



## HydraCT™ PWC® system

Our latest revolutionary PWC® annular remediation system for coiled tubing applications

Erlend Engelsjerd, Sales Manager

**POWERED BY INVENTION**



# What do HydraWell do?

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- **Install Engineered wellbore barriers**
  - CFD modelling and design
  - Analogues from over 560 barriers installed
  - Process focused verification
  - Qualification matrix providing assurance
- **Save Time and Cost**
  - Rig-less P&A - HydraCT™
  - Established track record



# Agenda

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- Development of PWC® fleet to HydraCT™
- Well Candidate Screening
- System Selection Process
- Design and Experience
- CFD
- Case Study – Ullrigg
- Case Study – North Slope Alaska
- Track Record
- Lessons learnt
- Ongoing Developments

- **Install Engineered wellbore barriers**

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- **Save Time and Cost**

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## HydraCT™ is leading the way to rigless P&A

Our latest Perf, Wash & Cement (PWC®) solution is engineered for coil tubing applications.

Our push for discovery and advancement means we constantly evolve our patented PWC® technology.

HydraCT™ is an industry first, advanced cementing system that has already allowed Operators to change to rigless P&A.

Potential to:  
Reduce costs by up to **60%**  
Cut Co2 emissions by **80%**

**Zero Rigs. Zero Rig Costs. Zero Compromise.**  
**TOTAL WELL ASSURANCE**

# How did we get here?

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As responsible P&A innovators, our technology has evolved over the years.



**HydraCT™**  
Coiled Tubing Based



**HydraTyphon™**  
Hybrid Cup + Jet



**HydraHemera™**  
Jet Based System



**Hydrawash™**  
Cup Based System

Value Creation

**2023**  
Eliminate Rig

Expand Operating Envelope

Reduce to <24hrs per Plug

**2010**  
Eliminate Section Milling

# HydraCT™ - How does it work?

Jet Propulsion  
Rotating Washing and  
Cement Head



Swivel Jet  
MK 1



Expandable  
Fluid Diverter



Expandable Fluid Diverter  
Indirect injection



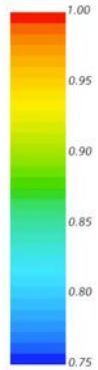
Jet Propulsion Rotating Washing  
Head  
Direct injection



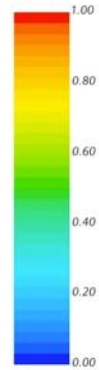
# CFD Modelling - Rotation

Plane following nozzles

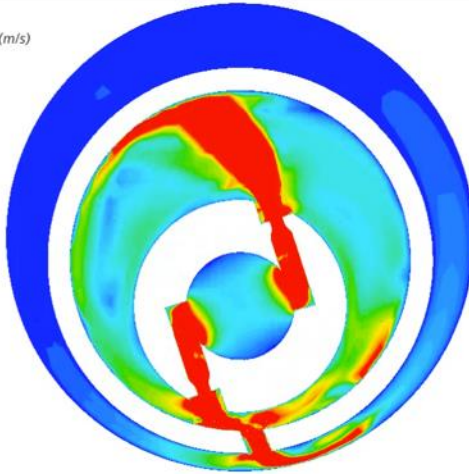
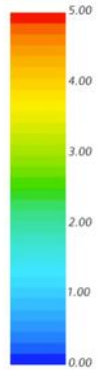
Volume Fraction of Cement



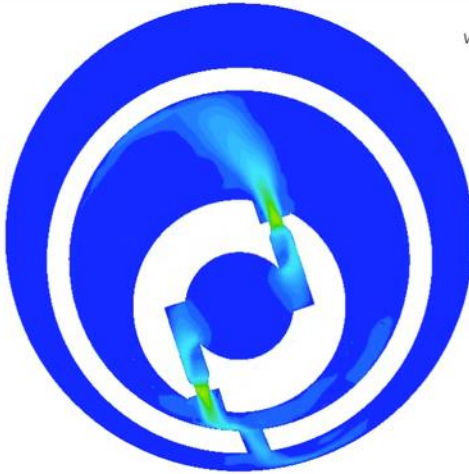
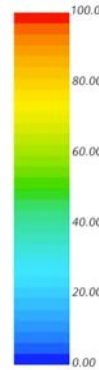
Volume Fraction of Cemen:



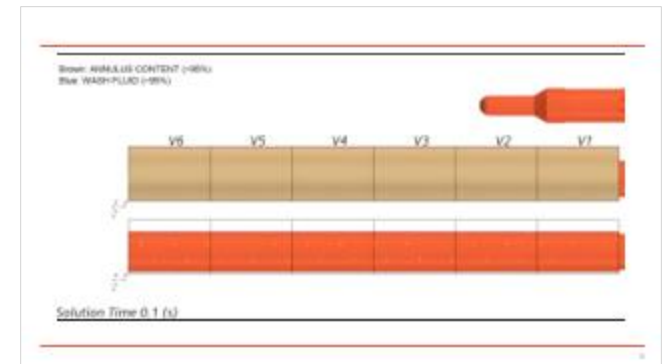
Velocity: Magnitude (m/s)



Velocity: Magnitude (m/s)

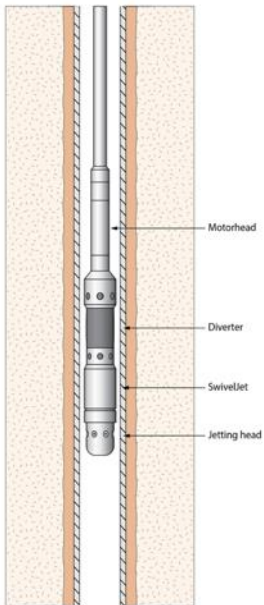


Solution Time 265.8 (s)

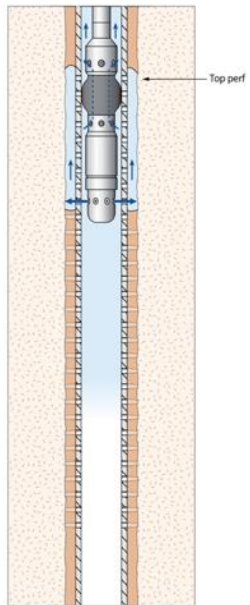


# PWC<sup>®</sup> operational steps

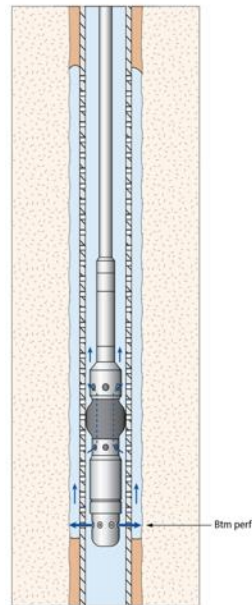
Perforate & RIH with HydraCT BHA



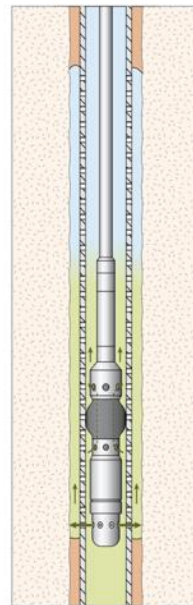
Wash perforations



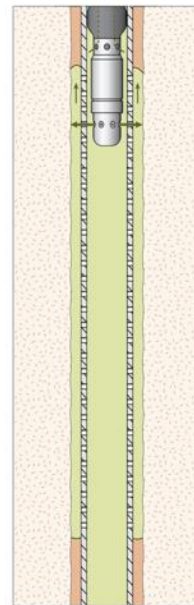
Wash perforations



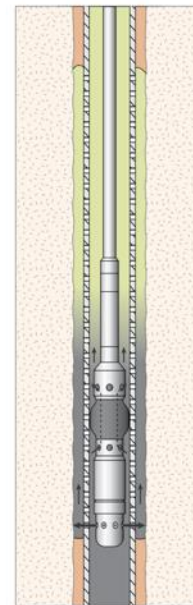
Place spacer



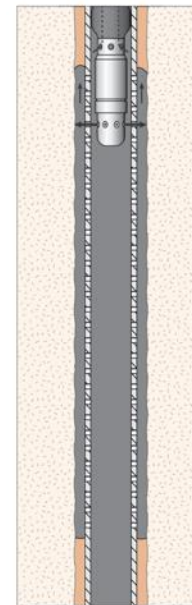
Place spacer



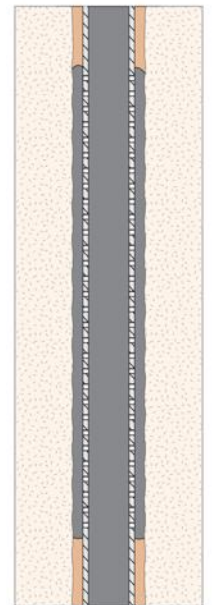
Place cement



Place cement



POOH





# Specifications and alternative applications

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## SPECIFICATIONS

- Tubing Sizes: 4-1/2", 5", 5-1/2", 6 5/8" & 7"
- Min. tool OD: 3.6"
- Flow rates: 2-5 bpm ( 300-800l/min)
- Coiled tubing size: 2" - 2 7/8"
- Rotational speed: Adjustable 20-150 rpm

## OTHER APPLICATIONS

- Sand screen cleaning
- DHSV cleaning
- Wellbore cleanouts
- Scale removal with abrasive media
- Tubing Cutting using abrasive media

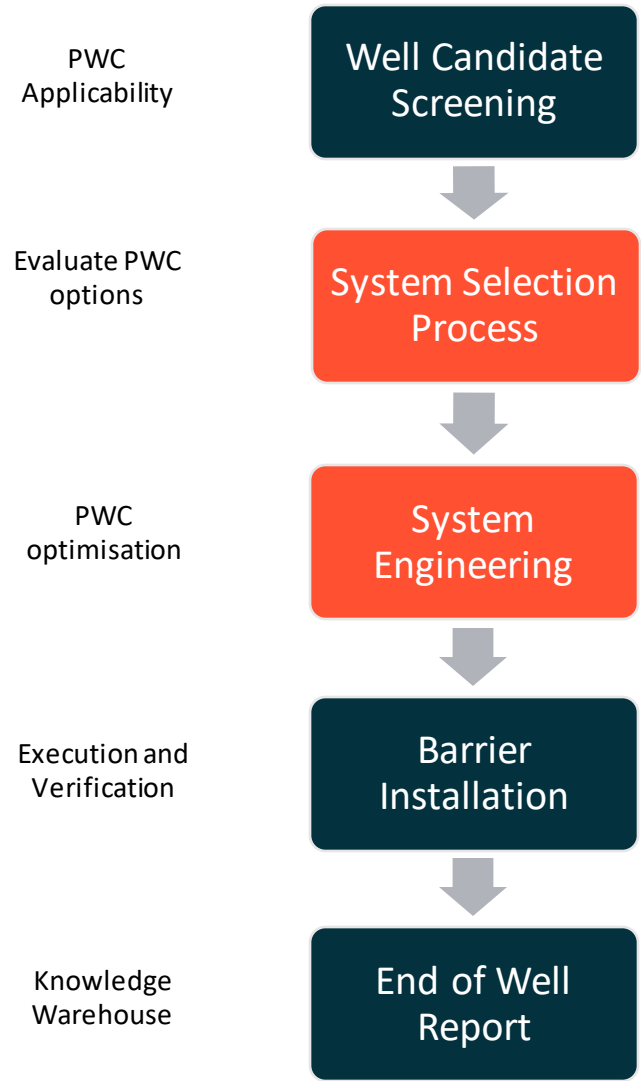
## FEATURES

- Jet propulsion driven wash/spacer/cement tool
- Expandable packer diverting Cement into annulus
- Incorporated pressure relief bypass system
- Integrated long lasting rotational face seal
- Adjustable RPMs
- Interchangeable wash head size
- Change from wash to cement mode downhole

## BENEFITS

- Ability to perform PWC® on CT or Limited Spec Rig
- Assurance of Cement displacement
- Risk reduction of over pressuring formation
- Increased Operational Reliability
- Flexibility to modify to well conditions
- Highly efficient Single trip system

# Not just a tool however – it's a Service



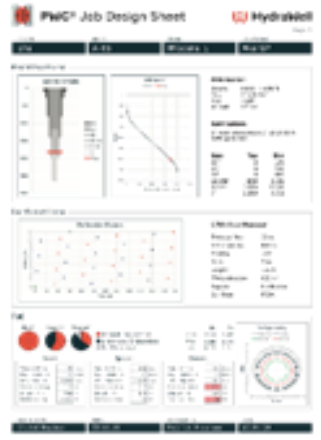
Inputs matched

**CFD database**  
Sizes, PWC Types, Fluids, TCP

**Engineering Database**  
550+ Plugs  
20,000+ Datapoints

Translating into

Digital Twin outline of job parameters for QA Process



# Case Study – Ullrigg



# HydraCT™ - Ullrigg U-8

## SUCCESSFULLY INSTALLED CROSS-SECTIONAL CEMENT BARRIER IN CASING WITH COIL TUBING POSITIONS

### AT A GLANCE

**When:** 2021

**Scope:** PWC® using coiled tubing in 6-5/8" x 10-3/4" casing

### CHALLENGE

The client required a PWC® supplier to wash and cement a 6-5/8" x 10-3/4" annulus avoiding rotation of the coiled tubing.

By running coil tubing as the deployment method, rotation of the BHA is not possible, therefore a self-rotating washing BHA is crucial for coil tubing applications.

HydraWell trialed our newly developed HydraCT™ solution demonstrating effective cleaning and cementing with only jet propulsion rotation.





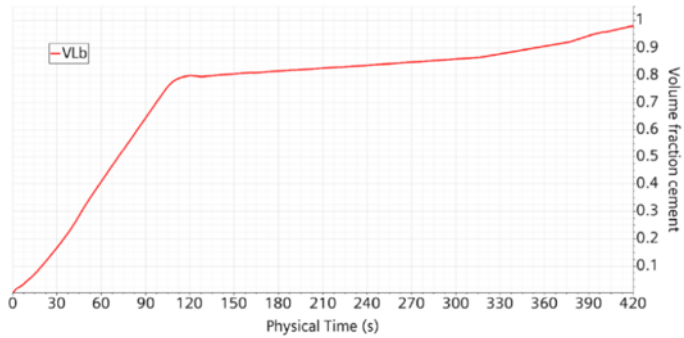
## CFD Simulation Result



## Operational Result

- 99% cement across cross-section\*
- \*Clamp section <95% cement

Fill fraction over time

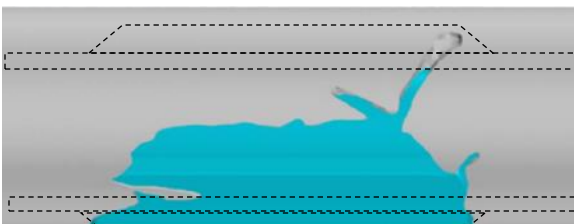


Final fill fraction

Final Fill	V0b	V1b	V2b	V3b	V4b	V5b	V6b	V7b	V8b	V9b	VLb
[%]	99.2	99.2	99.0	99.2	99.2	99.1	99.1	99.3	99.2	87.9	98.0

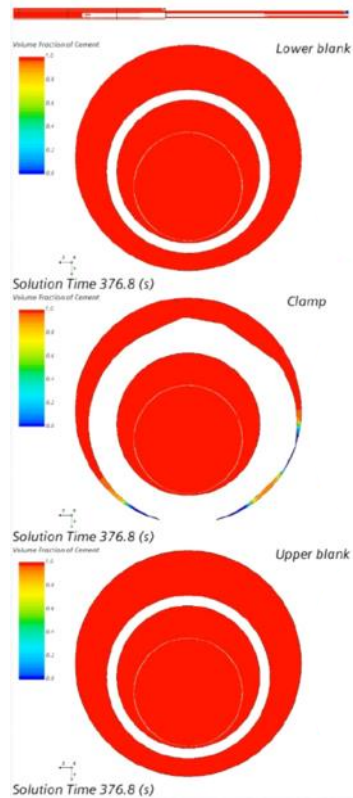
█ Cement fraction >95%

Clamp section



█ 100% cement  
█ 0% cement

Results: Critical areas



- Tagged TOC at planned TOC
- Drilled hard cement thru entire cemented interval.
- Isolation scanner used to log Cement bonding.
- Retrieved and cut joints fully cemented in cross section.

Inspection: Fully cemented cross-section

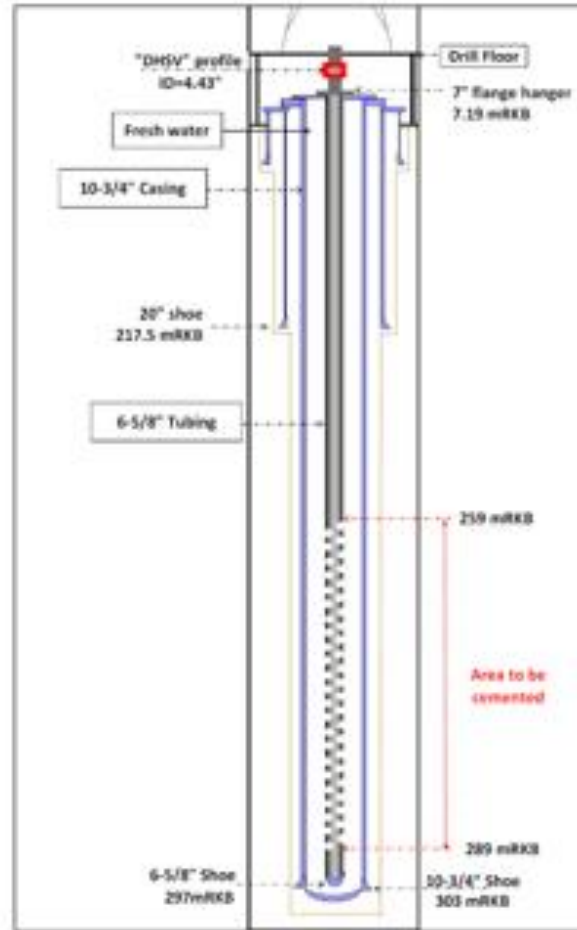


# HydraCT™ execution on Ullrigg U-8

## Sequence

- RIH while circulating 100l/min
- Wash Predrilled perforations from 259m to 289 m with 400l/min and 0,5 m/min thru 4 x 5/32" Nozzles
- Activated cementing mode 2 x 8/32" Nozzles with 5/8" ball
- Pumped and injected 5,5 m3 1,95 sg cement across perforations, 240l/min and 1,75 m/min pulling speed
- Circulated excess cement at 15 m above top perforation
- Washed well with 400l/ min while pulling out to surface.

U-8 Well Schematic

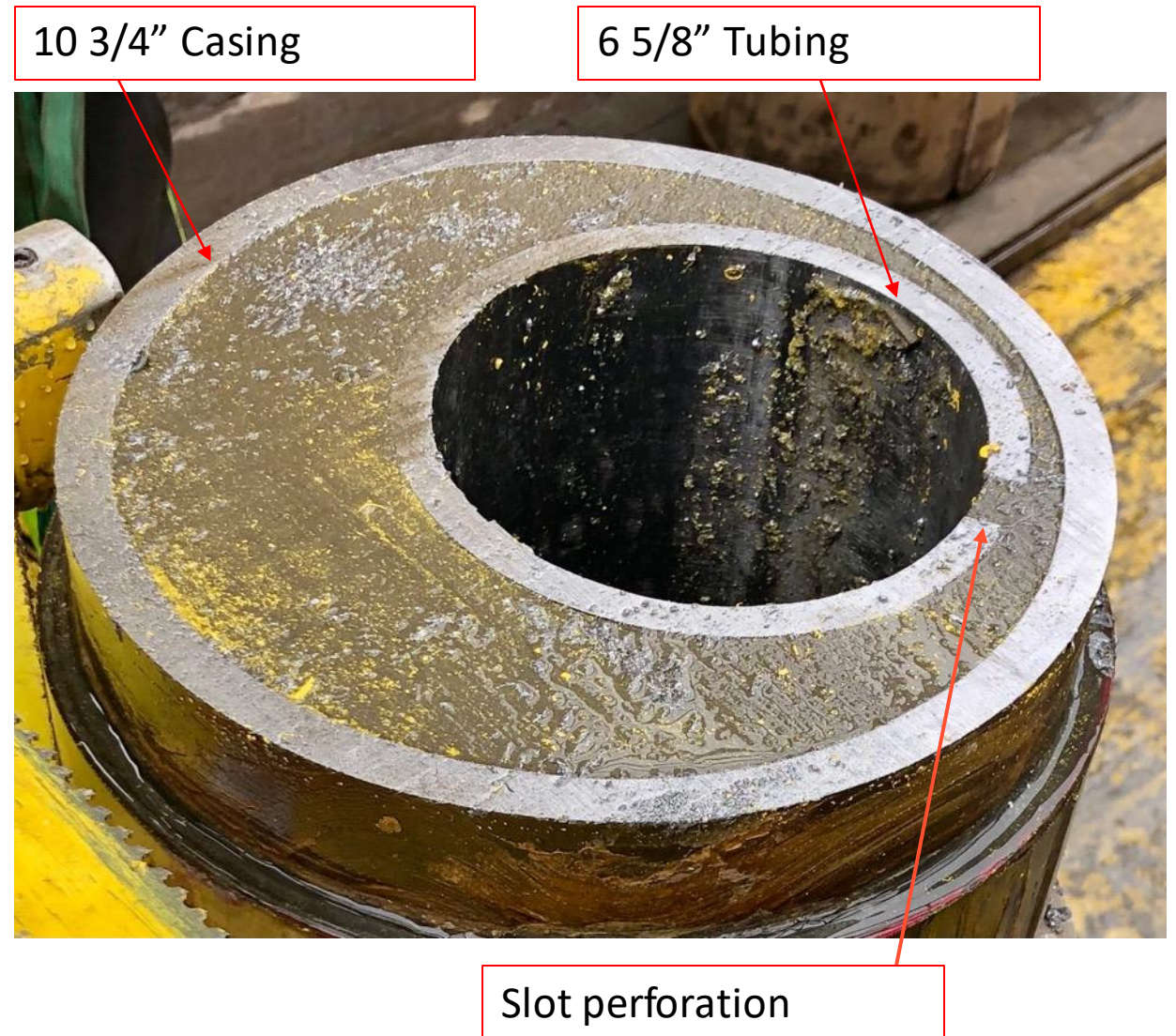


Customer:		Total									
Company Rep.:		Daniel Tomczak									
Platform/Rig:		Ullrig									
Well Number:		SIT									
Project No.:											
Type of Operation:		Run 01: Hydrwell Cementing and Jetting BHA									
Item	Assembly Drawing	Description/Setting	OD (in)	ID (in)	Length (cm)	Tensile	M/U Torque	Connection	Supplied by	Serial No.	Weight (lbm)
1		EXTERNAL CONNECTOR Dimple Connector Pull Test at 40k lbf	2.875	1.98	15		N/A	2" CT String 2 3/8" PAC OSI P/N	SILB CTS		
2		MHA Maximum Tensile: 70.7kIbs Maximum Torque: 1,800-ft-lb Hydraulic disconnect 7/8" Drop Ball Disc = 3 x Pin (+226 BAR shear pressure) Circulation Sub 3/4" drop ball Circ. Sub 6 pins (Whall "209 BAR/ 7100 ball" 453849) Fishing Tool = OS 3.00m long catch	2.875	1.125	80	70700.00	1980.00	2 3/8" PAC OSI BOX 2 3/8" PAC OSI P/N	SILB CTS		
		STABILIZER Maximum Tensile: 122.3kIbs Maximum Torque: 4,000 ft-lb	4.250	1.25	55	122000.00	1980.00	2 3/8" PAC OSI BOX 2 3/8" PAC OSI P/N	SILB CTS		
		Hydrwell PWC	4.250	0.750	130	N/A		2 3/8" PAC OSI BOX	Hydrwell		
		Cement Nozzle: 2x 8/32in Wash Nozzle: 4x 5/32in Shifting Ball: 5/8in * +/- 2000psi activation pressure*	3.850								
		Approved by (supplier):	Sign:								
		Client:									
		Schlumberger:									
		Schlumberger:									
		B.H.A. Prepared by:	Date:	Rev Number:	Total weight (kg):						
		Anders Hansen	08-Jun-21	1	TTC						
		Max OD (inch)	4.250	Tot. Length (cm)	280.00						



# HydraCT™ results from Ulrrigg U-8

- Drilled hard cement thru entire cemented interval.
- Tagged TOC at planned TOC
- Isolation scanner used to log Cement bond, perfect bond.
- Retrieved and cut joints fully cemented in cross section.



# Coil Tubing PWC®

HydraCT™ is a PWC system for installing a well barrier on coil tubing

Comparison HydraCT vs regular DP deployed Hemera

CFD Case #20	Kaparuk S3	Result
9-5/8" x 13" OH	7" x 8-1/2" OH	
60in <sup>2</sup> annulus x-section	18in <sup>2</sup> annulus x-section	30 % of annulus volume
12 x 0.5" perfs: 2.3in <sup>2</sup> TFA	21 x 0.84" perfs: 11,6in <sup>2</sup> TFA	494 % larger casing removal
HydraHemera™	HydraCT™	
2 x 8/32" nozzles	2 x 7/32" nozzles	
8" OD tool: 0.268" clearance	5.75" OD tool: 0.155" clearance	Tool closer to casing ID

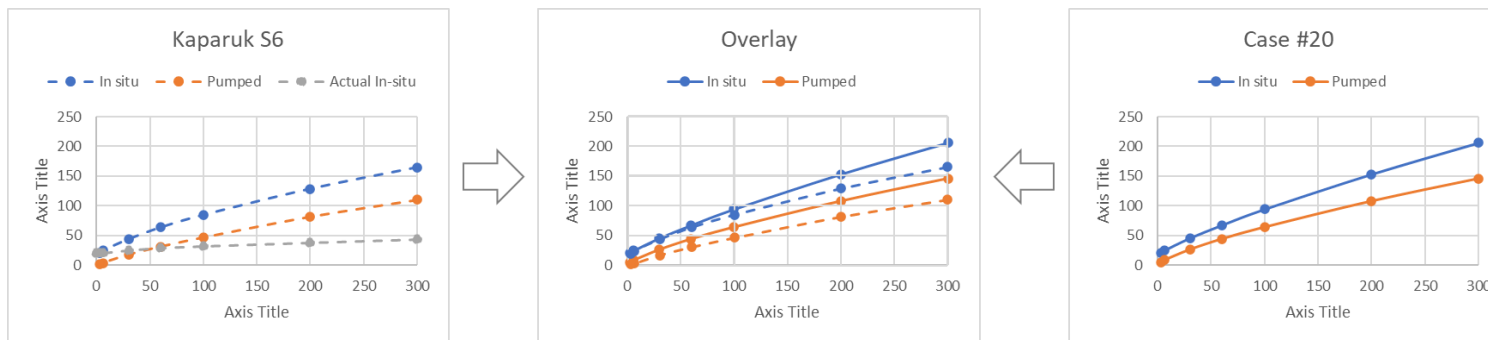
## Conclusions

The fluid properties used in Case #20 are more conservative than the proposed properties for Kuparuk S3.

Note that spacer/cement design can and should be improved to reduce the spacer density, rheology, and intermix viscosity.

The combined effect of reduced annulus volume and increased perforation TFA (access to the annulus) results in a significantly less challenging operation for Kaparuk S3 and implies that the running parameters can be reduced substantially while maintaining the same high quality cement barrier (99.4% cement fraction).

Similar fluid design



- All wells perforated on wireline prior to CT unit rigging up
- 2" short reel used for majority of the wells
- Pump pressures between 3000-4000 psi during washing with 3,5 bbl. / min slick seawater
- Cementing pressures between 3500-4500 psi with 1,65 bbl. / min
- 65 to 70 bbl. 15,8 ppg cement used.
- No closed loop circulation used, new water supply from tanks. Return fluid trucked off location.
- Seawater consumption between 1500 -1600 bbl.
- Operation time 12-16 hours
- PowerVis high-vis pills used for improved clean out and used for contaminating excess cement.

