ENER-CRETE THERMAL '50'

FOR WELLBORE APPLICATION
TECHNICAL DATA SHEET

DESCRIPTION

In an environment where wellbore temperatures exceed 115°C, due to well depth, processes such as steam flooding, etc., there is a need for a special cement. Under these types of conditions, regular cement undergoes severe chemical structural changes causing a rapid breakdown of the cement integrity. Ener-Crete's Thermal '50' overcomes this degradation by blending higher content of silica (SiO2), which extends the Thermal '50's stability to extreme temperatures up to +/-360°C.

CEMENT SYSTEM

Cement System
API Certified Oil Well "G"Cement + Silica Flour
Slurry Density
1884 kg/m^3
Slurry Yield
0.74 m^3/Tonne
Water Requirement
0.40 m^3/Tonne

CEMENT BLEND

Cement Blend
0-1-0 API Certified Oil Well "G"
Cement Silica Flour
Highend Gypsum
Silica Fume
$CaCl_2$
Polycarboxylate
FLA-6

WELL DATA

Well Data
Depth
+/- 300 meters
BHST
15
BHCT
20

PROPERTIES-PHYSICAL

- Appearance is a fine textured greyish-white powder
- Composition is a combination of Oil Well "G" cement and silica flour
- Bulk Density is 0.740 m3/tonne

PROPERTIES-CHEMICAL

- Solubility is that the product is insoluble in water pH ranges between 10-12 (in fresh water)
- Water requirement to mix product is 0.40 m3/tonne
- Product is a Thermally Stable Oilwell Cement

4810-47th STREET EAST, REDWATER AB T0A 2W0
Phone: (780)-638-9501

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MIXING & HANDLING

Storage Precautions-Thermal Cement is not hazardous. Keep dry and avoid excessive humid conditions. Best stored in cool, dry place.
Handling Precautions-When mixing with water, some heat will occur due to heat of hydration process. Mix continuously once started. Mixed it is caustic in nature pH 10-12, can cause burns to eyes and skin. Wearing appropriate PPE is a must. See SDS sheet for further information.

TESTS PERFORMED

ENG-TECH
Set Times, Initial and Final
Compressive Strength, 6 hour, 8 hour, 24 hour, 4 day, 7 day, 28 day
INTEGRA
Thickening Time
Rheology
Fluid Loss
Free Water, Vertical and 45^0 Angle
Compressive Strength, 24 hour & 48 hour

ENG-TECH Consulting Limited (ENG-TECH) was retained by Ener-Crete Systems Inc. to evaluate the set time and compressive strength of a Thermal '50' base blend (Oil Well "G" Cement + Silica Flour for wellbore applications . This report summarizes the testing program and final test results.

Three 3 L batches of Thermal '50' slurry were produced with water that had a temperature of 14°C, 20°C, or 28°C, at initial contact between cement and water. The batches had a water to cement ratio of 0.415, as reported in the technical data sheet submitted to ENG-TECH by Eler-Crete. The slurry was mixed in a mortar mixer for 5 minutes; then cast in 508 mm cubes: and finally cured in a controlled environment that had an ambient air temperature of 25±5°C and a relative humidity of 50±5%.

A total of 6 set of 3 cubes were cast for each of the water temperatures in order to determine the compressive strength of the material after 6 h, 8 h, 24 h, 4 days, 7 days, and 28 days, of curing. The compressive testing was conducted according to CSA A3000 .

For each of the 3 batches, a slurry sample was taken and tested according to ASTM C266 in order to determine the initial and final set times of the material.
Below is a table summarizing the compressive strength and set times results:

Water Temp* (^{0}C)	Mix Temp** (^{0}C)	Compressive Strength (MPa)						Set Times (min)	
		6 hr	8 hr	24 hr	4 day	7 day	28 day	Initial	Final
14	21	0.1	0.9	19.6	37.1	44.3	52.0	205	345
20	26	0.3	1.0	21.8	40.5	45.7	52.0	260	375
28	30	0.3	1.0	24.0	43.5	41.5	50.9	285	385

*Water temperature at initial contact between cement and water
**Mix temperature 5 minutes after the initial contact between cement and water

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ENER-CRETE SYSTEMS INC.

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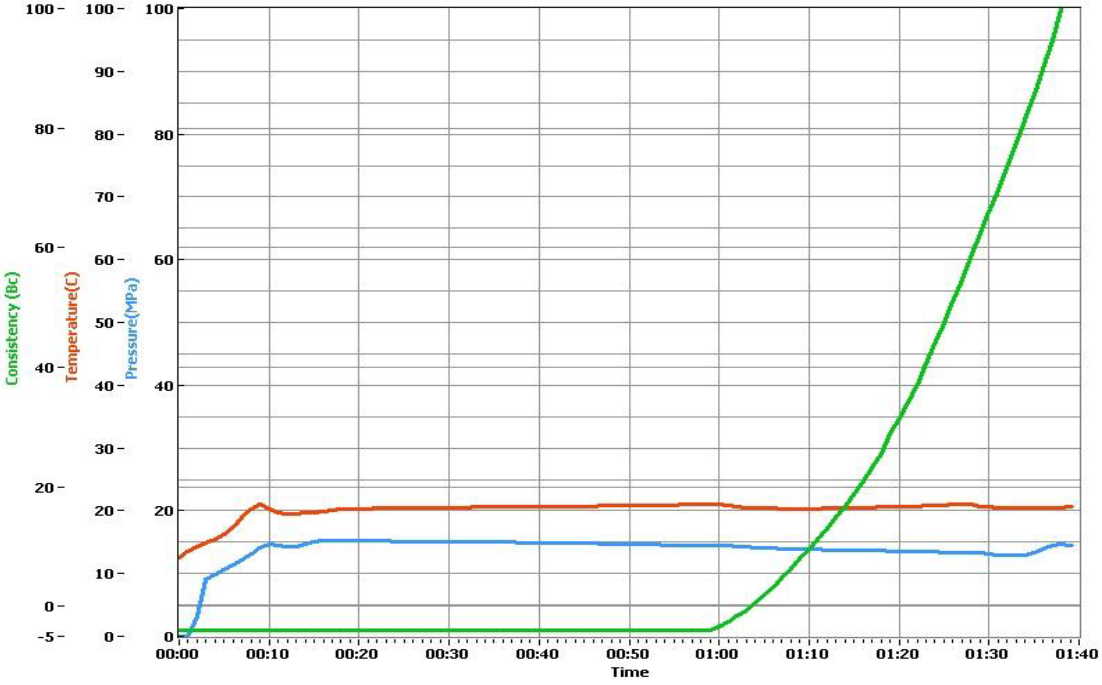
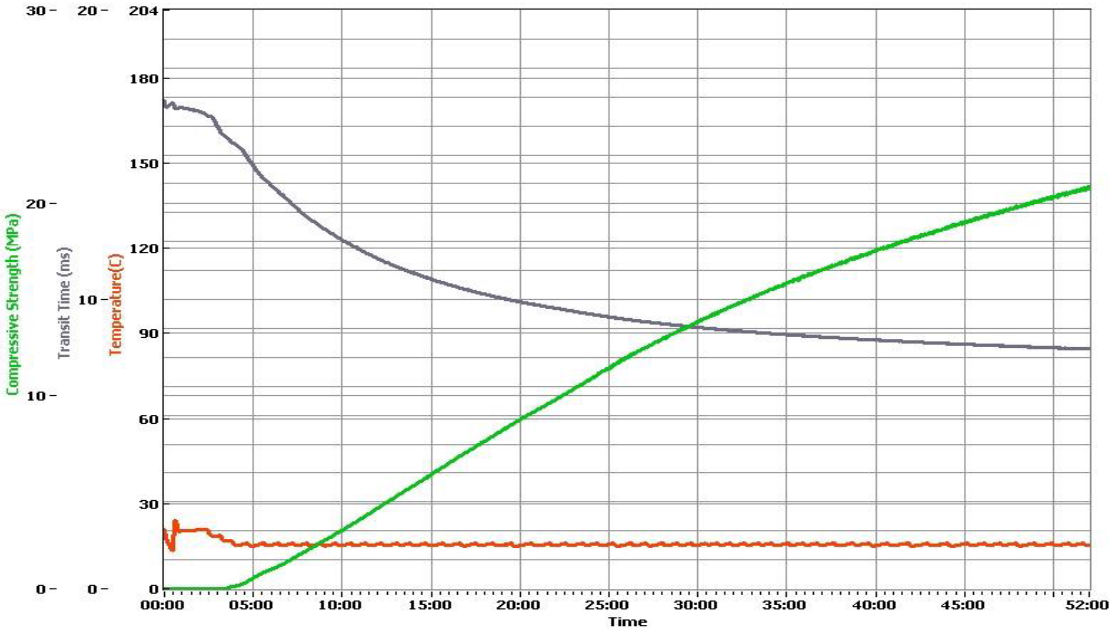
INTEGRA Laboratory Services Ltd

Thickening Time



Compressive Strength Development



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Rheology, Fluid Loss, Free Water

Rheology

n': 0.6617 k': 1.3373

Hole (mm)	Pipe (mm)	Plug Flow Rate (m^3/min)
158.8	114.3	0.22
200	114.3	0.35
200	139.7	0.32
222.3	139.7	0.40
222.3	177.8	0.32
250.8	177.8	0.44
311.2	244.5	0.55
311.2	219.1	0.61

Fluid Loss

22 cc API (11 cc/30 minutes)

Free Water

Vertical: 0.00%45^0

Angle: 0.00%

COMMENTS

This slurry mixes very easily and remains thin throughout the majority of the pumping time before the set.

The rheological data table displays the pump rates which must be exceeded to avoid a plug flow regime.

Strengths are for reference only. Actual strength values may vary under changing conditions in the wellbore, water quality, density variations. Strength samples should be taken during the ap-plication process and compared to the estimated wellbore temperature for additional strength development.

If the wellbore temperatures are typically below 30°C , Thermal Cement can be augmented with a small amount of calcium chloride which accelerates set time. Typical dosages of calcium chloride is 0.5-1.0% w/w, depending on wellbore depth & temperature. Viscosity and working time will reduce with the addition.

Caution working with calcium chloride should be taken as it is an extremely corrosive material. Using it incorrectly may lead to a flash set of the Thermal cement caused by excessive heat of hydration.

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GLOSSARY OF TERMS
(Alphabetically)

BHCT - *Bottom Hole Circulating Pressure*

BHST - *Bottom Hole Static Pressure*

$CaCl_2$ - *Calcium Chloride*

cement blend - *Cement powder, other cementitious and any added admixtures*

cement system - *Cementitious composition*

final set - *a degree of stiffening of a mixture of cement and water greater than initial set, generally stated in an empirical value indicating time in hours and minutes required for cement paste to stiffen sufficiently to resist to an established degree*

FLA6 - *Dicorp's oil cement admixture base PVA (poly vinyl acetate)*

API Cerified *Oil Well "G" cement or commonly known as Type "G" cement blend. API approved sulfate resistant cement*

initial set - *a degree of stiffening of a mixture of cement and water less than final set, generally stated in an empirical value indicating time in hours and minutes required for cement paste to stiffen sufficiently to resist to an established degree*

MPa - *megapascal, a unit of measurement for pressure*

SDS - *Safety Data Sheet*

Highend Gypsum - *Oil cementing grade 60-Gypsum*

PPE - *Personal Protective Equipment for Safety*

rheology - *the study of the flow of matter, primarily in the liquid or soft-solid states*

silica flour - *very finely divided silica, a siliceous binder component that reacts with lime under autoclave curing conditions*

silica fume - *a very fine noncrystalline silica produced in electric arc furnaces as a by product of the production of elemental silicon or alloys containing silicon*

slurry - *a mixture of water and any finely divided insoluble material, such as portland cement, slag, or clay in suspension*

polycarboxylate - *high range water reducing and superplasticizing admixture*

water to cement ratio - *the ratio of the mass of water to the mass of portland cement identified as "w/c"*

wellbore - *any hole drilled for the purpose of exploration or extraction of natural resources such as water, gas or oil,*

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FOR WELLBORE APPLICATION

Safety Data Sheet

SECTION 1. IDENTIFICATION

Product Identifier	Ener-Crete Thermal "50" For Wellbore Application
Other Means of Identification	
Product Family	ENER-CRETE Cements
Recommended Use	Special blend of cementitious materials with thermal properties.
Manufacturer	4810-47th STREET EAST, REDWATER AB T0A 2W0; www.enercrete.com
Emergency Phone No.	Ener-Crete Systems Inc., Phone: (780)-638-9501
SDS No.	0002
Date of Preparation	May 15, 2017

SECTION 2. HAZARD IDENTIFICATION

Classification

Skin irritation - Category 2; Serious eye damage - Category 1; Skin sensitization - Category 1; Carcinogenicity - Category 1A; Specific target organ toxicity (single exposure) - Category 3; Specific target organ toxicity (repeated exposure) - Category 1

Label Elements

Signal Word:
Danger
Hazard Statement(s):
Causes skin irritation.
Causes serious eye damage.
May cause an allergic skin reaction.
May cause cancer.
May cause respiratory irritation.
Causes damage to organs (lungs) through prolonged or repeated exposure.
Precautionary Statement(s):
Do not handle until all safety precautions have been read and understood.
Wash hands thoroughly after handling.
Contaminated work clothing must not be allowed out of the workplace.
Wear protective gloves/protective clothing/eye protection/face protection.
Use only outdoors or in a well-ventilated area.
Do not breathe dust/fume/gas/mist/vapors/spray.
Do not eat, drink or smoke when using this product.

IF exposed or concerned: Get medical advice/attention. **IF ON SKIN:** Wash with plenty of water.
Take off contaminated clothing and wash it before reuse.
If skin irritation or rash occurs: Get medical advice/attention.
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
Immediately call a POISON CENTRE or doctor.
IF INHALED: Remove person to fresh air and keep comfortable for breathing.
Call a POISON CENTRE or doctor if you feel unwell.
Store in a well-ventilated place. Keep container tightly closed.
Dispose of contents and container in accordance with local, regional, national and international regulations.
10% of the mixture consists of ingredient(s) of unknown acute toxicity.

SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	CAS No.	%	Other Identifiers
Portland cement	65997-15-1	30-70%	Not applicable
Silica, crystalline	14808-60-7	20-40%	Not applicable
Aluminum oxide	1344-28-1	0-5%	Not applicable
Iron oxide	1309-37-1	0-5%	Not applicable
Titanium dioxide	13463-67-7	0-5%	Not applicable

Notes

The exact percentage (concentration) of composition has been withheld as a trade secret in accordance with paragraph (i) of §1910.1200.

SECTION 4. FIRST-AID MEASURES

First-aid Measures

Inhalation

Move to fresh air. Keep at rest in a position comfortable for breathing. Call a Poison Centre or doctor if you feel unwell.

Skin Contact

Rinse with lukewarm, gently flowing water for 5 minutes. Take off immediately contaminated clothing, shoes and leather goods (e.g. watchbands, belts). Thoroughly clean clothing, shoes and leather goods before reuse or dispose of safely. If skin irritation or a rash occurs, get medical advice or attention.

Eye Contact

Immediately rinse the contaminated eye(s) with lukewarm, gently flowing water for 15-20 minutes, while holding the eyelid(s) open. Remove contact lenses, if present and easy to do. Immediately call a Poison Centre or doctor.

Ingestion

Never give anything by mouth if person is rapidly losing consciousness, or is unconscious or convulsing. Do not induce vomiting. Get medical advice or attention if you feel unwell or are concerned.

Most Important Symptoms and Effects, Acute and Delayed

If inhaled: can irritate the nose and throat, can cause lung injury. *If on skin:* skin sensitizer, may cause an allergic skin reaction in some people. May cause moderate to severe irritation. *If in eyes:* causes moderate to severe irritation. Symptoms include sore, red eyes, and tearing. *If swallowed:* can irritate the mouth, throat and stomach. Symptoms may include nausea, vomiting, stomach cramps and diarrhea.

Immediate Medical Attention and Special Treatment

Special Instructions

Not applicable.

SECTION 5. FIRE-FIGHTING MEASURES

Extinguishing Media

Suitable Extinguishing Media

Not combustible. Use extinguishing agent suitable for surrounding fire.

Unsuitable Extinguishing Media

None known.

Specific Hazards Arising from the Product

This product presents no unusual hazards in a fire situation.

SECTION 6. ACCIDENTAL RELEASE MEASURES

Personal Precautions, Protective Equipment, and Emergency Procedures

Use the personal protective equipment recommended in Section 8 of this safety data sheet.

Environmental Precautions

It is good practice to prevent releases into the environment. Do not allow into any sewer, on the ground or into any waterway.

Methods and Materials for Containment and Cleaning Up

Collect using shovel/scoop and place in a suitable container for disposal. Avoid generating dust.

SECTION 7. HANDLING AND STORAGE

Precautions for Safe Handling

Avoid repeated or prolonged skin contact. Do not swallow. Do not breathe in this product. Avoid generating dusts. Keep containers tightly closed when not in use or empty. Do NOT eat, drink or store food in work areas.

Conditions for Safe Storage

Store in an area that is: dry, well-ventilated. Protect product from contact with water, including humidity. Prevent rainwater and ground water from reaching storage area.

SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Appropriate Engineering Controls

Use local exhaust ventilation, if general ventilation is not adequate to control amount in the air.

Individual Protection Measures

Eye/Face Protection

Wear chemical safety goggles and face shield when contact is possible.

Skin Protection

Wear chemical protective clothing e.g. gloves, aprons, boots.

Respiratory Protection

Wear a NIOSH approved particulate respirator equipped with a N95, R95, or P95 filter.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Basic Physical and Chemical Properties

Appearance	Grey powder.
Odor	Odorless
Odor Threshold	Not available
pH	10-12
Melting Point/Freezing Point	Not available (melting); Not available (freezing)
Initial Boiling Point/Range	Not available
Flash Point	Not available
Evaporation Rate	Not available
Flammability (solid, gas)	Not applicable
Upper/Lower Flammability or Explosive Limit	Not available (upper); Not available (lower)
Vapor Pressure	Not available
Vapor Density (air = 1)	Not available
Relative Density (water = 1)	2.7-2.8
Solubility	Not available in water; not available (in other liquids)
Partition Coefficient, n-Octanol/Water (Log Kow)	Not available
Auto-ignition Temperature	Not available
Decomposition Temperature	Not available
Viscosity	Not available (kinematic); Not available (dynamic)

Other Information

Physical State	Solid

SECTION 10. STABILITY AND REACTIVITY

Reactivity

Not reactive under normal conditions of use.

Chemical Stability

Normally stable.

Possibility of Hazardous Reactions

None expected under normal conditions of storage and use.

Conditions to Avoid

Water, moisture or humidity.

Incompatible Materials

None known.

Hazardous Decomposition Products

Under normal conditions of storage and use, hazardous decomposition products should not be produced.

SECTION 11. TOXICOLOGICAL INFORMATION

Likely Routes of Exposure

Inhalation; skin contact; eye contact; ingestion.

Skin Corrosion/Irritation

May cause moderate or severe irritation based on information for closely related materials.

Serious Eye Damage/Irritation

May cause serious eye damage based on information for closely related materials.

STOT (Specific Target Organ Toxicity) - Single Exposure

Inhalation

May cause severe nose and throat irritation, severe lung injury.

Skin Absorption

No information was located.

Ingestion

May be harmful based on information for closely related materials.

Aspiration Hazard

Can cause lung damage if aspirated based on human experience.

STOT (Specific Target Organ Toxicity) - Repeated Exposure

Causes irritation of the respiratory system. Respiratory tract injury has been observed. Prolonged exposure to respirable crystalline silica has been known to cause silicosis, a lung disease, which may be disabling. The risk of contracting silicosis and the severity of the disease is clearly related to the amount of dust exposure and the length of time (usually years) of exposure.

Respiratory and/or Skin Sensitization

May cause an allergic reaction (skin sensitization) based on information for closely related chemicals.

Carcinogenicity

May cause cancer.

Reproductive Toxicity

No information was found.

Germ Cell Mutagenicity

No information was found.

Interactive Effects

No information was found.

SECTION 12. ECOLOGICAL INFORMATION

General Comments There are no known significant effects or critical hazards.

SECTION 13. DISPOSAL CONSIDERATIONS

Disposal Methods

Contact local environmental authorities for approved disposal or recycling methods in your jurisdiction.

SECTION 14. TRANSPORT INFORMATION

Environmental Hazards	Not applicable
Special Precautions	Protect from moisture.

SECTION 15. REGULATORY INFORMATION

Safety, Health and Environmental Regulations

Canada

WHMIS 1988 Classification

Class D2A

Class E

D2A - Very Toxic (Chronic toxicity; Carcinogenicity); E - Corrosive

SECTION 16. OTHER INFORMATION

SDS Prepared By	Ener-Crete Systems Inc.
Phone No.	(780)-638-9501
Date of Preparation	May 15, 2017
Disclaimer	To the best of our knowledge, the information contained herein is accurate. However, Ener-Crete Systems Inc. assumes no liability whatsoever for the accuracy or completeness of the information contained herein.

Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.