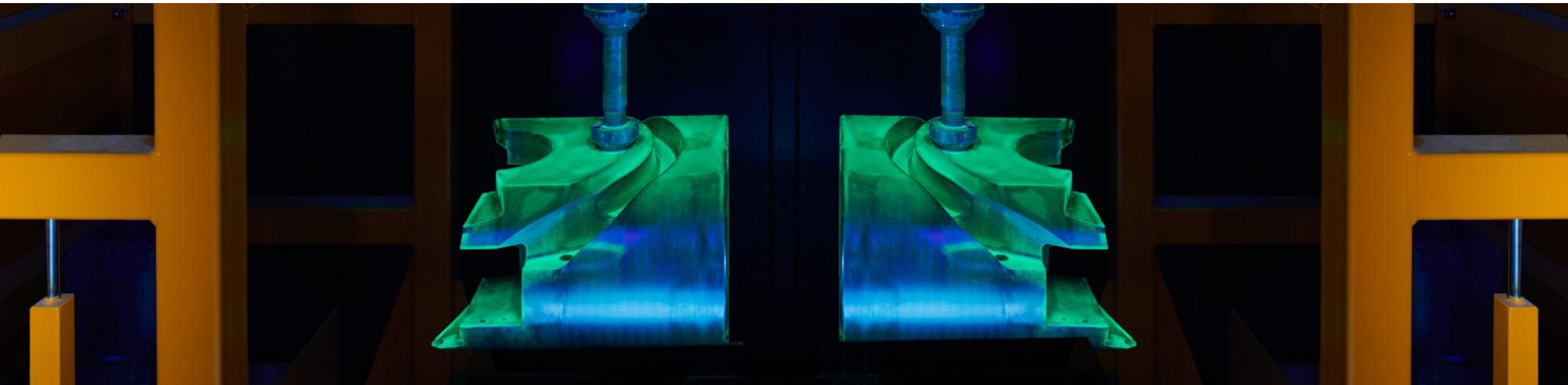


# A Sustainable Circular Economy Success Story Using Drilled Cuttings in Cement

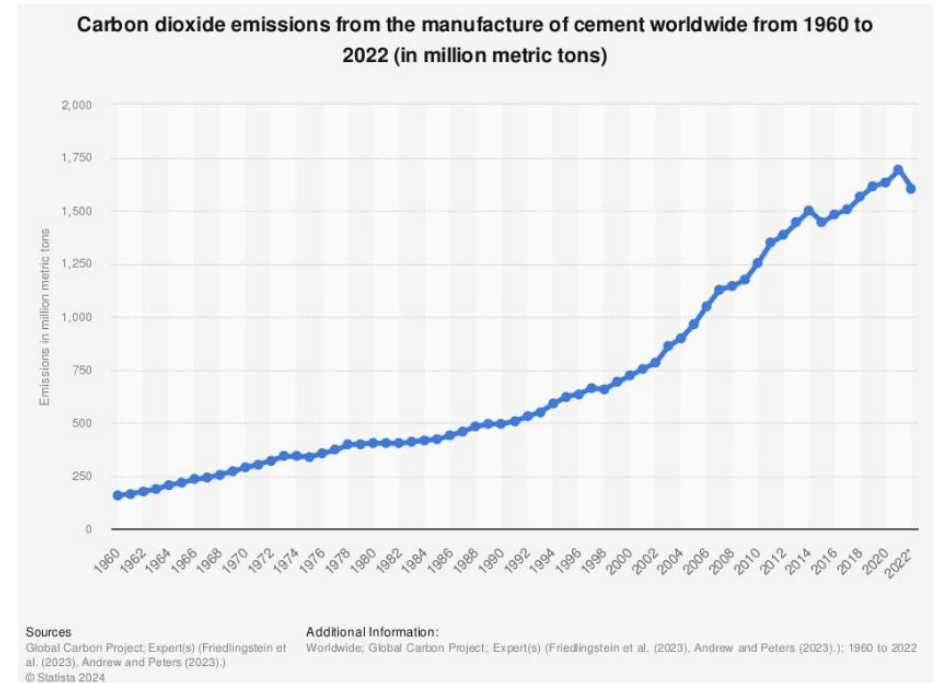
Havtil Technical Seminar: "Plugging and Abandonment of Wells"

7<sup>th</sup> May 2026

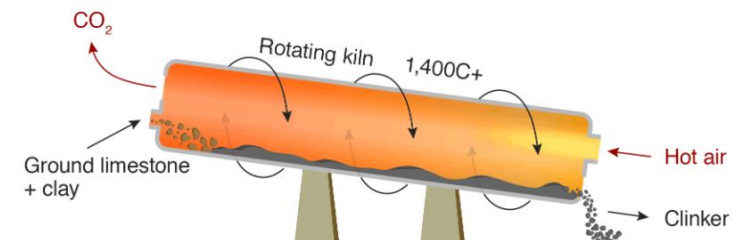


# Why is Cement Production so CO<sub>2</sub> Intensive?

- Cement manufacture is responsible for ~8% of global CO<sub>2</sub> emissions → and rising!
- Around 40% of CO<sub>2</sub> emissions comes from combustion of fuel, fine grinding, etc., and 60% from decarbonization of limestone to form clinker minerals.
- This single chemical reaction is a major emitter of global carbon dioxide emissions:

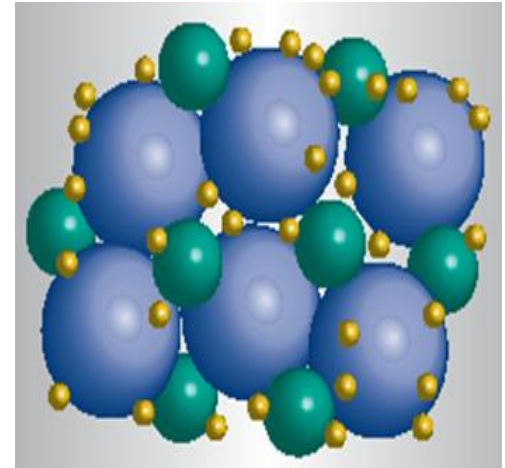


## Cement Manufacturing Process



# Lowering Our Cementing CO<sub>2</sub>(e) Footprint: Possible Alternatives?

- Lower CO<sub>2</sub> intensive cement blends are used in the oilfield every day.
  - API Class G + silica flour cement → High bottom hole temperature sections
  - Lightweight cement blends → Isolating weak top-hole formations
  - Flexible / expandable cement blends → Dynamic stress environments
- These slurry solutions are not used to lower cementing CO<sub>2</sub>(e) footprint due to **COST.**
  - Many blend components are more expensive than cement
  - Blending requires additional labour and logistics
  - Significant R&D investment to develop blended solutions
- Need to ensure blend components are significantly cheaper than Portland cement to recover the above costs.



# Base Oil Recovery: The Start of Our Journey

- In Norway, 10's k MT of oil-wet drilled cuttings / slops are generated and backloaded for disposal via land fill each year.
- A “Thermomechanical Cuttings Cleaner” (TCC) process is utilized to process the cuttings and separate them from base oil.
- By the end of the TCC process, a significant quantity of processed cuttings are generated, which until recently had no identified technical function.

Extraction from “Cuttings Pit”



Heating Process to Separate Base Oil / Drilled Cuttings



Processed Dried Cuttings Transported to Skips





# Qualification Process

• Would a Drilled Cuttings Cement Blend (DCCB) be:

a) Technically Feasible?



- Performance Testing (API RP 10B-2, 2024)
- Blend Characterization
- Blend Flowability

b) Operationally Safe?



- Chemical Composition
- Respirable Particle Content
- SDS Creation

c) A Robust Well Barrier Material?



- Compressive Strength Development / Trend
- Set Cement Permeability



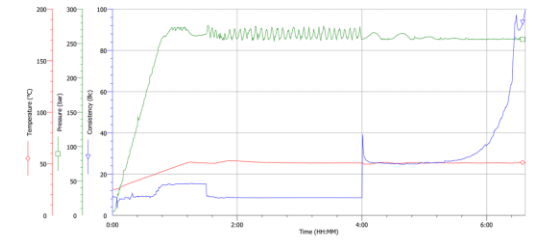
## Laboratory Cement Test Report SCA 2024-387 v1

LAR Name : SCA 2024-387		Client : SLB	Location : Bergen WCB Lab	Signature		
Date : Nov-21-2024		Well Name : Cutting Project	Rig :	Asksandr Kirakov		
Job Type	: 9.56" Liner	MD	: 2.890 m	TVD	: 1.785 m	
BHST	: 78 °C	BHCT	: 51 °C	BHP	: 264 bar	
Starting Temp	: 21 °C	Time To Temp	: 01:11 hr:min	Heating Rate	: 0.42 °C/min	
Starting Pressure	: 34 bar	Time To Pressure	: 00:47 hr:min	Schedule	: Simulated	
<b>Composition</b>						
Slurry Density	: 1.90 SG	Yield	: 80.37 L/100kg	Mix Fluid	: 48.31 L/100kg	
Solid Vol. Fraction	: 43.75 %	Slurry Type	: Conventional	Mix Water	: 33.01 L/100kg	
<b>Code</b>	<b>Concentration</b>	<b>Sack Reference</b>	<b>Component</b>	<b>Density</b>	<b>Lot Number</b>	
D907	80.00 % BVWOB	Cement sack: 43 kg	Cement	3.22 SG	SIB8173 / Site 112	
	20.00 % BVWOB		Cutting	2.76 SG	SIB8194 / Cuttings	
D242	0.10 L/100kg BVWOB		Antifoam	0.90 SG	SIB8091 / 1A00096345	
D155	10.00 L/100kg BVWOB		Anti-settling	1.40 SG	SIB8151 / No LOT	
D168	3.40 L/100kg BVWOB		Fluid loss	1.98 SG	SIB8089 / FSD0045938	
D240	1.80 L/100kg BVWOB		Dispersant	1.13 SG	SIB7984 / 92400674	
Fresh Water	33.01 L/100kg of cement		Base Fluid			
<b>Rheology</b>						
Temperature			RAM @ 21 °C			
(rpm)	Up (deg)	Down (deg)	Average (deg)	(rpm)	Up (deg)	
300	86.0	86.0	86.0	300	109.0	
200	65.0	66.0	65.5	200	85.0	
100	43.0	42.0	42.5	100	57.0	
60	33.0	32.0	32.5	60	44.0	
30	24.0	24.0	24.0	30	33.0	
6	17.0	16.0	16.5	6	19.0	
3	16.0	15.0	15.5	3	14.0	
10 sec Gel	25 deg - 26.61 bf/100R <sup>2</sup>			10 sec Gel	15 deg - 15.97 bf/100R <sup>2</sup>	
10 min Gel	64 deg - 68.12 bf/100R <sup>2</sup>			10 min Gel	78 deg - 83.03 bf/100R <sup>2</sup>	
Rheo. computed	PV: 71.09 cP, Ty: 16.62 bf/100R <sup>2</sup>			Rheo. computed	PV: 62.77 cP, Ty: 20.24 bf/100R <sup>2</sup>	
<b>Thickening Time</b>			<b>UCA Compressive Strength @ 64°C</b>			
Consistency	Time		Time	CS		
30 Bc	05:51 hr:min		08:37 hr:min	3 bars		
70 Bc	06:25 hr:min		11:06 hr:min	34 bars		
100 Bc	06:36 hr:min		12:00 hr:min	45 bars		
			24:00 hr:min	177 bars		
<b>Free Fluid</b>			<b>Static Gel Strength</b>			
0.0 / 250 mL in 2 hrs			Time	SGS		
At 21 °C and 45 deg inclination			05:48 hr:min	100 bf/100R <sup>2</sup>		
Sedimentation: None			06:22 hr:min	500 bf/100R <sup>2</sup>		
<b>Fluid Loss</b>						
API Calculated Fluid Loss 36 mL						
16 mL in 30 mins at 51 °C and 69 bar						
<b>Comments</b>						
SIB8173 Dyckerhoff G from Silo 112, received in Bergen Lab on 27.09.2024.						
SIB8194 Cuttings, received in Bergen Lab on 04.10.2024						
Mixing Order: FW + D242 + D155 + D168 + D240 + (D907+Cutting)						
RAM: Right After Mix.						
Time to add cement/blend: 24 sec. Good, visible vortex.						
Surface 10 Min Gel. Maximum Deviation: 64. Minimum Deviation: 27						
BHCT: 10 Min Gel. Maximum Deviation: 75. Minimum Deviation: 43						
Thickening Time Test Performed with Go - No Go Test: 90 min Dynamic Conditions, then 150 min Static, then Start again.						
D240 acts as a retarder and must be treated like a retarder.						
The mixing of D242 and D155 may cause precipitates/solids to form. Proceed with caution with any contact of these additives.						
<b>URGENT - D168 and D155 are extremely incompatible. Ensure there is NO RAW CONTACT between these additives.</b>						

Customer: SLB  
Well/Cutting Project  
BHCT 51 °C  
BHP 264 bar

Project  
Line: L193 Kg  
Slurry: 80% BVWOB Dyckerhoff G + 20% BVWOB Cuttings + 0.1 D42 + 10.0 D155 + 3.4 D168 + 1.8 D240 (BVWOB)

38 Bu: 05:01:00  
79 Bu: 06:25:00  
100 Bu: 06:37:30



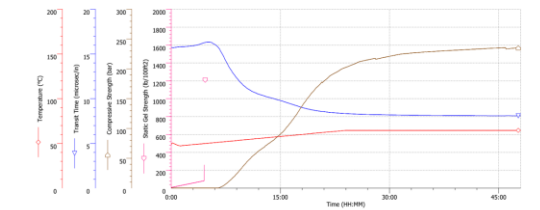
Test File Name: SCA 2024-387 v1 Core 1 TT Cutting Phase II BU\_25\_S\_Cut.M



SLB Well ID: Cuttings Project  
Slurry: 1.90 SG  
Current Strength 250 bar  
Current Travel time 7.38 microseconds

Project  
Algorithm: Compressive strength (less than 14 digits)  
Line: L193kg  
Slurry

Test time: 06:42  
Test pressure: 249 bar  
Time to 3 bar: 07:01:30  
Time to 50 bar: 09:43:00  
Strength @ 15 min: 62 bar  
Strength @ 30 min: 202 bar



Test File Name: SCA 2024-341 v6 SCSA 6 Record @ 47°C for 74 min with 20% Cuttings SIB8758

Criteria	Acceptable Limits for Onshore	Acceptable Limits for Offshore	Blend Results	Acceptability
Flowability	CI < 31% or HR < 1.45	CI < 31% or HR < 1.46	22% 1.27	Passable Acceptable for on and offshore
	FFc > 2	FFc > 2.5	2.74	Weakly Cohesive Acceptable for on and offshore
	AE (3mm/s) < 400mJ	AE (3mm/s) < 300mJ	279	Weakly Cohesive Acceptable for on and offshore
Non-Segregation Robustness	Cv < 6%	Cv < 4%	0.5	Very Robust Acceptable for on and offshore

# Qualification Process

- Would a Drilled Cuttings Cement Blend (DCCB) be:

## a) Technically Feasible?



- Performance Testing (API RP 10B-2, 2024)
- Blend Characterization
- Blend Flowability

## b) Operationally Safe?

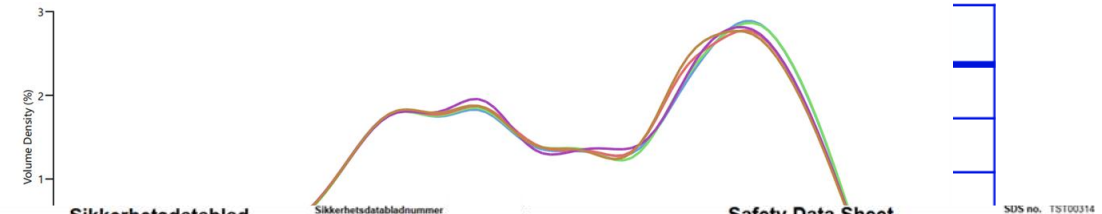


- Chemical Composition
- Respirable Particle Content
- SDS Creation

## c) A Robust Well Barrier Material?



- Compressive Strength Development / Trend
- Set Cement Permeability



**Sikkerhetsdatablad**  
Sikkerhetsdatabladnummer TST00314

**Drilled Cuttings Blend**  
Revisjonsdato 17.mar.2025  
Versjon 1

**1. Identifikasjon av stoffet/preparatet og av selskapet/foretaket**

**1.1 Produktidentifikator**

Produktnavn	Drilled Cuttings Blend
Produktkode	TST00314
Land restriksjoner	Limited to use in these countries: Norway
UFI:	HX01-M0FS-T00K-4AVY

**1.2 Relevante identifiserte anvendelser av stoffet eller blandingen og anvendelser som frarådes**

**Anbefalt bruk** Brukes som sementerings tilsetningsstoff i behandling av olje- og gassbrønner

**Frarådet bruk** Forbrukeranvendelse

**1.3 Opplysninger om leverandøren av sikkerhetsdatabladet**

**Leverandør** Schlumberger Norge AS  
Risabergveien 3  
4056 Tananger  
Norway  
+47 5157 7424  
SDS@slb.com

**1.4 Nødetelefonnummer**

**Nødetelefon** (24 timer) Australia +61 2801 44558, Asia Pacific 65 3158 1074, Kina 86 10 5100 3039, Europa 44 (0) 1235 239 670, Midt-Osten og Afrika +44 (0) 1235 239 671, New Zealand +64 9929 1483, USA 001 281 595 3518, Canada 001 613 996 6666

**National Poison Center Numbers**

Norge	Giftinformasjonen: +47 22 59 13 00
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**2. Fareidentifikasjon**

**2.1 Klassifisering av stoffet eller stoffblandingen**

Klassifisering i henhold til regulering (EU) nr. 1272/2008 [CLP]

Helsefare	Kategori
Respirasjonshudirritasjon	Kategori 2
Alvorlig øyeskade/øyneirritasjon	Kategori 1
Spesifikk miljøorgantoksisitet - enkel eksponering	Kategori 3
Spesifikk miljøorgantoksisitet - gjentatt eksponering	Kategori 2

**Safety Data Sheet**  
SDS no. TST00314

**Drilled Cuttings Blend**  
Revision date 17-Mar-2025  
Version 1

**1. Identification of the Substance/Preparation and of the Company/Undertaking**

**1.1 Product identifier**

Product name	Drilled Cuttings Blend
Product code	TST00314
Country Limitations	Limited to use in these countries: Norway
UFI:	HX01-M0FS-T00K-4AVY

**1.2 Relevant identified uses of the substance or mixture and uses advised against**

**Recommended Use** Used as a cementing additive in oilfield applications

**Uses advised against** Consumer use

**1.3 Details of the supplier of the safety data sheet**

**Supplier** Schlumberger Norge AS  
Risabergveien 3  
4056 Tananger  
Norway  
+47 5157 7424  
SDS@slb.com

**1.4 Emergency Telephone Number**

**Emergency telephone** (24 Hour) Australia +61 2801 44558, Asia Pacific +65 3158 1074, China +86 10 5100 3039, Europe +44 (0) 1235 239 670, Middle East and Africa +44 (0) 1235 239 671, New Zealand +64 9929 1483, USA 001 281 595 3518, Canada 001 613 996 6666

**National Poison Center Numbers**

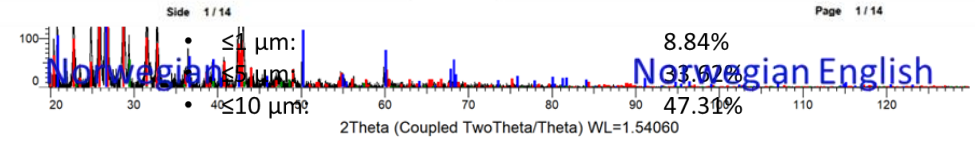
Norway	Poison information centre: +47 22 59 13 00
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**2. Hazards Identification**

**2.1 Classification of the substance or mixture**

Classification according to Regulation (EC) No. 1272/2008 [CLP]

Health hazards	Category
Skin corrosion/irritation	Category 2
Serious eye damage/eye irritation	Category 1
Specific target organ toxicity - Single exposure	Category 3
Specific target organ toxicity - Repeated exposure	Category 2



# Qualification Process

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- Blend Flowability



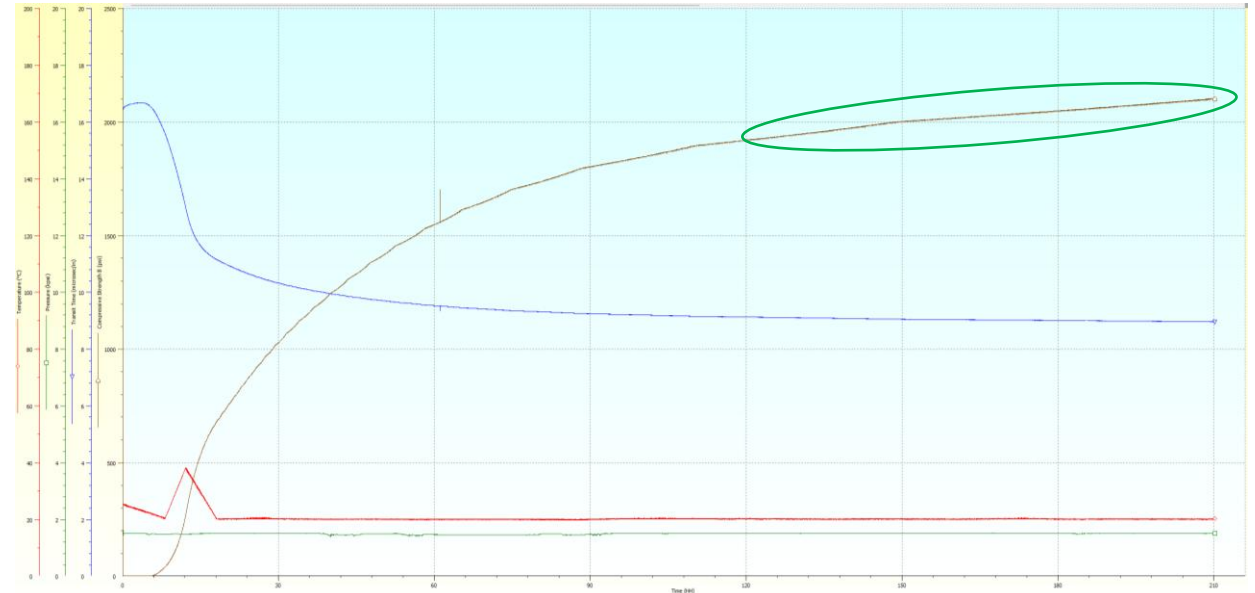
## b) Operationally Safe?

- Chemical Composition
- Respirable Particle Content
- SDS Creation



## c) A Robust Well Barrier Material?

- Compressive Strength Development / Trend
- Set Cement Permeability



✓ No Compressive Strength Deterioration

✓ Water Permeability Testing Result – **7 nD**

# Field Candidate Selection

- ✓ Low risk operation
- ✓ Verification not required as per NORSOK D-010

## Job Objective

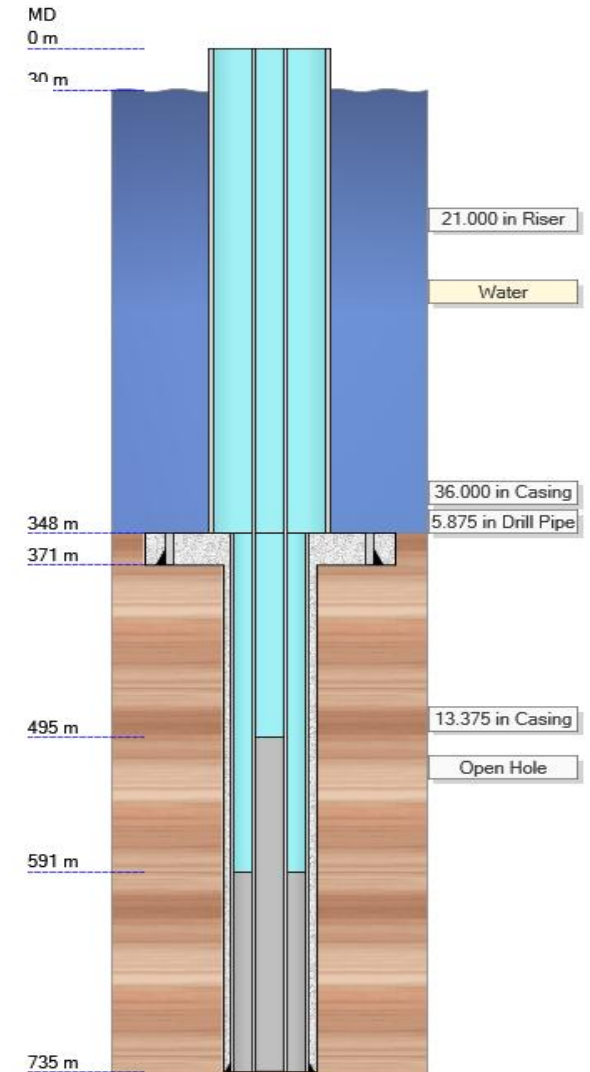
**Primary** Place 150 m cement plug inside the 13 3/8" casing on top of a mechanically set plug to permanently abandon the well.

## Acceptance Criteria

**Primary** Plug #4 execution as per plan  
(RIH to tag top of cement would proceed if rig operations allowed)

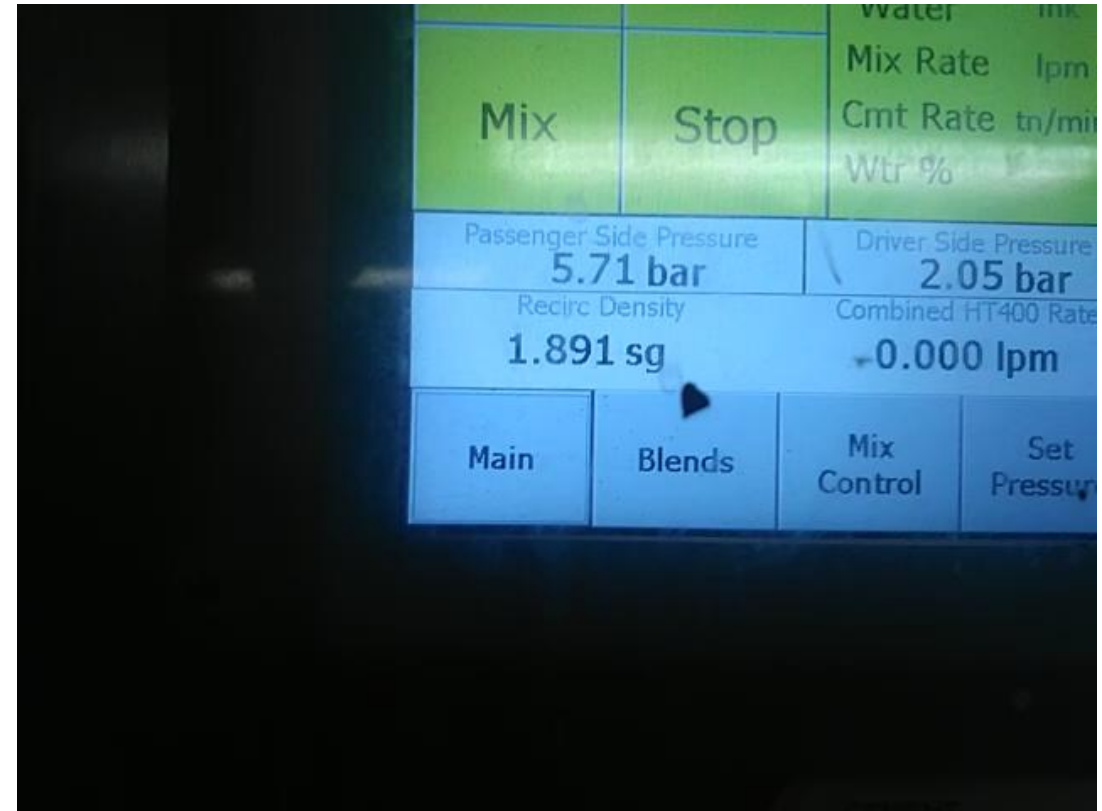
## Pumping Schedule

Fluid Name	Stage Volume (m <sup>3</sup> )	Pump Rate (lpm)	Stage Time (hr:mn)	Cum. Time (hr:mn)	Comment
Sponge Ball			00:10	00:10	Drop sponge ball ahead of slurry
Cement Slurry (1.92 SG)	11.8	500	00:24	00:34	Mix and pump slurry
Sponge Ball			00:10	00:44	Drop sponge ball behind slurry
Sea Water:	6.2		00:08		
> Sea Water	4.2	1000	00:04	00:48	Continue displacement
> Sea Water	2.0	600	00:03	00:51	Slowdown displacement rate



# Job Execution

- Bulk transfers proceeded seamlessly with no stoppages observed.
- Perfectly mixable slurry and easy to weigh up to desired density.
- No abnormal pump pressures were experienced during job execution.
- Displacement and POOH proceeded according to plan.
- TOC verification was cancelled, however cup samples and “Bucket Test” sample set earlier vs. onshore UCA chart.
- Outstanding operator feedback.

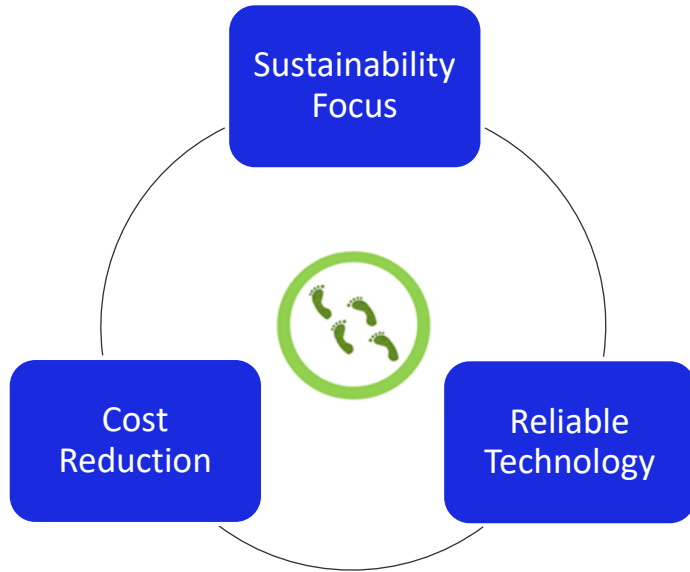


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- Outstanding operator feedback.



# Conclusions and Forward Plan



- Concept of incorporating drilled cuttings as a filler in cement was proven:
  - ✓ Technically Feasible
  - ✓ Operationally Safe
  - ✓ Robust Well Barrier Material
- Trial operation was flawlessly executed in the field, thus validating all qualification testing.
- Represents a novel and exciting concept with immense upscaling potential on the Norwegian Continental Shelf and beyond.
- A sustainable circular economy success story allowing:
  - ✓ Provide a purposeful use for materials previously considered as waste.
  - ✓ Reduce the CO<sub>2</sub>(e) footprint of delivered cement blends / slurries.
  - ✓ Reduce demand for new products when planning cementing operations.

# Questions / Thoughts?

