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ИЗПОЛЗВАНЕ НА ЖЕЛЕЗНИЯ СИЛИКАТ ОТ МЕДНАТА ИНДУСТРИЯ: ПЪТ КЪМ УСТОЙЧИВИТЕ СТРОИТЕЛНИ ПРАКТИКИ В СЪОТВЕТСТВИЕ С ESG РЕГУЛАЦИИТЕ

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UTILIZATION ISF FROM THE COPPER INDUSTRY: A PATHWAY TO SUSTAINABLE CONSTRUCTION PRACTICES IN COMPLIENCE WITH ESG REGULATIONS

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Abstract:
Iron silicate fines (ISF), a by-product of copper production, present a promising opportunity for sustainable utilization in the construction sector, aligning with the principles of environmental, social, and governance (ESG) regulations. This article explores the potential of ISF as a supplementary material in construction applications, reflecting on their compatibility with evolving sustainability standards. Through an in-depth analysis of ESG principles, particularly focusing on the imperative of resource efficiency and waste reduction, this article elucidates the role of ISF in promoting circular economy practices within the construction industry in several key areas (clinker, blended cement, mortar, concrete, ceramics, etc.). The utilization of ISF in wide area of construction materials not only mitigates environmental impacts associated with their disposal but also contributes to the conservation of natural resources by reducing the reliance on virgin materials. Furthermore, incorporating ISF into construction products enhances their durability and performance, thereby extending the lifespan of infrastructure assets and fostering resilience against environmental stressors. This article underscores the importance of collaboration among stakeholders, including policymakers, industry players, and community representatives, to drive meaningful change towards a more sustainable construction sector. By aligning with ESG regulations and embracing the principles of the circular economy, the construction industry can pave the way for a greener, more resilient future, characterized by responsible resource management and inclusive growth.

Keywords:
ISF, circular economy, ESG, sustainability, resource efficiency, waste reduction, collaboration among stakeholders

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1. INTRODUCTION

The construction industry stands at a pivotal point in its evolution, driven by the urgent need to embrace sustainability and circular economy practices for decreasing impact on the nature. The new European circular economy principles 2030 [1] extended the 3R concept (reduce, reuse and recycle) to a multi-stage plan with nine circular economy “R” strategies or principles: refuse, rethink, reduce, re-use, repair, refurbish, remanufacture, repurpose and recycle. These principles lay on the basis that the new building materials should be not only recycle in the end of their life period but should be designed for maintenance and durability in such a way that encourages longer use than the industry standard in practice and at scale and in such a way that does not compromise circular treatment at the end of functional life (so called longevity).

Even more, the circular economy is a whole economic system in which the value of products, materials and other resources in the economy is maintained for as long as possible, enhancing their efficient use in production and consumption, thereby reducing the environmental impact of their use, minimising waste and the release of hazardous substances at all stages of their life cycle, including through the application of the waste hierarchy. The goal is to maximise and maintain the value of the technical and biological resources, products and materials by creating a system that allows for durability, optimal use or re-use, refurbishment, remanufacturing, recycling and nutrient cycling. EU legislative frameworks and policies addresses the prioritisation of the avoidance or minimisation waste (Re-use, Repair, Refurbish/Remanufacture and Repurpose) over waste treatment (Recycling). The concepts of eco-design, waste as a resource or post- consumer waste (at the end of a consumer-product lifecycle), should also be taken into consideration.

The transformation of industrial wastes into by-products is a crucial strategy for the metallurgical sector to meet the stringent requirements of the European Sustainability Reporting Standards [2,3,4,5]. By reducing waste, lowering emissions, and enhancing economic viability, this approach not only aligns with ESG regulations but also promotes materials for a more sustainable and resilient construction industry. Comprehensive and transparent reporting on these initiatives is essential to demonstrate commitment to sustainability and to reap the associated environmental, economic, and social benefits.

Central to this transformation is the innovative applications of industrial by-products, new for the construction sector, such as iron silicate fines (ISF), derived from the copper smelting process. ISF is increasingly recognized for its potential to revolutionize various construction materials, including clinker, blended cement, mortar, concrete, and ceramics [6]. By incorporating ISF into these materials, the construction sector not only lessens the environmental impacts related to its disposal but also substantially decreases the dependence on virgin raw materials, thus preserving natural resources.

The utilization of ISF aligns seamlessly with Environmental, Social, and Governance (ESG) regulations and the principles of the circular economy. These frameworks advocate for sustainable resource management, reduction of carbon footprints, and the fostering of inclusive growth. By incorporating ISF, the construction industry can adhere to stringent ESG standards, demonstrating its commitment to environmental stewardship and social responsibility.

Moreover, the application of ISF in construction materials presents a multitude of benefits. It enhances the performance and durability of these materials, contributes to cost savings, and reduces the overall environmental footprint of construction activities. This innovative approach exemplifies how industrial symbiosis – the collaboration between different industries to utilize by-products – can lead to substantial environmental and economic advantages.

2. BENEFITS OF ISF IN CONSTRUCTION

ISF have emerged as a valuable material in the construction industry due to its versatility and environmental benefits. The integration of the material in various applications offers a range of advantages that are increasingly recognized and positively received by the industry.

2.1.Cement clinker production

One of the most significant applications of ISF is in the production of clinker. ISF can partially replace traditional raw materials like clay and limestone, which are essential for clinker production. This substitution not only helps in reducing the consumption of virgin raw materials but also decreases the energy required for clinker production due to the favourable chemical composition of ISF. The cement industry, facing intense pressure to lower its carbon footprint, has welcomed ISF as a sustainable alternative that aligns with environmental regulations and reduces overall CO_2 emissions.

2.2.Blended cement

ISF offers numerous benefits when used in blended cements, especially in reducing the environmental impact and enhancing material properties. One of the most significant advantages is the ability to reduce Portland cement content by up to 20%. This reduction directly correlates with a substantial decrease in CO_2 emissions, as the production of Portland cement is highly energy-intensive and a major source of greenhouse gases. ISF becomes one of the first materials out of those mentioned in EN 197 [7] with European Technical Assessment [8] ISF as a reliable and sustainable alternative, officially recognizing its potential in creating greener construction materials. This certification ensures that ISF meets stringent quality and performance criteria, making it a viable option for widespread use in blended cements. Aurubis Bulgaria become the first copper plant ever that reach this certificate within the copper industry.

2.3.Concrete and mortar production

In concrete and mortar applications, ISF enhances the durability and mechanical properties of the materials, by acting as a kind of supplementary cementitious material. The construction industry appreciates these benefits as they contribute to the creation of more durable infrastructure, ultimately leading to cost savings and extended lifespan of buildings and structures. The positive reception of ISF in these applications is evident from its increasing incorporation in many building projects and sustainable construction practices. Establish customers are working with ISF for every cubic meter in all types of concrete for each structure – from houses, to industrial buildings, huge floorings, hydraulic structures and retaining walls till multiple story buildings.

2.4.Ceramic industry

The use of ISF in ceramic production is another area where it shows significant promise. ISF issued as a raw material in the manufacturing of ceramic tiles and bricks, replacing natural clays and other traditional materials. This not only conserves natural resources but also reduces the energy consumption and CO_2 emissions associated with ceramic production. The ceramics industry, known for its high energy usage, finds ISF particularly attractive as it helps in meeting stringent environmental standards and enhances the sustainability profile of their products. Moreover, it improves mechanical properties, together with thermal and acoustical ones, which are easily achieved with ISF.

2.5.Asphalt production

ISF contributes to a denser pore structure in the asphalt, which enhances its durability and longevity. This improved pore structure reduces the penetration of water and other deleterious substances, leading to increased resistance to wearing and frost resistance. Moreover, the use of

ISF in asphalt production not only reduces natural materials such as aggregates, by conserving natural resources but also lead to reduction in the amount of bitumen required. This makes ISF an eco-friendly alternative that aligns with sustainable construction practices.

3. ISF AND ESG REGULATIONS

3.1.Principles of the ESG regulations in construction

ESG regulations in the construction sector focus on promoting sustainable practices, improving transparency, and fostering long-term environmental stewardship. Key frameworks include the Corporate Sustainability Reporting Directive (CSRD), the EU Taxonomy Regulation, and the EU Circular Economy Action Plan, each of which drives the industry towards greener practices and resource efficiency.

3.1.1. Corporative Sustainability Reporting Directive (CSRD)

The CSRD enhances sustainability reporting by mandating large companies, including those in construction, to disclose detailed information on their environmental, social, and governance impacts. This includes carbon emissions, resource utilization, and labour practices. The goal is to provide stakeholders with comprehensive data to make informed decisions and push companies towards sustainable operations.

3.1.2. Taxonomy regulation

The EU Taxonomy Regulation classifies environmentally sustainable economic activities, setting criteria for actions that significantly contribute to climate change mitigation and other environmental objectives. For the construction sector, this means prioritizing low-carbon materials, energy-efficient designs, and sustainable building practices, thus channeling investments into environmentally friendly projects with materials with lower environmental impact.

3.1.3. EU Circular Economy Action Plan

The Circular Economy Action Plan aims to transition the construction sector from a linear to a circular economy, focusing on the reuse and recycling of materials. Initiatives under this plan encourage the use of recycled content, enhance building durability and reparability, and reduce construction waste. These measures help lower the environmental impact and promote resource efficiency.

3.2.Role of ISF

ISF helping the construction sector achieve its sustainability goals as defined by these ESG regulations by offering substantial benefits in several directions:

3.2.1. Environmental sustainability

Environmental sustainability by using ISF focuses on reducing negative environmental impacts, primarily through replacing a portion of high carbon consuming materials, following by lowering the greenhouse gas emissions, minimizing waste, and conserving natural resources. CSRD directive mandates detailed reporting on these environmental impacts, including carbon emissions and resource use. Companies like Aurubis must disclose how their operations really contribute to the sustainability goals. Taxonomy regulation, on the other hand, sets criteria for activities that significantly contribute to environmental objectives, such as climate change mitigation. Construction companies that use low-carbon materials like ISF can be qualified as environmentally sustainable under the taxonomy and get additional benefits including reduced bank credits. The EU Circular Economy Action Plan promotes the use of recycled materials and aims to reduce waste. Using ISF in construction aligns with this by repurposing industrial by-products and reducing the need for virgin materials.

3.2.2. Resource efficiency

Resource efficiency involves optimizing the use of materials to reduce waste and ensure long-term sustainability of resources. By using ISF final products are optimized, waste is reduced, and final characteristics are significantly improved. CSRD directive encourages construction companies to report on how they manage and use resources efficiently. ISF helps them for reduction of the natural resources and give them positive effect on reporting by tracking them. Moreover, ISF give a positive example through the taxonomy as a sustainable resource management practice and incentivizes investments in projects that use resources efficiently. ISF reduces dependency on new raw materials which fits to the principles of the EU Circular Economy Action Plan for a circular approach to resource use, emphasizing recycling and reuse of materials.

3.2.3. Economic viability

Economic viability ensures that sustainable practices are also cost-effective, enhancing long-term business profitability and competitiveness. CSRD regulation gives a transparency in sustainability reporting and attract investors who are increasingly considering ESG criteria in their investment decisions willing to partner with companies, who are also reporting on the same directive and offers real solution in large scale. Taxonomy provides clarity and guidance on sustainable investments with ISF, helping businesses identify and invest in economically viable, environmentally sustainable activities. Innovations like ISF and competitiveness are supported by the EU Circular Economy Action Plan by promoting a sustainable business model that can reduce costs and create new economic opportunities for many companies who are not aware with it, taking into account all the experience from the established customers with practice in utilization and reporting.

3.2.4. Industrial symbiosis

Industrial symbiosis involves collaboration between different industries to utilize by-products, creating mutual benefits and reducing waste. ISF’s application in construction exemplifies industrial symbiosis, turning a by-product of the copper industry into a valuable resource for construction. This not only reduces waste but also supplies the construction industry with a sustainable material, fostering a circular economy and demonstrating practical benefits of cross-industry collaboration. CSRD regulation encourages ISF customers to report on collaborative efforts and resource-sharing initiatives that enhance sustainability. Moreover, EU Circular Economy Action plant promotes industrial symbiosis as a key strategy for achieving circular economy goals, reducing waste, and optimizing resource use across industries and finally the taxonomy recognizes and supports these activities that demonstrate significant environmental benefits through efficient use of by-products.

By integrating ISF into construction materials, the sector can substantially advance its ESG performance. This approach supports environmental sustainability by reducing emissions, enhances resource efficiency through the use of recycled materials, ensures economic viability by lowering costs and improving material performance, and exemplifies industrial symbiosis by turning waste into a resource. These benefits collectively align with the goals of the CSRD, EU Taxonomy Regulation, and the EU Circular Economy Action Plan, paving the way for a more sustainable and resilient construction industry.

4. CONCLUSION

This article delves deeply into the integration of Environmental, Social, and Governance principles within the construction sector, emphasizing the critical importance of resource efficiency and waste reduction. The utilization of iron silicate fines from the copper industry emerges as a significant contributor to promoting sustainable practices in construction, aligning with ESG objectives. The article highlights that ESG principles are not merely regulatory requirements but essential components for fostering long-term sustainability and resilience within industries. Resource efficiency, a cornerstone of ESG, is achieved through the innovative use of ISF, which enhances the performance and sustainability of construction materials while reducing the environmental footprint. This approach addresses the imperative of minimizing waste, thereby contributing to a circular economy—a system where resource use is optimized, and waste is continually repurposed. The article illustrates that through strategic utilization of industrial by-products like ISF, the construction industry can make significant strides in reducing its environmental impact, conserving natural resources, and promoting a circular economy, thereby fulfilling its ESG commitments and paving the way for more sustainable construction practices for more resilient future.

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