



A low cost technology you aren't using, that can put money back in your pocket today

"Technology in Concrete"

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PAVE AHEAD
DURABLE. SUSTAINABLE. CONCRETE.

TEAM

Joseph Viggiano – Eastern Concrete / US Concrete

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Dealing With Concrete Problems....



Murphy's Law (Magnified):

"If Anything Can Go Wrong, It Will, and
It Will Be at the Worst Possible Moment"



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Simple field issues cause us great pain!

Excess water additions

Poor testing – Slump and Air

Poor cylinder making, handling and transportation

Improper Initial field Curing

Others ??

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Strength Test Specimens

Standard Curing - ASTM C31

Maintain moisture

Initial temperature in field

60°F to 80°F

$f'_c > 6000$ psi - 68°F to 78°F

Transport to lab within 48 hrs

Transportation time 4 hrs or less

Lab curing 73.5±3.5°F and moist



Initial Curing is a frequent problem

Field Observation

Properly stored in initial curing environment 1/3 of time



COLORADO READY MIXED CONCRETE ASSOCIATION

Field Examiner Summary Details

August, 2015*

Contributing Companies	Number of Assessments August, 2015	Number of Assessments YTD
Bestway Concrete	22	96
Martin Marietta	33	121
Ready Mixed Concrete Co.	9	26
Trans Colorado Concrete	4	12
Transit Mix Concrete	8	33
United Companies	8	31
Aggregate Industries	7	18
Metro Mix Concrete	9	9
Grand Junction Ready Mix	13	17

Average Score 9 (Properly stored in an initial curing environment)	34%	30%
the mixer truck discharge?)	93%	81%

How does Improper Initial Curing Temperatures impact our industry?

- Inaccurate break reports – leading to:
 - Unnecessary destructive testing
 - Project delays
 - Excess man hours
 - Stress on Customer relations
 - Excessive overdesign - \$\$ to mixes

What can we do about it?



What can we as an Industry do about it?

Use Temperature Data Loggers

-Track temperatures during initial curing



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Logger Info & Examples



- Prices from \$25 to \$200 +
- 1 channel to 4+ channels
- Memory – length of recording
- Waterproof
- USB, Bluetooth, Wi-Fi



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Temperature Data Loggers

Inexpensive

Simple to implement and use

Provides detailed readings of curing temperature
(no more He said She said)

Can improve your statistical deviation = \$\$

Can save man hours = \$\$

Can improve customer relations

Maybe change the behavior of 3rd party Testing labs?

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What Will My Customer Say?

Who do we approach and how?

Construction Managers

General Contractors

Concrete Sub Contractors

3rd Party Testing Agencies

Survey, Interviews & Pre-Pour Conference

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Survey Summary

General Contractors/CM

Contracts 3rd Party Testing
 10 – Companies Participated
 100 % Positive Initial Response

G/C - Self Perform Group

Contracts 3rd Party Testing
 18 – Companies Participated
 94.50% Positive Initial Response
 5.5% Negative Initial Response

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Customer Comments

General Contractors/CM

“Making 3rd party testing more reliable, and ensuring correct break results are a game changer!”

“As a GC and self perform contractor we like the idea and think monitoring can help improve field handling.”

“We have had some bad experiences with improper field testing leading to costly time and headaches only to prove the in place product met all the requirements.”

“This should be standard in all curing boxes.”

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Customer Comments

G/C – Self Perform Group

“What if there is not a cure box being used? Cylinders are being stored in the heated job trailer.”

“We monitor the concrete in place, we should be doing so for test cylinders.”

“We would be ok with it if there is no cost to us. If there is hardware that we would be responsible to provide, we would not be interested in participating.”

“We just recently had an issue with low strength cylinders and it cost everyone involved money to investigate. Only to find out the concrete exceeded the specification requirements.”

Survey Summary

Sub Contractors

Contracts 3rd Party Testing
 16 - Companies Participated
 75% Positive Initial Response
 25% Negative Initial Response

3rd Party Testing Agencies

Contracted for 3rd Party Testing
 6 – Companies Participated
 50% Positive Initial Response
 50% Negative Initial Response

Customer Comments

Subcontractors

"We usually do not control the 3rd party testing but we would be all for someone monitoring the way they handle test specimens."

"We would allow it on any of our jobs. Improving monitoring usually means things are more likely to be reported correctly."

"This would not be our decision. Concrete testing is a major problem for most of us but I am not sure this is the answer."

"Our concern is about maintaining the cure box correctly and being held responsible if they don't."

3rd Party Testing Comments

"Who will provide the cure box?"

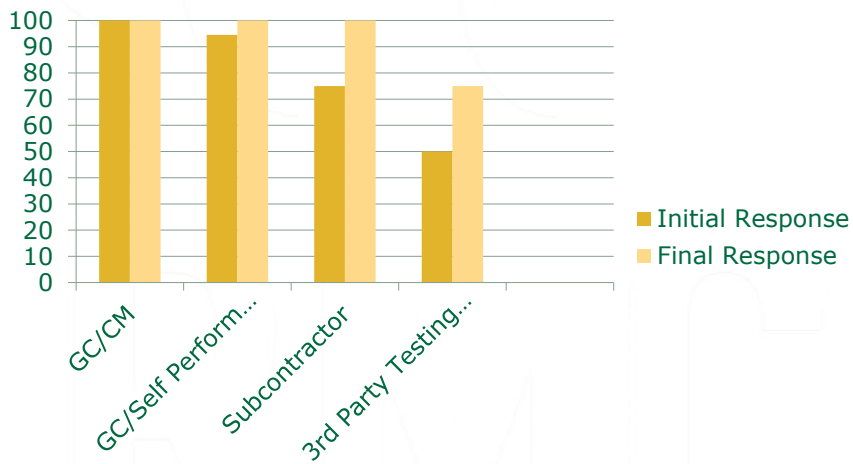
"Will we be notified if the curing is not being maintained?"

"What if there is not a cure box provided?"

"What if we do not want these in our cure box?"

"We were unaware this was even possible to do."

Customer Survey Results



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Implementation & Data Findings



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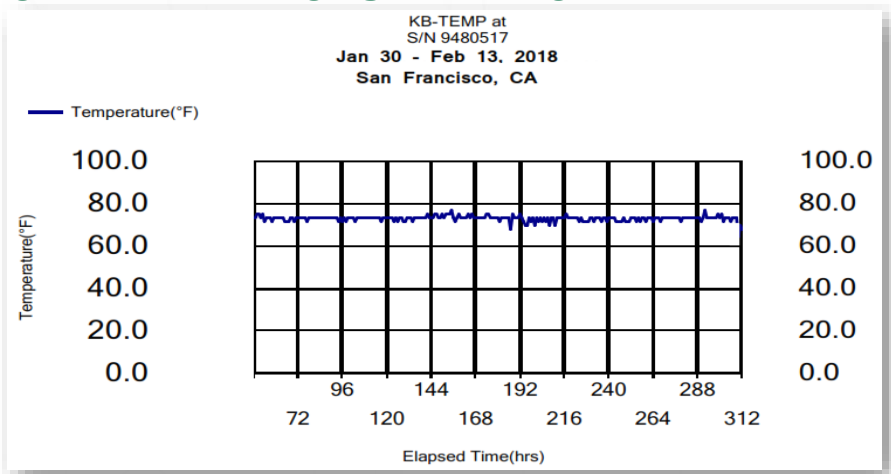
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Implementation / Use

- Discuss the temperature logger during pre-pour meetings
- Determine who will provide the cure box
- Insert logger into the cure box or cooler and activate
- Gather data by downloading weekly/monthly
- Utilize data as needed to improve initial curing or to isolate dates for low break results



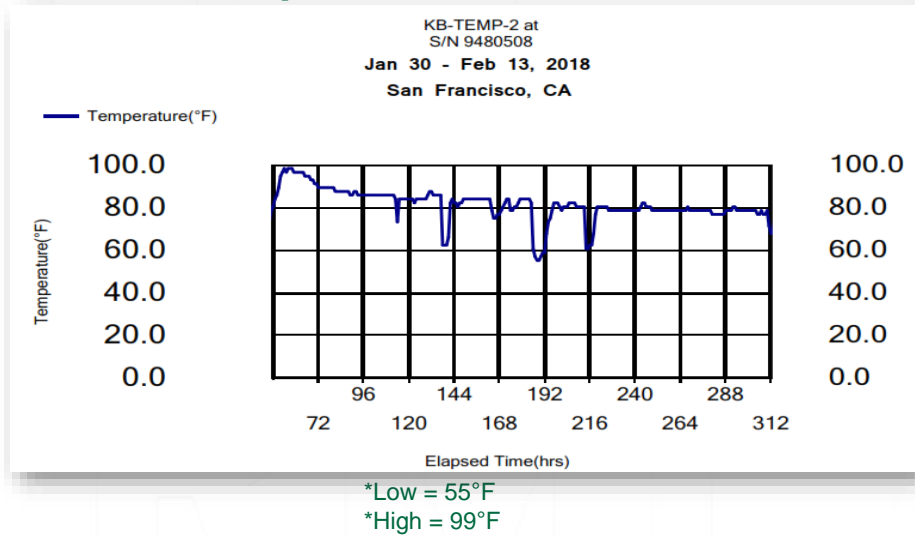
THERMOSTATICALLY CONTROLLED CURE BOX – 14 DAY OBSERVATION



*Low = 68°F
*High = 78°F



WOODEN CURE BOX WITH INSULATION (NO THERMOSTAT) – 14 DAY OBSERVATION



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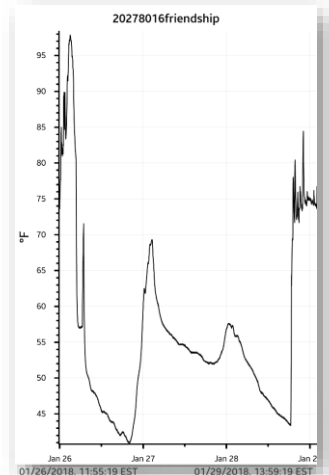
Example results

I was able to drop this pendant in a testing cooler at 6:45 p.m. Friday night. There were five cylinders in the cooler. I retrieved the pendant at 6:30 Monday morning. There were still five cylinders in the cooler.



Serial Number:	20278016 --	
Date Time, GMT -05:00	Temp, (*F)	
1/26/2018 11:55	73.62	
1/26/2018 11:56	74.08	
1/26/2018 11:57	74.93	
1/26/2018 11:58	74.85	
1/26/2018 11:59	74.93	
1/26/2018 12:00	75.47	
1/26/2018 12:01	75.93	
1/26/2018 12:02	76.17	
1/26/2018 12:03	76.4	
1/26/2018 12:04	76.71	
1/26/2018 12:05	77.01	
1/26/2018 12:06	77.25	
1/26/2018 12:07	77.4	
1/26/2018 12:08	77.63	
1/26/2018 12:09	77.63	
1/26/2018 12:10	77.63	

Report sent Directly From Phone



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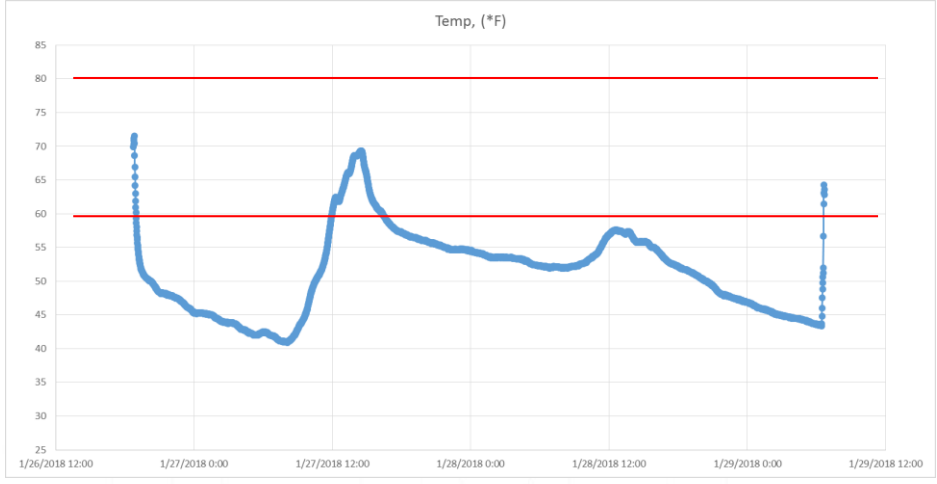
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Example Results- 1/26-1/29/2018



I was able to drop this pendant in a testing cooler at 6:45 p.m. Friday night. There were five cylinders in the cooler. I retrieved the pendant at 6:30 Monday morning. There were still five cylinders in the cooler.



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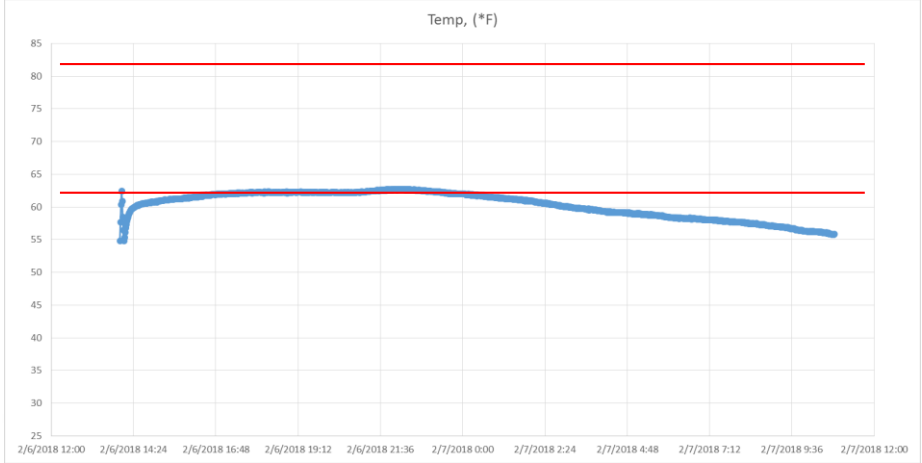
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Example Results – 2/6-2/7/2018



Put this Data Logger in the cooler at 2 p.m. on February 6th and retrieved it on February 7th at 10:50 a.m. this testing company typically does everything the correct way they filled the cooler halfway with hot water. The coldest the outside temperature got down to at night was 32 degrees and it was 34 degrees outside when I picked the Data Logger out of the cooler.



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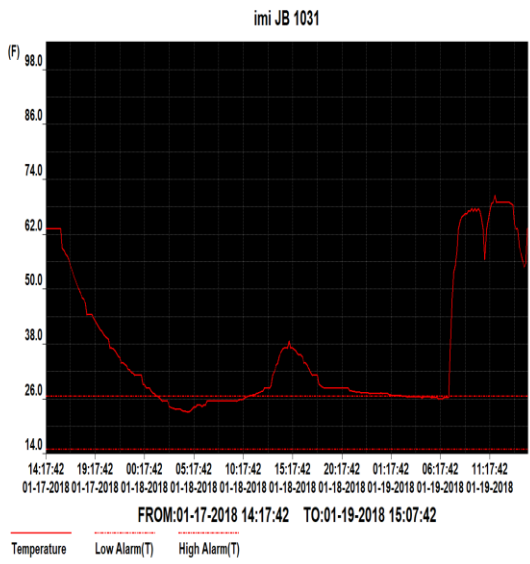
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Field Results

4000 PSI Non-Air
Ambient Temperature 14 degrees.
Concrete Temp 73 degrees.
4.5" Slump 1.8% Air
Cast: 1/17/2018 14:15
Cure: Field -Unprotected Cure Box
Cylinder Breaks:

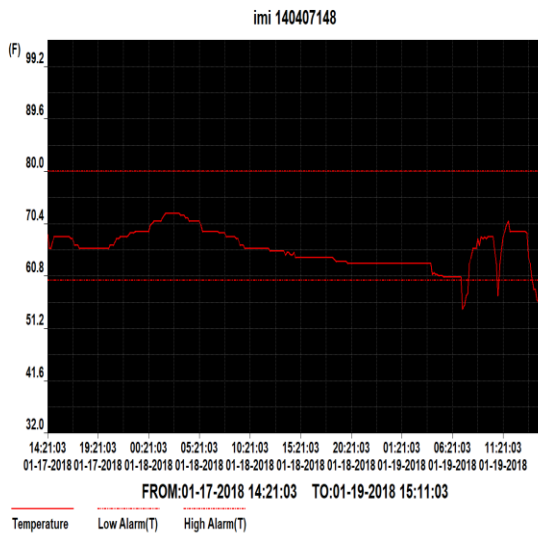
- 1/19/2018 -
790psi & 890psi (2 Day Breaks)
- 1/24/2018 -
2650psi & 2740psi (7 Day Breaks)
- 1/31/2018 -
4300psi & 4490psi (14 Day Breaks)



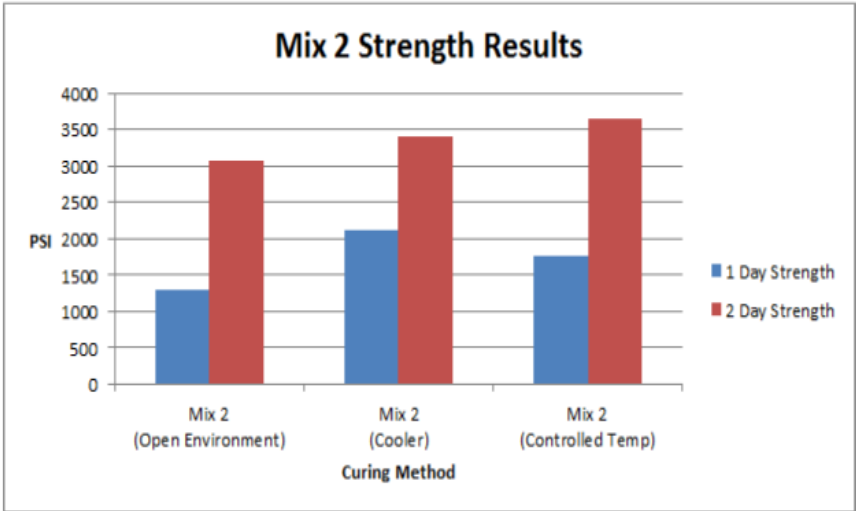
Field Results

4000 PSI Non-Air
Ambient Temperature 14 degrees.
Concrete Temp 73 degrees.
4.5" Slump 1.8% Air
Cast 1/17/2018 14:19
Cure: Field - Insulated Cure Box
Cylinder Breaks:

- 1/19/2018 -
2710psi & 2780psi (2 Day Breaks)
- 1/24/2018 -
5620psi & 5740psi (7 Day Breaks)
- 1/31/2018 -
6410psi & 6450psi (14 Day Breaks)



Early Strength Results for Mixes with Various forms of Curing



\$Benefits to the Bottom Line\$

Putting Money Back In Your Companies Pocket



What does the temperature data logger have to do with it?

Using the temperature data logger to prove the conditions in which your cylinders were cured can guarantee you're using the most accurate information available to you.

What can we do with this information?

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Accurate Standard Deviations and Over Design

Ideally 30 or greater consecutive test results

ACI 318-08 sets the parameters for mix over design and gives equations to do so

To complete the over design equation you need the average strength required to produce the design strength ($f'c$) based on a standard deviation (s)

Where are break results for standard deviation obtained, and what are the benefits and pitfalls of each method?

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Field Cast & Cured Specimens

(Where most strength results are gathered from and used in standard deviation)

Benefits

Accurate results of real world performance

Can be cast, cured, & transported by your own people

Greatest sample size opportunity

Detriments

Subject to improper curing**

Countless variables on jobsites

Subject to incorrect testing & transportation issues

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What does it all mean?

Improper Curing can equate to a **10-38% drop** in strength test results. That's an average of **23%**

This means besides..

Batching

Driver Mixing Habits

Contractor Remixing Habits

Along with any other variable that can decrease your concrete strength you still have the potential to lose **23% on average** for something as simple as curing.

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How much does improper curing cost you?

A Standard deviation that is off by 23%, will throw off an over-design by 4.6%

(using a 20% value for overdesign)

Using a 600 Pound cement factor

4.6% Incorrection = 27.5 pounds per yard

27.5 pounds x 150,000 Cy = 4.125 Million pounds

4.125 Million / 2000 pounds = 2062 Tons

2062 Tons x \$75 (avg. market price of cement) = **\$154,687**

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How can a Temperature Data Logger benefit you?

Gain more accurate Standard Deviation data

Obtain Less back charges/penalties for break strength issues

Create a reputation of quality as a supplier

Less Man hours and material costs for call back testing (Windsor probe testing, Schmidt Hammer, coring etc.)

A more economical yard of concrete

Helping to educate and create a better customer

Creating a culture of joint responsibility for contractors and third party testing labs

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Conclusion

Temperature Data Loggers at an investment of **\$50**, requires minimal training, minimal effort, and can potentially..

Save approximately **.50 cents – \$1.00** per yard by correcting your standard deviation and over design (varies based on volume produced, average cement factor, and other variables)

Reduce the ready mix suppliers potential for low break strength liability

Ultimately Create a reputation of Quality for the Concrete Supplier

Not Bad For \$50 Bucks Huh??

Special Thanks:

Superior Concrete, Harrisonburg VA

Scott Boshart – VP Sales & QC

NRMCA:

Karthik Obla, Ph.D., P.E., FACI - Vice President, Technical Services

Eileen Dickson - Vice President, Education



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Thank you for your attention – Q&A



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