



SEE INSIDE YOUR
PROCESS

REAL TIME PRODUCTION EFFICIENCY BASED ON COMBINATION OF NON-NUCLEAR DENSITY & MAGNETIC FLOW INSTRUMENTATION

Kent Wei, Changhua Qiu, Ken Primrose, Wadoud Hazineh ITS

Andre Boer, Diot Maingay, Krohne

Frank Boseman, Damen

WEDA 7th June 2019

OVERVIEW

Introduction

Preliminary tests

Field tests

Results

Conclusion

GROWING INTEREST IN NON-NUCLEAR DENSITY METERS

Operational benefits

- Reduce maintenance costs
- Eliminate local compliance rules, regulations
- Simpler transport and installation
- Opportunity for additional information

CSR (Corporate responsibility and risk) benefits

- Sustainable – no nuclear source in operations
- No remainder disposal
- Eliminates risk and lowers insurance costs
- Simplifies working procedures

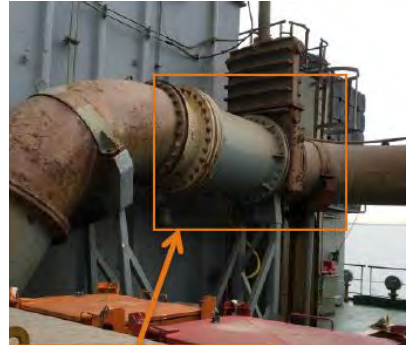


DENS-ITOMETER PRODUCT HISTORY

Seven year development program with leading dredging company
Installed with major operators and tested round world
Sensor durability demonstrated at flow rates > 30,000 tonnes / hr
Proven performance....

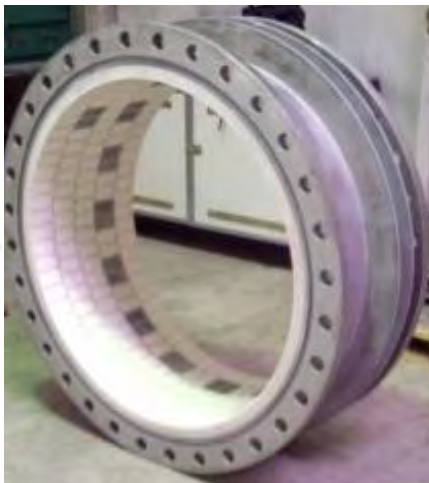


INSTALLATIONS



OPERATING PRINCIPLE

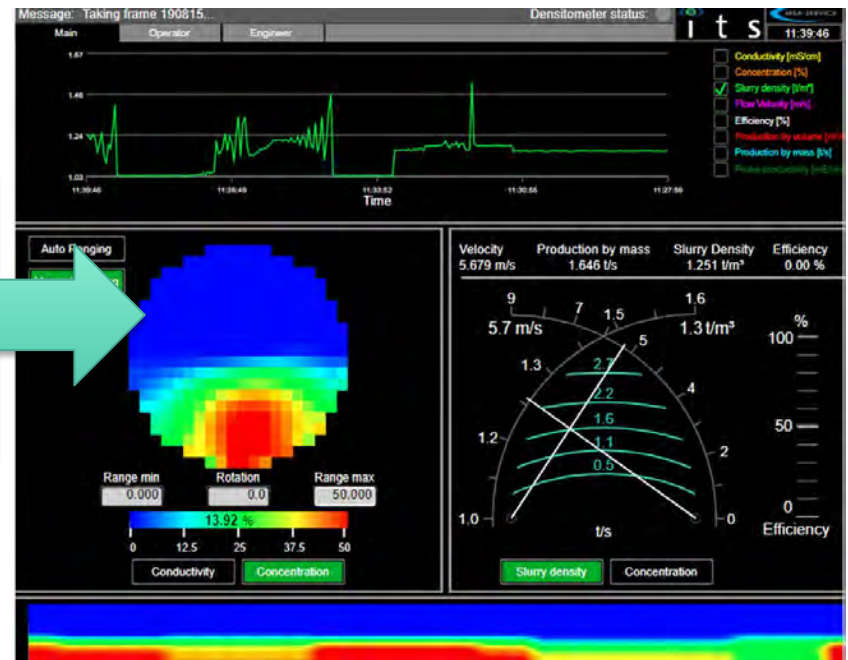
Inject current across electrodes



Measure voltages

$$V = IR$$

Determine conductivities



INTEGRATED PRODUCTION METER

Every gamma meter paired with flow meter

Many dredgers use mag flow

Similar measurement principle

- Electrically insulated pipe
- Electrodes

Combined sensor

- Less tiles
- Less flanges
- Shorter
- Same measurement point

- More data and improved efficiency



OVERVIEW

Introduction

Preliminary tests

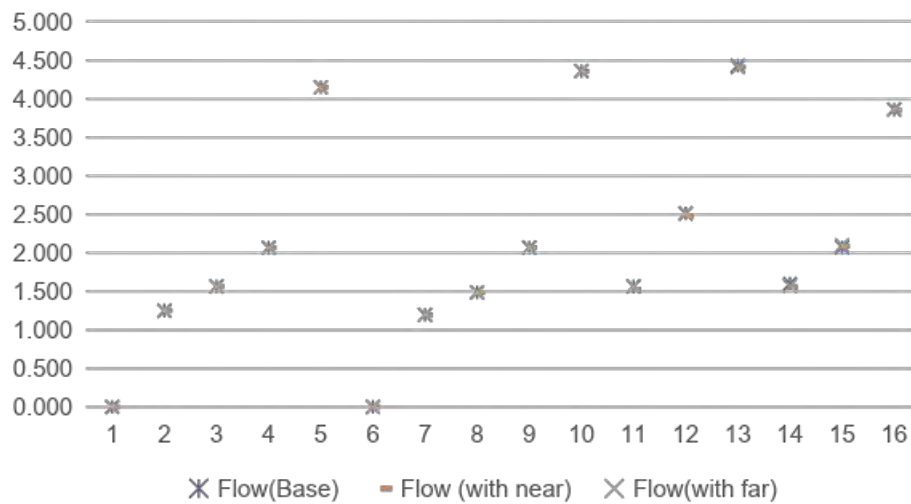
Field tests

Results

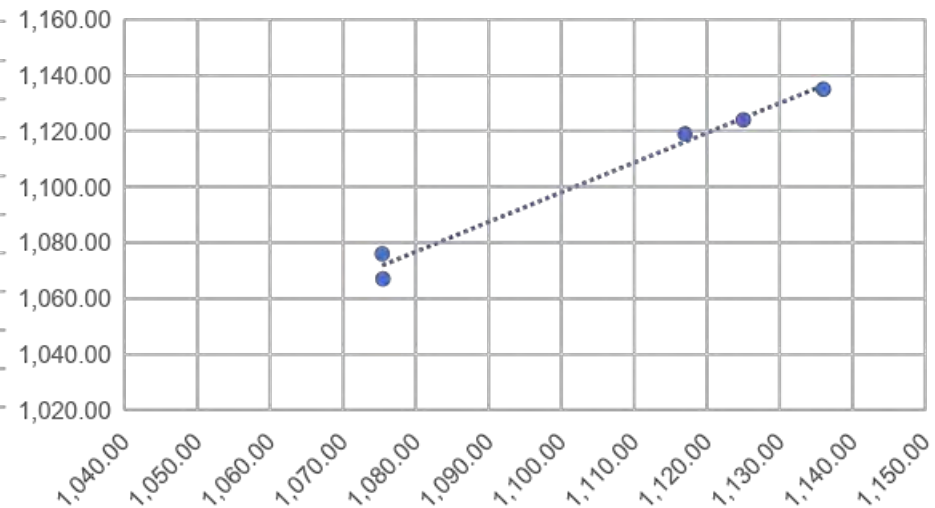
Conclusion

RESULTS OF FLOW LOOP TRIALS

Magflow rates by test point



Correolis (x-axis) vs Tomography density (y-axis)



OVERVIEW

Introduction

Preliminary tests

Field tests

Results

Conclusion

FULL SCALE SYSTEM CHALLENGES

Interference

- Both electrical measurements
- Strong, homogenous electrical field

System size

- Same dimensions as existing flow meters
- Integrate with hard ring

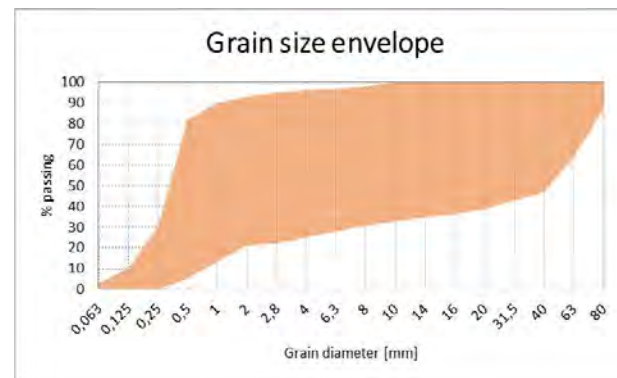
Integration

- Pipe
- Enclosure
- Software

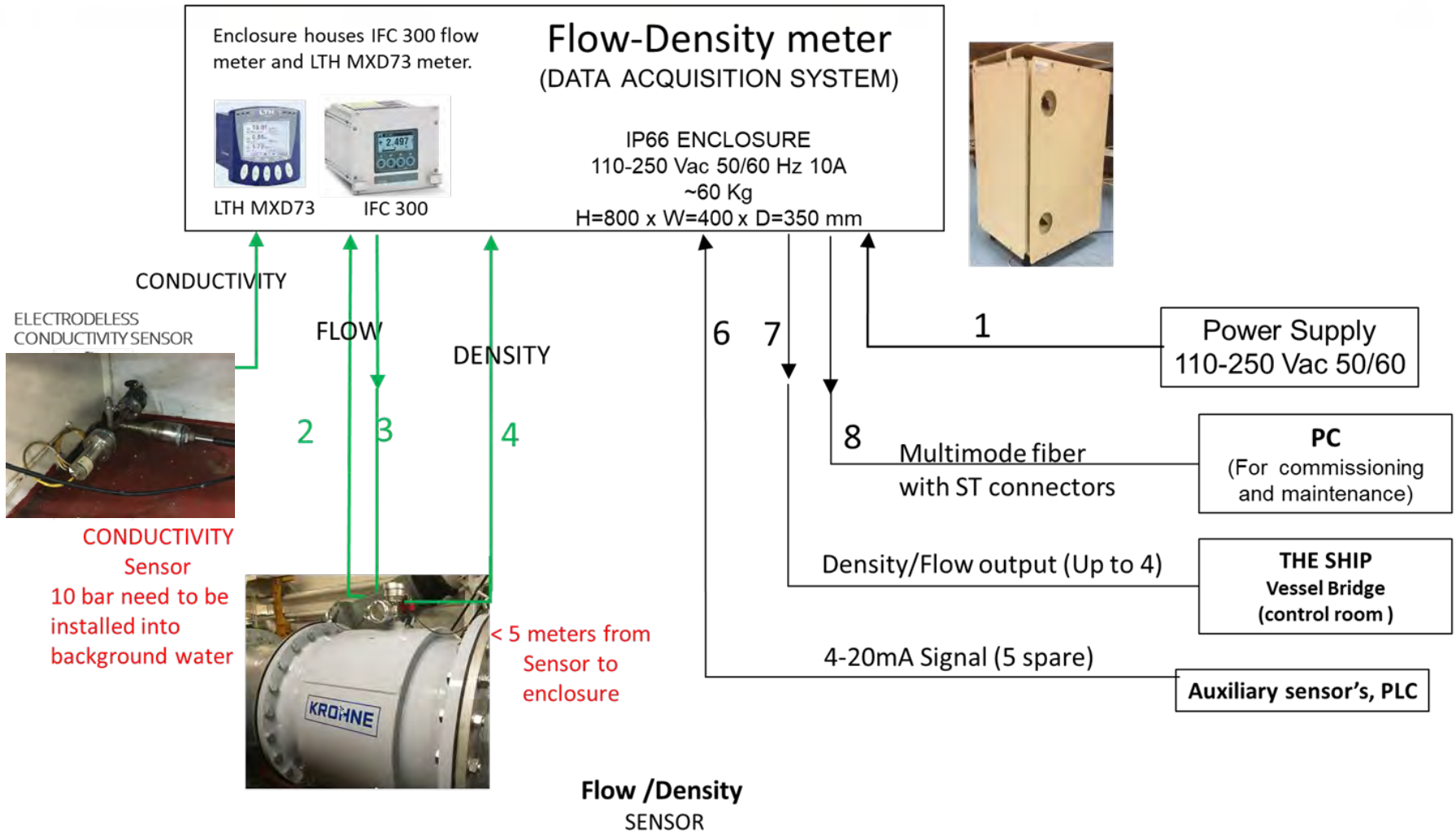
FULL SCALE TRIALS WITH DAMEN AND CEMEX

Sand Falcon

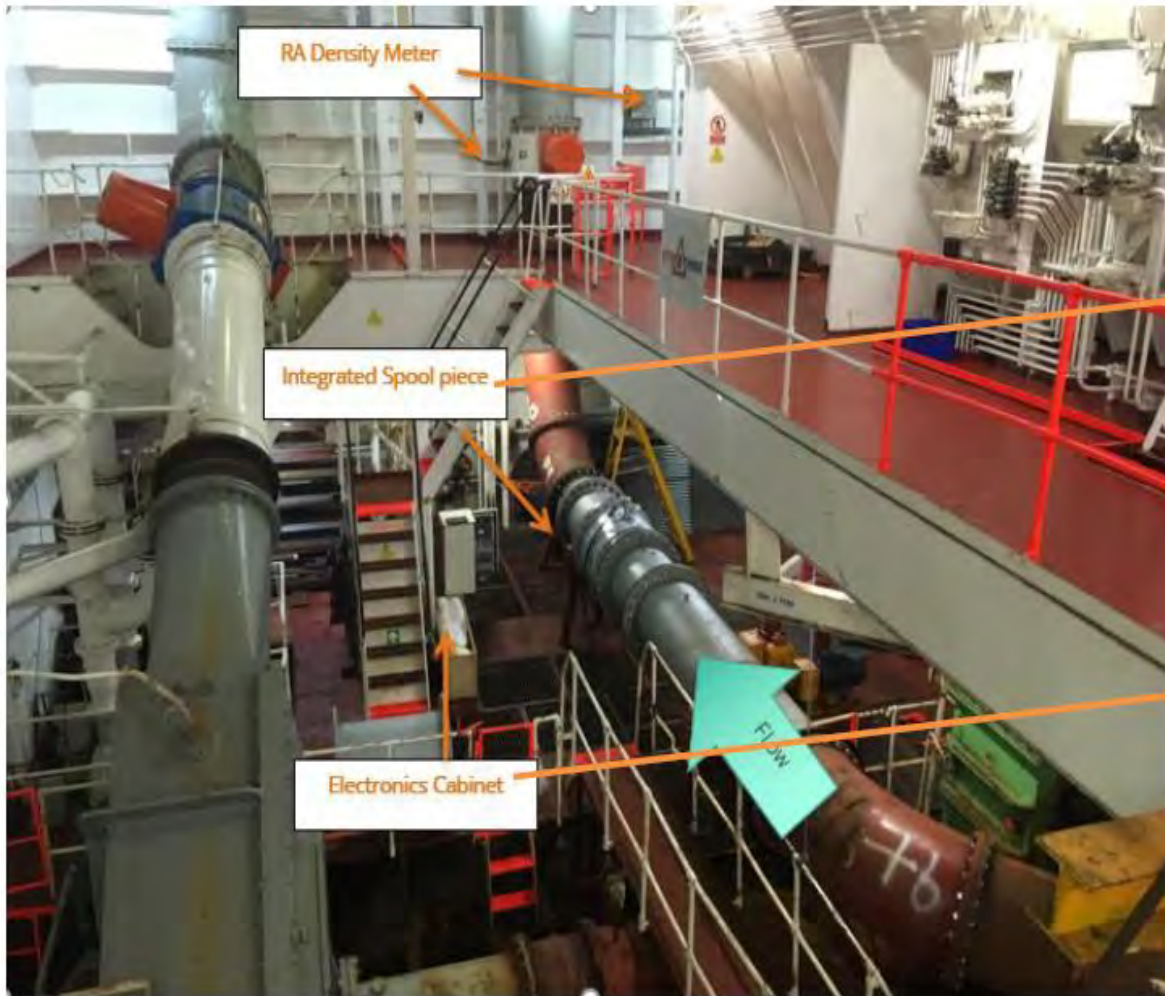
- Owner / Cemex
- THSD
- DN800 PN10
- Sea water – sand/gravel
- Reference meters
- Min 10 full cycles
- 95% agreement



SYSTEM LAYOUT



SYSTEM LAYOUT



OVERVIEW

Introduction

Preliminary tests

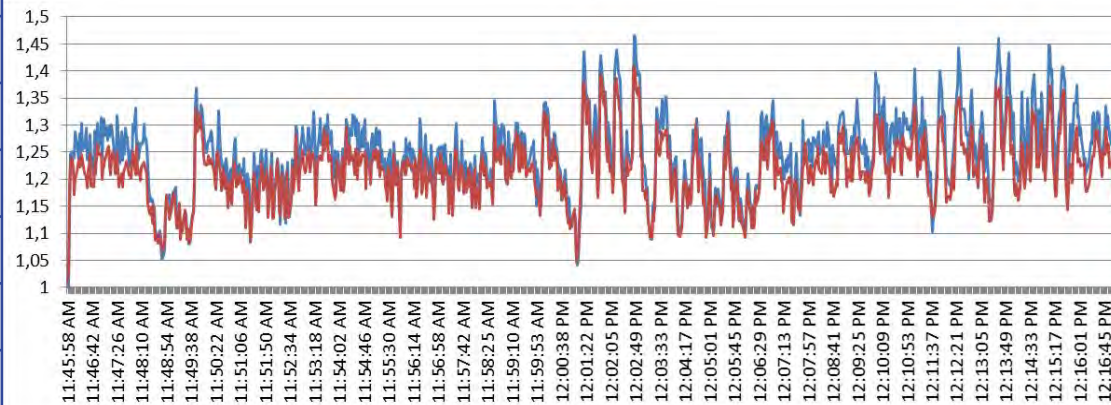
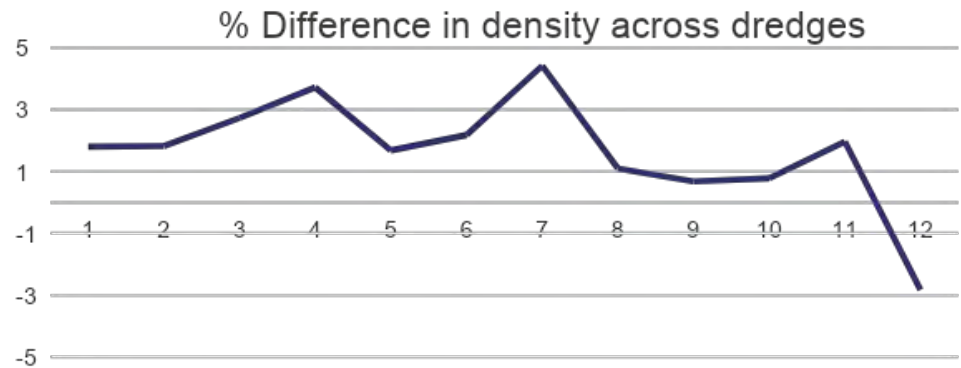
Field tests

Results

Conclusion

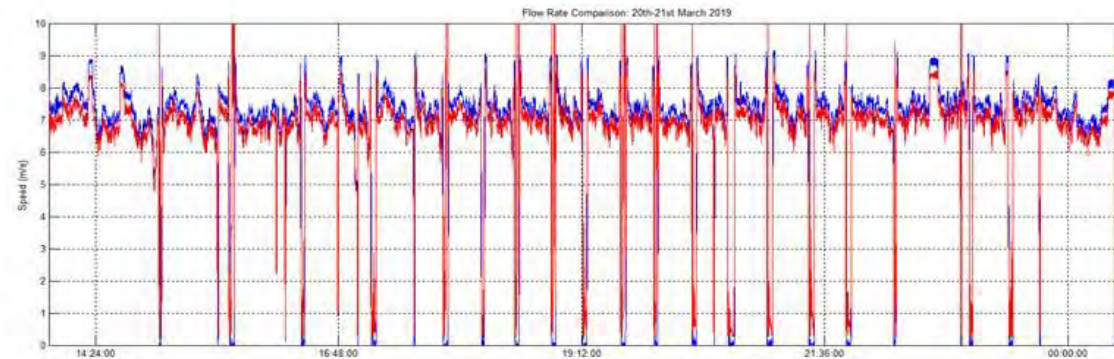
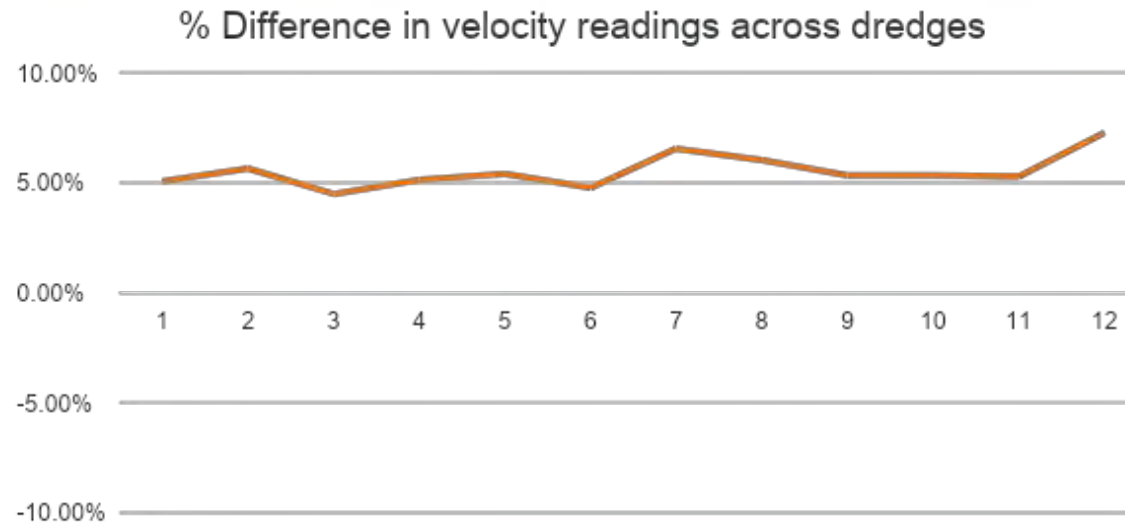
SAND FALCON RESULTS – SOLIDS CONCENTRATION

Dredging time (hh:mm)	No of cycles	% difference	Correlation
02:47	5	1.8	0.96
12:26	32	1.82	0.96
12:18	27	2.73	0.93
00:24	1	3.72	0.96
05:51	6	1.68	0.95
04:52	4	2.18	0.99
05:19	7	4.42	0.93
05:27	13	1.1	0.93
06:37	17	0.68	0.96
07:14	12	0.78	0.93
03:16	5	1.97	0.97
02:53	4	-2.83	0.97
	133 [total]	1.67% [average]	0.95 [average]

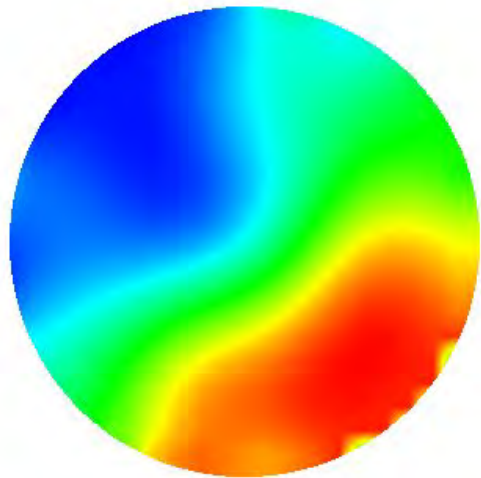


SAND FALCON RESULTS – VELOCITY MEASUREMENT

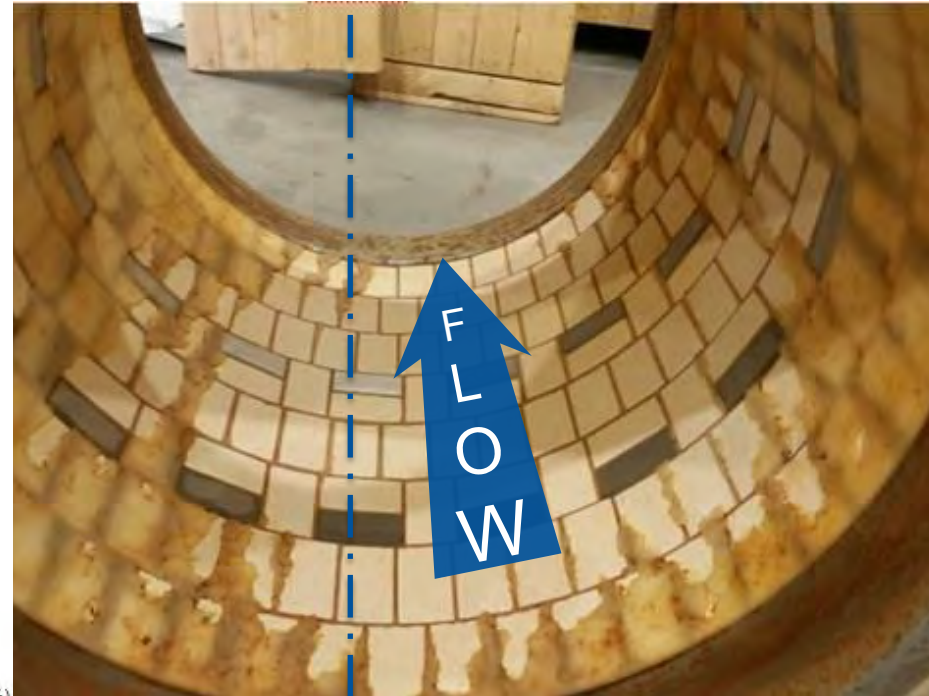
Dredging time (hh:mm)	No of cycles	Average difference (m/s)	% difference
02:47	5	0.392	5.07%
12:26	32	0.438	5.66%
12:18	27	0.359	4.49%
00:24	1	0.397	5.14%
05:51	6	0.385	5.40%
04:52	4	0.381	4.77%
05:19	7	0.478	6.56%
05:27	13	0.516	6.03%
06:37	17	0.434	5.34%
07:14	12	0.428	5.34%
03:16	5	0.394	5.28%
02:53	4	0.558	7.28%
	133 [total]	0.43 [average]	5.53% [average]



SAND FALCON RESULTS – FLOW VISUALISATION



Mean solids distribution (%v/v) over 1,000 measurements (30 min)



Sensor after 6 weeks operation

CONCLUSIONS

CEMEX

- Met all performance requirements – to be fitted to new dredger
- Improved Lloyds (ECO) Classification

Feed back from crew

- System more responsive
- Tomography is valuable additional feature
 - Increased production efficiency
 - Early identification of stuck draghead on the tomograph.
 - Faster responding: maintain optimum sailing speed and dredging depth
 - Faster completion of a loading cycle and lower fuel consumption

Launched as Krohne product

ACKNOWLEDGEMENTS





SEE INSIDE YOUR
PROCESS

Thanks and any questions....

REAL TIME PRODUCTION EFFICIENCY
BASED ON COMBINATION OF
NON-NUCLEAR DENSITY & MAGNETIC FLOW INSTRUMENTATION

WEDA 7th June 2019