

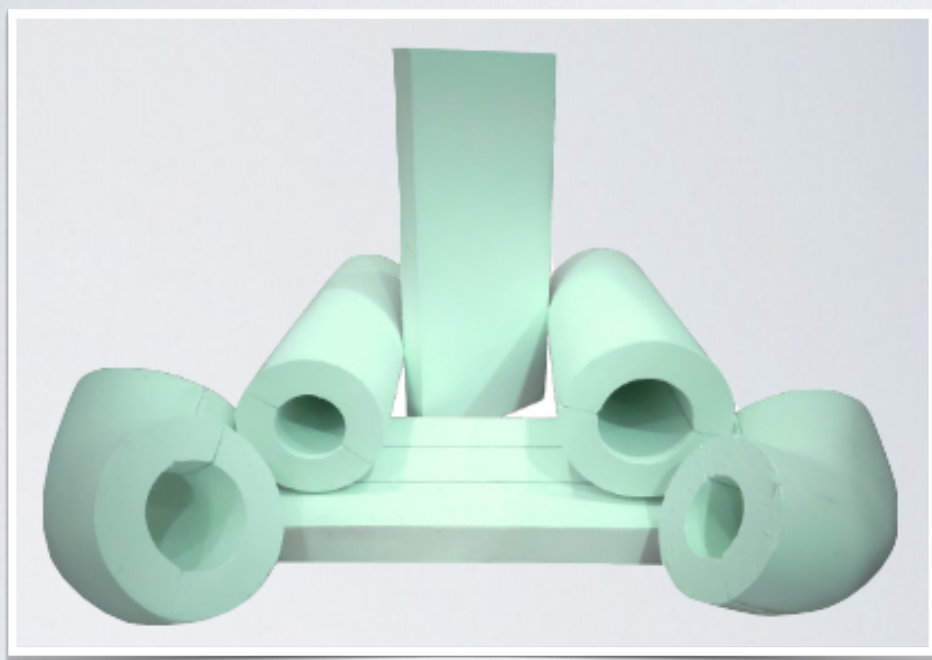
## Comparing Expanded Perlite & Calcium Silicate Insulations

### 30 SECOND TAKEAWAY

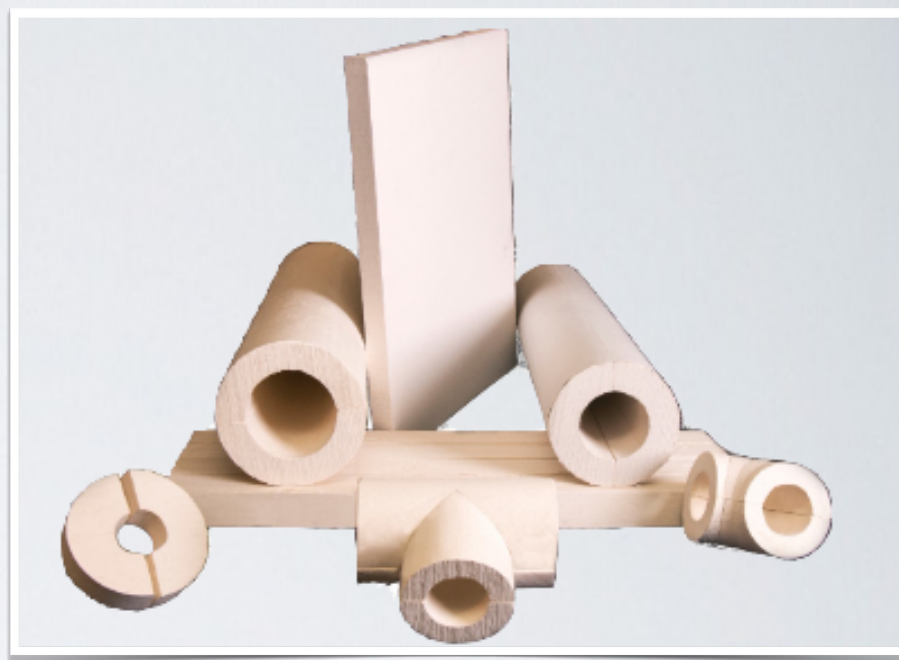
1. THESE TWO INSULATION MATERIAL TYPES HAVE SIMILAR PHYSICAL PROPERTIES WITH A FEW KEY EXCEPTIONS
2. EXPANDED PERLITE HAS AN EXCELLENT HISTORY FOR MITIGATING CORROSION UNDER INSULATION (CUI) DUE TO ITS CHEMISTRY AND WATER REPELLENCY
3. TPSX-12® CALCIUM SILICATE CONTAINS A UNIQUE FORMULA CONSISTING OF 50% PERLITE AND IS ALSO TREATED TO BE DURABLY WATER REPELLENT
4. TPSX-12® PROVIDES ALL THE BENEFITS OF EXPANDED PERLITE WITH HIGHER COMPRESSIVE STRENGTH AND LOWER THERMAL CONDUCTIVITY IN HOT SERVICE

## Comparing Expanded Perlite & Calcium Silicate Insulations

- Many Engineers inquire as to the differences between the two high temperature insulations TPS currently offers.
- First, our company offers both Expanded Perlite per ASTM C610 and Calcium Silicate per ASTM C533 type I (calsil) pipe and block insulations so we can be objective about the pros and cons of each material type, their associated benefits and publish third-party physical property data to help Engineers make informed, data driven decisions about where and when to specify each material to optimize process control and worker safety.



TPS EP-12® Expanded Perlite per ASTM C610



TPSX-12® Calcium Silicate per ASTM C533 type I

## How Are These Two Generic Material Types Similar?

- Both generic insulation material types have over 50 years of history within industrial plants
- Both contain ZERO asbestos and were developed to replace asbestos fiber reinforced insulations
- Both are indicated for continuous service up to 1200°F (650°C)
- Both are available in pre-formed pipe cover for small, medium and large diameter piping
- Both are available in plain and v-scored block to insulate equipment, tanks and large diameter vessels
- Both are available from the factory in pressed or mitered elbows and other fittings
- Both can be easily fabricated in the field and expertly installed by skilled tradespeople
- Both offer high compressive strength to support the metal jacketing from in-situ physical damage
- Both contain integral corrosion inhibiting inorganic silicate chemistry activated in the presence of water
- Both are treated with a silicone emulsion that allows bulk water shedding



## The History of Expanded Perlite

- Many refineries and chemical plants in the United States Gulf Coast report excellent historical performance of Expanded Perlite to prevent corrosion under insulation (CUI) on mild steel and external stress corrosion cracking (ESCC) on austenitic stainless-steel piping, vessels, tanks and equipment.
- One former corrosion Engineer explained her historical perspective in this article.
  - <https://www.corrosionpedia.com/the-detrimental-effects-of-wet-insulation-in-the-cui-range/2/1870>
  - "Back in 1974, after years of struggling with CUI, the refineries switched completely to expanded perlite, which is water repellent (throughout its thickness) to a temperature well above the CUI range (~450°F). Expanded perlite became the only approved hot insulation material for these facilities..."
  - "The consistent discovery to date is this: Wherever expanded perlite was used and the equipment was properly designed to drain water, there was no corrosion."
- Despite this strong reputation regarding CUI, Expanded Perlite's main drawback was and is its fragile nature.
- Some brands are very fragile causing high rates of breakage in transit (>25%) which increases cost of ownership.
- Additionally, perlite can be quite friable which is undesirable on pipes and equipment subject to vibration.

## The History of Calcium Silicate

- Historically, there were numerous different manufacturers using one of two types of manufacturing processes:
  - Filter Pressing or Wet Molding
- First generation calcium silicate (1973-2002) was highly water absorbent and did not contain integral corrosion inhibiting chemistry so it developed a historical association with CUI especially in hot, humid climates.
- Over time, many Engineers eliminated calsil from their project specifications causing the market to decline and by 2002 caused all but one company to exit the market leaving a monopoly paradigm.
- In 2018, TPSX-12® filter pressed calcium silicate entered the North American market.
- Today, both brands of calcium silicate contain integral corrosion inhibiting chemistry and are advertised to shed bulk water during inclement weather installations, although the performance of the repellency varies by brand.

## Why Expanded Perlite is Effective at Mitigating CUI

- The historical performance of Expanded Perlite is well known and observable, but the reasons why are often limited to an observable physical property.
- Many attribute the success to the fact that perlite insulation is water repellent up to 450°F, but most do not realize the hydrophobic treatment is an organic silicone which will oxidize at high temperatures.
- Once the silicone treatment burns off, expanded perlite becomes extremely absorbent. Even with the hydrophobicity intact the insulation is highly vapor permeable and will absorb significant moisture in hot, humid environments like the U.S. Gulf Coast.
- Despite these facts, expanded perlite still works even when the water repellency burns off in hot service or when it absorbs moisture from the air in humid conditions.
- This is because the CHEMISTRY of expanded perlite by its very nature behaves as a corrosion inhibitor that lies dormant when the insulation is dry and is activated in the presence of water absorbed into the insulation.
- This chemistry provides a two-prong defense against corrosion by forming an on-demand passivation layer on the metal surface and simultaneously buffers the pH of any absorbed water.
- Five different inorganic silicates with varying solubility rates will migrate via osmosis from the insulation onto the metal asset and with heat and time provide lasting on-demand protection against corrosion.

## Key Physical Property Comparison

- First, it is important to note that many of the physical properties of TPS branded Expanded Perlite and Calcium Silicate are the same or similar including:
  - Max Service Temperature (1200°F)
  - Density (<14 pcf)
  - Linear Shrinkage (<1%)
  - Abrasion Resistance (<10% weight loss by tumbling)
  - Flexural Strength (>75 psi)
  - Corrosion Test Methods (<DI water control)
  - Non-Combustibility & Flame Spread/Smoke Developed Indices (0/0)
- However when it comes to compressive strength and high temperature thermal conductivity, this is where TPSX-12® calcium silicate provides clear performance advantages along with tangible ROI.
  - Due to the filter pressing process unique to TPS calsil, it provides more than DOUBLE the ASTM minimum required compressive strength for calsil (100 psi) and expanded perlite (70 psi).
  - Due to integral opacifiers and its Tobermorite crystal structure, calsil is very effective at blocking radiant heat which is the primary mode of heat transfer in high temperature applications.

Insulation Type	Compressive Strength (ASTM C165)	Thermal Conductivity @ 600°F Mean (ASTM C518)	Thermal Conductivity @ 700°F Mean (ASTM C518)
TPS EP-12® Expanded Perlite	>95 psi @ 5% strain	0.72 BTU-in/hr-ft²-°F	0.77 BTU-in/hr-ft²-°F
TPSX-12® Calcium Silicate	>220 psi @ 5% strain	0.57 BTU-in/hr-ft²-°F	0.63 BTU-in/hr-ft²-°F

## Unique Formula Provides Best of Both Worlds

- TPSX-12® Calcium Silicate is unique in several ways compared to the incumbent brand of wet molded calsil.
  - First, it is filter pressed making it dramatically stronger
  - Second, the concentration and application method of the hydrophobic treatment results in significantly better water shedding abilities more closely resembling expanded perlite insulation.
  - Third, the unique formula of TPS calsil consists of 50% perlite as the primary siliceous source.
- These advancements in calsil manufacturing technology, chemistry and formulation provide all of the corrosion inhibiting benefits of expanded perlite combined with the higher strength and lower conductivity of calsil.
- Typically, the wall thickness of calsil can be 1/2" less than perlite which also reduces the cost of metal jacketing.
- This information provides compelling reasons to consider specifying TPSX-12® Calcium Silicate in facilities that have historically enjoyed the CUI mitigating benefits of expanded perlite, but have struggled with its' fragile and friable nature along with the higher thermal conductivity and extended lead times.