Thermo Stone

Thermo stone is a lightweight cement-based material, containing many gas bubbles evenly distributed in the volume, produced by blending and maturing of a mixture of cement, lime, sand, water, agent generating cells. The reduced unit weight makes for ease of handling, reduced floor/foundation loading, insulation, fire resistance.

It Developed in Sweden in the 1920s by Dr. Johan Axel Eriksson who was looking for a building material with the properties of wood without the disadvantages of wood: combustibility, decay and insect damage. He was working on a variety of aerated concrete samples. Running short of time, he decided to speed up the curing process by placing the sample in the laboratory autoclave. The porous mass survived the overnight autoclaving and the resulting cured brick possessed greatly increased strength and a new, stronger crystalline composition. In the heat and pressure of the steam curing, the silica and lime components had become fused into a form of calcium silicate hydrate crystal, similar to the volcanic rock, known in nature as Tobermorite. He succeeded in producing a highly cellular, lightweight masonry material, and quickly became very popular and was often referred to as “blue concrete” in Sweden due to its bluish tinge. Thermo stone is a lightweight manufactured building stone. It is used in a wide range of commercial, industrial, and residential applications and has been in use in Europe for over 70 years, the Middle East for the past 40 years, and South America and Australia for approximately 20 years.

Thermo stone is very light colored. It contains many small voids that can be clearly seen when looked at closely. The closed air pockets contribute to the material’s insulating properties and also its aerated

nature. Although there is no direct path for water to pass through the material, an appropriate coating is required to prevent water penetrating into the thermo stone material.

Raw Material

Basic requirements of the quality of raw materials necessary for thermo stone production

Sand (fine sand must be free from stone, clay, salty impurities and organic substances)

SiO_3	at least	80%
	of this	75% as quartz
	better at least	80% as quartz
Loss on ignition	Less than	5%
Al_2O_3	Less than	7%
$Na_2O + K_2O$	Less than	2%
Fe_2O_3	Less than	3%
MgO	Less than	2%
SO_3	Less than	3%
Silt	Less than	2.5%
Chloride	Less than	0.05%

Lime

Ground calcium oxide		90% < 0.1mm
CaO total	Preferably more than	90%
CaO akliy	Less than	85%
MgO	Less than	2%
SiO_2	Less than	5%
$Al_2O_3 + Fe_2O_3$	Less than	2.5%
SO_3	Less than	0.3%
$Na_2O + K_2O$	Less than	1.5%
Residual	Less than	3.0%

Cement (standard Portland cement with no additions of fuel ash or slags)

Free CaO	Less than	1.5%
Sulphate total	Less than	3.0%
Autoclave		0.25-1.0%
Spec. suriace	Approx.	3.000-4.000cm^2/g

Aluminum (some main values)

Specific surface	At least	15.000cm^2/g
Metal content	Ca.	95% powder
	Ca.	80% paste

Manufacture of thermo stone

The thermo stone production process starts by grinding sand to the appropriate fineness. Workers then measure out the materials by weight and place them in an automatic mixer. Expansive agents (Aluminum powder is used at a rate of 0.05%-0.08% by volume) and water are added last to create cement slurry. As soon as the expansive agents, water and concrete come into contact, a chemical reaction occurs, creating microscopic bubbles of hydrogen. When thermo stone is mixed and cast in forms, several chemical reactions take place that give thermo stone its light weight (20% of the weight of concrete) and thermal properties. Aluminum powder reacts with calcium hydroxide and water to form hydrogen. The hydrogen gas foams and doubles the volume of the raw mix (creating gas bubbles up to 3mm (¼ inch) in diameter). At the end of the foaming process, the hydrogen escapes into the atmosphere and is replaced by air. Immediately after mixing, workers pour fresh concrete slurry into steel molds. If they are producing reinforced thermo stone, these molds contain steel reinforcing materials. Within about three hours, the concrete expands to around twice its original volume, filling the mold. It takes a few more hours for the thermo stone to cure enough to support its own weight. The material can then be cut and shaped.

While thermo stone can support its own weight within a few hours, it is not yet fully cured. The concrete must be placed inside an autoclave for 12 hour, a device that subjects it to high pressure steam at temperatures of around 190 degrees Celsius and the pressure reaches 8 to 12 bars. quartz sand reacts with calcium hydroxide to form calcium silica hydrate, which gives thermo stone its high strength and other unique properties. This cures the concrete completely, giving it the necessary structural properties and stability to be used in buildings.

Autoclaved aerated concrete can be used in a variety of structural and nonstructural applications, just like regular concrete. Unlike ordinary concrete, however, thermo stone requires a stucco-type finish to prevent weather damage. Special polymer-modified stuccos make thermo stone more resistant to water penetration while still allowing the material to breathe. Some builders also finish thermo stone with heavy acrylic paints.

$CaO+H_2O \rightarrow Ca(OH)_2$
$Al + Ca(OH)_2 \rightarrow Al\ CaO_2 + H_2$ gas

Advantages of thermo stone

1. Faster Construction

- Reduces construction time by 20%.
- Different sizes of blocks help reduce the number of joints in wall masonry.
- Lighter blocks make construction easier and faster.
- Easy to install. Sets and hardens quickly.

2. Reduces Noise Pollution and Improves indoor Air Quality

An additional quality contributing to the sustainability of a building product is its ability to reduce and absorb noise or to improve or maintain indoor air quality. Due to its millions of independent air cells, which dampen sound transmission, thermo stone has excellent sound insulation and absorption qualities. Moreover, because thermo stone construction has very low air infiltration, indoor air quality of thermo stone structures is improved relative to competitors.

3. High Thermal Efficiency and energy saving

Building constructed of thermo stone provides substantial energy saving in both hot and cold climates. The unique closed cellular structure and the thermal mass contribute to a high R-value and air tightness which reduce heating and cooling costs and improve indoor air quality.

4. Fire Resistance

- Non-combustible and fire resistant up to 1600° C.
- Can withstand up to 6 hours of direct exposure.

5. Earthquake Resistant

- Thermo stone blocks reduce mass of a structure, thus decreasing the impact of an earthquake on a building.
- Non-combustible nature provides an advantage against fires, which commonly accompany earthquakes.

6. Precision

- Available in exact sizes.

- Results in smooth walls with perfect contact between different elements.
- Reduces finished and plastering.

7. Workability

Thermo stone products can be easily cut, drilled, nailed and grooved with manual or power tools. This provides higher productivity in hydro- sanitary and electrical installation such as pipe or ducts which can be placed after the structure has been built.

8. Sustainable

- Retains properties over time.
- Made of non-allergenic material.
- Use of thermo stone improves indoor air quality.

9. Cost Effective

- Reduces operating cost by 30% to 40%.
- Reduces overall construction cost by 2.5% as it requires less jointing and reduces need for cement and steel.
- High-insulation blocks save up to 30% in energy costs.
- Wall painting and plastering last longer as almost nil efflorescence affects. This translates into lower maintenance costs.

10. Lightweight

- 3-4 times lighter traditional bricks, therefore, easier and cheaper than to transport.
- Usage reduces overall dead load of a building, thereby allowing construction of taller buildings.