

## THERMAL PROPERTIES OF LIGHTWEIGHT CONCRETE MADE WITH ELEMIX® ADDITIVE

### Technical Bulletin Overview

Elemix® concrete additive is an innovative patented product which produces lightweight concrete by dispersing specially designed polymer spheres throughout the concrete composition. The resulting lightweight concrete not only provides lower densities with structural strengths but also delivers improved thermal performance.

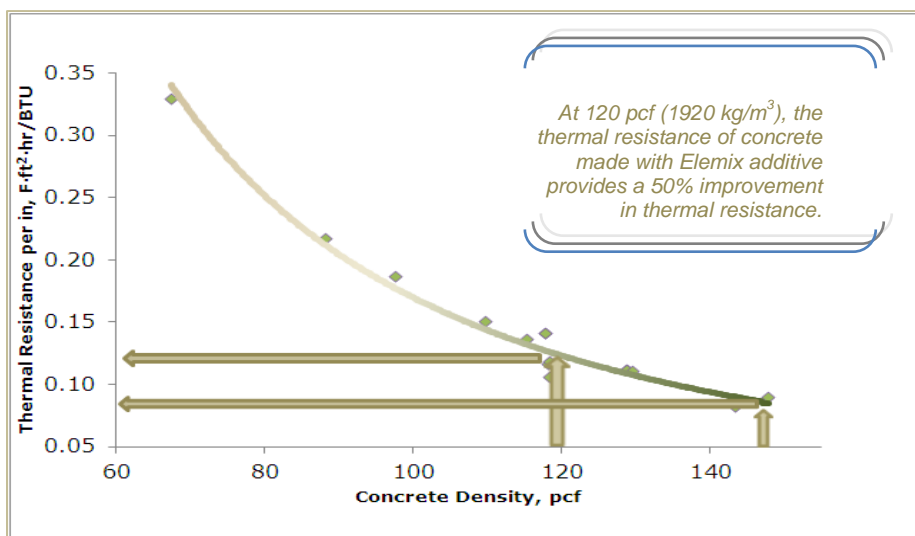
### Discussion:

The heat transfer through a material is dependent on three mechanisms: convection, conduction, and radiation. In a concrete wall, the heat transfer at the surface is due to convection and radiation, while the heat transfer through the interior of the wall is due mainly to solid conduction. Reducing the solid conduction will reduce heat transfer and improve the overall thermal performance.

Elemix additive particles consist of approximately 96% trapped air in a closed-cell structure, resulting in a very low thermal conductivity. The addition of these lightweight synthetic particles reduces solid conduction through concrete and improves thermal performance.

Since the thermal conductivity of Elemix additive is much lower than the thermal conductivity of the concrete matrix, the overall thermal benefit of using Elemix additive increases as the loading increases. Guarded hot-plate testing in accordance with ASTM C177 was conducted at a third party lab to demonstrate this concept. The results show that densities of 70 to 130 pcf (1120 to 2080 kg/m<sup>3</sup>), provide 0.33 – 0.11 F·ft<sup>2</sup>·hr/BTU-in (0.44 to 1.30 W/mK), respectively, in concrete mixes produced with Elemix additive. These test results agree well with the ASHRAE handbook design values<sup>1</sup>.

The following graph illustrates the relationship between density and the thermal resistance of concrete made with Elemix additive.



<sup>1</sup>ASHRAE Handbook Fundamentals *Typical Thermal Properties of Common Building and Insulating Materials – Design Values*

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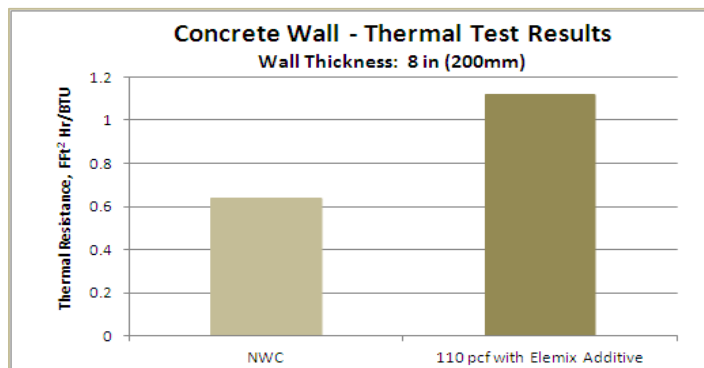
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## Examples:

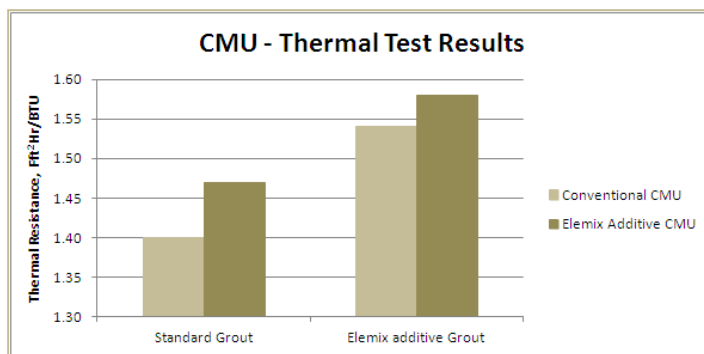
### Concrete Walls

In the following example, the thermal resistance of an 8" (200mm) normal weight concrete (NWC) wall is compared with an 8" (200mm) concrete wall made with Elemix additive at 110 pcf (1760 kg/m<sup>3</sup>). When using Elemix additive, the thermal resistance of the wall is increased by 75%.



### Block Walls

In a study to determine the impact of Elemix additive on Concrete Masonry Unit (CMU) construction, Elemix additive was shown to improve the thermal performance of both the block and the grout filled cells. All tests were run in accordance with ASTM C1363.



## Terminology and Definitions:

Thermal data can be represented in a variety of forms with varying units of measure. Provided below are concise definitions of the terminology and units used in this bulletin.

- **Conduction:** A heat transfer mechanism which describes the transfer of thermal energy between adjacent molecules in a material due to a temperature gradient.
- **Thermal Conductivity:** A material property used to measure a material's ability to conduct heat. Reducing the thermal conductivity of a building component results in improved thermal performance. Thermal Conductivity is often expressed in units of BTU-in/F·ft<sup>2</sup>·hr (US) or W/m·K (SI).
- **Thermal Resistance (R-value):** A material property used to measure a material's ability to prevent steady-state heat transfer; the reciprocal of thermal conductance. Increasing the thermal resistance of a building component results in improved thermal performance. It is often expressed in units of F·ft<sup>2</sup>·hr/BTU (US) or m<sup>2</sup>·K/W (SI)

### Available Test Reports upon Request:

- ASTM C177 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot-Plate Apparatus (Netzsch)
- ASTM C1363 Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus (NCTL)

## Elemix® Concrete Additive

*Elemix concrete additive utilizes advanced polymer technology to deliver stronger, longer lasting, more efficient concrete applications. Available globally, with consistency, Elemix additive provides concrete designers and manufacturers with an edge over the competition. Elemix additive is suitable for any application where lightweight and durability are important including; ready mix in grouts and fills, poured in place, elevated decks and toppings, and manufactured concrete products, including block and precast building components.*

**The use of Elemix additive in concrete is covered by one or more of the following U.S. Patent Nos. 7,644,548; 7,648,574; 7,632,348; 7,658,797.**

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