Flottweg
Separation Technology

Flottweg
Separation Technology

Centrifuges for Dewatering and Thickening

Annual Class III & IV Workshop for
Water & Wastewater Operators
July 25 & 26, 2018

Environmental
Since OTCO 1964
Training Center

Dewatering

Thickening

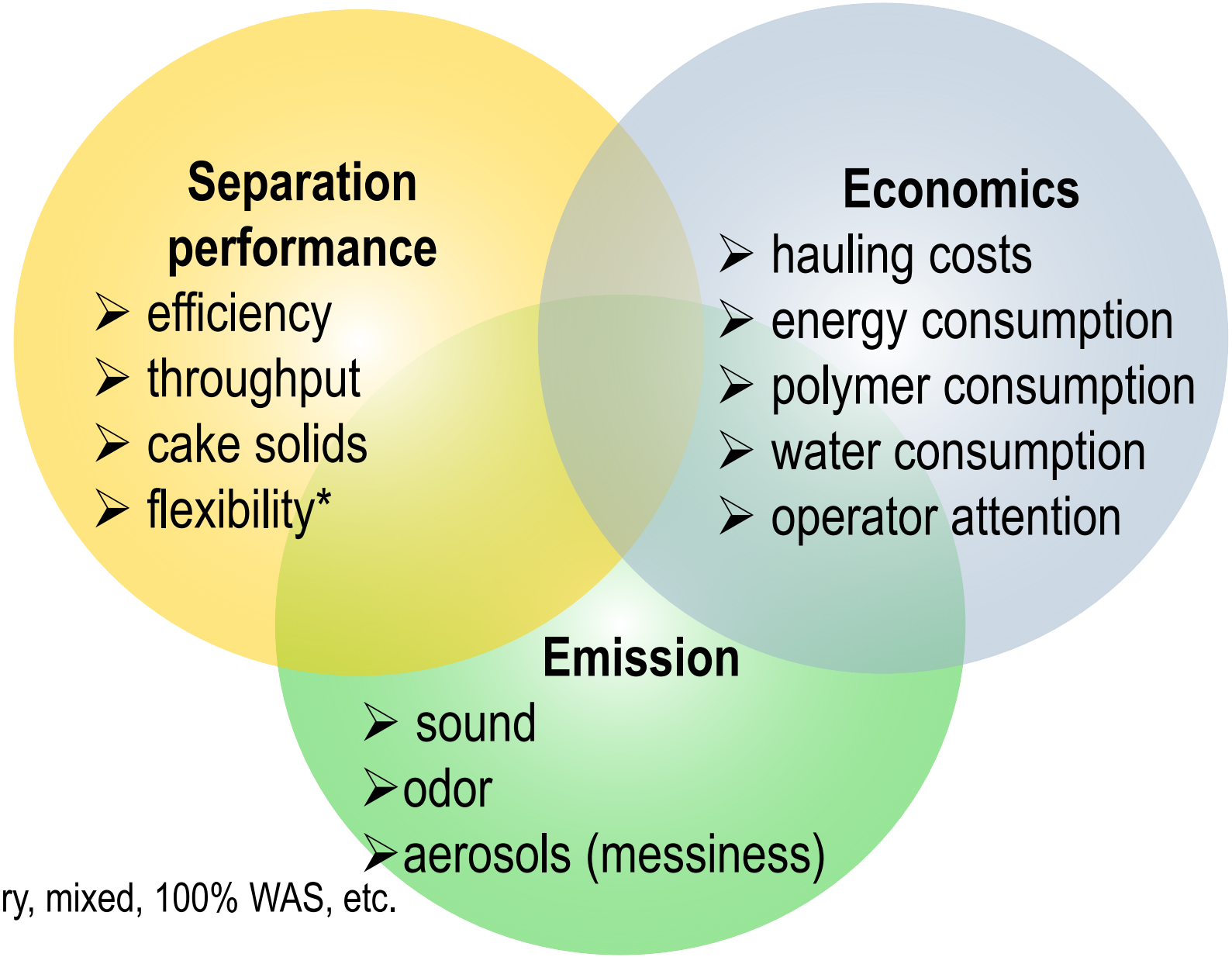
Features & Benefits

Example Installations

Questions

Sludge Dewatering

Important Parameters



*primary, mixed, 100% WAS, etc.

Cost of Treatment

Items to Consider

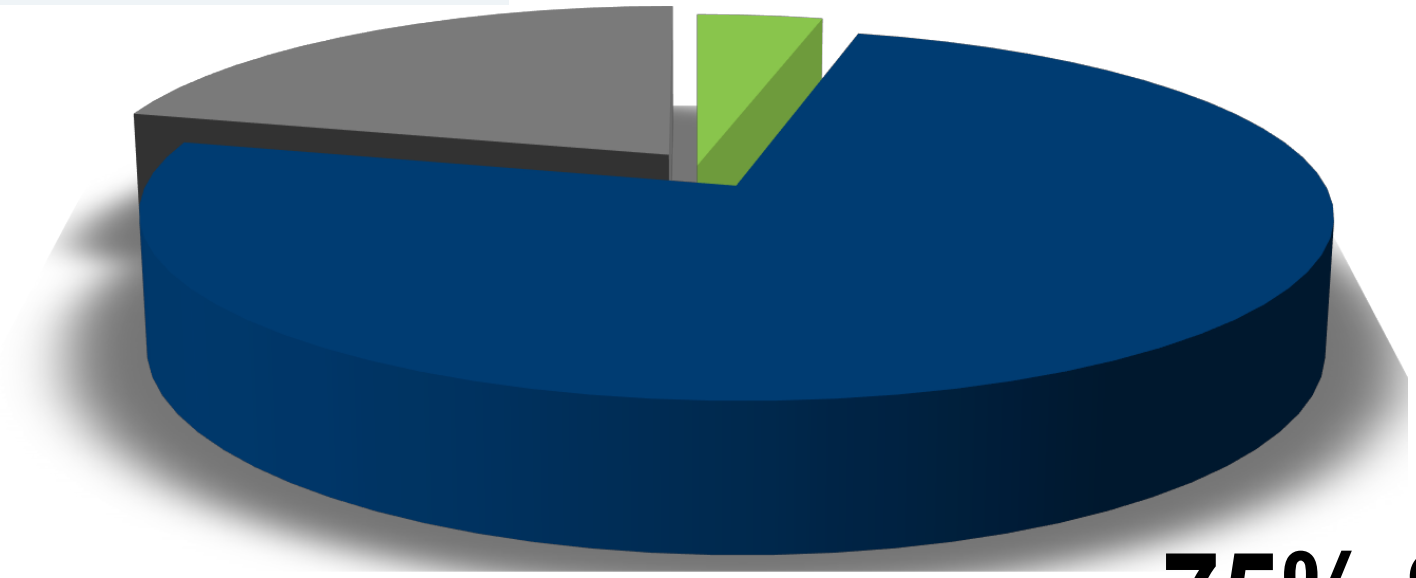
21% POLYMER COSTS

$3.00 / lb active substance

($1.20 / lb neat, 40% activity)

4% POWER COSTS

$0.06 - $0.12 / kWh



75% SLUDGE DISPOSAL COSTS

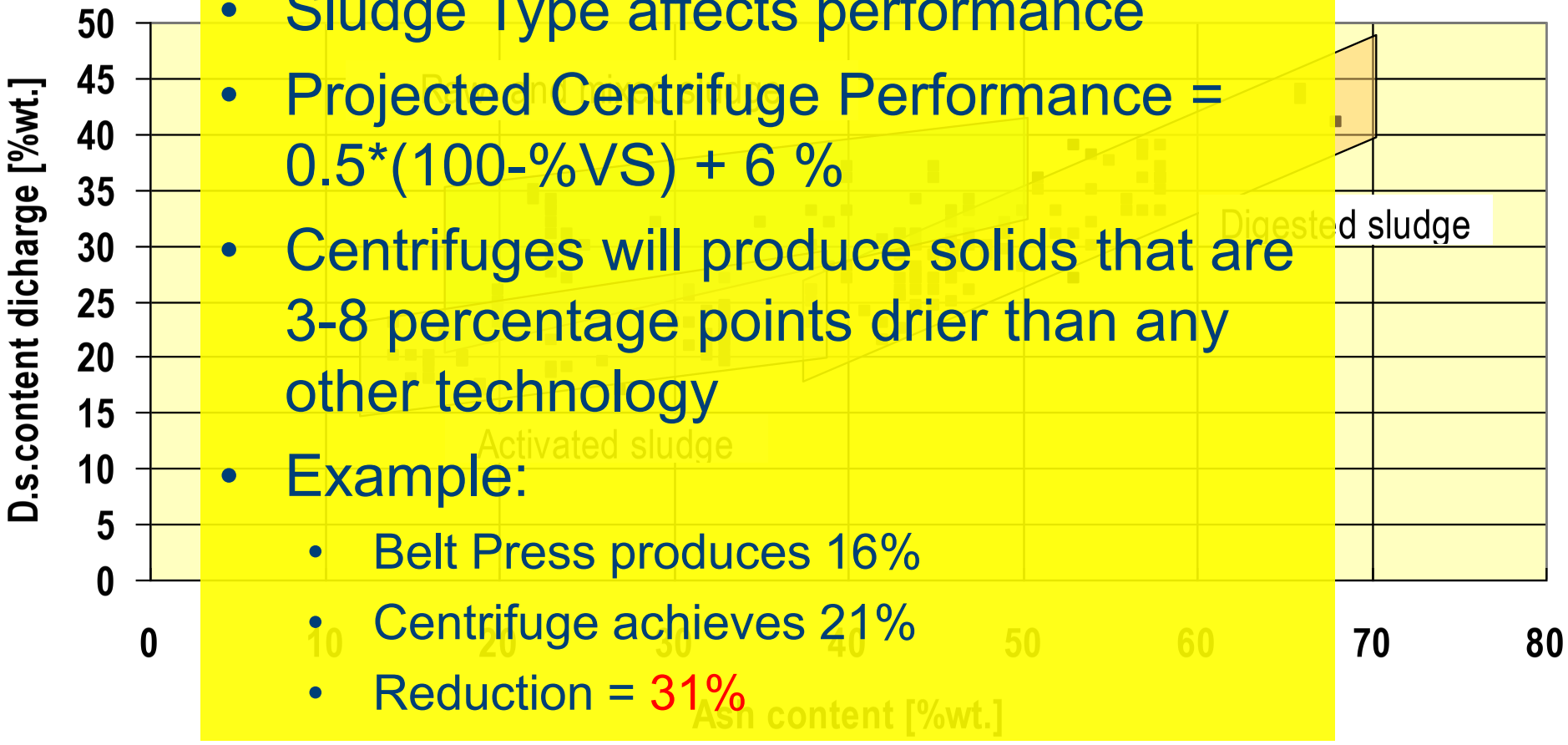
~$52.00+ / ton solids

Performance
Process
Typical performance on different types of sludges

Type of Sludge	Feed Solids (%)	Polymer (kg/Tonne dry solids)	Cake (% TS)
Primary, Undigested	4-8	2-15	25-40
WAS, Undigested	1-4	7-15	16-25
Primary + WAS, Undigested	2-4	2-8	25-35
Primary + WAS, aerobic digested	1.5-3	7-15	16-25
Primary + WAS, Anaerobic digested	2-4	7-15	22-32
Primary Anaerobic Digested	2-4	4-6	25-35
WAS aerobic digested	1-4	10	18-21
Hi-temp Aerobic	4-6	10-20	20-25
Hi-temp Anaerobic	3-6	10-20	22-28
Lime Stabilized	4-6	7-12	20-28

Performance
Typical Performance Figures

Sludge Type	A Feed Solids Conc. %	B Cake % Solids	C ppm Centrate	Solids Capture Efficiency	Polymer Dose Kg/T (active)
Alum (low NTU raw water)	1 - 6	10-15	200-1000	Up to 99.9%	2 – 4
Alum (high NTU raw water)	1 - 6	20-25	50-1000	Up to 99.9%	1 – 2
Ferric and Lime treated	1 - 6	25-35	50-500	Up to 99.9%	1 – 2
Lime softening	3 - 10	50-60	100-1000	Up to 99.9%	0 – 1
Ferric hydroxide	1 - 6	15-25	100-1000	Up to 99.9%	1 - 3



WHAT DOES THIS REALLY MEAN?

- Sludge Type affects performance
- Projected Centrifuge Performance = 0.5*(100-%VS) + 6 %
- Centrifuges will produce solids that are 3-8 percentage points drier than any other technology
- Example:
  - Belt Press produces 16%
  - Centrifuge achieves 21%
  - Reduction = 31%

Advantages – Dewatering

Centrifuge vs. Other Technologies

	Centrifuge	Belt Press	Fan Press	Screw Press
Continuous Operation	++	0	+	+
Unsupervised Operation	++	--	--	+
Odor Emission	++	--	0	++
High Dry Solids	++	0	0	0
Varying Sludge Properties	++	+	0	+
Hydraulic Capacity	+	+	-	--
Footprint	++	0	-	0
Installed Power	0	+	++	++
Polymer Consumption	0	+	-	--
Water Consumption	++	-	-	-
Manpower	+	-	-	+
Service Interval	++	+	+	++
Maintenance Costs	$	$$	$	$
Capital Investment	$$	$	$$$	$$

Sedimentation Pool

Sedimentation by Gravity

Clarification Area = Pool Surface:

$$A = l \cdot w,$$

A: Surface, l: Length, w: Width

Driving Force f = Gravity = 1 x g

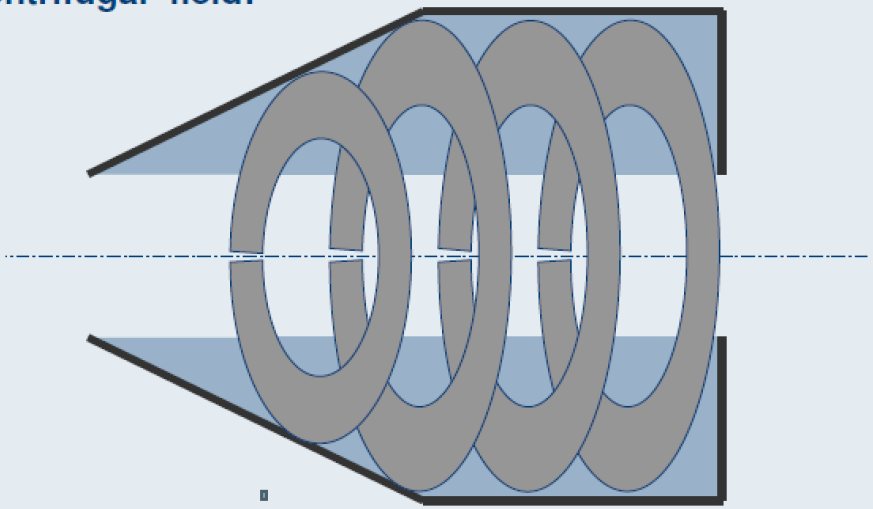
Equivalent Clarification Area Σ = Driving Force f x Surface A

$$\Sigma = f \cdot A = l \cdot w$$

Centrifuge

Basics

Continuously operating settling tank in the centrifugal field:



New Design Features

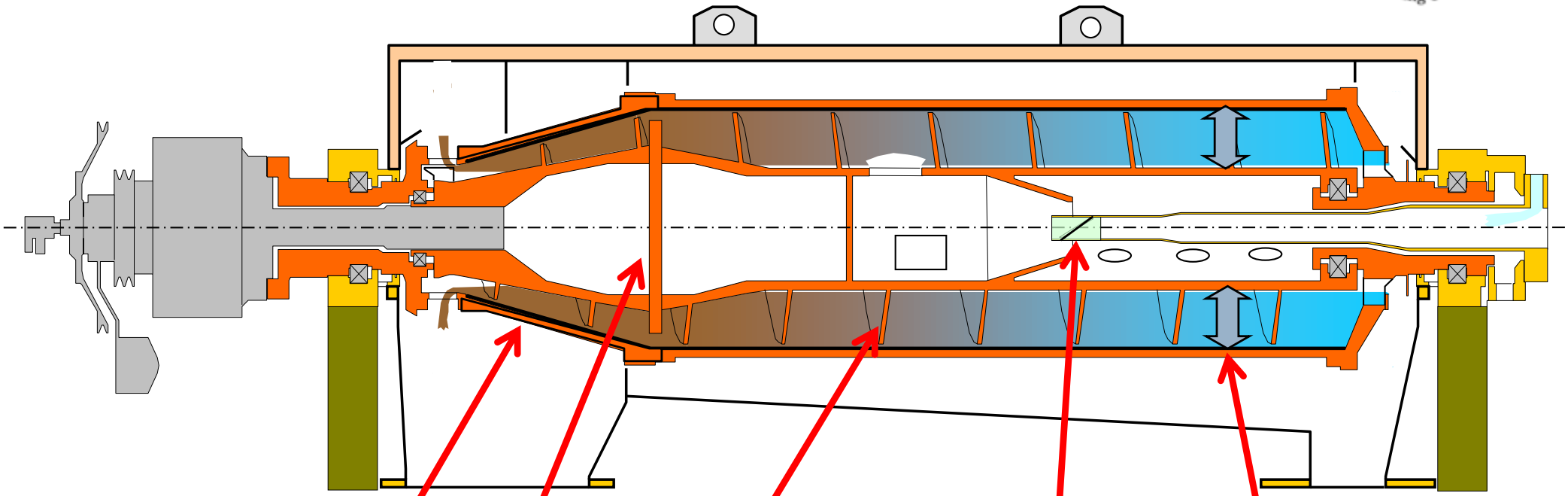
Technology Improvements over the last 20 Years

New design elements:

- Double Cone Scrolls
- Deep Pond Technology
- Fully Flighted Scroll with Axial Windows
- Dual Independent Drive Systems
- Centrate Energy Recovery

The end result is a more energy efficient user-friendly centrifuge.

Typical Modern Centrifuge Design Features



Steep cone design
(increased separation volume)

Double Cone and Baffle Disk Intensive compacting (drier solids) and longer clarification area (cleaner centrate).

Full flighted Scroll with axial flow windows (improve centrate flow/quality)

Gentle product feed and acceleration

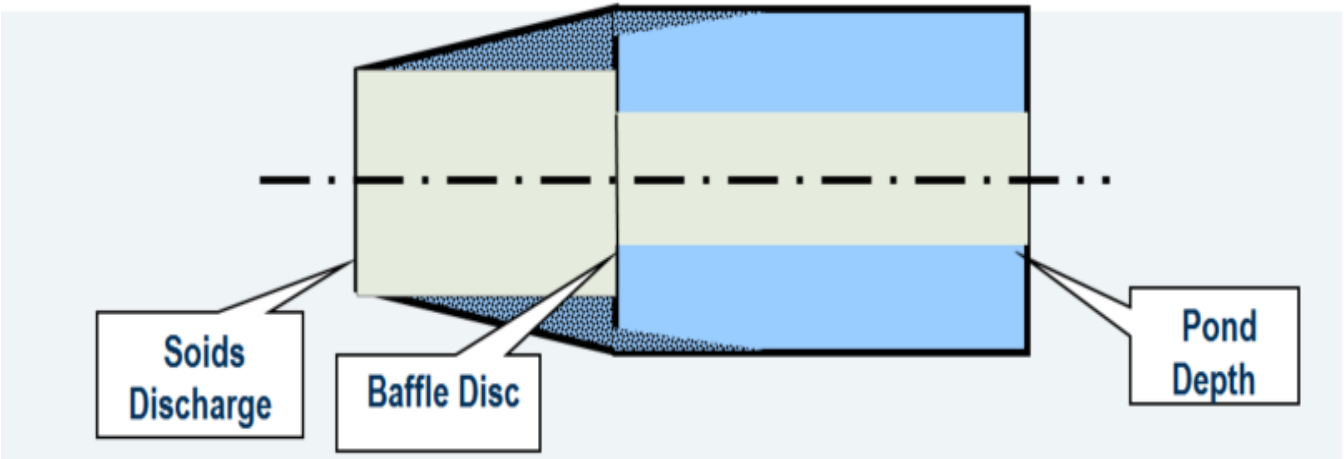
Deep Pond Design
(Better efficiency and compacted solids, more sludge treatable at same diameter bowl)

New Design Features

Double cone scroll with baffle disk

Deep Pond Design

"Negative Weir"



The double cone and baffle disc builds up a wall of solids that creates a deeper pond than a scroll without a baffle disc.

Benefits:

- Longer residence time = drier solids & cleaner centrate.
- Less energy consumed. Pond level closer to rotating axis.

Deep Pond Design

Weir Radius

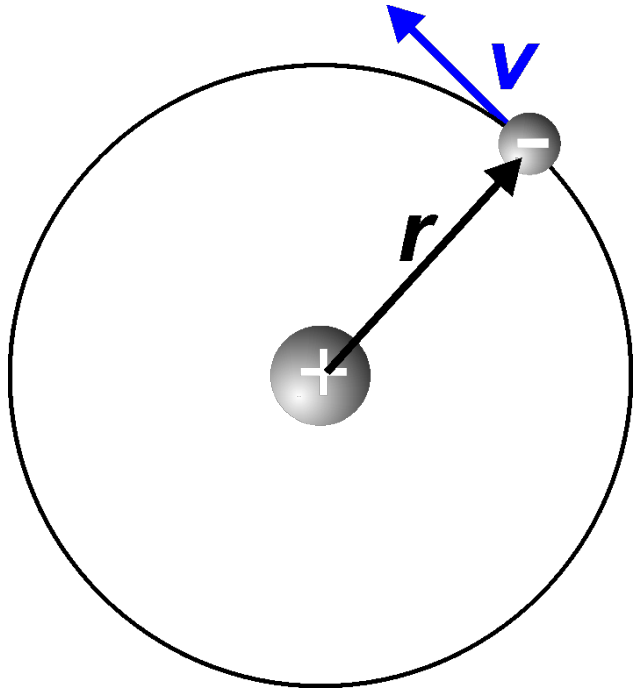
Energy losses with continuous dewatering centrifuges are mainly due to the liquid and solid phase taking the rotary energy out of the decanter. The larger the distance to the rotary axle the more energy is lost.

Applied decanter design means reducing energy losses by bringing the overflow edge closer to the axle via smaller weir diameter.

State-of-the-art deep pond technology reduces specific energy consumption significantly:

Dewatering as low as 0.2 kW/gpm
(0.9 kWh/m³)

Thickening as low as 0.06 kW/gpm
(0.25 kWh/m³)

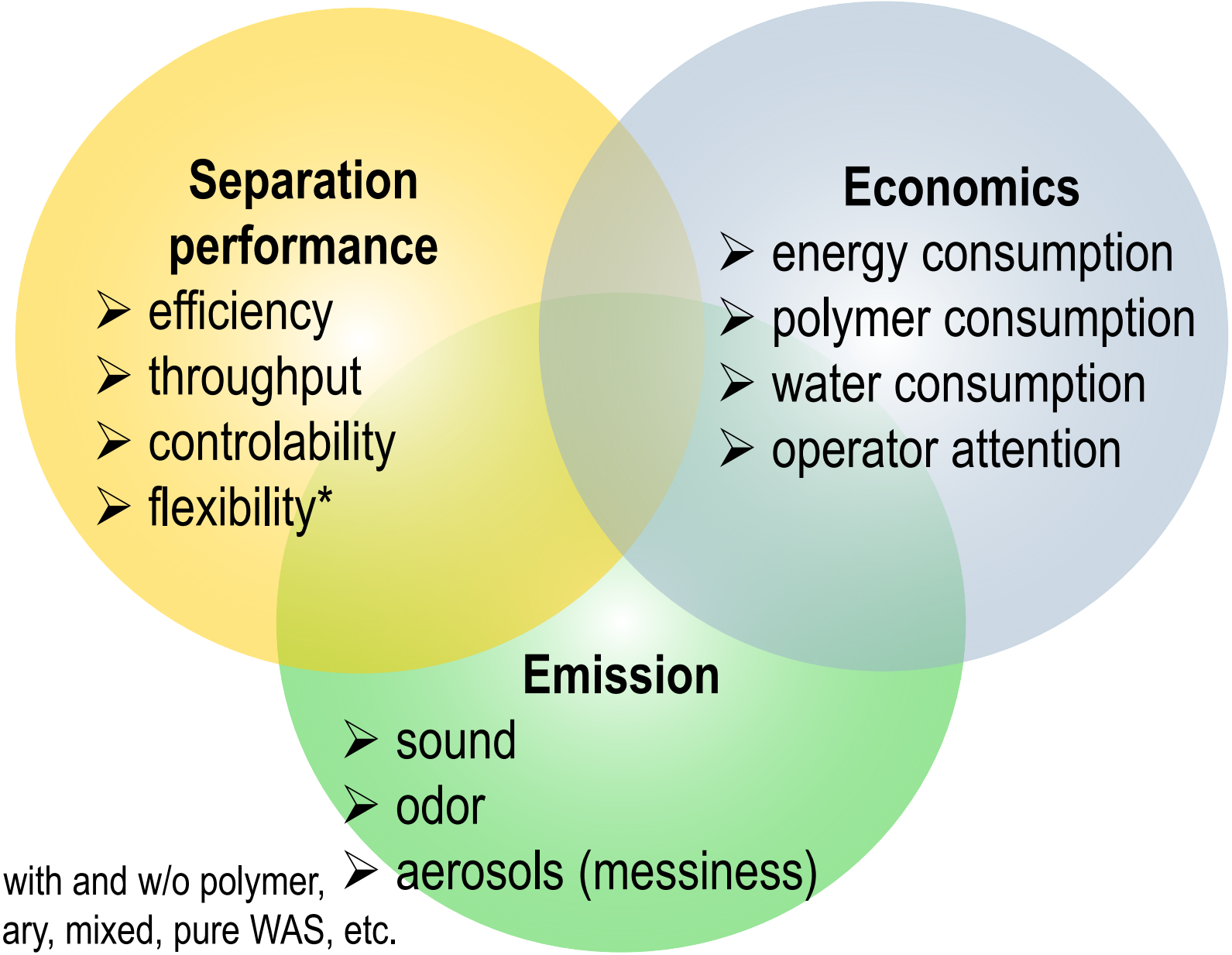


- Dewatering
- Thickening

- Features & Benefits
- Example Installations
- Questions

Sludge Thickening

Important Parameters



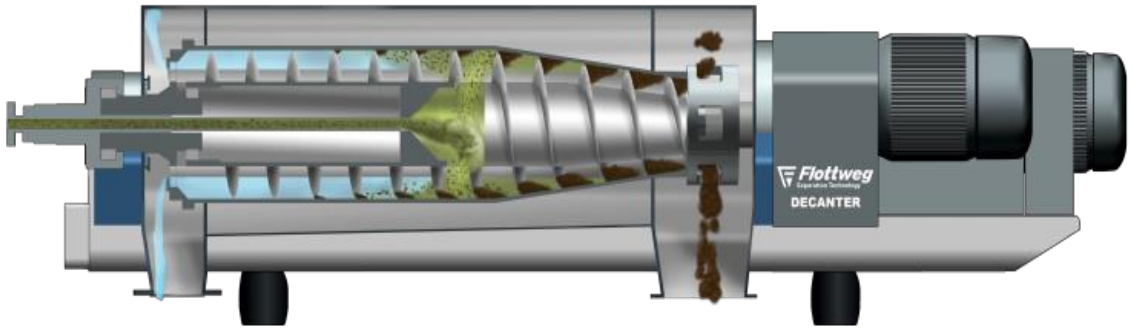
* with and w/o polymer, primary, mixed, pure WAS, etc.

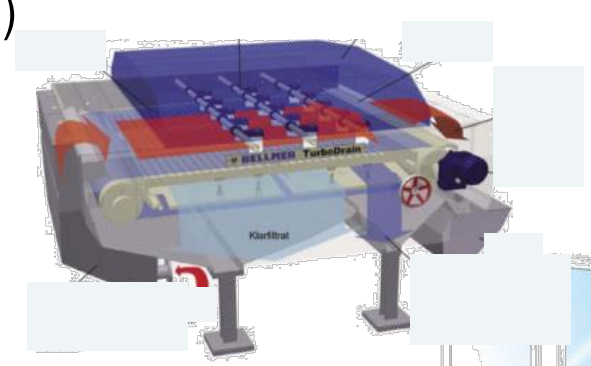
Sludge Thickening

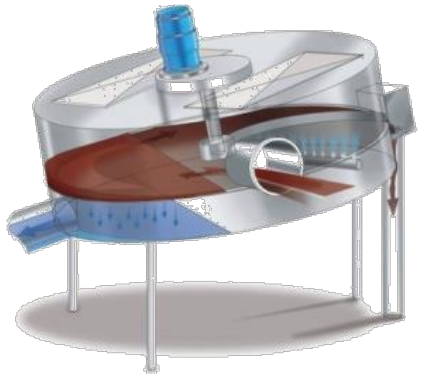
Different Types of Equipment

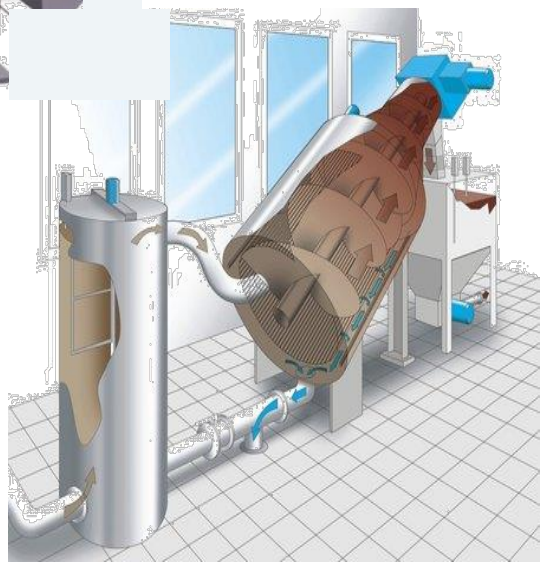
Mechanical sludge thickening can be achieved with various types of equipment.

- decanter centrifuges
- gravity belt thickeners (GBT)
- disk thickener
- screw thickener
- others (flotation, static)









Decanter centrifuges are a superior thickening technology, even for small and medium sized plants.

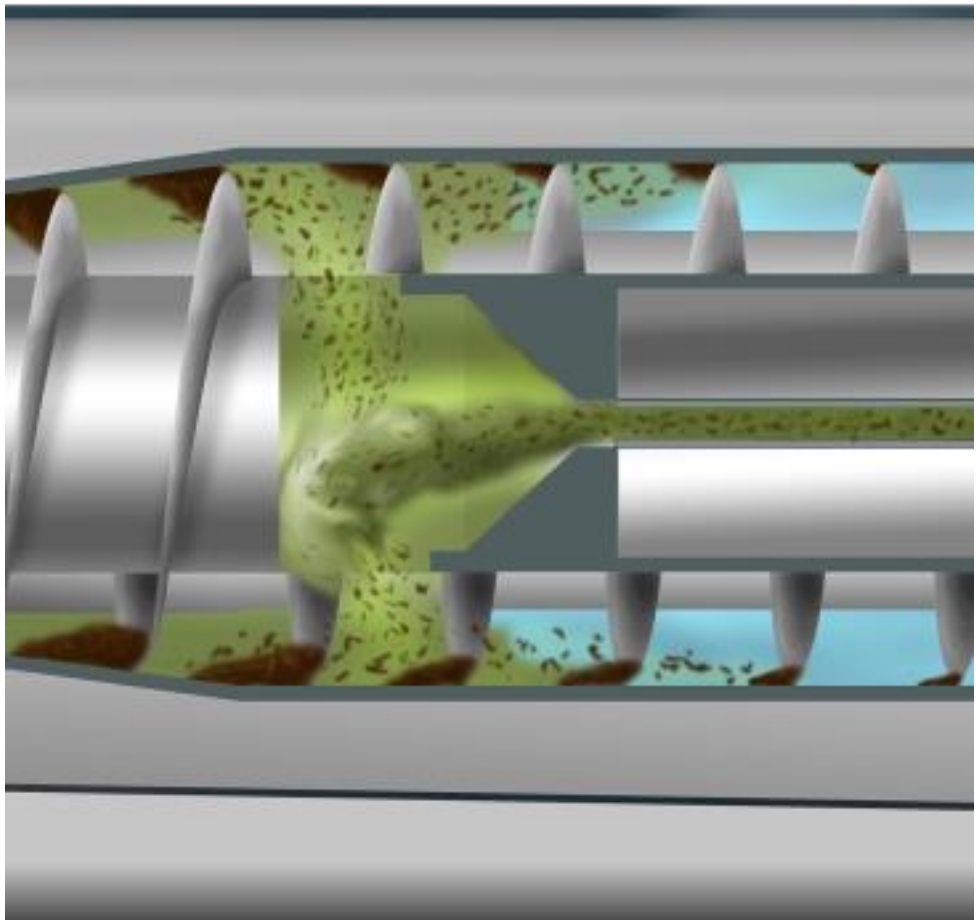
source of pictures:
Huber SE and
Gebr. Bellmer GmbH

Sludge thickening

Centrifugation instead of filtering

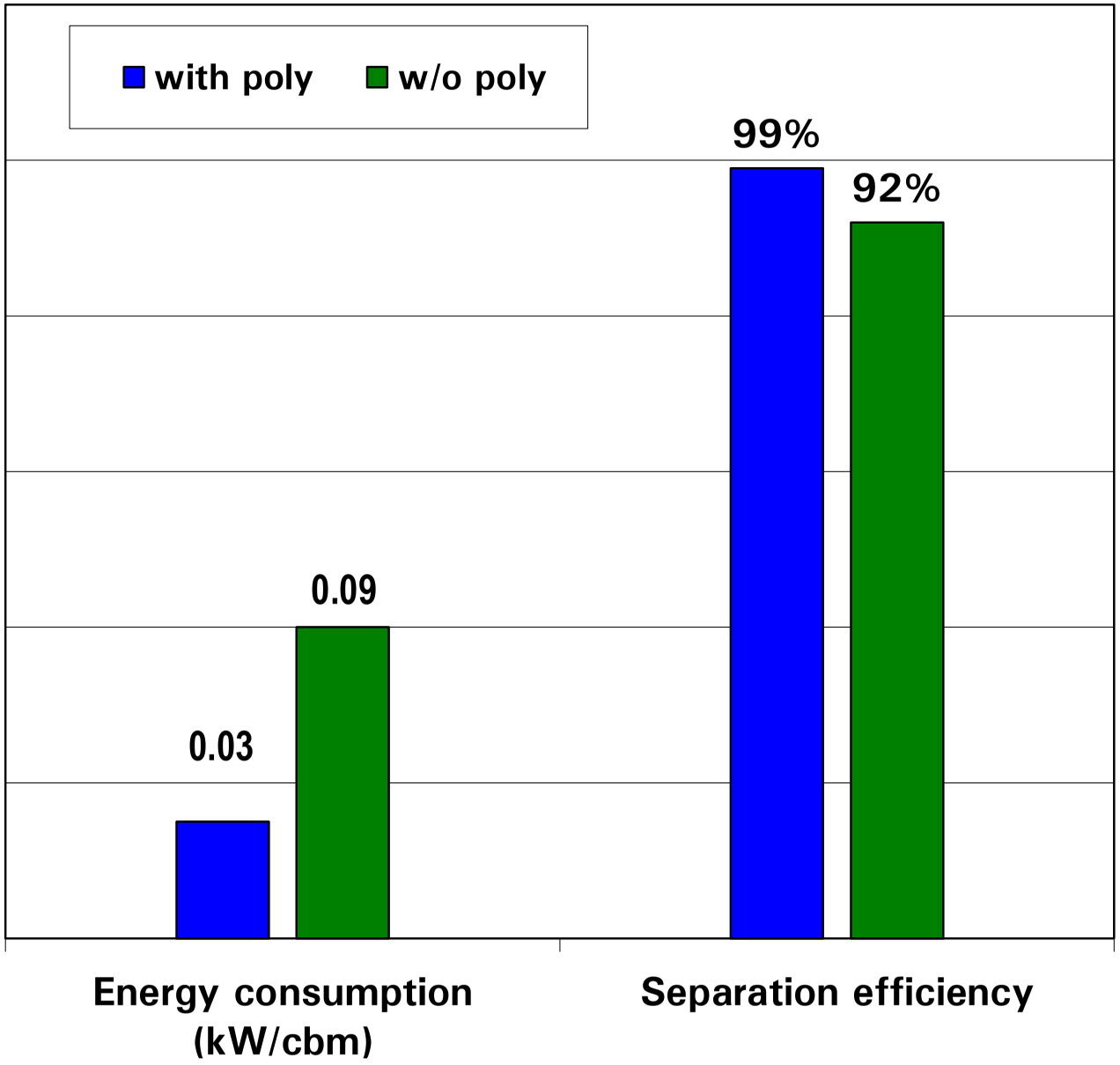
Separation and compression by centrifugal force

- allows operation without polymer
- optional polymer for cleaning up fines
- no total flocculation (GBTs, drums)
- no overdosing (polymer feed control)
- no negative influence of heavy polymer dosing



Sludge thickening

Advantages of thickening centrifuges



Real reference:

C4E-4/454 OSE decanter:

Sludge flow: 88 gpm

concentration:
0.7 – 0.9 %

underflow:

Polymer consumption:
none or 1.0 lb/t ds

Sludge thickening

Advantages of thickening centrifuges

Thickening centrifuge

- Very low polymer use
  1.0 – 4.0 lb/t dss (or even none)
  compared to
  8.0 – 16.0 lb/t dss (other thickeners)

- Very high capture rate
  99 % (with polymer)
  compared to
  80 – 90 % (other thickeners)

- Very small space requirements

- Unattended operation (24/7)

- Low energy usage

Thickening centrifuge with thickened sludge sensor

- Thickened sludge concentration
  remains constant (e.g. 6.0 ± 0.1 %)

- Optimized digestion leads to
  - Higher gas yield
  - Better dewaterability of digested sludge

- Fluctuating feed concentrations are
  automatically handled by
  controlled thickened sludge concentration
  (e.g. during torrential downpour)
  - No manual adjustment

Sludge thickening

Advantages of thickening centrifuges

Thickening centrifuge protects plant staff

- No aerosol and odor emission
  (decanter is an enclosed system)

- Very quiet operation (low g-force)

Sludge thickening

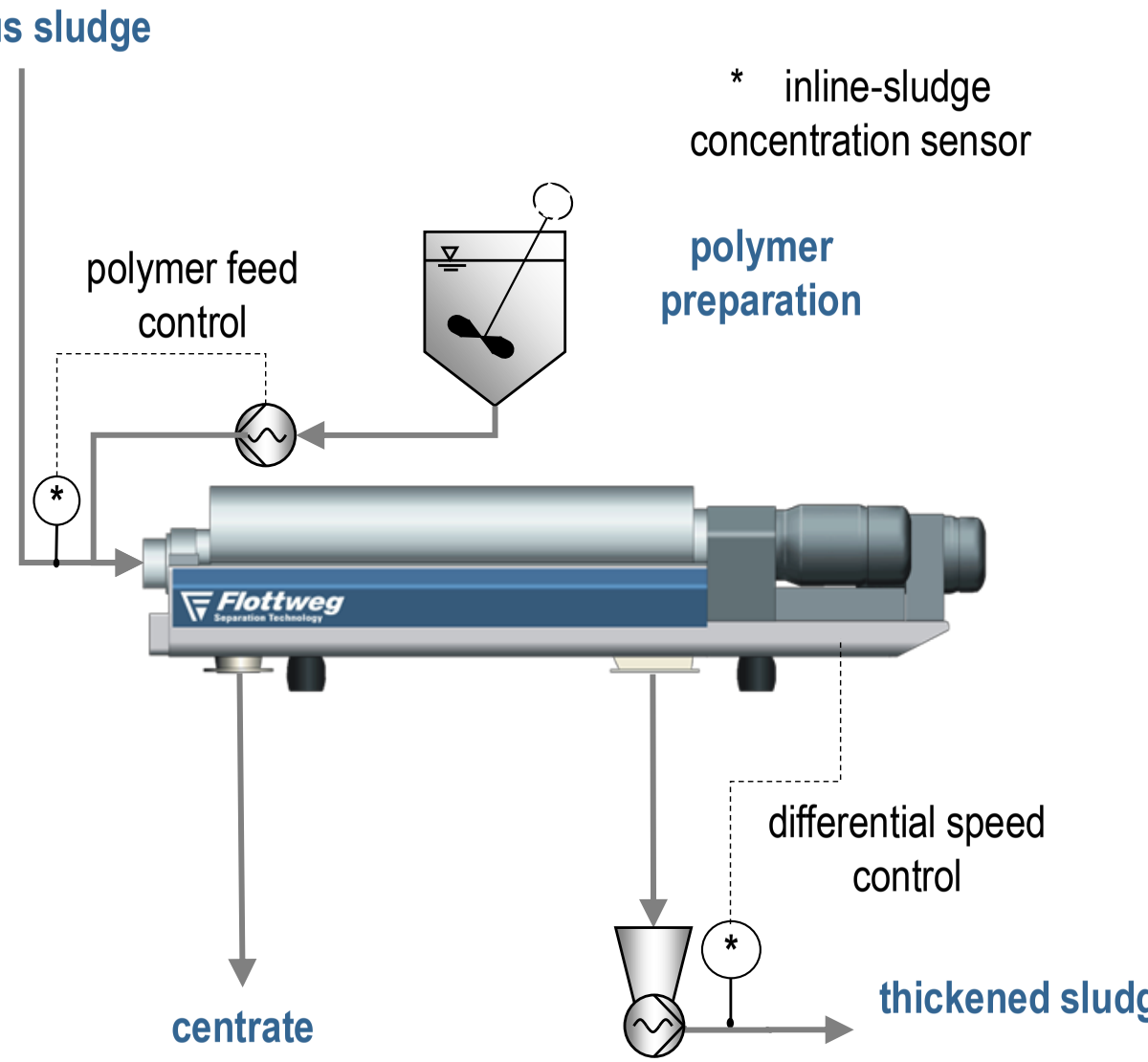
Advantages of thickening centrifuges

Thickening centrifuge with thickened sludge sensor

- Automatic adjustment of differential speed to match any set point of thickened sludge concentration

Thickening centrifuge with feed sludge sensor

- Automatic adjustment of polymer flow to current solid feed rate
  - No overdosing (cost savings)
  - No underfeeding (separation efficiency)



Sludge thickening

Advantages of thickening centrifuges

Thickening centrifuges last forever

- more than 100,000 operating hours and 20 years before first scroll rebuild

Landshut, Germany; 1 unit Z53-4/454 OSE

Sludge thickening

Advantages of thickening centrifuges

- low specific energy consumption
- reasonable price
- small footprint with high performance
- no water consumption during operation, only needed during shutdown
- no odor emission
- no health endangering cleaning necessary
- minimal need for supervision and control through continuous and automatic operation (up to 24/7)
- no or minimal polymer consumption
- all product wetted parts in stainless steel
- advanced wear protection and solid construction leads to long service life

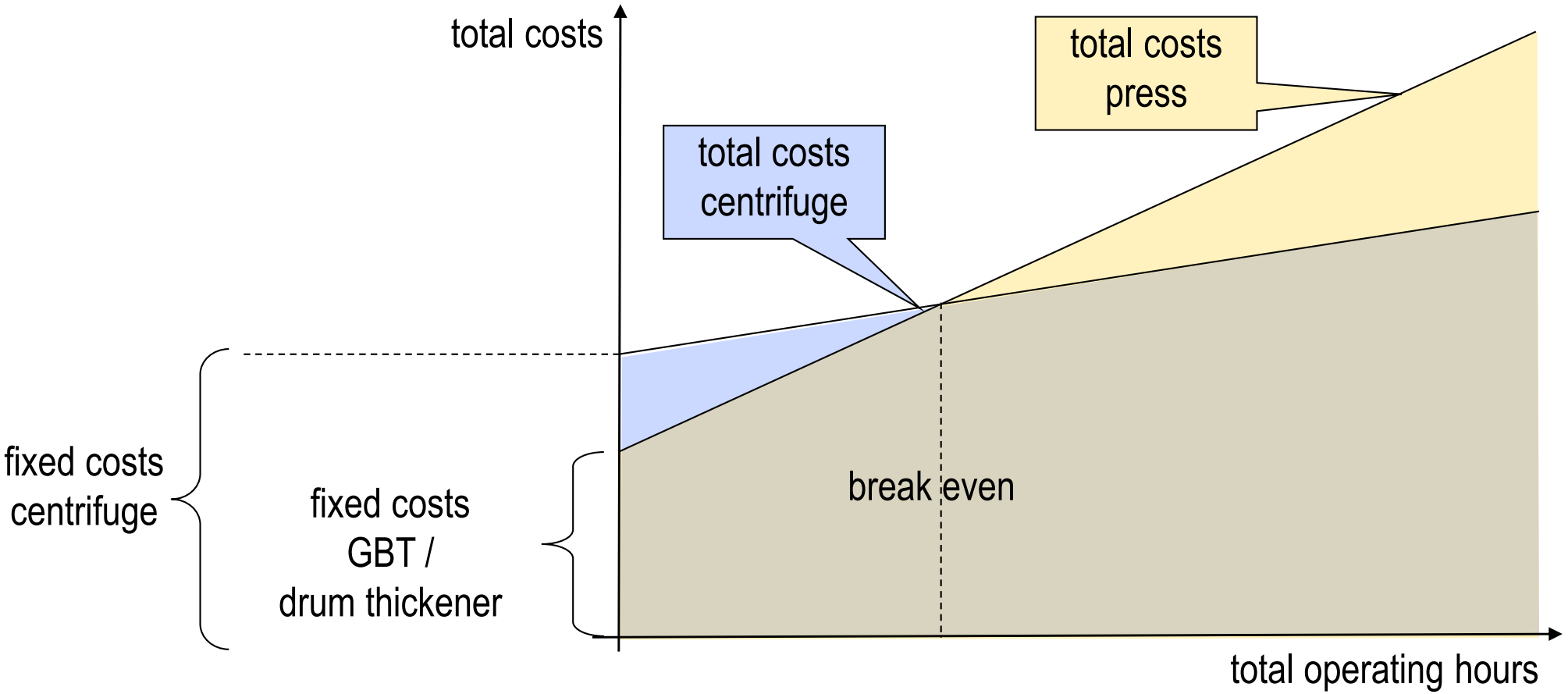
Sludge thickening

Advantages of thickening centrifuges

	OSE	flotation	rotary drum thickener	gravity belt thickener	static thickener
24/7 without supervision	✔				
no odor emission	✔		✔	✔	
manual cleaning					
different sludge properties	+ +	--	--	0	+
dryness of sludge adjustable	+ +	--	--	0	--
footprint	+ +	0	+ +	+	-
water consumption	+	+	--	--	+ +
aeration	+	+ +	-	--	+ +
polymer costs	($)	$	$$$	$$$	($)
invest (machine)	$$	$$	$	$	$$

Sludge thickening

Break even



The thickening centrifuge is an **economic** alternative – even for **small and medium sized plants !**

Sludge thickening

Marietta, OH

1 unit C5E-4/454 OSE

- Dewatering
- Thickening
- 
  Features & Benefits
- Example Installations
- Questions

New Design Features

Full flighted scroll with axial flow windows

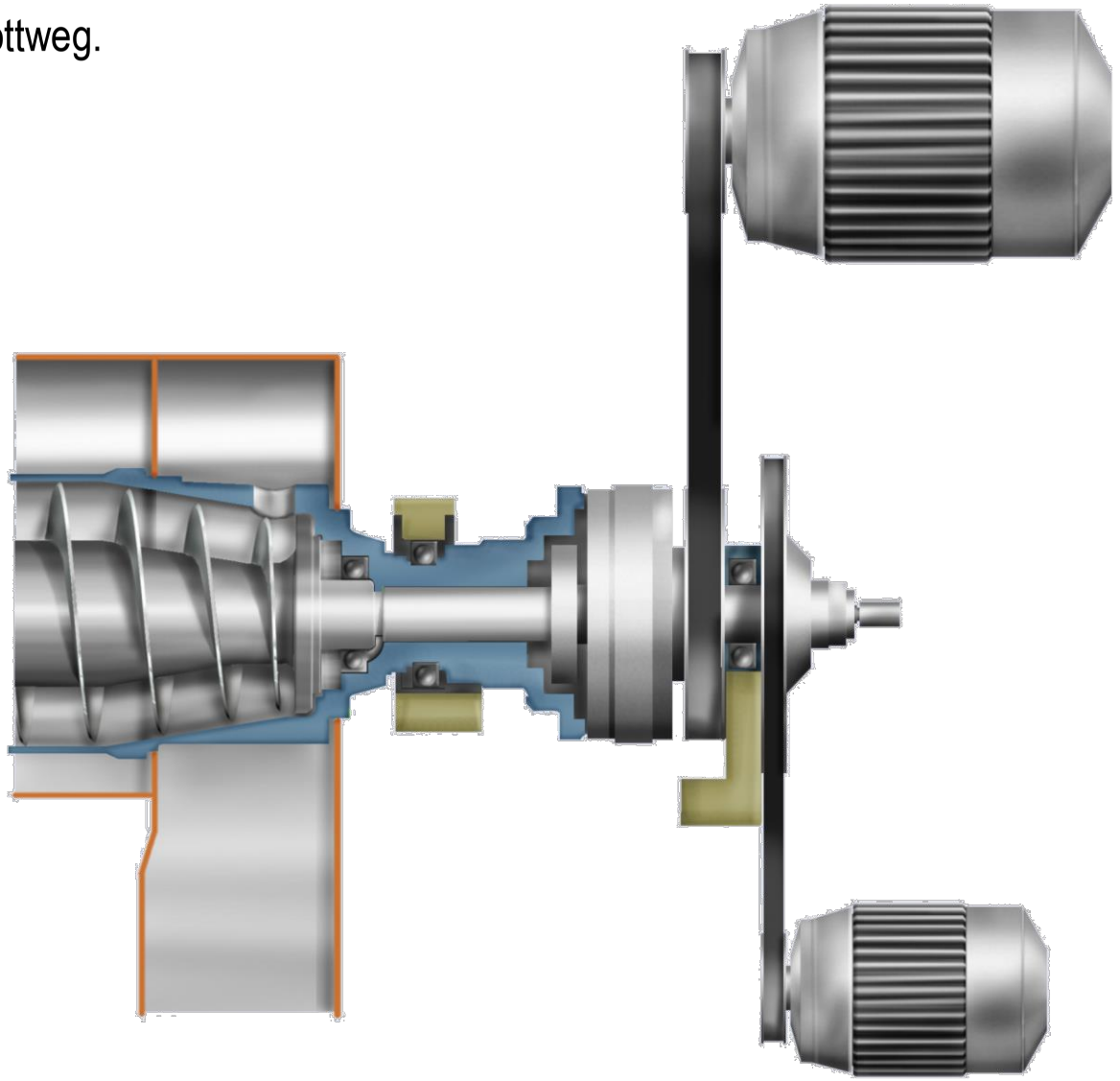
- New axial flow windows (only HTS scrolls)
- Still full flighted scroll blades

Dual Independent Drives

State-of-the-art technology invented by Flottweg.

Features:

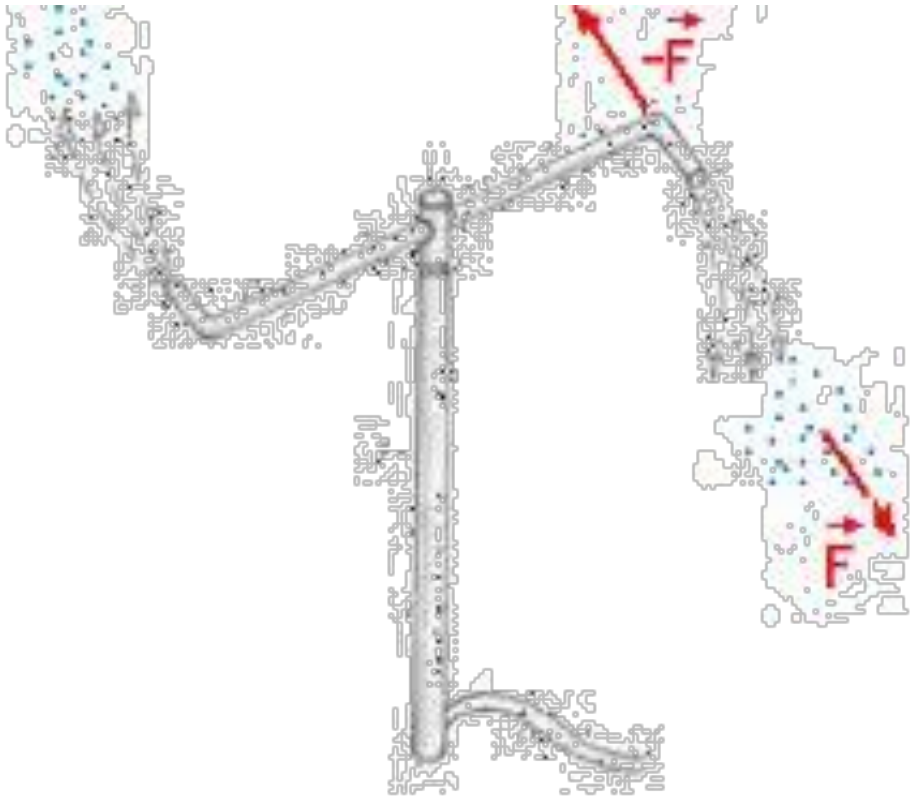
- Automatic and unattended operation via torque control
- Highest efficiency and reliability
- Lower installed HP
- Small space requirement
- Independent scroll and bowl operation
- Standard off-the-shelf motors and frequency inverters



Centrate Energy Recovery System

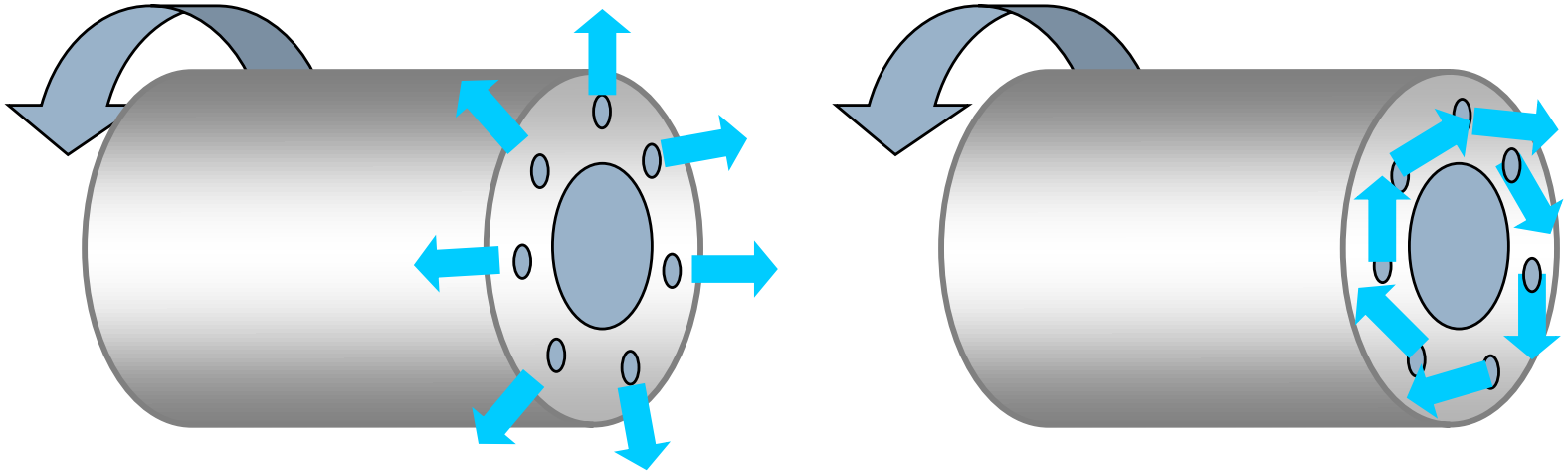
Working Principle

How does it work?



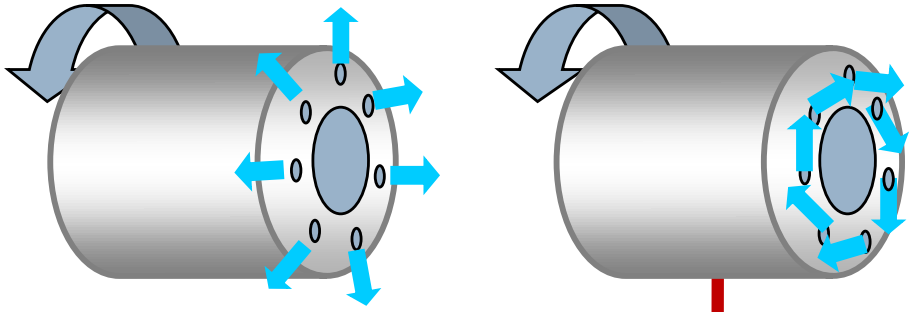
Centrate Energy Recovery System

Working Principle



Traditional design	New design
Centrate is discharged straight into the housing.	Centrate is redirected and <u>tangentially</u> discharged into the housing.
Rotational energy of the centrate is lost!	Rotational energy is recovered!

Centrate Energy Recovery System



... **save up to 20%**

additional **energy** *by using centrate energy with* **Recuvane®**

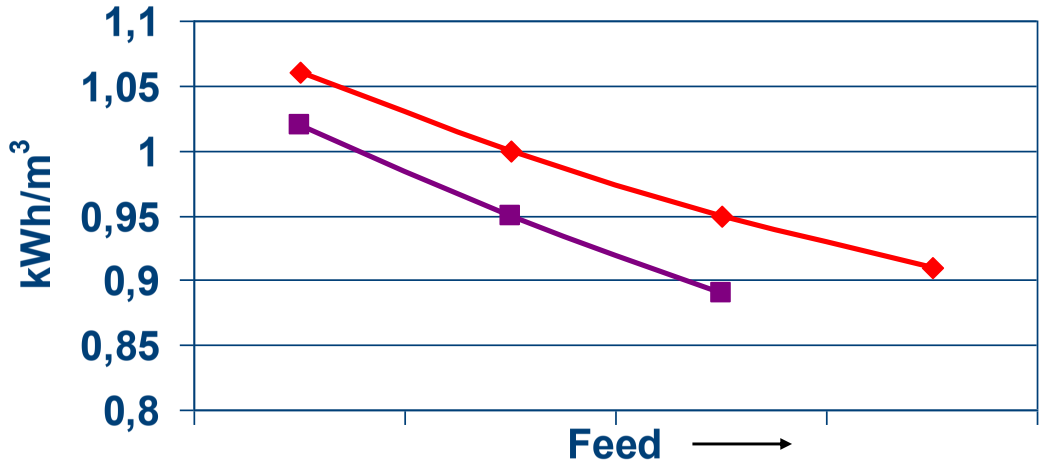
Centrate Energy Recovery System

Reduced Energy Consumption

- **Deep pond design**
  reduces energy consumption by 25-30%

- **Dual Independent Drives**
  lower installed HP and reduces energy consumption compared to hybrid, hydraulic or back drives

- **Centrate Energy Recovery**
  reduces energy consumption by 20% by using centrate energy



- Dewatering
- Thickening
- Features & Benefits
- 
  Example Installations
- Questions

Types of Installations

Single units

2 unit C5E-4/454 HTS

Types of Installations

Trailer mounted unit

1 unit C4E-4/454 HTS & OSE

Types of Installations

Skid mounted unit

1 unit C5E-4/454 HTS

- Dewatering
- Thickening
- Features & Benefits
- Example Installations
- Questions

QUESTIONS?

For More Information:

Flottweg Factory Contact:
Rob Rhea
rrhea@flottweg.net
859/982-7608
www.flottweg.com

Your Local Representative:
J Dwight Thompson Company
Marc Nusser
marc@jdtco.com
513/800-9009
www.jdtco.com

Flottweg
Separation Technology

Flottweg
Separation Technology

Engineered For Your Success

Flottweg SE • Industriestraße 6-8 • 84137 Vilsbiburg • Tel.: +49 8741 301-0 • Fax: +49 8741 301-300 • mail@flottweg.com • www.flottweg.com