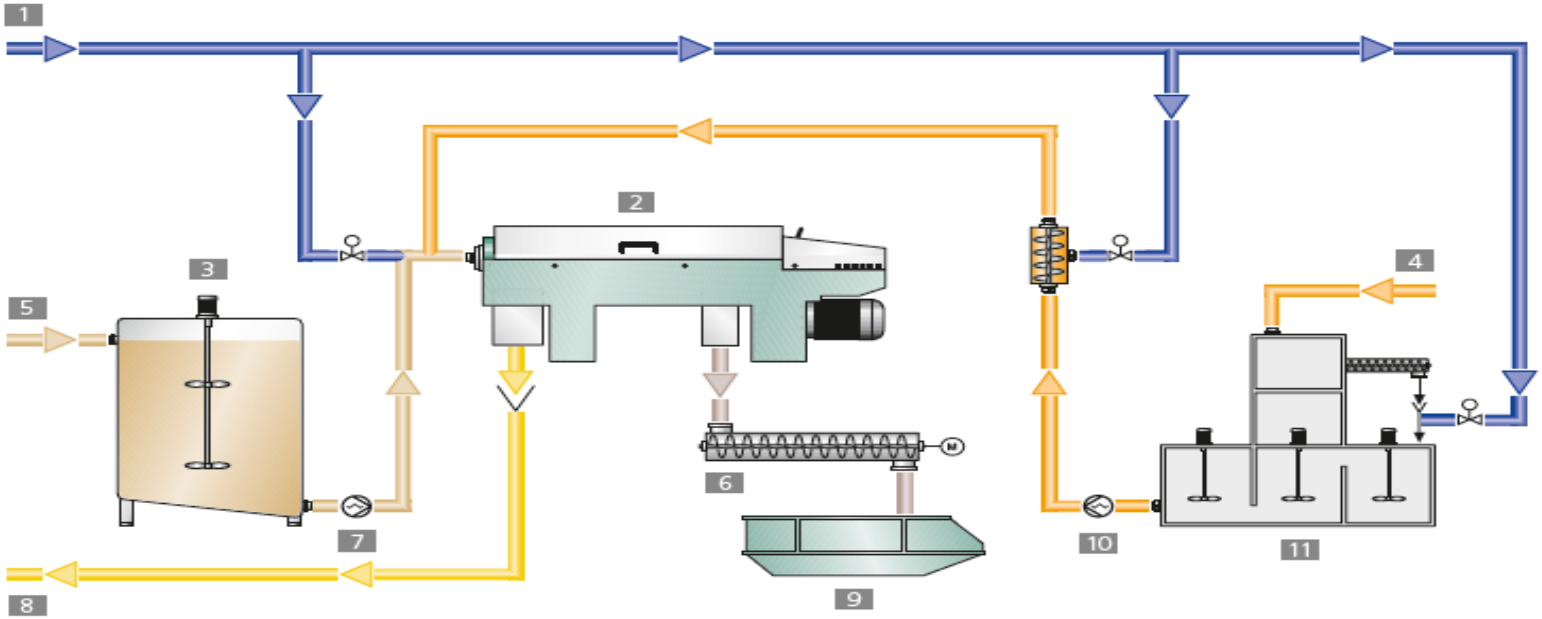
Main processes Environmental Technology

Dewatering



Dewatering

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Important Requirements in Sludge Dewatering

1. Accuracy of differential speed
2. High G-force capacity
3. High torque capacity
4. High length to diameter ratio

GEA's Solution

1. Summation Drive System, Scroll adjustment accuracy 0.05 rpm
2. Maximum G-force, up to 4,500 x G
3. High Torque Capacity through our Summation Drive System
4. High length to diameter ratio, 4:1 or more

Dewatering

- **Feed concentration:** **2% - 4% DS**
- **Dewatered sludge concentration:** **22% - 28% DS**
- **Polymer consumption:** **6 - 10 g/kg DS**
- **Liquid phase:** **< 0,1% DS**
- **Separation degree:** **> 95%**

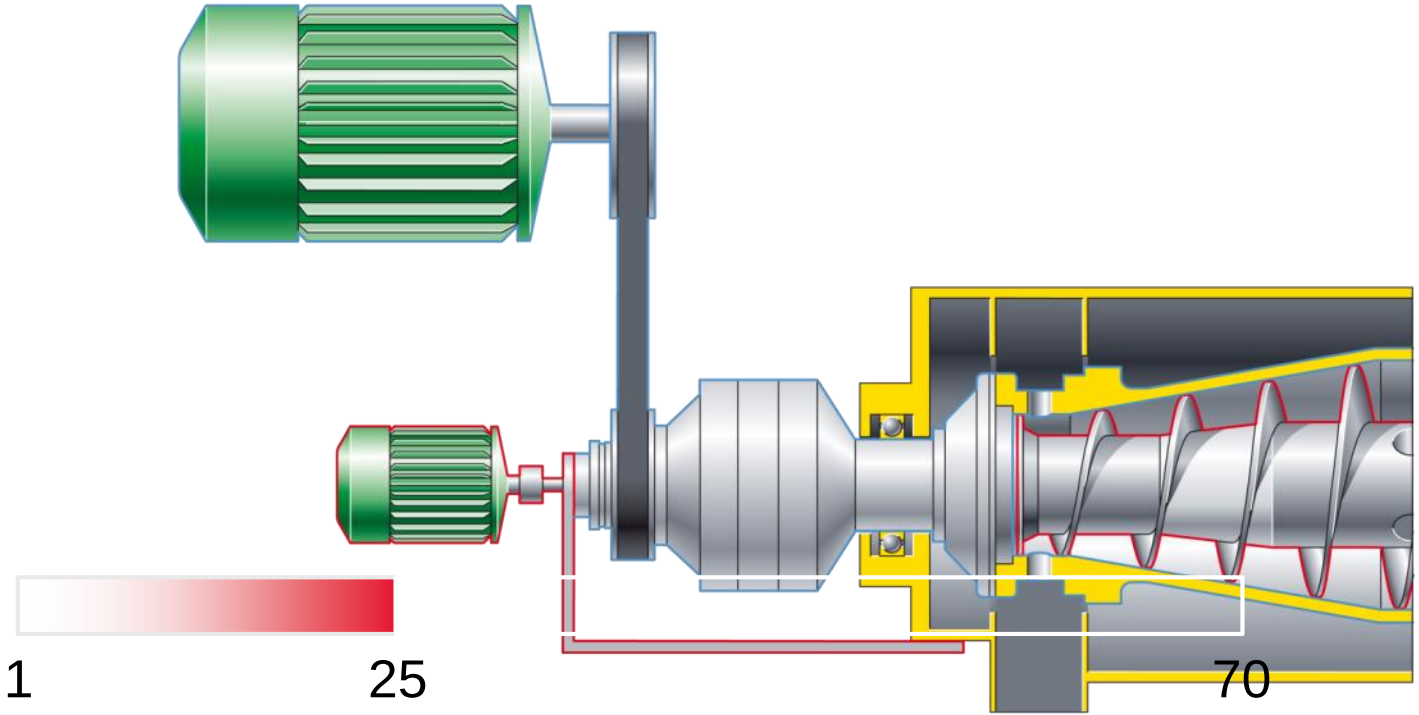
What does high performance mean to you?

- maximum throughput capacity
- maximum separation efficiency
- maximum cake dryness
- Minimum electrical power
- Minimum polymer consumption

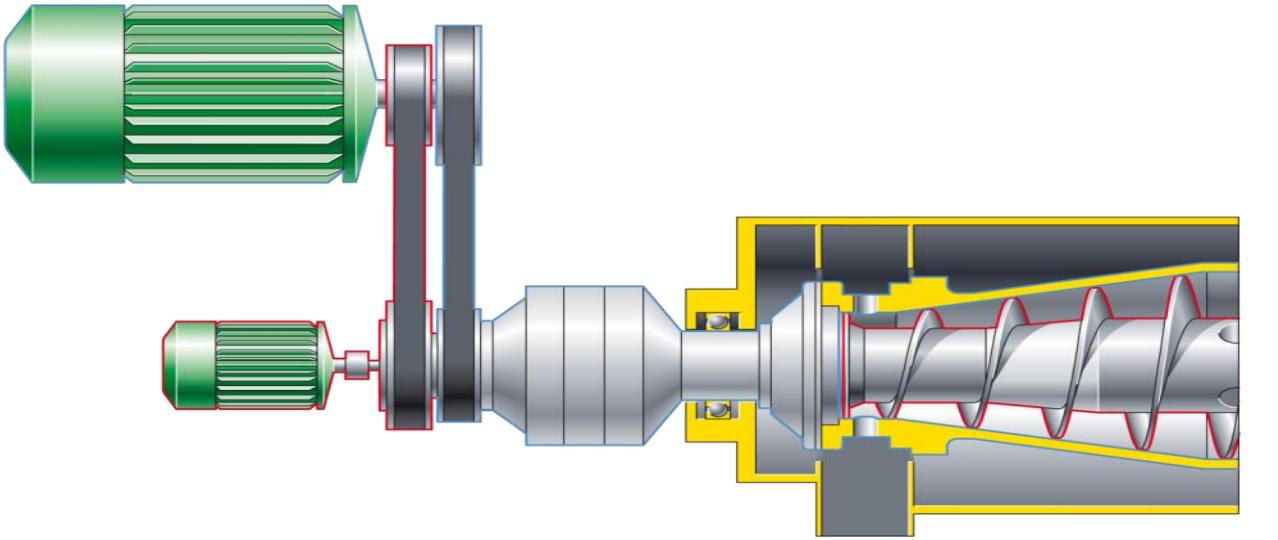
what is new?-summationdrive

- GEA Westfalia Separator ® summationdrive
- Consistent design with modular concept
- Service concepts for committed availability

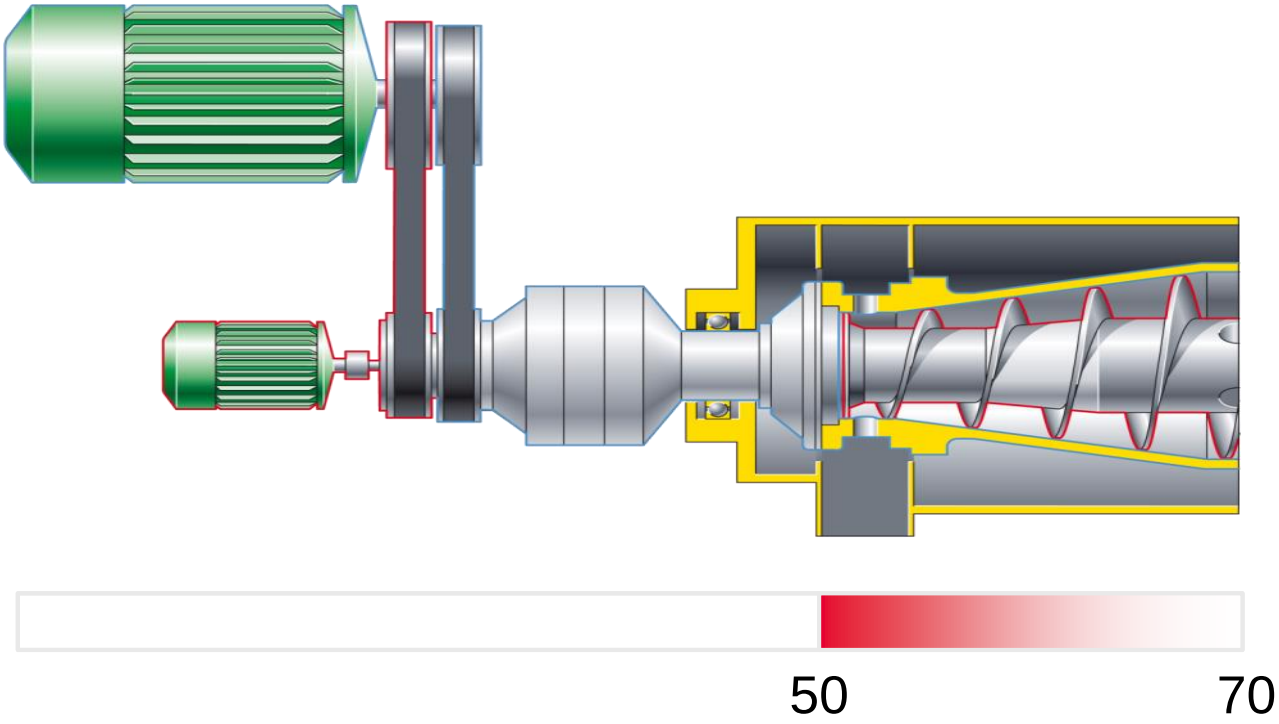
Low differential speed: configuration with torque plate



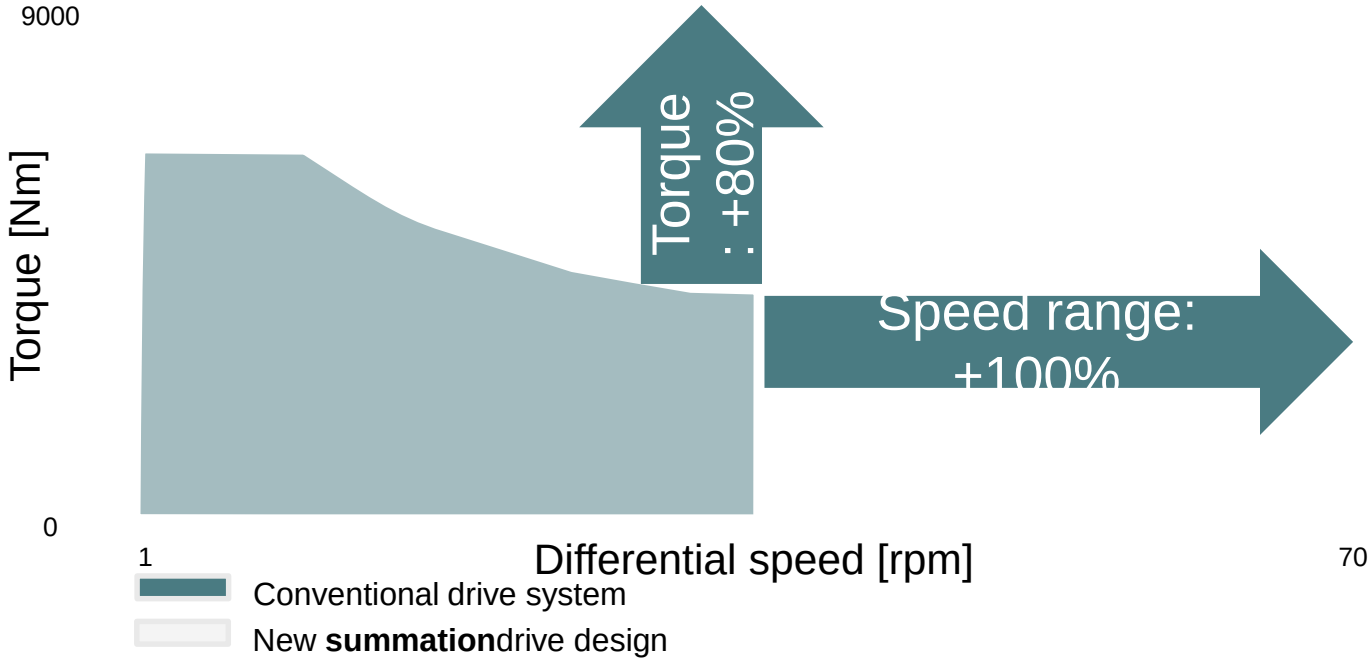
Medium and high differential speed: configuration with pulleys



Medium and high differential speed: configuration with pulleys



New Summationdrive
- constant torque and higher differential speed

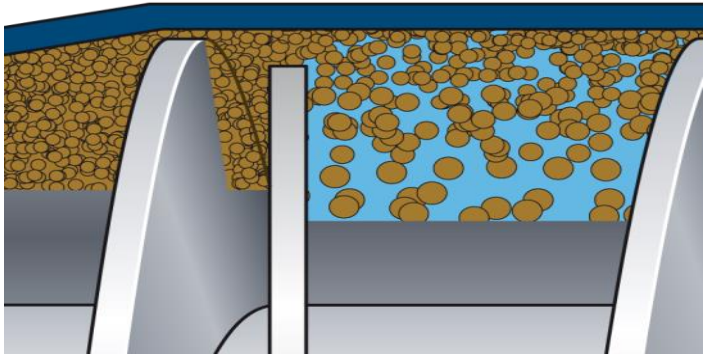


GEA Westfalia Separator® summationdrive - Overview

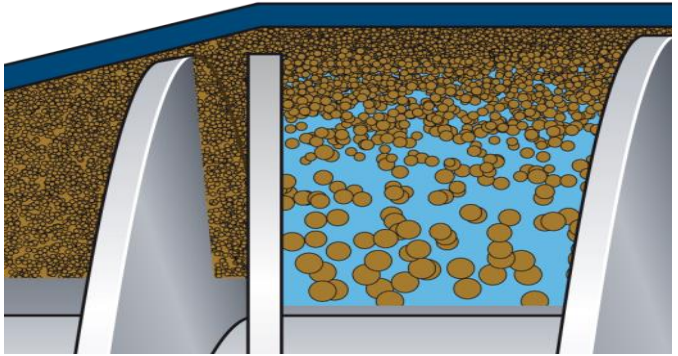
- One Drive Concept for all applications
- and all CF decanters
- Full torque within the whole differential speed range
- Very wide control range for the differential speed
- No energy circulation, power is only fed into the system
- Gearbox makes a summation of the power from each motor and transfers it to bowl and scroll (origin of the name)
- Designed, tested and manufactured by GEA Westfalia Separator

Your Performance

- Maximum separation efficiency
  - Deep pond*
    - the deeper the pond the higher the pressure at the bowl shell onto the separated solids and the smaller the particles that can be separated



Shallow pond

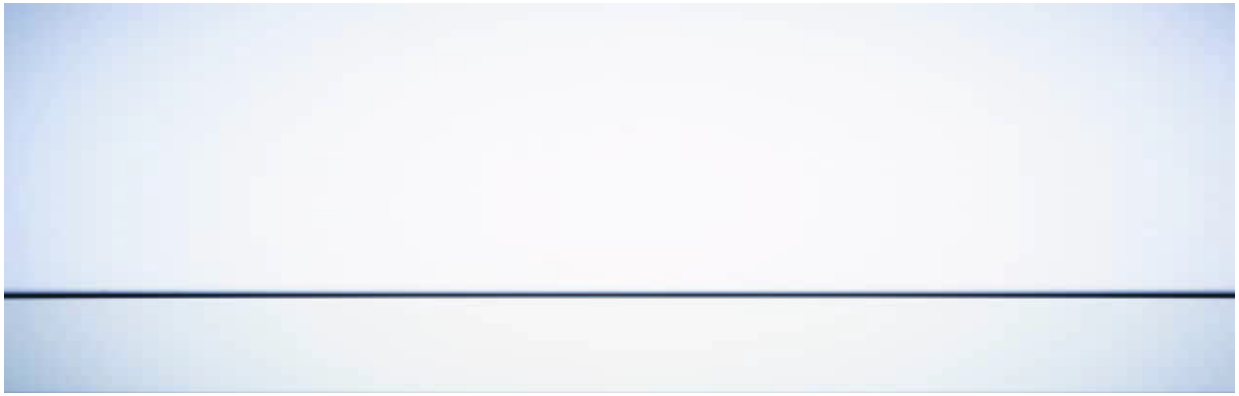


Deep pond

* pond depth is dependent on application, for e.g. dewatering purposes or classification bowls in shallow pond design have to be used

Your Performance

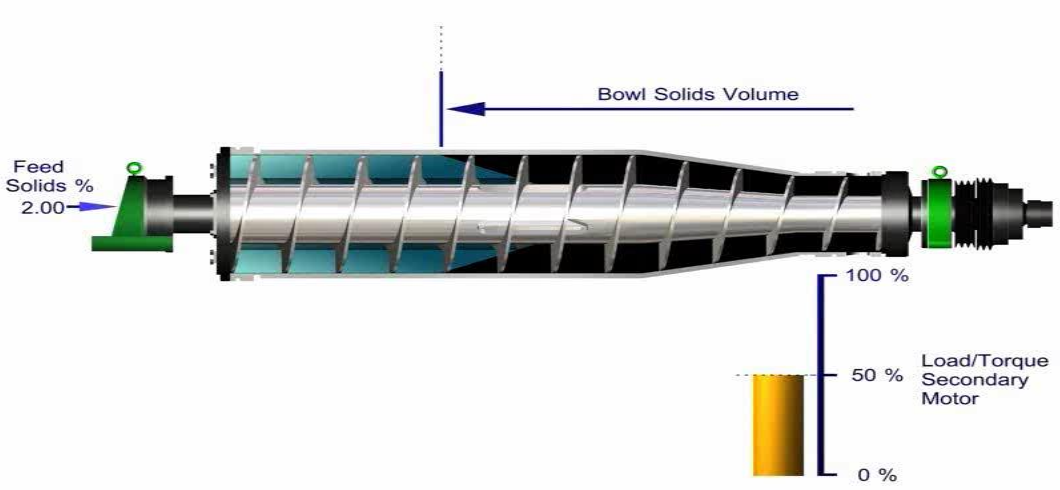
- Maximum separation efficiency
  - Deep pond*
    - the deeper the pond the less turbulence in the bowl the better the separation efficiency



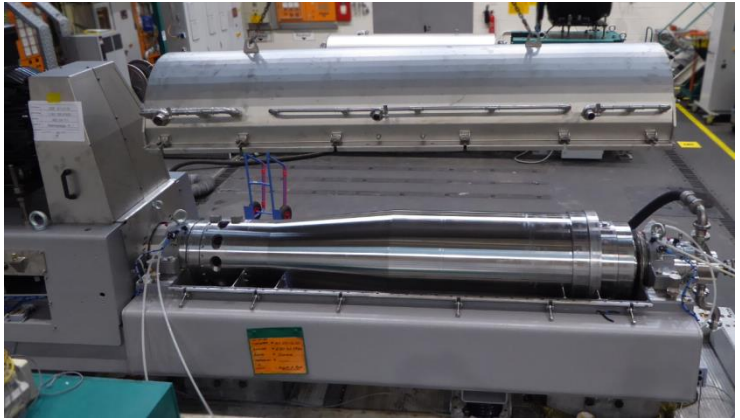
* pond depth is dependent on application, for e.g. dewatering purposes or classification bowls in shallow pond design have to be used

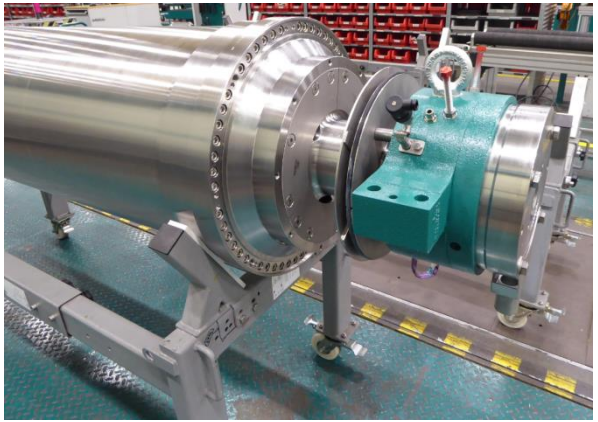
Your Performance

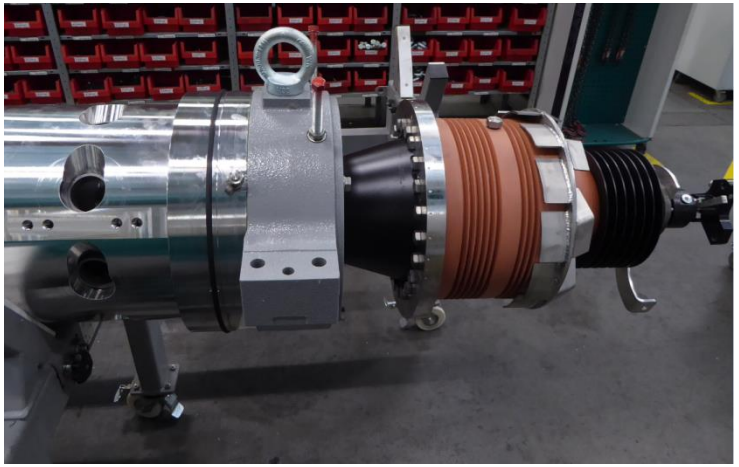
- Maximum separation efficiency
  - Westfalia Separator® summationdrive
    - Automatic control to always have optimal torque and differential speed independent of feed conditions

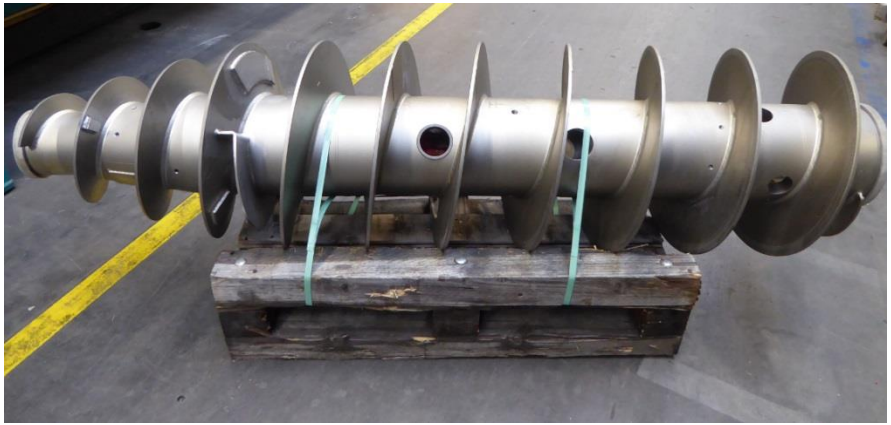


Production Niederahr - waterMaster CF6000









Decanter scroll – wear protection - welding

Decanter scroll – wear protection - TILES

CERAMETAL GROUP
UNITED HARDMETAL

CERATIZIT

CERATIZIT Horb GmbH - Postfach 1205 - 72152 Horb

Werksbescheinigung
(DIN EN 10024 - 2.1)

Nr. : 542068-0020-006
Datum : 01.04.03
Kunde : GEA Westfalia Separator Industry GmbH
Bestell-Nr.:

Bestell- : datum

Department: Tel: 07451/522-306
Abteilung: WT H.Westermann

Produkt/ product: VHM Verschleißsegment / Tile	Abmessung/Dimension: 40 * 25/22,5 * 5,5 mm
Artikel-Nr./Part No.	8177-1079-140
HM-Sorte/Carbide grade	KR16 Sinter-Hip
Vickershärte/Hardness (HV10)	1600 ± 60
Porosität/Porosity (ISO)	max. A02 B02 C02 Keine Eta-Phase
Dichte/Density (g/cm^3)	14.40 ± 0.05
ASTM G65 Trockentest/drytest	< 2,0 mm^3
ASTM B611 Nasstest/wet test Verschleißwiderstand/ abrasion resistance	< 1,9

Bemerkungen/Remarks:
Diese Werte gelten für alle aus diesem Material gefertigten Chargen und Teile.

These values are valid for all parts and lots made from the carbide grade KR16.

Es wird bestätigt, daß die Lieferung geprüft wurde und den Vereinbarungen bei der Bestellannahme entspricht.
We confirm, that the delivery agree with the above mentioned specification

Heinz Westermann

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GEA Automation Concept

Control cabinet - compact

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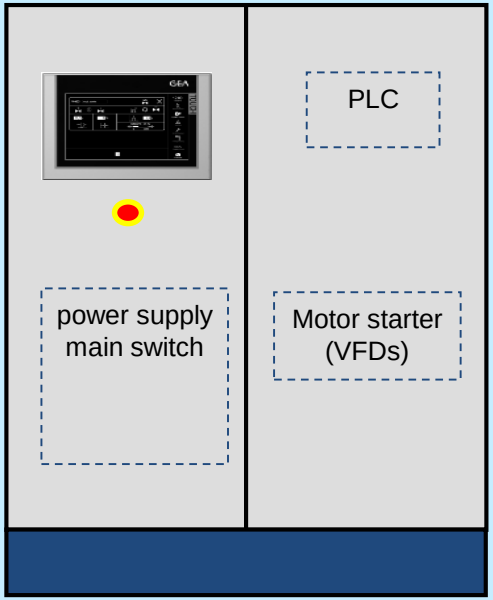
GEA IO 9

PLC SIEMENS

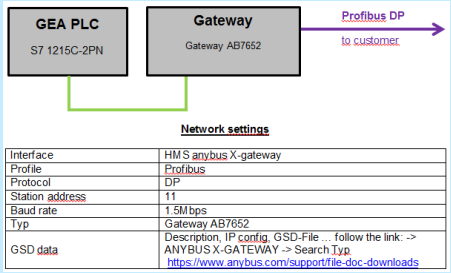
All functions of the centrifuge can be controlled and monitored

Compact control cabinet



PROFIBUS

Connection to the customer



Network settings

Interface	HMS anybus X-gateway
Profile	Profibus
Protocol	DP
Station address	11
Baud rate	1.5Mbps
Typ	Gateway AB7652
GSD data	Description, IP config, GSD-File … follow the link: -> ANYBUS X-GATEWAY -> Search Typ https://www.anybus.com/support/file-doc-downloads

VFD´s

DANFOSS FC 300 SERIES

variable speed control

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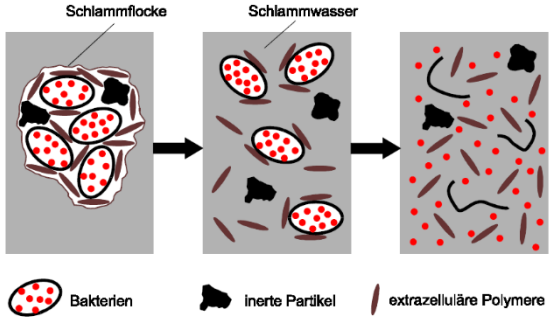
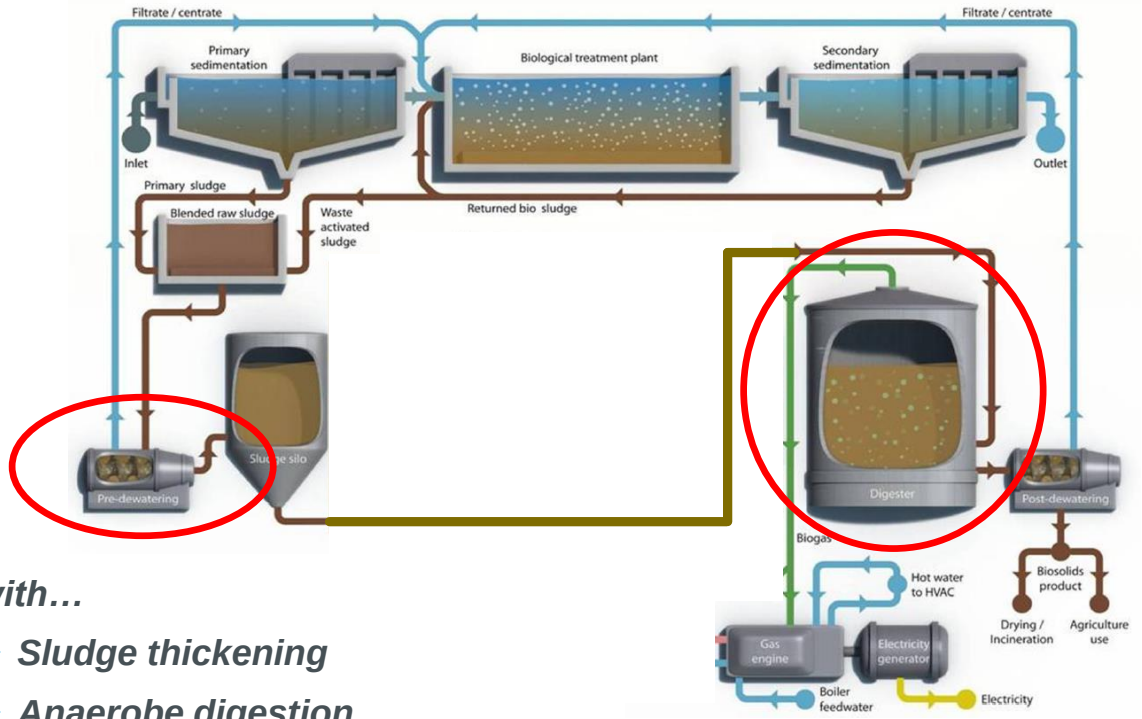


Decanter in THP process

Thermal Hydrolysis with CAMBI
CAMBI Process

At first… WWTP Process as usual…

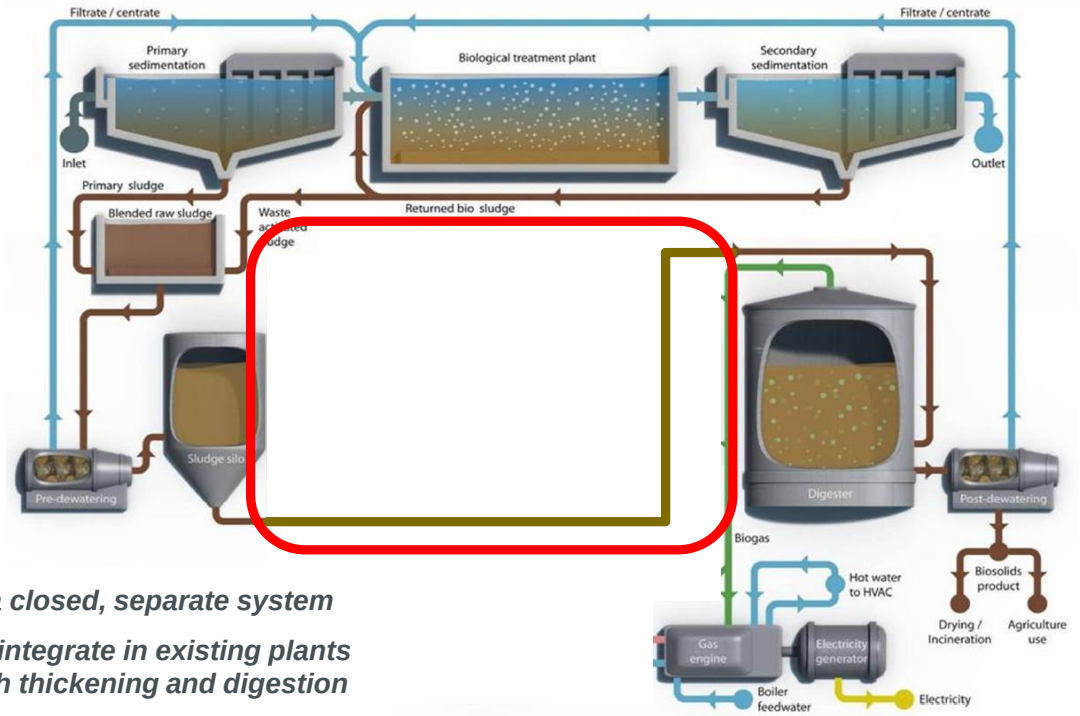


with…

- ***Sludge thickening***
- ***Anaerobe digestion***

Thermal Hydrolysis with CAMBI
CAMBI Process

And now… The “CAMBI-Box”



- ***Is a closed, separate system***
- ***To integrate in existing plants with thickening and digestion***
- ***… and also for new plants***

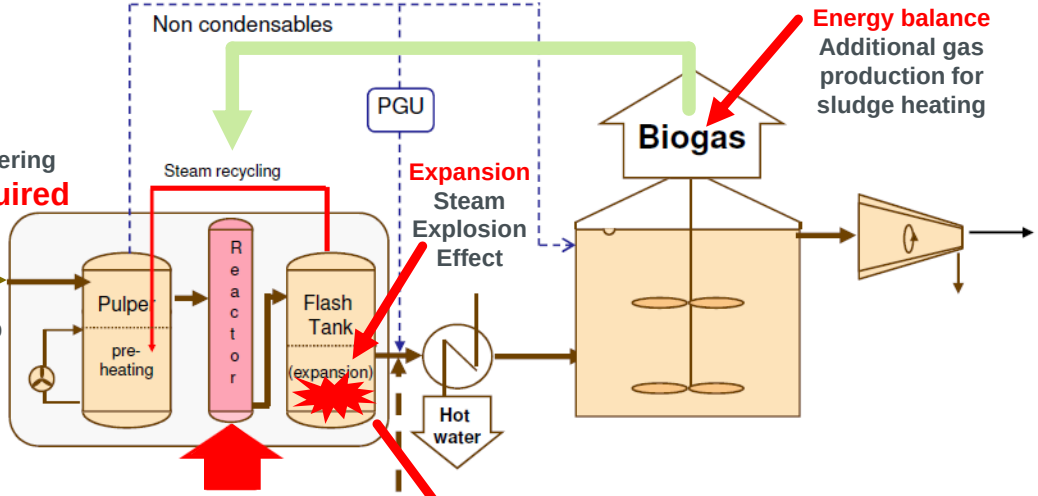
Thermal Hydrolysis with CAMBI
CAMBI Process

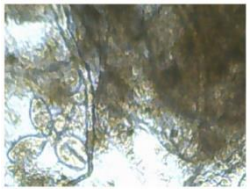
Details

- Sludge from Pre-dewatering
- **Stable solids required**
  TS = (16…18)%

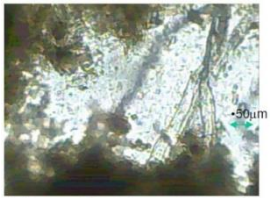
Higher => difficult to pump

Less => not efficient because too much energy is needed to heating up additional water in the CAMBI process

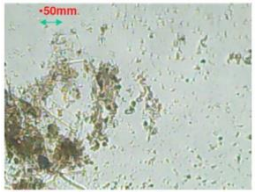




Mixed sludge



Thermal treatment (165°C)



Thermal hydrolysis + steam explosion

Thermal Hydrolysis with CAMBI
Cambi Process – Influences to process performance

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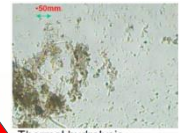
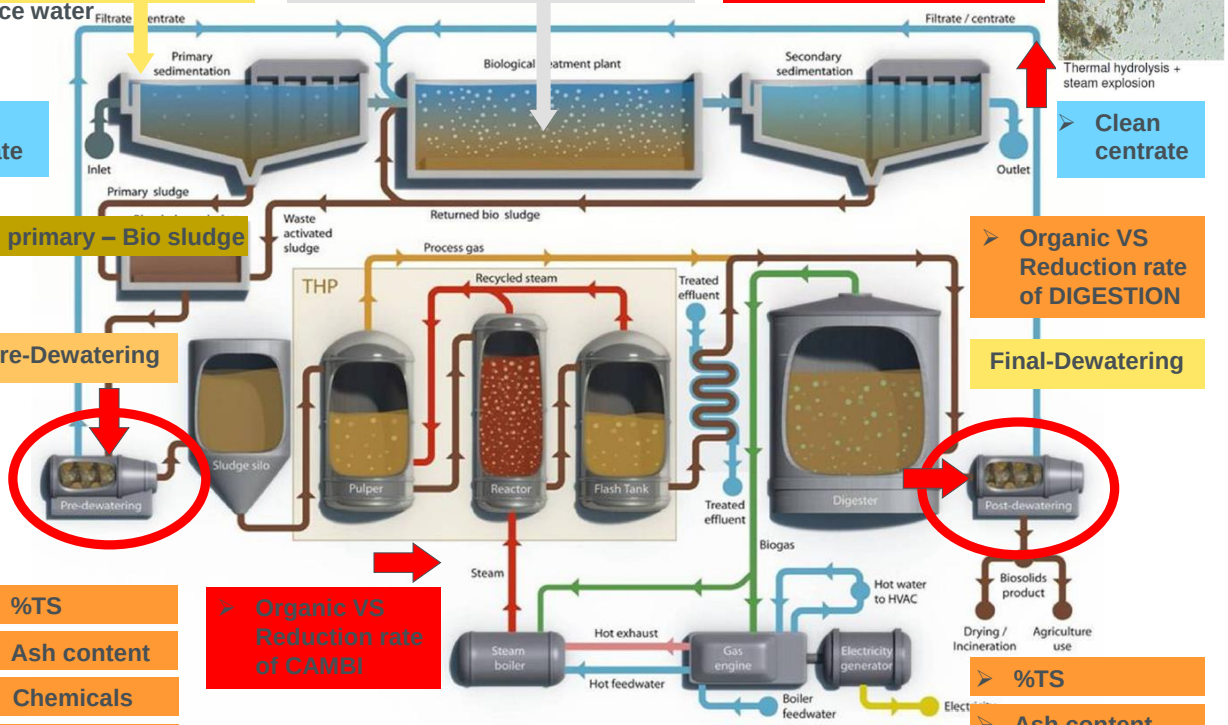
- Composition: e.g. industrial dischargers, surface water
- Type and variation of biological treatment, e.g. used chemicals
- Recirculation of fine particles! Especially CAMBI



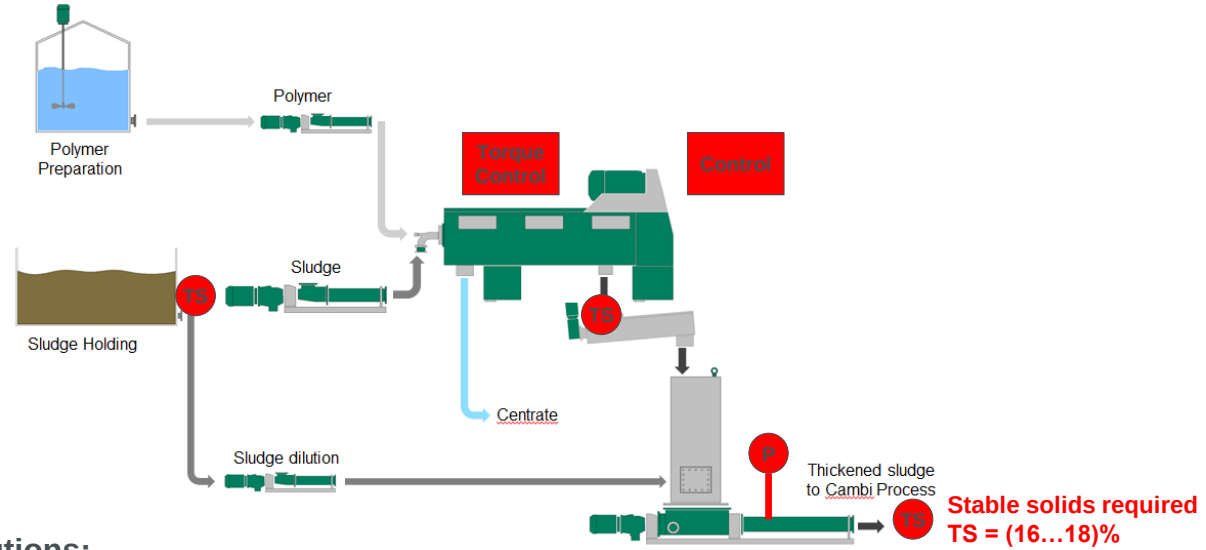
- Clean centrate
- Clean centrate
- Ratio primary – Bio sludge
- Organic VS Reduction rate of DIGESTION
- Pre-Dewatering
- Final-Dewatering



- %TS
- Ash content
- Chemicals
- Oil & fats
- Organic VS Reduction rate of CAMBI
- %TS
- Ash content

Separation Technology in CAMBI
Pre-dewatering

Sludge mixing systems

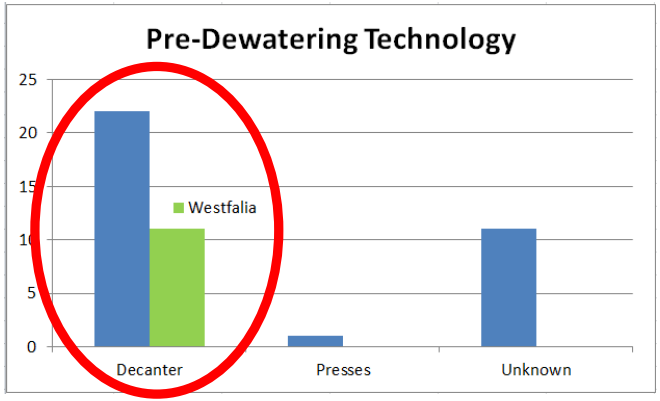


Solutions:

- Stable solids by control calculation of mixing %TS feed, load of the decanter and %TS solids
- Controled by thickened sludge pump pressure
- **Possible development**: Direct controlled stable (16…18)% by decanter torque control system

Separation Technology in CAMBI
Pre-dewatering

Most common application with decanter technology!

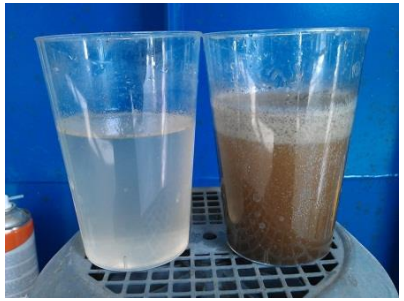


- Decanters can handle variation of sludge concentrations in feed by stable solids %TS
- Very less polymer consumption **=> normal range (2…6) kg/tTS**
- High capture rate – very clean centrate quality **> 98%**
- Exact adjustment to **stable (16…18)% TS** with different ways:
  1. VARIPOND system (Westfalia)
  2. Control adjustment by torque or differential speed set points
  3. Sludge mixing systems

Separation Technology in CAMBI

Westfalia decanter in CAMBI – Project Fredericia / Denmark

Pre-Dewatering



Poly: (2…3) kg/tTS

Recovery: Total clean centrate

Final-Dewatering

Poly: (12…16) kg/tTS

Recovery: (96…98)%

Soldis: (26…31)%

Final Dewatering

Analysen		Rohprobe Raw sample	Klarphase Clear phase
TR DS	% w/w	4,2	0,90
gel. Stoffe Dissolved substance	%		0,84

References Ukraine

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References in Ukraine

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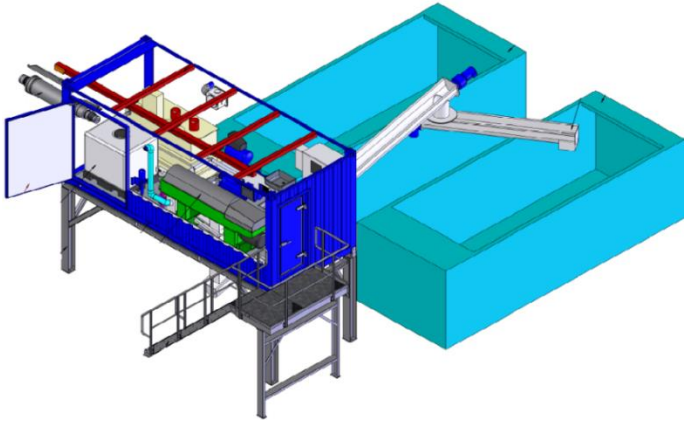
Country	Year	Qty.	Type of Machine	Customer	Application
Ukraine	1999	1	CA 220-00-00	Cargill, Donezk	industrial wastewater
Ukraine	1999	1	CA 220-00-00	Cargill, Donezk	industrial wastewater
Ukraine	2000	1	OSC 4-91-006	JSC Kreativ, Kirovograd	industrial wastewater
Ukraine	2003	1	AD2040	WWTP Charkov	municipal wastewater
Ukraine	2003	1	AD2040	WWTP Charkov	municipal wastewater
Ukraine	2003	1	AD2040	WWTP Charkov	municipal wastewater
Ukraine	2007	1	UCA 501-00-02	JSC Enzym, Lviv	wastewater
Ukraine	2007	1	UCD 305-00-02	Slavitech	bio. excess sludge dewatering
Ukraine	2008	1	UCD 345-00-02	ENVIRO	industrial wastewater
Ukraine	2008	1	UCD 305-00-32	Westa-Dnepr, Dniepropetrovsk	industrial wastewater
Ukraine	2008	1	UCD 305-00-02	CJSC Kraft Foods Ukraina	industrial wastewater
Ukraine	2009	1	UCD 305-00-02/32	WESTA, DNEPROPETROVSK	industrial wastewater
Ukraine	2009	1	UCD 305-00-02/32	WESTA, DNEPROPETROVSK	industrial wastewater
Ukraine	2009	1	UCD 305-00-02/32	Coca Cola Kiev	aerob stabilised sludge
Ukraine	2009	1	UCD 205-00-02/32	INTERLABTRADE LLC, Kiev	wastewater
Ukraine	2009	1	UCD 345-00-02	STOV Zavidivske	wastewater
Ukraine	2011	1	UCD 346-00-32	LLC Chipsy Lyuks	potato wash water
Ukraine	2011	1	UCD 305-00-32	Dnepropetrovsk Food	coffee wastewater
Ukraine	2011	1	UCD 305-00-32	SPR Group, Baryspol	municipal wastewater
Ukraine	2011	1	UCD 305-00-32	SPR Group, Baryspol	municipal wastewater
Ukraine	2011	1	UCD 346-00-32	LLC Chipsy Lyuks	potato wash water
Ukraine	2011	1	UCD 305-00-32	Dnepropetrovsk Food	coffee wastewater
Ukraine	2011	1	UCD 345-00-32	Myronivsky Hliboproduct (MHP)	bio excess sluge
Ukraine	2014	1	UCD 305-00-32	DE GEA WS Ukraine	municipal wastewater

Municipal Waste Water Treatment

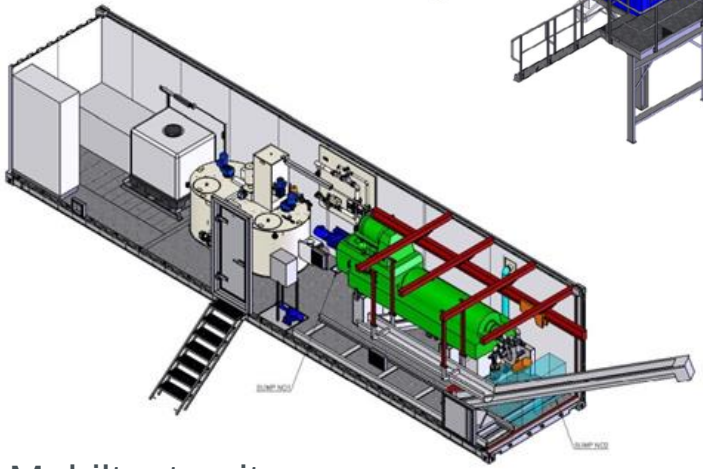
- Cooperation and partnership with reputable big companies and municipal corporations

- Specialist for large Projects
  - Changi Singapore
  - Thames Water London (UK) Crossness and Beckton
- New Trends
  - Thermal Hydrolysis Process

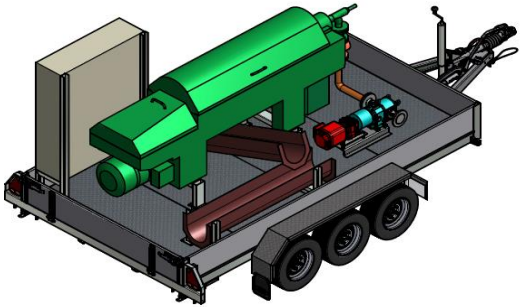
Skids, container units and mobile trailers



Excess sludge
Dewatering unit
UCD 346



Mobiltest unit
waterMaster e CF4000



Manure trailer
UCD 305

Mobile Anlage UCF 466

Mobile Anlage UCF 466

Car Trailer UCD 305

Car Trailer UCD 305

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