SAS International

ADVANCEMENTS IN LOW EMBODIED CARBON STEEL FOR SUSTAINABLE CONSTRUCTION

March 2024

ABSTRACT

This publication explores how global steel producers are finding new ways to make steel with a lower carbon footprint. It explores the features of metal and production, current challenges, and benefits for construction. Additionally, it introduces SAS International's SAS Horizon programme, which uses the latest innovations in steel production and its own design and manufacturing innovations to provide a low embodied carbon metal ceiling products.

INTRODUCTION

Steel producers worldwide are at the forefront of innovation, changing the story of a material known for high carbon emissions. Historically linked with significant environmental impact in construction, alongside materials like concrete and glass, steel is now undergoing a positive transformation. The use of electric arc furnaces powered by renewable energy to create 'low embodied carbon' steel presents a solution that aligns with sustainability goals, breaking from traditional practices. This initiative not only brings a durable material with various benefits to construction but also tackles longstanding environmental issues in the steel industry, fundamentally reshaping the nature of construction materials.

BENEFITS OF METAL

This latest innovation in steel production is anchored in a revolutionary reduction in embodied carbon, harmoniously combined with inherent material durability and flexibility. This combination contributes to an extended life cycle for construction products and projects, ensuring longevity and resilience. Beyond merely reducing the need for premature replacements, this heightened durability also enhances the overall sustainability of structures, paving the way for a future material designed with circularity in mind.

Steel's remarkable versatility provides architects and designers with a creative canvas, where sustainable practices seamlessly integrate with the aesthetic vision of construction projects. This adaptability spans diverse architectural styles, granting design freedom without compromising on environmental responsibility.

The optimised manufacturing processes and material properties of metal contribute to potential cost savings. Low embodied carbon steel not only curtails carbon emissions but also positions itself as a pragmatic choice, highlighting that sustainability need not be sacrificed for economic considerations.

Timeline of Steel Production Technology Development:

2000s: Introduction of electric arc furnaces (EAFs)

A pivotal shift from traditional blast furnaces aimed at reducing carbon emissions in steel production.

2010s: Advancements in energy efficient EAF technologies

Continued focus on enhancing efficiency and incorporating renewable energy sources for a more sustainable steel production process.

2020s: Exploration of hydrogen-based technologies

Significant efforts towards replacing carbon-intensive fuels with hydrogen for cleaner steel production.

Integration of carbon capture and storage (CCS) technologies: Notable development capturing and storing carbon emissions to mitigate environmental impact.

An example of the development of fossil free steel

"SSAB is already one of the world's most carbon emission-efficient steel companies. We are now about to revolutionize iron-ore based steelmaking and aim to be the first in the world to deliver fossil-free steel to the market in 2026. SSAB wants to offer customers the competitive advantage of a completely fossil-free value chain. By around 2030, all our production sites will be able to deliver fossil-free steel." (SSAB, 2023 'Fossil Free Steel')

Future Trends in Steel Production

- Green Hydrogen Integration: Adoption of green hydrogen technology to replace carbon-intensive fuels, reducing carbon emissions in steel production.
- Carbon Capture, Utilisation, and Storage (CCUS): Implementation of advanced CCUS technologies to achieve carbon neutrality in steel production.
- Enhanced Energy Efficiency: Continued efforts in improving energy efficiency through technologies like energy efficient EAFs and innovative heat recovery systems.
- Digitalisation and Industry 4.0: Integration of digitalisation and Industry 4.0 technologies throughout the supply chain for real-time monitoring, predictive maintenance, and resource savings.
- Circular Economy Practices: Widespread adoption of circular economy principles, designing products for recyclability and promoting closed-loop systems and circular supply chains.
- Bio-Based Reductants: Research and development exploring the use of bio-based reductants in steel production, contributing to a lower carbon footprint.

CHALLENGES IN ACHIEVING LARGE-SCALE PRODUCTION

While the journey toward low carbon steel production has made strides, several obstacles are slowing down progress. It's essential to recognise and tackle these challenges to steer the industry toward a more sustainable path.

Limited Availability of Green Hydrogen

A significant hurdle is the limited availability of green hydrogen, a crucial component in reducing carbon emissions during steel production. The problem lies in the scalability of renewable energy infrastructure needed for green hydrogen production.

Green hydrogen production faces hurdles in scalability, with the infrastructure required for large-scale manufacturing still in developmental stages. The limited scalability inhibits the seamless integration of green hydrogen into global steel production processes, restricting its accessibility for widespread adoption.

Economic Viability

The economic viability of green hydrogen production is a challenge, marked by high initial investment costs that may deter widespread implementation. Ongoing operational expenses further contribute to the economic challenges, making large-scale green hydrogen facilities less accessible for steel manufacturers.

Innovation and Collaboration

Advancements in technology are essential to address scalability and economic challenges, requiring collaborative efforts between industry, governments, and research institutions. Governments and private sectors need to invest in infrastructure to support the production and distribution of green hydrogen, fostering a conducive environment for innovation.

Transition to Green Hydrogen

The industry must navigate a gradual transition, overcoming challenges through pilot projects and incremental scaling before achieving widespread adoption of green hydrogen in steel production. Collaboration on an international scale is crucial to share knowledge, best practices, and resources for overcoming challenges related to the limited availability of green hydrogen.

Dependency on Shipping transits

Shipping raw materials to steel production facilities and delivering finished steel products to consumers often involves extensive global logistics. The reliance on maritime transportation, which is a substantial contributor to carbon emissions, results in an increased carbon footprint for the steel industry. Area for improvement or consideration include:

- Steel production centres concentrated in specific locations lead to long-distance shipping, increasing the carbon footprint.
- Complex logistics and supply chain inefficiencies result in higher energy consumption and emissions.
- Investigate cleaner shipping technologies and optimize supply chain routes for reduced reliance on long-distance transportation.
- Evaluate carbon emissions from shipping routes and implement strategies for route optimisation, energy-efficient vessels, and alternative fuels.
- Collaborate within the steel industry and with transportation stakeholders to establish standards for sustainable shipping practices and promote eco-friendly technologies.

Advancing Sustainable Practices in the UK and Global Steel Producers

Despite global efforts to transition to low carbon steel production, the lack of substantial progress in both the United Kingdom and certain global steel producers adds complexity to the industry's evolution. Obstructions to progress include:

Regulatory Challenges in the UK

Limited progress in the UK is attributed to the lack of regulatory frameworks supporting low carbon steel initiatives. Addressing this challenge requires the implementation of policies and incentives that encourage innovation and the adoption of sustainable steel production practices.

Global Steel Producers' Struggles

Different global steel producers face varied regulatory landscapes, impacting the uniform adoption of low carbon practices. Establishing international standards could streamline efforts and encourage a more cohesive approach to low carbon steel production on a global scale.

Research and Development Hurdles

Limited investment in research and development within the UK steel industry contributes to slow progress. Global steel producers face similar challenges, emphasizing the need for collaborative efforts in research and development to drive innovation and progress.

Overcoming Challenges

- Advocacy for regulatory reforms in the UK and globally is essential to create an environment conducive to low carbon steel production.
- Encouraging increased investment in research and development, both within the UK and internationally, is crucial for overcoming technological hurdles and fostering innovation.

- A collaborative approach between the UK and global steel producers can facilitate the sharing of best practices and solutions to common challenges, accelerating progress towards a more sustainable steel industry.

Addressing the lack of progress in the UK and among global steel producers requires a concerted effort to navigate regulatory challenges, invest in research and development, and foster international cooperation in the pursuit of low carbon steel production.

ADVANTAGES OF LOW CARBON STEEL IN THE CONSTRUCTION SECTOR

The impact of low embodied carbon steel on construction projects is substantial and multifaceted, influencing various aspects of the project lifecycle:

Lowering Environmental Impact

Low embodied carbon steel contributes to a significant reduction in the overall carbon footprint of construction projects, aligning with sustainability goals. The production of low embodied carbon steel often involves more efficient use of resources, minimizing environmental impact during manufacturing.

Long-Term Sustainability

The inherent durability of low embodied carbon steel leads to a longer lifecycle for construction components, reducing the need for frequent replacements and minimizing material waste. The use of low embodied carbon steel aligns with circular economy principles, promoting the recyclability and reuse of materials at the end of their life cycle.

Construction Costs and Efficiency

While initial costs may vary, the long-term durability of low embodied carbon steel can result in cost savings through reduced maintenance and replacement expenses. The use of sustainable materials can align with streamlined construction processes, contributing to project efficiency and potentially reducing construction timelines.

Regulatory Compliance and Market Demand

The adoption of low embodied carbon steel helps construction projects comply with increasingly stringent environmental regulations and standards. As sustainability becomes a more critical consideration for consumers, businesses, and governments, using low embodied carbon steel enhances a project's market appeal and competitiveness.

Innovation and Industry Leadership

Integrating low embodied carbon steel into construction projects demonstrates a commitment to innovation and sustainability, enhancing the project's standing in the industry. Sustainable practices, including the use of environmentally friendly materials, can attract investors and stakeholders interested in projects with long-term viability.

Community and Stakeholder Relations

Construction projects employing low embodied carbon steel contribute positively to community relations by addressing environmental concerns and showcasing a commitment to responsible building practices. Using sustainable materials aligns with the values of stakeholders, fostering positive relationships and collaboration throughout the project.

In summary, the shift to using low embodied carbon steel in construction has far-reaching effects beyond just the environment. It touches on long-term sustainability, cost efficiency, following regulations, staying competitive in the market, leading the industry, and fostering positive relationships with communities and stakeholders. It reflects a thoughtful and responsible approach to construction that aligns with the growing expectations of a more sustainable and environmentally aware world.

THE SAS HORIZON PROGRAMME

Aligned with SAS International's commitment to sustainability and environmental stewardship, the launch of the SAS Horizon products programme is a meaningful step in our ongoing efforts. This programme seeks to diminish the environmental impact of both our current and forthcoming products by reducing the embodied carbon and fostering innovation.

Horizon Development Process

The production of low embodied carbon steel, a one of the key facets of SAS International's collaborative efforts with steel producers, involves a departure from traditional steel and ceiling manufacturing processes. The innovative approach focuses on mitigating environmental impact throughout the entire production lifecycle in both the raw materials and SAS own manufacturing processes including:

Sustainable Raw Material Sourcing - We prioritise suppliers following responsible mining practices for iron ore extraction, minimizing environmental impact.

Recycled Content Integration - Low embodied carbon steel incorporates high levels of recycled content 90% plus, reducing reliance on virgin materials and supporting circular practices.

Energy-Efficient Manufacturing - Utilizing advanced technologies like electric arc furnaces powered by renewables significantly reduces the carbon footprint associated with steel production.

Renewable Technologies and Onsite Generation - Along with the steel producers, SAS International adopts renewable technologies, including onsite solar power, for sustainable ceiling manufacturing.

Waste Reduction Designs - Innovative manufacturing techniques and material optimization minimize waste generation, focusing on efficiency and repurposing by-products.

Recyclability and Circular Economy - Designed for easy recycling, low embodied carbon steel aligns with a circular economy, minimizing waste and promoting resource efficiency.

Low-Impact Packaging - SAS ceiling systems feature eco-friendly, minimalistic packaging to reduce the environmental footprint throughout the product lifecycle.

Innovative Production Techniques - SAS International employs advanced manufacturing processes to optimize material use and minimize waste in a streamlined, environmentally conscious manufacturing process.

Impact of SAS Horizon

With a continuous demand for low embodied carbon and highly sustainable products by end-users, governments, clients, developers, architects, and contractors, the implementation of the SAS Horizon programme can offer a significant contribution to meet these demands.

A key feature of the initiative is its significantly reduced impact on the environment. In traditional steel production, about 2.7 - 3.4kg of CO_2 produced for every kilogram of steel produced. However, the innovative low embodied carbon steel used in SAS Horizon ceiling systems has achieved a remarkable reduction, with emissions as low as 0.8kg of CO_2 per kilogram of steel.

The SAS Horizon programme holds the potential to cut the embodied carbon of SAS's current ceiling systems by as much as 60%, all while preserving quality, durability, longevity, and future recyclability. This notable difference highlights the project's effectiveness in supporting the construction industry's goal to decrease carbon footprints and adopt sustainable options.

In addition to this important feature, SAS Horizon promotes several other significant benefits, including:

- Efficient resource management, from selecting materials to minimizing waste.
- Compliance with green building standards such as LEED, BREEAM and WELL.

- Positive client perception by building a reputation for responsible construction practices and contributing to long-term success.
- Adaptability to regulatory changes by proactively addressing sustainability concerns.
- Enhancing the economic viability of construction projects through efficiency, durability, and sustainable practices.
- A holistic approach to construction with involvement from stakeholders throughout the supply chain.

The noticeable decrease in carbon emissions linked to low embodied carbon steel enhances its attractiveness for construction projects worldwide. Owners, developers, architects, and contractors now have the ability to intentionally lower the embodied carbon of their structures without sacrificing structural integrity or design aesthetics. Choosing SAS Horizon ceiling systems transforms into a strategic decision, not only supporting the project's environmental sustainability but also aligning with regulatory requirements and eco-certification standards.

CONCLUSION

The pursuit of sustainable steel production is characterised by innovation, collaboration, and a dedication to environmental responsibility. Global steel producers lead this transformative movement, reshaping the terrain of construction materials and products. Is latest development of low embodied carbon steel not only starts to tackle environmental challenges for steel as a future construction material but also establishes a precedent for a future where sustainability and construction seamlessly coexist.

As SAS International moves forward with initiatives like SAS Horizon, it plays a role in shaping the future of the industry. This future is characterised by a strong commitment to reducing operational and product carbon footprints, embracing innovative technologies and design, and adopting and promoting a circular economy. Through these combined efforts, SAS can take a leading role on a path to creating a sustainable future for metal construction products.

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SAS Horizon
Please visit: *SAS International*

Sources
SSAB, 2023: *https://www.ssab.com/en/fossil-free-steel#ffs*