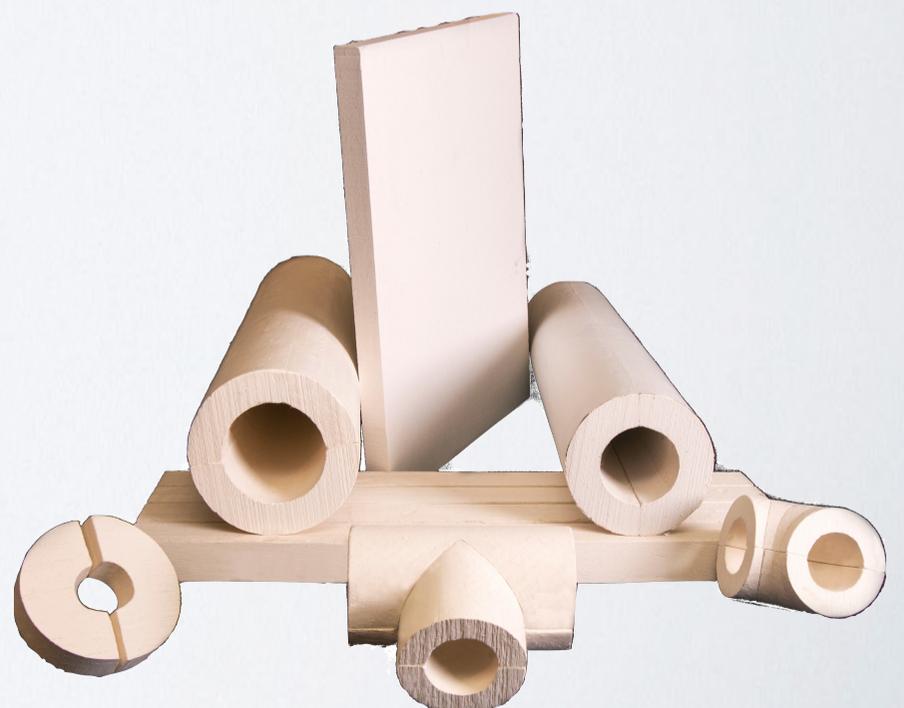
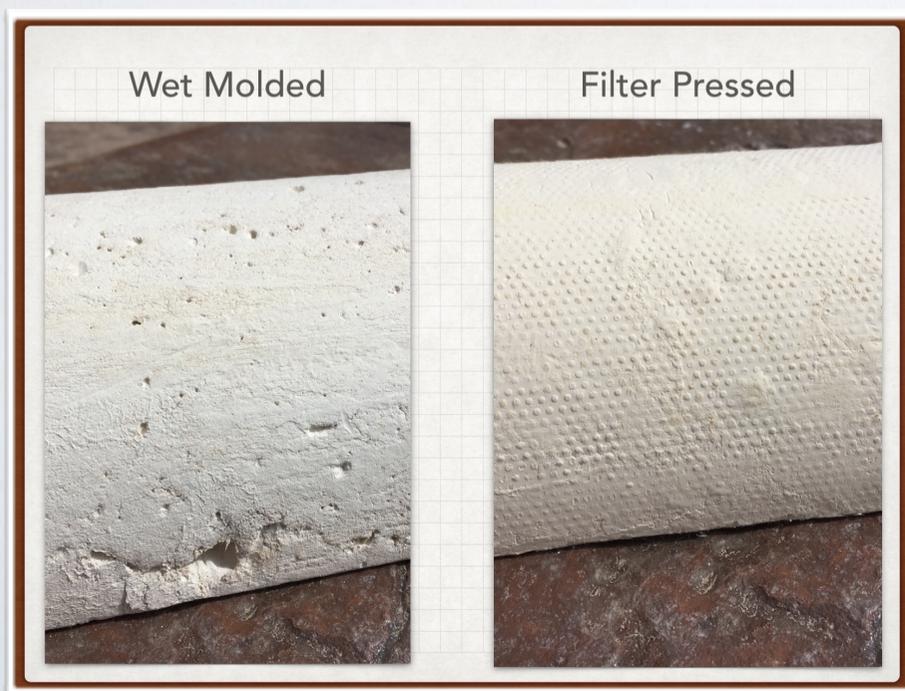


## TPSX-12<sup>®</sup> Calcium Silicate- Third Party Test Results

- Thermal Pipe Shields contracted with Tutco Scientific Corporation located in Fruita, Colorado to conduct the entire battery of third party test methods to validate compliance of TPSX-12<sup>®</sup> in accordance with ASTM C533 type I “Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.”
- The independent third party laboratories that performed the testing are respected industry experts in chemistry and physical testing of thermal insulations. Thermal tests were performed by TSRK Enterprises of Grand Junction, Colorado and strength tests were performed by Microbac Laboratories of Boulder, Colorado.
- The two different materials tested were TPSX-12<sup>®</sup> filter pressed, water resistant calcium silicate pipe and block insulation and the incumbent North American brand named wet molded product randomly procured in the market and produced by the historical sole source monopoly supplier.
- The purpose of the extensive testing battery was twofold. First, to quantitatively measure and report all physical properties of TPSX-12<sup>®</sup>. Second, to compare selected third party results derived from the same laboratories to the North American historical monopoly supplier product. Thermal testing was limited to reduce project cost (see pg. 3).

## Conclusions

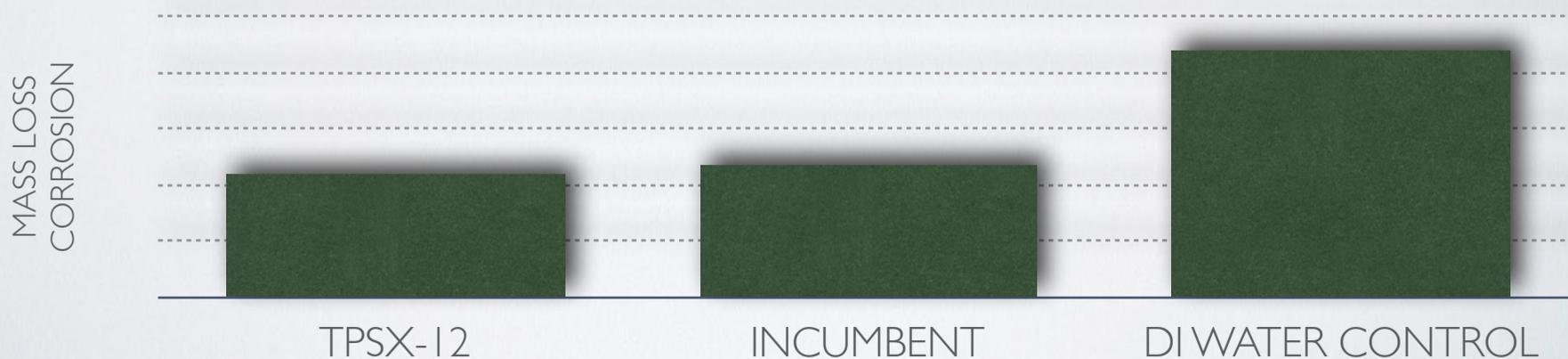
- The North American wet molded product produced by the historical monopoly supplier meets and exceeds all physical property requirements in accordance with ASTM C533 type I.
- TPSX-12<sup>®</sup> also meets and exceeds all physical property requirements in accordance with ASTM C533 type I.
- In addition, due to the filter pressing process unique to TPSX-12<sup>®</sup>, several of the tested physical properties outperformed the incumbent North American product. First, TPSX-12<sup>®</sup> provides a 90% increase in compressive strength. Second, TPSX-12<sup>®</sup> provides a 57% increase in flexural strength. Finally, these two properties combine to provide improved performance during the friability test with 61% less weight loss by tumbling at 10 minutes.
- These enhanced physical properties will provide benefit during transit, storage and installation. TPSX-12<sup>®</sup> is the strongest available type I calsil insulation to robustly support the cladding and prevent in situ system damage.



## TPSX-12<sup>®</sup> Calcium Silicate- Third Party Test Results

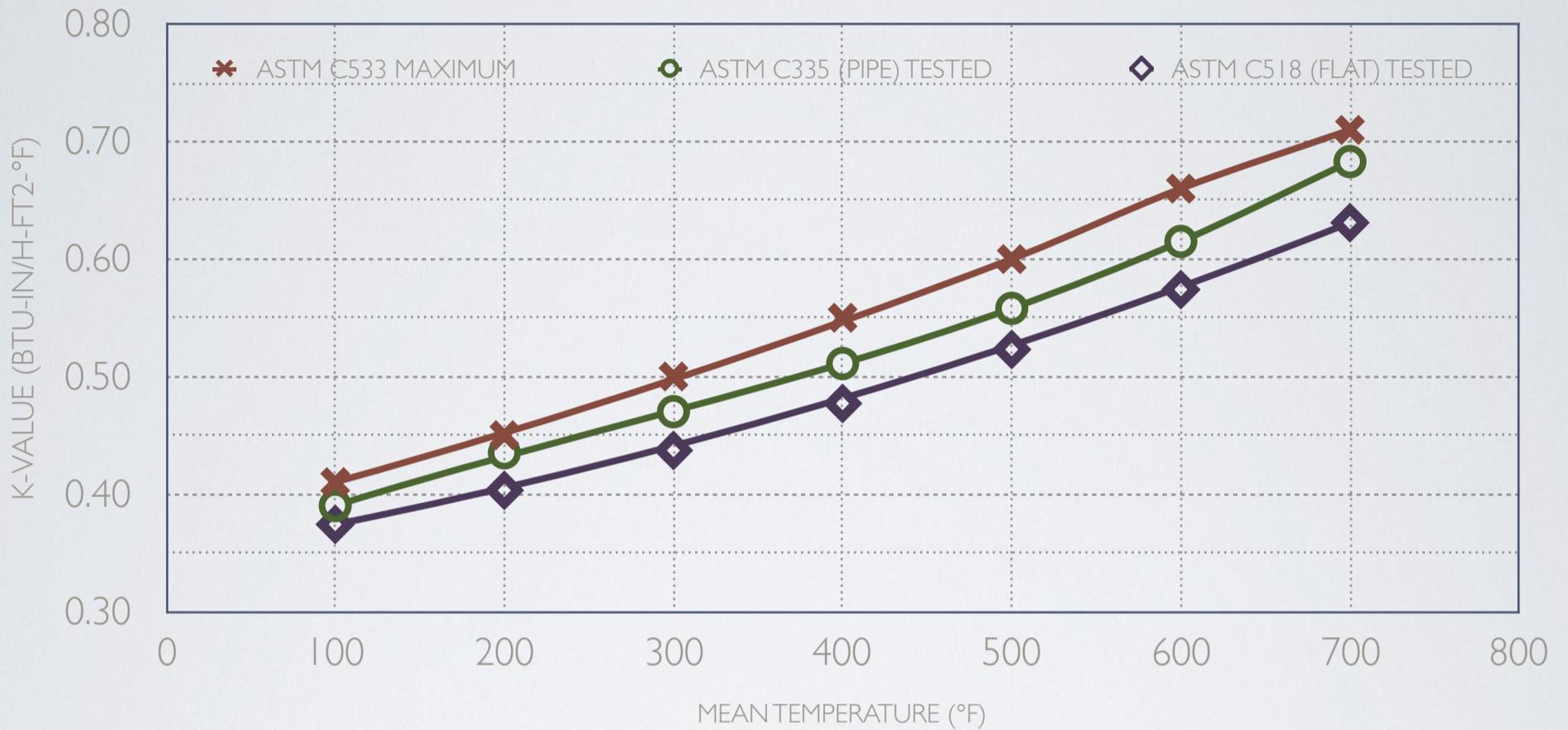
Test Method	TPSX-12 <sup>®</sup>	Incumbent	ASTM C533 Type I
ASTM C533, Type I Material Standard	Meets or Exceeds All Test Methods	Meets or Exceeds All Test Methods	Meet or Exceed All Test Methods
ASTM C302/C303 Dry Density	12.6 lbs. per cu. ft. (202 kg/m <sup>3</sup> )	14.4 lbs. per cu. ft. (230 kg/m <sup>3</sup> )	<15 lbs. per cu. ft. (240 kg/m <sup>3</sup> )
ASTM C165 Compressive Strength	226 psi @ 5% strain (1558 kPa)	119 psi @ 5% strain (820 kPa)	>100 psi @ 5% strain (688 kPa)
ASTM C203 Flexural Strength	83 psi (572 kPa)	53 psi (365 kPa)	>50 psi (344 kPa)
ASTM C356 Linear Shrinkage	0.80% after 24 hr. soaking heat @ 1200°F (650°C)	0.76% after 24 hr. soaking heat @ 1200°F (650°C)	<2.0% after 24 hr. soaking heat @ 1200°F (650°C)
ASTM C447 Max Service Temp	1200°F (650°C)	1200°F (650°C)	1200°F (650°C)
ASTM C421 Abrasion Resistance	Weight Loss by Tumbling 9.0% after 10 minutes	Weight Loss by Tumbling 14.5% after 10 minutes	Weight Loss by Tumbling <20% after 10 minutes
ASTM C692/C871/C795 Corrosion Tests (Stainless)	Passes	Passes	Passes
ASTM C1617 Mass Loss Corrosion	Passes <DI Water Control	Passes <DI Water Control	Passes <DI Water Control
ASTM E136 Non-Combustible	Passes	Passes	Passes
ASTM E84 Surface Burning Properties	Flame Spread - 0 Smoke Developed - 0	Flame Spread - 0 Smoke Developed - 0	Flame Spread - 0 Smoke Developed - 0

### ASTM C1617 RESULTS



## TPSX-12<sup>®</sup> Calcium Silicate- Third Party Test Results

THERMAL CONDUCTIVITY



Mean Temp °F	C533 Maximum	TPSX-12 <sup>®</sup>	
		C335 (Pipe)	C518 (Flat)
100	0.41	0.390	0.374
200	0.45	0.435	0.403
300	0.50	0.470	0.437
400	0.55	0.511	0.477
500	0.60	0.558	0.523
600	0.66	0.615	0.574
700	0.71	0.683	0.631
800	N/A	N/A	0.693
900	N/A	N/A	0.761
1000	N/A	N/A	0.835
1100	N/A	N/A	0.914