Our Foundation is Science...Our Focus is Innovation

Magnesium Oxy-sulfate Cement (MOS)

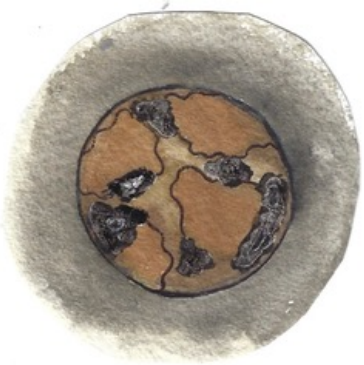
The Opportunity

Frequently, traditional construction builds face extended timelines, cost overruns, skilled labour shortages, quality issues and barely meet increasing environmental standards.

By 2060 the world is expected to build 230 billion square meters in new construction – adding an equivalent of New York city every month

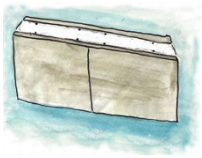
Volume of buildings on earth will double in the next 40 years

It's estimated that the world produced 4.1 billion metric tons of cement in 2019



We are Part of the Solution

The adoption of prefabricated construction, in combination with advances in material science, presents a tremendous opportunity for the construction industry to close the productivity gap, improve building safety, increase building performance and generate significant economic returns.



Material Innovation: *Future* vs. *Present*

Magnesium Oxy-sulfate Cement

Raw Material: Magnesite - $MgCO_3$

Calcination Temperature of $MgCO_3$ is 650C to 900C

Green House Gas Emissions are lower at this stage of production vs Portland Cement.

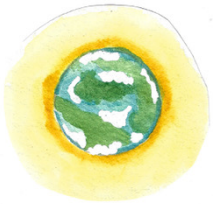
Magnesium Oxide: MgO

Carbon Dioxide: CO_2

MOS Cement

a byproduct of the chemical reaction but the carbon footprint is offset by lower GHG usage in the calcination process

Higher fire rating, 3x stronger and more resilient cement material with a >50% lower carbon footprint



Vs.

Portland Cement

Raw Material: Limestone – $CaCO_3$

Calcination Temperature of $CaCO_3$ is 1450C

Green House Gas Emissions are very high in order to maintain required temperature.

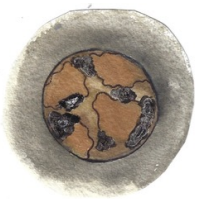
Calcium Oxide: CaO

Carbon Dioxide: CO_2

Portland Cement

a byproduct of the chemical reaction that adds to GHG pollution from the calcination process

Roughly 1 ton of CO_2 pollution per 1 ton of cement produced



ZS2 Technologies and MgO Cement

Magnesium Oxy-sulfate Cement Technologies

Production of Magnesium based cement can vary depending on the salt material used. The three most common salts used are Chloride, Phosphate and Sulfate.

$$MgO + Salt + H_2O \rightarrow Magnesium\ Oxy\ salt\ cement$$

Magnesium Oxy-chloride (MOCC) cement, commonly known as 'Sorel Cement' has been around for years competing against Portland cement but has yet to breakthrough into the mainstream construction industry. One reason being that MOCC has high corrosive potential when in contact with steel and embedded metals. This causes issues with steel rebar and common metal fasteners.

Magnesium Oxy-sulfate Cement (MOS)

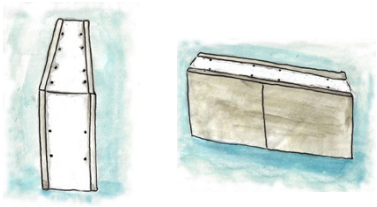
At ZS2 we use Sulfate which lowers corrosivity of the cement compared to MOCC. There is less then <0.001% chloride giving MOS higher water resistance capabilities, while maintaining superior strength qualities.

$$MgO + MgSO_4 \rightarrow 3Mg(OH)_2\ MgSO_4\ 8H_2O$$

Lighter than conventional cement by **30%**	**Stronger** than regular Portland Cement	**Very high fire rating** – Crystalline water content wt% 35-45
No corrosive Chlorides (<0.001%)	**Impervious to mould and bacteria**	**Low carbon footprint**

ZS2 TechBoard™

First generation ZS2 TechBoard™ is a magnesium oxide sulfate (MOS) cementious & concrete fire rated building and structural board. Working in concert with our partners, the elimination of chlorides is achieved with a proprietary formula utilizing sulfate technology.



Artist Rendition of ZS2 TechPanel™

Prefabricated Construction Methodology
&
Innovative Material

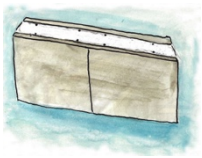
- *Non-combustible*
- *Anti-mold, anti-bacteria,*
- *High strength & impact resistant*
- *Water resistant*

Product Comparison:

	ZS2 TechBoard™	*Lumber Stick Frame Construction*	*Tilt-Up Concrete Panels*	*OSB/Wood Insulated Panels*	*ICF – Insulated Concrete Forms*
Carbon Footprint	Low	Medium	High	Medium	High
Mold/Bacteria Resistant	Yes	No	No	No	Yes
Thermal Insulation (R-Value)	High	Low	Low (Unless Insulated)	High	High
Fire Suppression	Yes	No	No	No	No
Flame Spread	No	High	No	Massive	High
Toxic Off Gassing	No	Yes	No	High	No
Toxin-Free	Yes	No	No	No	No
Structural	Yes	Yes	Yes	Yes	Yes
Impact Strength	High	Medium	High	Medium	Low
Water Resistant	Yes	No	Yes	No	Yes

Innovation in Construction: *Future* vs. *Present*

Prefabrication Construction Vs. Traditional Construction



Artist Rendition of ZS2 TechBoard™

I. Improved quality of the building comes from producing standardized products offsite.

II. Flat-pack panels therefore make it possible to transport more materials for a significantly cheaper price.

III. Accelerated build schedules

Cut building timeline by 55%

IV. Greater certainty on both build times and build costs.

Up to 41% less expensive

Traditional construction methods face extended timelines, cost overruns, skilled labour shortages, quality issues and barely meet increasing environmental standards.

Non optimal activities cost the US construction Industry $177 billion in labour costs in 2018 alone

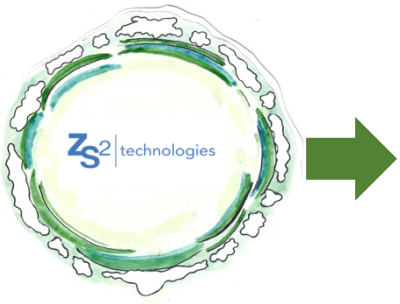
It's estimated that the world produced 4.1 billion metric tons of cement in 2019

ZS2 Technologies is part of the Solution:

UN Sustainability Goals

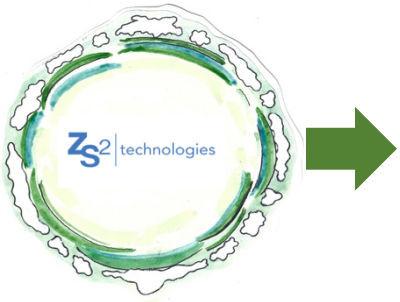
(https://www.un.org/sustainabledevelopment/climate-change/)

Goal 9: *Build resilient infrastructure, promote sustainable industrialization and foster innovation*



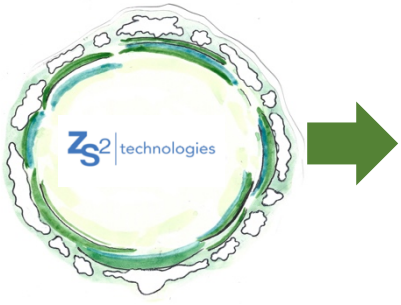
9.4 - By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities

Goal 11: *Make cities inclusive, safe, resilient and sustainable*



11.B - By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015-2030, holistic disaster risk management at all levels

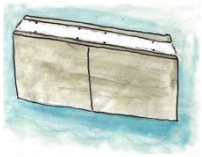
Goal 12: *Ensure sustainable consumption and production patterns*



12.5 - By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse

12.8 By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature

Goal 13: *Take urgent action to combat climate change and it's impacts*

MOS Cement →  → Higher fire rating, stronger and more resilient cement material with a >50% lower carbon footprint

13.1 Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries

13.3 Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning

Future Technologies for ZS2

Magnesium Carbonate Cement: *Carbon Negative*

$$MgO + CO_2 + H_2O \rightarrow MgCO_3.3H_2O$$

For every ton of cement produced 1/10th a ton of carbon can be absorbed.

R&D

ZS2 Technologies is focused on continuous research and development of innovative building and material technologies. This focus is supported by strategic partnerships with innovative market leaders who share our vision to develop stronger, safer and better building solutions. Working with commercial, government and academic partners, ZS2 is committed to building a better planet.