



evocos

D Y N A M I C S E T T L E R S

Redefining Separation

The new pinnacle of mechanical solids separation

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Evodos Dynamic Settlers

A breakthrough liquid-liquid-solids separation

Big expensive problem

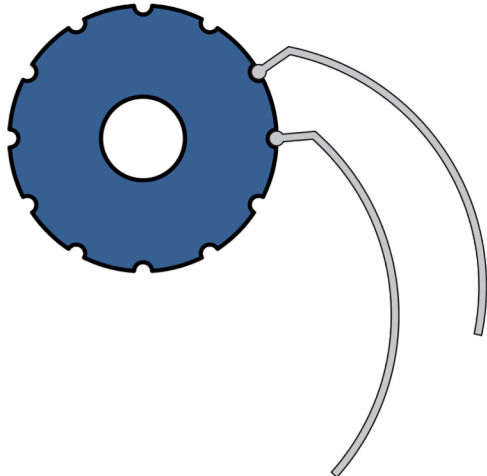
To remove ultra-fine particles from fluids

Evodos solution

Mechanical separation and automatic discharge



A centrifuge like no other

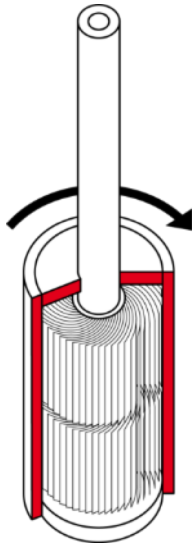


- It's all about the hinge!
- Plates close to capture and open to discharge
- Simple but transformative (and patented)
- Technology proven through field testing



Evodos Dynamic Settlers

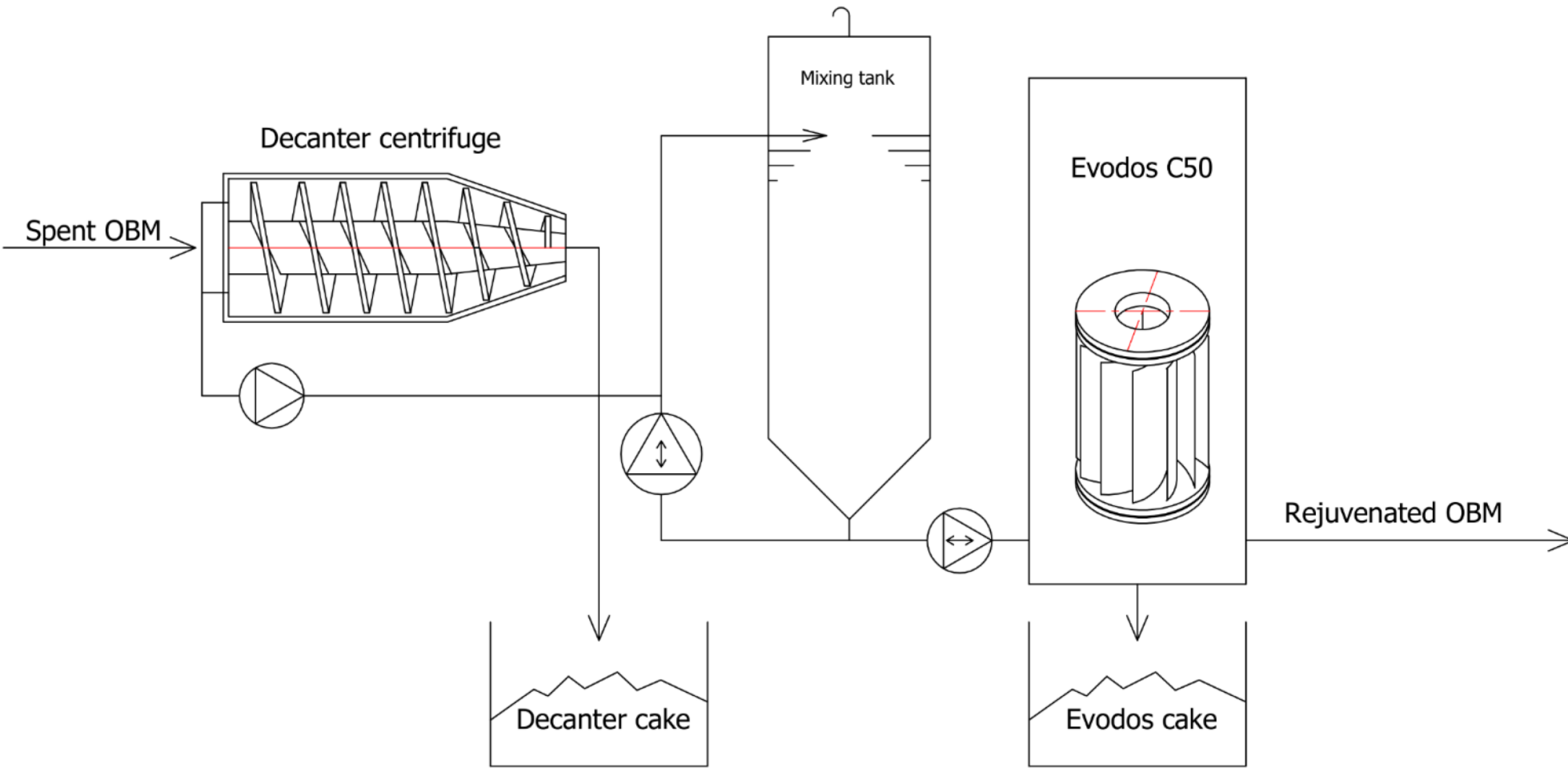
The Evodos difference



	Particle size removed	Easy discharge	Energy use	Discharge	Chemicals required?	Remote monitoring?
Evodos	> 1 micron	Yes Clog-proof No flush cycle required	Low Up to 4,500 G	High dry weight content	No	Yes
Conventional centrifuges	> 15 microns	No Sticky particles get stuck	High Up to 15,000 G	High liquid content	Often flocculants needed	No

Evodos C50 test set-up and initial results

Test set-up



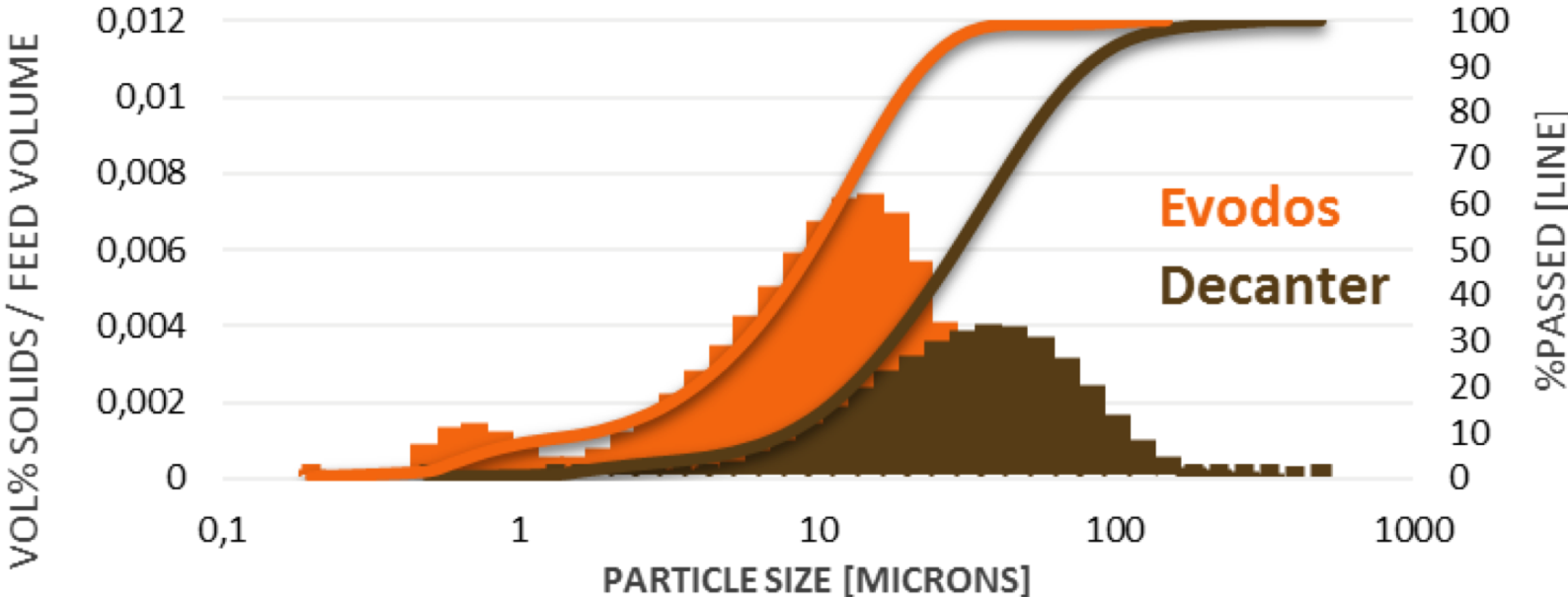
Evodos C50 test set-up and initial results

Test results

Feed OBM : 10.2 ppg

Effluent centrifuge: 9.3 ppg

Effluent Evodos: 8.3 ppg

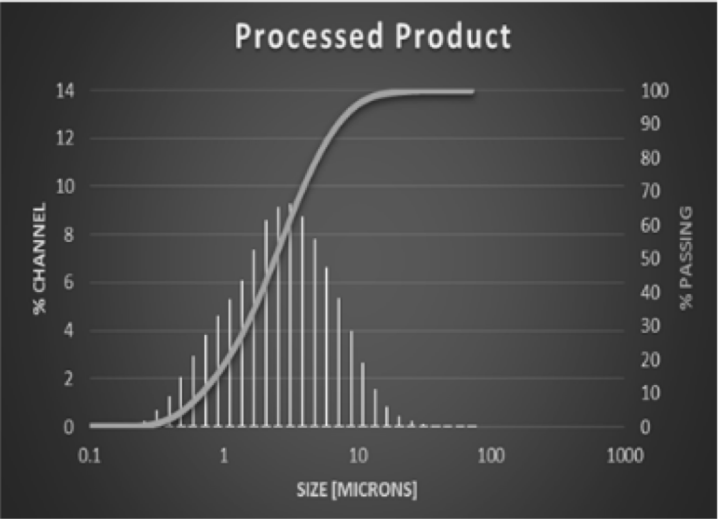
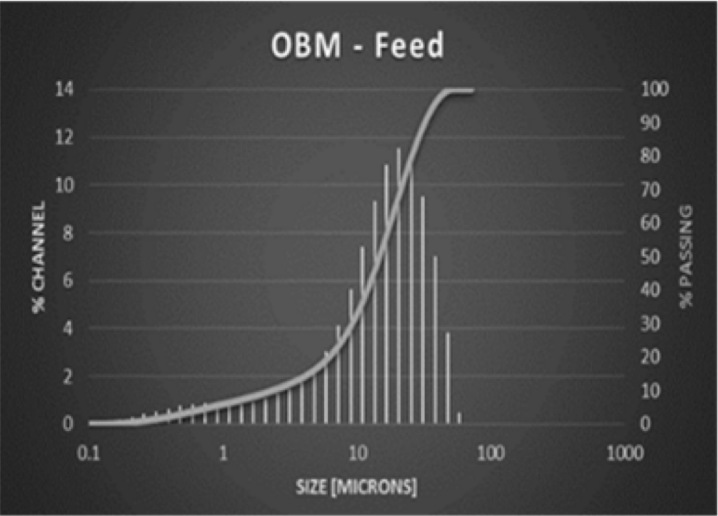


(Cake analyses)

Evodos C50 test set-up and initial results

Results Testing Mineral Oil Based Mud / North Sea LMP - Europe

<u>Fluid properties</u>	SBM Feed 65°F	Effluent Product	Solids Reduction
Mud Weight [ppg]	9,51	8,43	
Mud Weight [kg/L]	1,14	1,01	
Oil/Water ratio	61/39	60/40	
AV @150°F 150°F [cP]			
PV @70°F 70°F [cP]	55	38	
YP @70°F 70°F [lb/100 ft²]	25	24	
Yield Strength [lb/100 ft²]			
Electrical Stability [V]	699	754	
Corrected solids [vol.%]	11.3%	5.1%	55%
V_LGS [vol.%]			
V_HGS [vol.%]			



Evodos rig site set-up

Evodos C100 - Integrated Containerized Solution

Scope of supply:

- 2x Evodos C50
- Feed Control System
- Full EX controls for hazardous environments
- Temp range 32-100°F (0-40°C)
- Remote monitoring
 - locally or via www



Evodos demonstration in Europe (SBM)

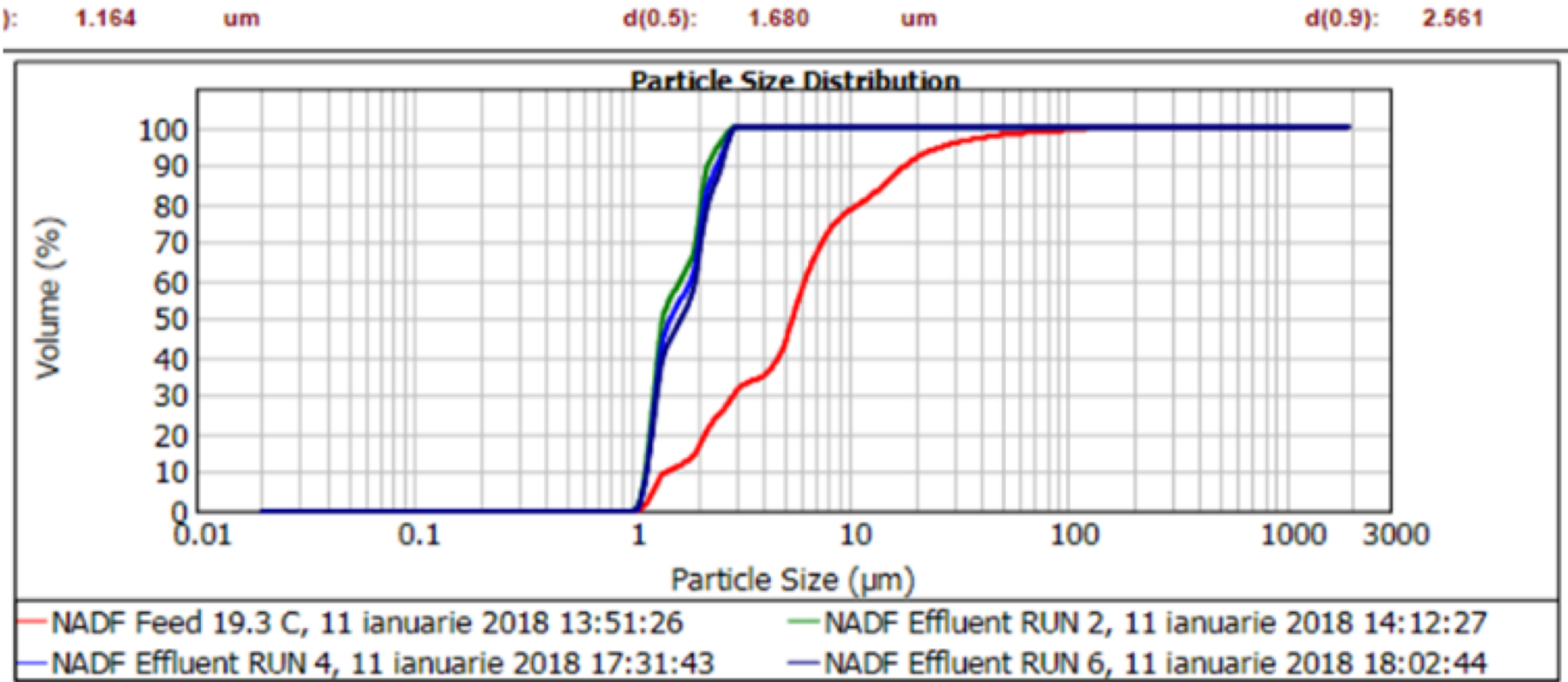
<u>Fluid properties</u>	SBM Feed 65°F	Centrate at 4500G	Solids Reduction
Mud Weight [ppg]	9,97	8,55	
Mud Weight [kg/L]	1,195	1,025	
Oil/Water ratio	69/31	70/30	
AV @150°F 150°F [cP]			
PV @150°F 150°F [cP]	41	30	
YP @150°F 150°F [lb/100]	12	11	
Yield Strength [lb/100 ft ²]			
Electrical Stability [V]	405	529	
Corrected solids [vol.%]	12.1	6.1	50%

Evodos realized 50% solids reduction

Evodos demonstration in Europe (SBM)

Feed:
D50 = ±5 micron

Effluent:
D50 = ±1.5 micron

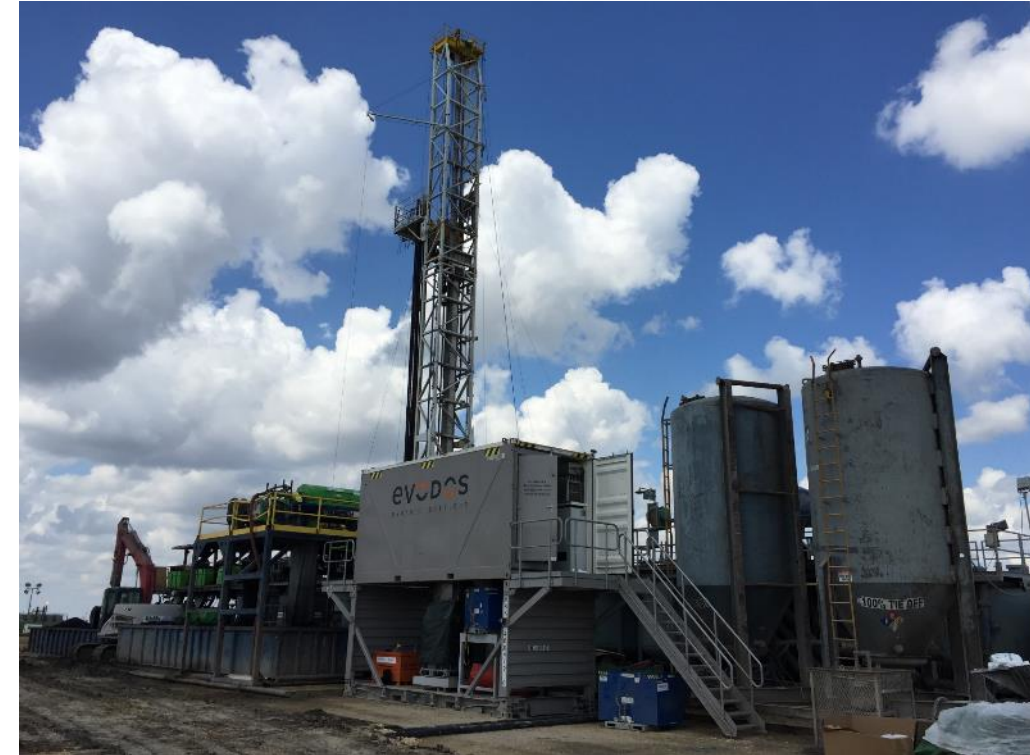


PSA – Feed & effluents

Evodos Dynamic Settlers

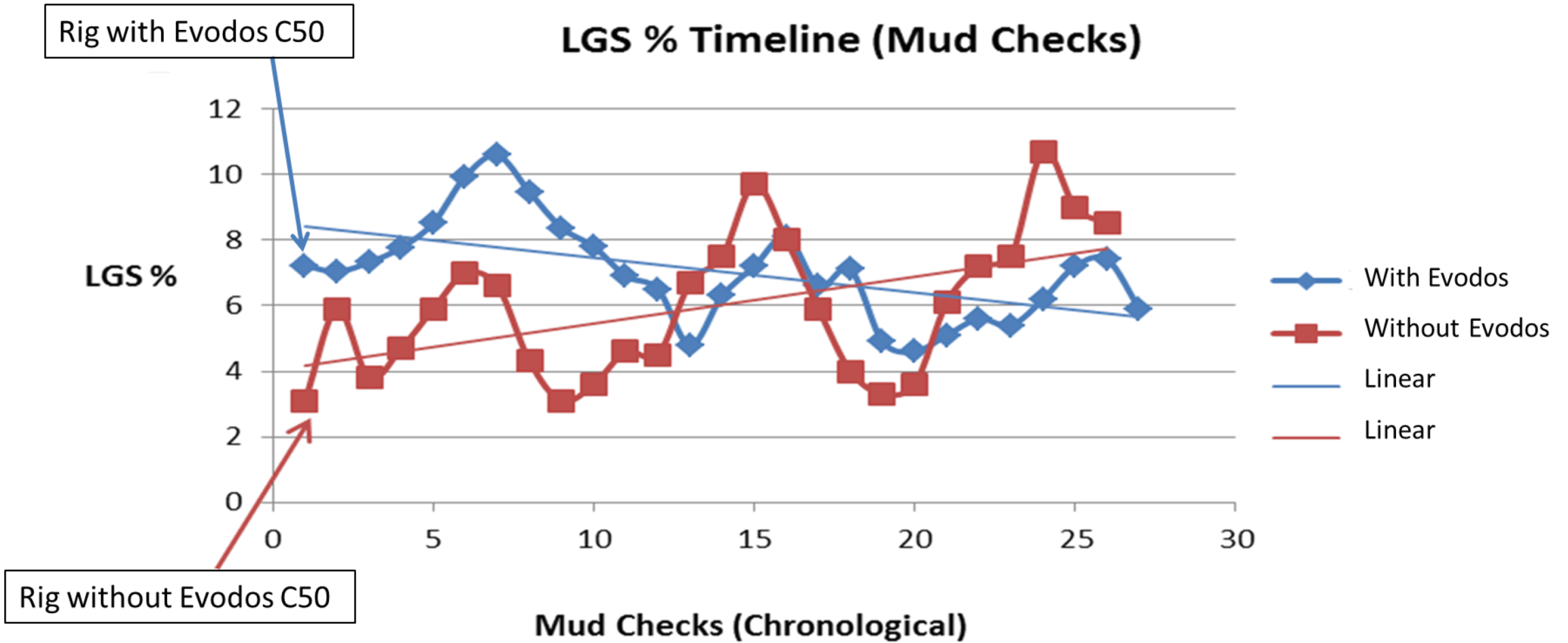
Demonstration at a drilling location (DJ Bassin, CO)

<u>Fluid properties</u>	Feed 111°F	Centrate Product	Solids Reduction
Mud Weight [ppg]	9.40	8.50	48%
Mud Weight [kg/L]	1.13	1.02	
Oil/Water ratio	86/14	87/13	
AV @150°F 150°F [cP]	13	9.5	
PV @150°F 150°F [cP]	9	7	
YP @150°F 150°F [lb/100]	8	5	
Yield Strength [lb/100 ft ²]	2	1	
Electrical Stability [V]	699	754	
Corrected solids [vol.%]	11.2%	5.2%	54%
V_LGS [vol.%]	9.7%	3.7%	62%
V_HGS [vol.%]	1.5%	1.5%	2%



Evodos Dynamic Settlers

Two rig comparison (DJ Basin, CO)



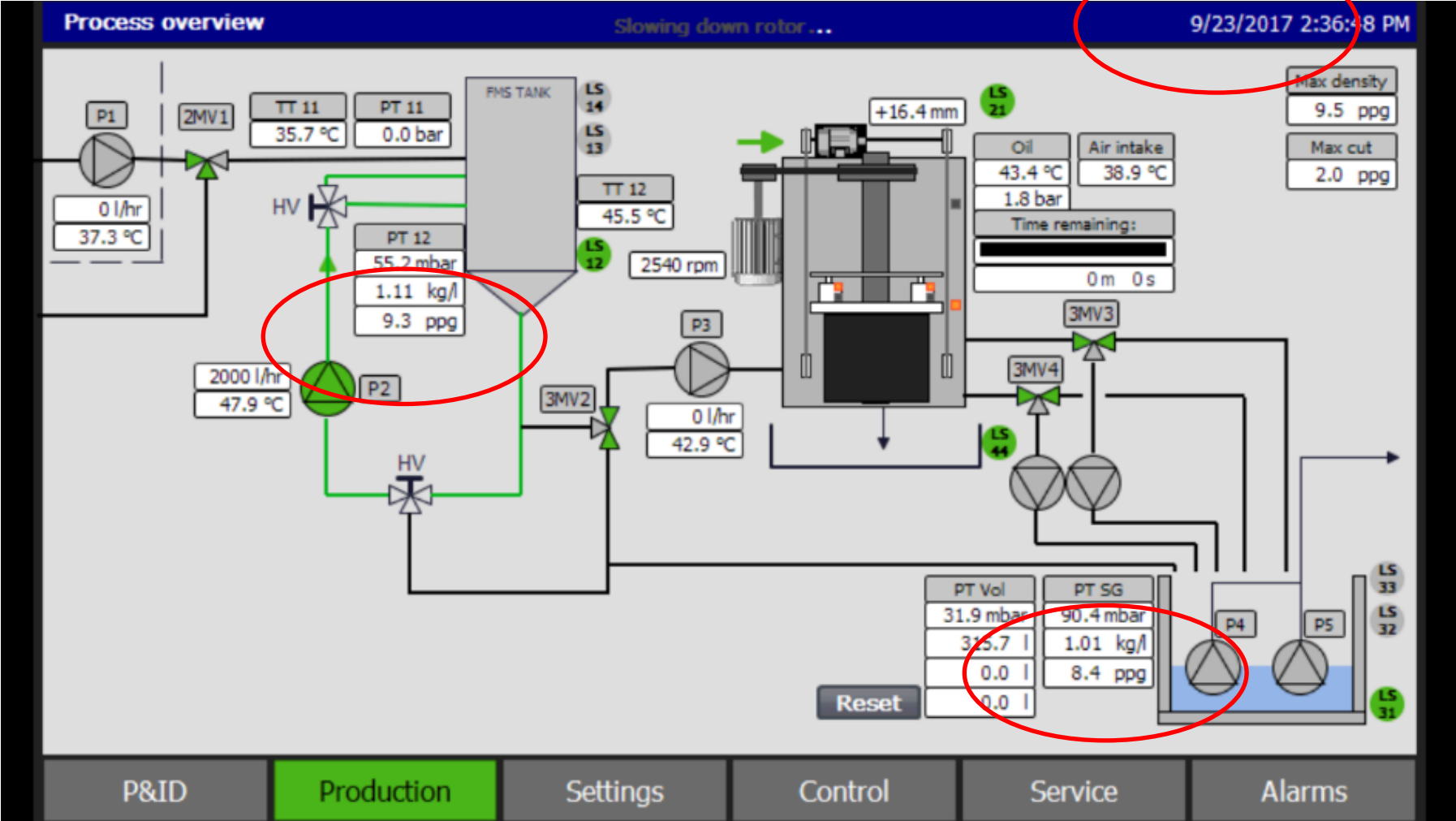
Representative samples on Evodos on LGS reduction (Eagle Ford, TX)

<u>Fluid properties</u>	Eagle Ford well	Effluent	Solids
	Feed 100°F	Product	Reduction
Mud Weight [ppg]	9,4	8,4	
Oil/Water ratio	78/22	87/13	
PV @80°F 80°F [cP]	46	22	
Electrical Stability [V]	848	1281	
Corrected solids [vol.%]	13,1%	5,8%	56%

Solids reduction by Evodos: 55%

Evodos Dynamic Settlers

Actual process measurements



Conclusions

- Consistent results in removal of ultra-fines from drilling fluids
 - No significant difference in performance Evodos between diesel, synthetic or mineral oil based drilling fluids
 - Conventional centrifuge down to 7-15 micron, Evodos down to 0.5-1 micron
 - Evodos reduces mud weight by 1 ppg after big bowl high speed centrifuge
 - Effluent of cutting dryer is optimally processed to reduce ultra-fines content in total mud system
- Optimized mud-weight and mud property control
 - Dilution through on site rejuvenation of active mud instead of freshly added diesel leading to significant cost savings
 - Optimal mud rheology during drilling, better control on ECD and on solids content enabling drilling of longer horizontal sections



QUESTIONS?

evodos
DYNAMIC SETTLERS



Thank you for your time
and attention

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Other Evodos applications

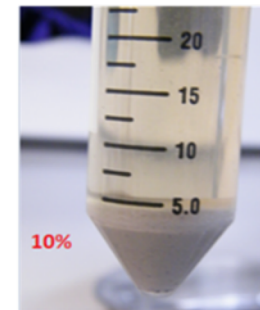
Recovery of Formate brines

The problem:

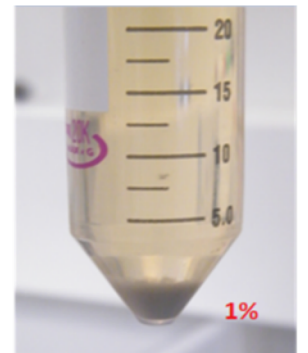
- Conventional centrifuges fail to remove solids from (formate) brines and water based muds

Evodos solution:

- ✓ Evodos' high separation efficiencies and low associated fluid losses
- ✓ Evodos success demonstrated to leading supplier of formate brines
- ✓ Vast cost savings and performance improvements



Before processing



After processing

Oil Based Mud Rejuvenation

Benefits C100 cost savings on rig site

Benefits Evodos C100 on rig site

Waste disposal cost incl. transport	55 \$/bbl
Cost price for new mud	100 \$/bbl
Decanter costs	0 \$/day
Operator(s) cost	0 \$/day
Generator cost	200 \$/day
Evodos C100 cost	2250 \$/day
Total operational cost per day	2450 \$/day

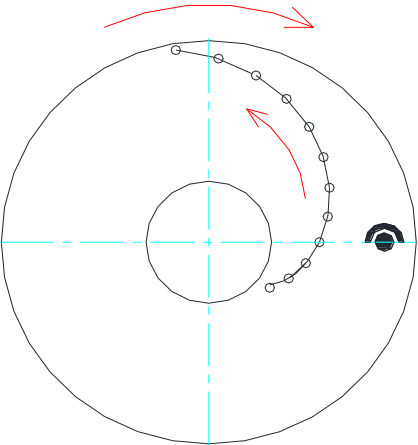
Process volume is 10 bbls/hr for OBM with a 10-20 cP viscosity and a 40%-50% solids removal efficiency based on a PSD with a d50 of 3-7 micron.
 Yellow fields are variable input values

Benefits per operating day

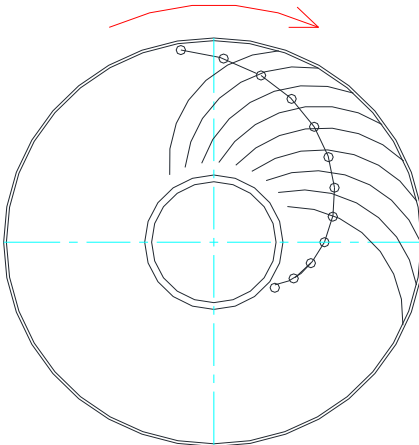
The Evodos can process a feed volume of continuously for	10 bbl/hr		
Processed per day	22 hours/day		
LG solids contents is	220 b/d		
and we can remove per pass giving a LG solids % of	12,0% vol %		
	50% vol %		
	6,0%		
The Evodos discharges and delivers	26 b/d	discharge volume	
	194 b/d	fresh product	
The cost for making disposal cost Evodos discharge	194 bbls rejuvenated mud		
operational cost per day	26 bbls	is	\$1.452
Total cost for making fresh rejuvenated mud with a new solids content of		is	\$2.450
Cost per bbl	194 bbls	is	\$3.902
	6,0%		
			\$20
To end up with	194 bbls	via dilution	
with a new LG solids content of	6,0%		
you need a dilution factor of	100%		
So you take to be diluted mud and add fresh mud	97 bbls		
	97 bbls	costing	\$9.680
Cost per bbl			\$50
Cost savings irt dilution per operating day			\$5.778

Path of a particle in rotating fluid cylinder

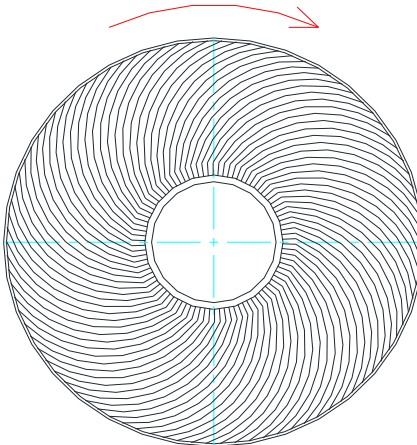
1. Rotating water cylinder, cross-section.



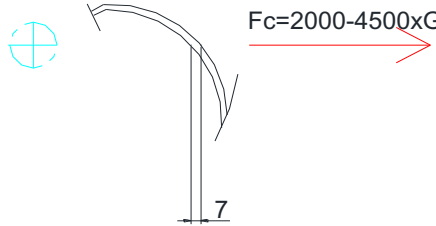
2. Spiral plates limit path of particle.



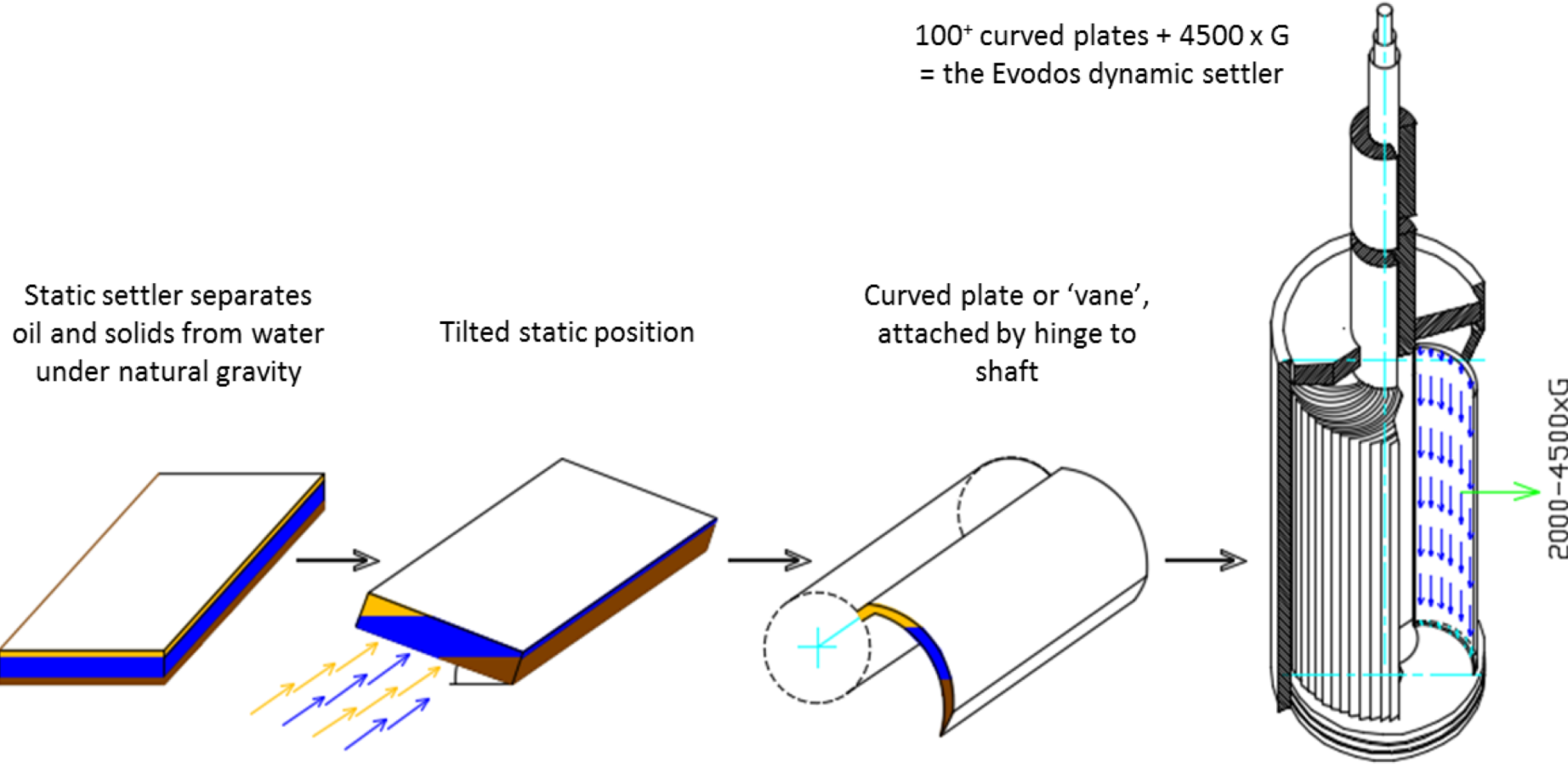
3. 90, 135 or 180 SPT vanes hinged to main shaft.



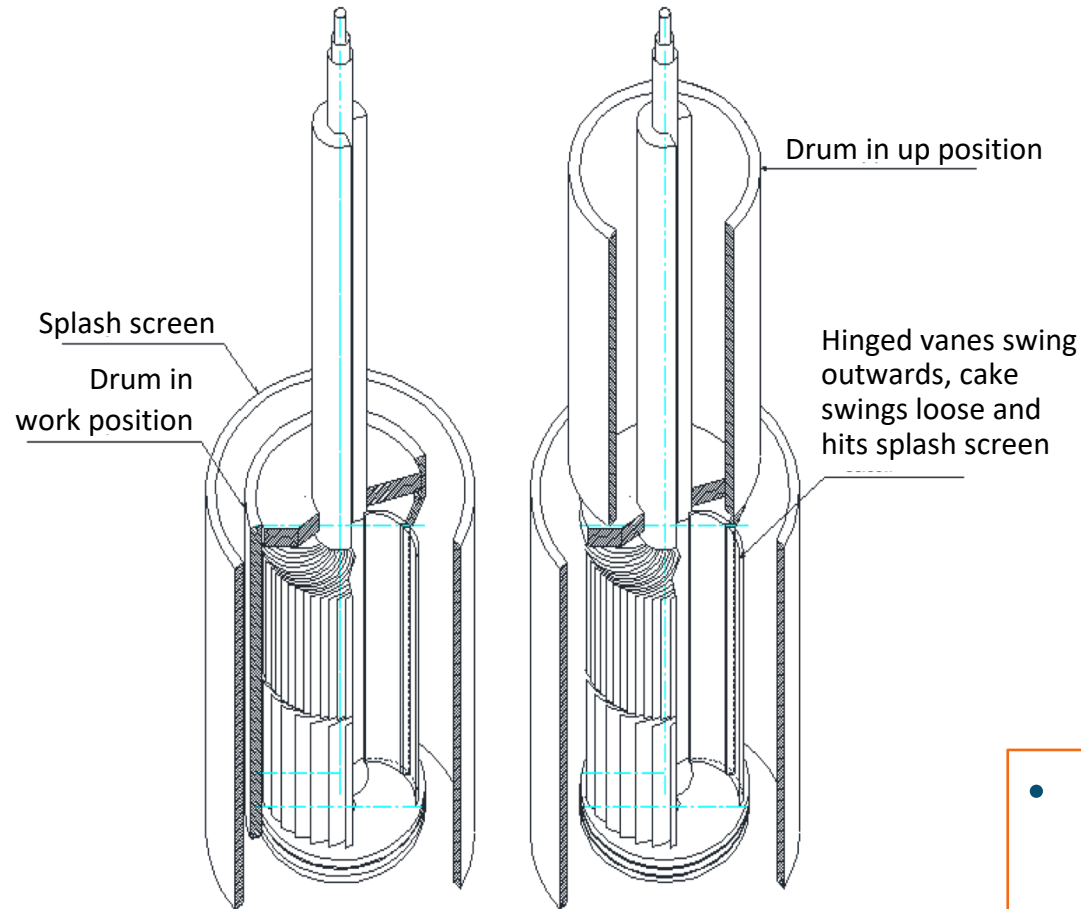
4. Plate pack detail. Max. swimming distance = 7 mm.



Evodos 'dynamic settling' is a breakthrough in centrifuge technology



Evodos is 'clog-proof' - all that is captured is discharged



Evodos plate-pack loaded with oil-based mud solids



Evodos plate-pack after mechanical solids discharge

- Evodos discharges the greasiest, and most abrasive and sticky substances
- No water or detergents needed, so no added waste
- No expensive and disruptive fouling

The competition in Oil & Gas

Other approaches to drilling fluids treatment

	Purely mechanical process	Low cost operations & maintenance	No impact on emulsion	Storage volume & cost	Easy discharge	Energy efficiency	High dry weight discharge
Evodos	✓	✓	✓	✓	✓	✓	✓
Electrical Separation	✗	?	✗	✓	✗	✗	✗
Chemicals + centrifuge	✗	✗	✗	✓	✓	✗	✗
Dilution	N.A.	✗	✓	✗	N.A.	N.A.	N.A.