

# WellCem AS

## Plug & Abandonment Workshop Quality Airport Hotel 14 June, 2012

**ThermaSet® - An alternative plugging material**

**Colin Beharie**

# Agenda

- 1. Company Profile**
- 2. ThermaSet® - Overview**
- 3. P&A Qualification testing and results**
- 4. Target applications and conveyance methods**
- 5. Summary**
- 6. Questions**

# WellCem AS Company profile

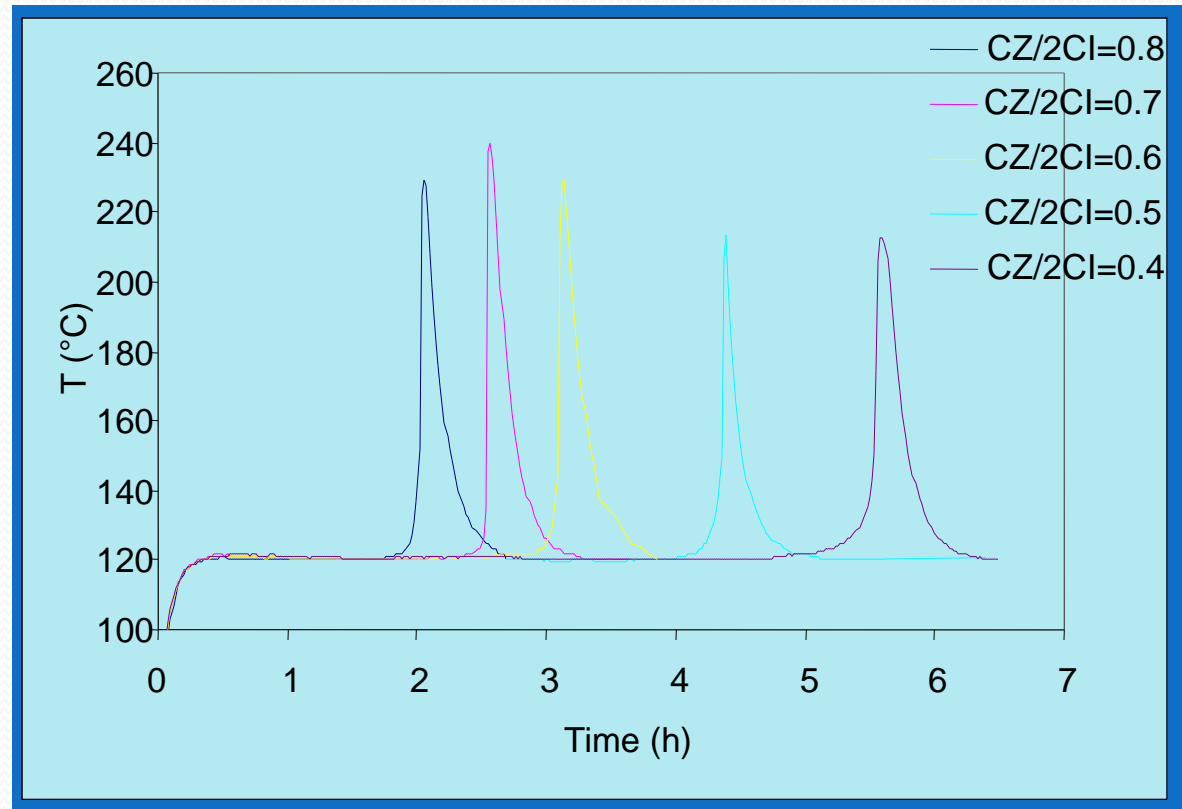
- WellCem is a Company providing Well Therapy solutions to the oil and gas industry
- Head office in Tananger, Norway
- The Company has developed and patented a multi component resin based polymer
- Current Contracts for the Middle and Northsea Area
- Expanding Northsea, Middle East, Canada

# What is ThermaSet® ?

- A non-reactive **polymer** – particle free liquid
- Specific gravity can be adjusted from 0.7 - 2.5 SG
- Viscosity range 10 -2000 CP
- Operating temperature range from -9 °C to 150 °C BHT, resistant to 320°C in cured conditions

# How does ThermaSet<sup>®</sup> works?

- Curing triggered by down hole temperature (clock starts)
- Curing/setting times can be accurately regulated from a few minutes to several hours



# R&D Confirmation

Key test: Relevant for P&A

- Long –term integrity of ThermaSet® as permanent P&A well barrier material – SINTEF
- ThermaSet® Material Isolation Behind Screen to Shut Off Gas and water – IRIS
- Qualification test of ThermaSet® to ISO 14310 V3 – IRIS
- Shear bond strength test – West Lab
- Milling of ThermaSet® with Wireline Tractor – Aker Solution / WellCem

# Qualification of ThermaSet as Permanent P&A barrier material

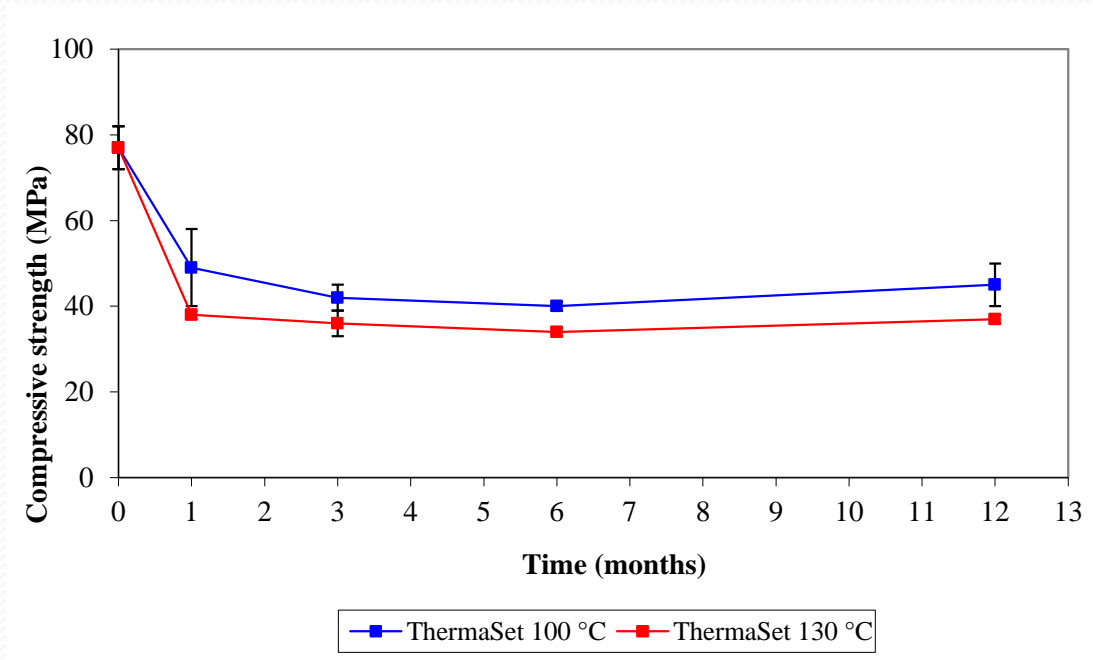
- Resistance to downhole chemicals
  - Crude oil (500 bar, 100 °C and 130 °C)
  - Methane (500 bar, 100 °C and 130 °C)
  - CO<sub>2</sub> (5%) (500 bar, 100 °C and 130 °C)
  - H<sub>2</sub>S (5000 ppm) (10 bar, 100 °C and 130 °C)
  
- Long-term integrity
  - 1, 3, 6 and 12 months exposure to chemical environments
  - Flexural strength, compressive strength, physical properties, permeability

# Results

	<u>Portland Cement</u>	<u>ThermaSet</u>
Compressive strength (MPa)	58	77
Flexural Strength (MPa)	10	45
<i>E-modulus (MPa)</i>	<i>3700</i>	<i>2240</i>
Rupture Elongation (%)	0.01	3.5
Tensile Strength (MPa)	1	60
Failure flexural strain (%)	0.32	1.9



# Results



Compressive strength of ThermaSet after long-term exposure to crude oil at 500 bar / 7250 psi

# Results

Liquid permeability (mD)\*

	Initial	12 months
ThermaSet @ 100 °C	< 0.0000005	0.000004
ThermaSet @ 130 °C	< 0.0000005	0.000002

Liquid permeability of ThermaSet samples  
after 12 months exposure to crude oil at 500  
bar / 7250 psi

# Results

## Shear bond Strength test

Parameter	Veslefrikk slurry		ThermaSet	
Shear bond strength at 24 hours	9860	KN	50000	KN
Shear bond strength at 24 hours	0,62	Mpa	3,12	Mpa
Shrinkage	5	mm	0	mm

### Test Condition

Test Temperature: 120 °C

Pressure: 3000 psi

Total volume: 1200 ML

# Comparison Lab test vs real downhole applications

## Downhole

- ThermaSet cures at high temperature and high pressure and remains at these conditions
- Limited surface area exposure to downhole fluids

## Laboratory Test

- Temperature and pressures cycles during preparation and exposure
  - Large sample surface area exposed to fluids
- 
- Therefore – Test shows that ThermaSet will last for hundreds of years

# Target Applications

- Drilling Phase – Lost Circulation
- Production – Zonal isolation, Water / Gas shutoff
- P&A
  - Reservoir Plug
  - Balance Plugs
  - Plugging of areas affected by collapsed tubing
  - Plugging of control lines
  - Squeeze jobs to seal of casing and tubing leaks
  - Sealing of micro annuli

# Conveyance Methods

- Fluid Displacement - Can be displaced with any fluid
- Pumped down-hole using conventional cementing techniques and equipment
- Coil tubing
- Pump through the BHA /Drill bit
- Wireline Tools

# Case History

## Barrier Problem

Collapsed tubing and ruptured production casing at 6100 ft and had pressures in annuli A & B coming from a formation at the ruptured point. Very low reservoir pressure

### ***Solution:***

- 0.85 SG ThermaSet® made it possible to pump the ThermaSet® plug through collapsed tubing, squeezed the desired volume into reservoir through perforations and keep the top of plug above the collapsed points in tubing in a very controlled way.

### ***Result:***

- **After setting time the plug was tagged at the desired depth and was pressure tested both for inflow and at 2500 psi surface pressure – both tests were OK. ThermaSet® was designed for a four hour setting time**

# Benefits of ThermaSet®

Reliable - permanent sealing of reservoirs and plugging of casing/annulus

Effective – reduction of permeability

Superior - mechanical properties

lasting – durability.

*You will only have to do the job once*





**Thanks' for your attention**