Suststeel

The innovation in the anti-corrosion protection of structural steel

HELLAS

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ΕΣΠΑ 2021-2027
Partnership Agreement 2021-2027

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O.P. Region of Central Macedonia

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Βιώσιμη Ανάπτυξη για Όλους
Partnership Agreement 2021-2027

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Laboratory of Building Materials

Suststeel: Unique anti-corrosion protection system for structural steel rebars

POLYCHIMIKI G. MATZIARIS S.A. - UZIN Hellas in collaboration with the Laboratory of Building Materials of the School of Civil Engineering of the Aristotle University of Thessaloniki has registered the Patent of the Suststeel system, which concerns sustainable, hybrid, nanostructured, anti-corrosion coating series for structural steel bars.

This teamwork was implemented within the framework of the Recovery Plan for Europe through the Action "Investment Projects of Innovation" of the Central Macedonia Program NSRF 2021 - 2027 (KMP6-02817).The patent, issued by the Industrial Property Organization of Greece (OBI) with patent number 20250100072, is an important milestone in the development of anti-corrosion products for the protection of structural steel.

The Suststeel system is a pioneering technology that will increase the Life Cycle of structural steel and reinforced concrete and consequently, the sustainability of structures.The protection of structural steel with the Suststeel system will improve its antioxidant properties, both during its transportation and storage, as well as during its final integration into the concrete environment, offering sustainability at very little additional cost.

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Reinforced concrete corrosion: An enormous global problem

- ✓ It is known that corrosion of both steel and composite structures - where metal elements are contained in concrete - has a significant impact on the global economy and inextricably affects infrastructure projects, transportation, utilities, production and processing and by extension every modern construction.
- ✓ According to the most recent study by the International NACE Organization, the global cost of corrosion is estimated at 2.5 trillion US dollars annually, which is equivalent to 3.4% of the global Gross Domestic Product (GDP) (for the year 2013)By using available corrosion control practices, it is estimated that savings of between 15 and 35% of the cost of corrosion could be achieved. That is, between 375 and 875 billion dollars annually on a global basis, so it would constitute a significant cost saving. If one considers that the above-mentioned cost savings against corrosion do not include any individual consequences for human safety or the natural environment, one can understand the enormous potential burden of corrosion costs.
- ✓ As early as 1949, the need for systematic studies to assess the current impact of metal corrosion on the international economy and to provide strategies to minimize its impact was recognized. The fact that corrosion control provides cost benefits is a lesson learned time and again by industry, often too late and after catastrophic events (e.g. accidents, failures and loss of production).
- ✓ To achieve the full extent of the potential savings, a mandatory Corrosion Management System is required and integrated into the overall management system of each economic organization.

Is there a sustainable solution to the problem?

- ✓ The combined use of steel and concrete has many advantages. The steel compensates for the weak tensile strength of concrete, while the alkaline environment of concrete favors the formation of a passive film on its surface that protects it, -theoretically-, from corrosion. The performance of reinforced concrete structures under normal conditions is not a problem within their expected service life. However, the passive film can be damaged due to carbonation of the concrete and/or the penetration of toxic ions, leading to the initiation of corrosion processes.
- ✓ The damage caused by corrosion of reinforcement includes not only the reduction of its strength and ductility, but also the creation of cracks in the reinforced concrete, due to the volumetric expansion caused by the secondary corrosion products of the metal, which are 2 to 6 times larger than the initial volume of the steel and additionally wear out the steel-concrete interface points, resulting in the destruction of their cohesion and their final detachment/flaking, which ultimately leads to collapse.
- ✓ Among the appropriate corrosion prevention techniques, are the protective barrier coatings (Barrier Coatings), which function as protective films on the metal surface of the structural steel and isolate or suppress the electrochemical charge caused by harmful compounds in the concrete environment, thus protecting the structure.

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The Challenge

- ✓ The philosophy behind using barrier coatings is to enhance their lifespan and functional performance. By coating the metal with these protective materials, its resistance to demanding environments and harsh conditions of use is improved.
- ✓ But the physicochemical properties of each barrier coating must match perfectly with those of the underlying substrate, without altering the inherent characteristics of the metal.
- ✓ Therefore, it is a great challenge to find a way to perfectly chemically/physically bond the protective coating to the steel metal substrate, harmonizing the optimal antioxidant properties to ensure the long-term extension of the service life of the structures.

Suststeel: Unique investment opportunity

- ✓ The Suststeel system uniquely protects structural steel from corrosion.
- ✓ It creates a revolutionary new range of protected steel, which adds sustainability to reinforced concrete and consequently to constructions.
- ✓ Suststeel's innovation is a unique investment opportunity for pioneers in the structural steel industry.

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Why is Suststeel a sustainable structural steel protection system?

- ✓ It effectively protects steel from natural corrosion, mechanical wear and harmful environmental conditions.
- ✓ It contributes to sustainability through the use of non-toxic, recyclable and/or biodegradable materials and therefore to the sustainability of constructions.
- ✓ It complies with the strictest environmental criteria, ensuring that the developed product meets all safety requirements.
- ✓ It increases economic efficiency, by reducing the cost of maintenance and replacement of structural steel in constructions.

Suststeel: Sustainable innovation

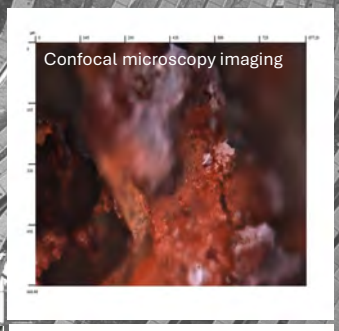
It reduces the microeconomic scale of steel production costs, because:

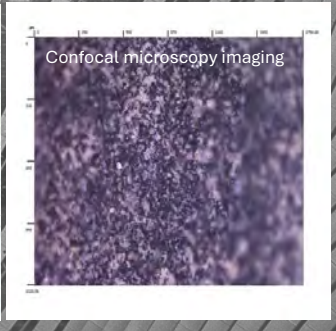
- ✓ Its application requires low costs of adapting mechanical equipment, because it is carried out in situ during the shaping of the steel.
- ✓ No large investment capital is required for the addition of its spraying equipment.
- ✓ It exploits the high heat of the steel - during its shaping - and does not require additional costly energy.
- ✓ It has low-cost efficiency and adds very high added value to the final corrosion-resistant steel.
- ✓ It saves resources due to the many times longer life cycle of the protected steel and consequently of the structures.

What unique does Suststeel offer?

1. Neutralization of the steel surface

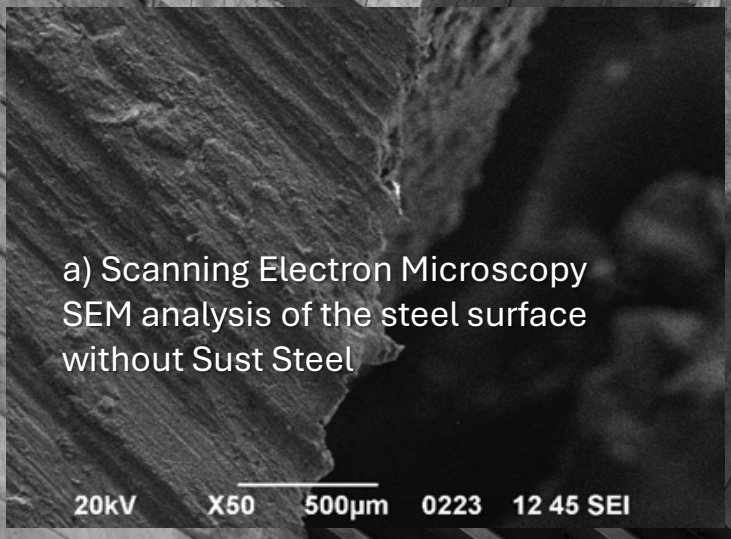
✓ The Suststeel system offers chemical inertness and stability, making surface corrosion almost impossible, both from external conditions and from the internal conditions prevailing in the concrete environment.





2. Hybrid character OIH (Organic-Inorganic-Hybrid)

- ✓ The Suststeel system initially contains organosilicate substances (ormosils) that, after hardening, are converted into inorganic silicon dioxide (SiO_2), one of the most durable and impervious materials on the planet.



a) Scanning Electron Microscopy SEM analysis of the steel surface without Sust Steel

b) Scanning Electron Microscopy SEM analysis of the steel surface with Sust Steel

What unique does Suststeel offer?

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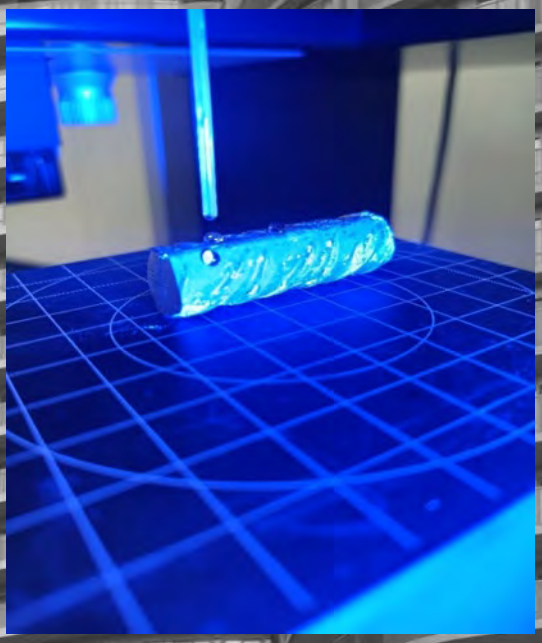
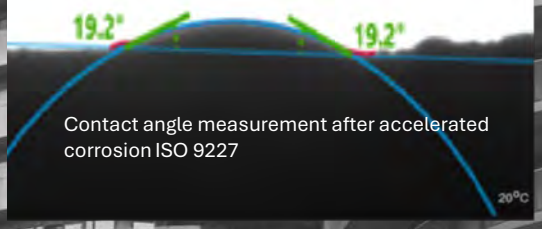
What unique does Suststeel offer?

3. Hydrophobization



✓The Suststeel system modifies the surfaces of structural steel, as well as its interfaces with concrete, so that they are less wetted by water and the poisonous components dissolved in it, so that they "self-clean", and therefore better protected against corrosion.

a) Steel **without** Suststeel system



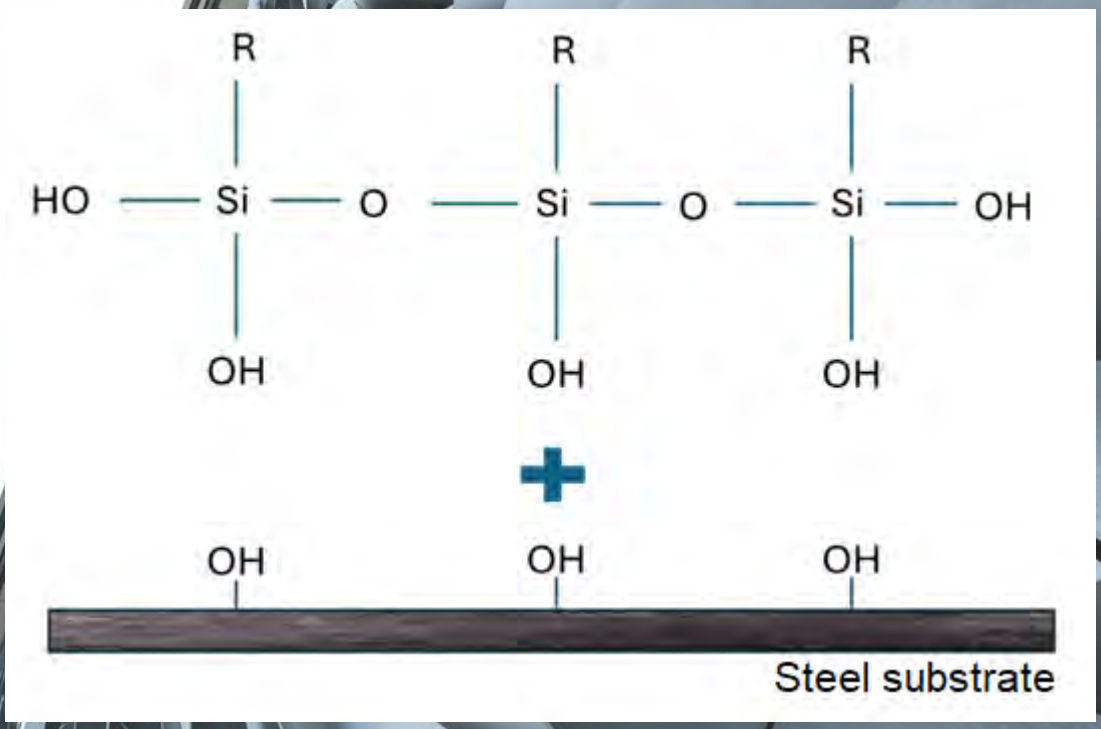
Contact angle measurement after accelerated corrosion ISO 9227

b) Steel **with** Suststeel system

Contact angle measurement after accelerated corrosion ISO 9227

4. Permanent adhesion & perfect cohesion

✓ The Suststeel system ensures irreversibility of the crosslinking of the coating on the structural steel substrate, due to the van der Waals forces and the strong chemical bonds (Si-O-Si) that are created.



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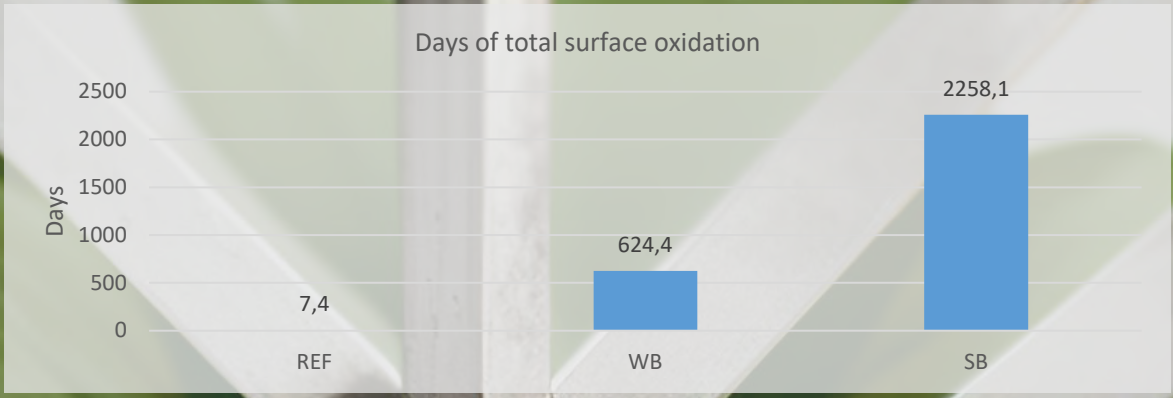
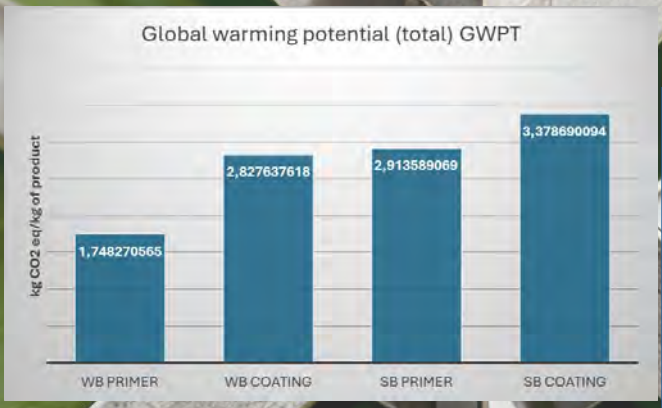
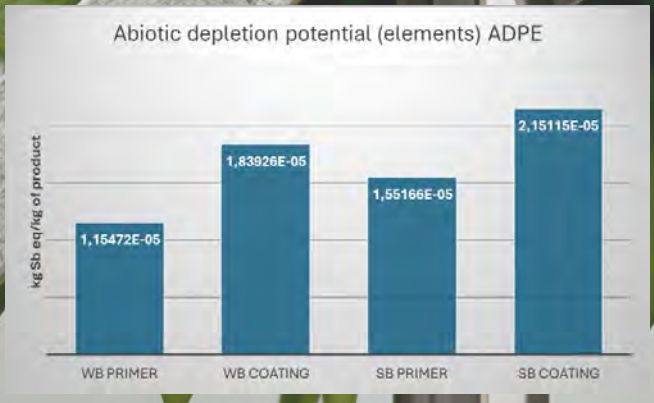
5. Increased Life Cycle (LC) of structural steel







The Suststeel system multiplies the life cycle of structural steel by up to 2500 times and improves its environmental impact and carbon footprint, because it reduces the possibility of overheating the Planet (Global Warming Potential) related to climate change and finally reduces the abiotic possibility of depletion and consumption of natural resources (Abiotic Depletion Potential).

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SustSteel: Unique novelty

- ✓Unique protective coating system for the anti-corrosion protection of structural steel.
- ✓Unique application method during the production/forming process of structural steel.
- ✓Unique sustainability in construction & infrastructure projects.
- ✓Unique business sustainability opportunity for pioneers in the structural steel industry.

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