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Ground Granulated Blast-Furnace Slag (GGBFS) Market - Global Industry Size, Share, Trends, Opportunity, and Forecast, 2018-2028 Segmented By Type (Alkalinity Blast-Furnace Slag, Acidic Blast-Furnace Slag), By Application (Portland Cement and Concrete, Bricks and Blocks, Road Construction, Soil Stabilization, Waste Treatment, Others), By Region and Competition

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Abstracts

The Global Ground Granulated Blast-Furnace Slag (GGBFS) Market achieved a volume of USD 405.45 million tonnes in 2022, and it is expected to experience robust growth throughout the forecast period with a Compound Annual Growth Rate (CAGR) of 2.85% until 2028 and is expected to reach at 475.26 million tonnes by 2028. GGBFS is a valuable by-product derived from raw iron production, and when added to concrete, it enhances properties such as strength, workability, and durability. Unlike concrete without GGBFS, slag concrete develops its strength more gradually. The production of GGBFS involves heating limestone, iron ore, and coke to a temperature of 1500°Celsius.

The primary constituents of blast furnace slag include CaO, SiO2, Al2O3, MgO, and other minor oxides in small quantities. The use of granulated blast furnace slag significantly reduces the consumption of limestone, the primary raw material for cement production, by approximately 40%. For over a century, GGBFS has been widely used as a supplementary cementing material due to its exceptional cementitious and pozzolanic properties. It is notably the only component of concrete that contains appreciable quantities of sulfide.

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GGBFS is one of the most extensively researched and effective cement replacement materials in concrete manufacturing. As an eco-friendly and cost-effective building material, it serves as an ideal substitute for Ordinary Portland Cement (OPC). The market is driven by increased research and development efforts and the introduction of various GGBFS products by key industry players.

For example, Tata Steel, a renowned Indian company, is one of the leading manufacturers of Ground Granulated Blast Furnace Slag (GGBFS), known for offering premium quality products that meet industry standards. In July 2021, JFE Steel Corporation, in collaboration with prestigious academic institutions like Tohoku University and Nihon University, made a significant breakthrough by developing an innovative and cutting-edge material called alkali-activated material (AAM). This development is expected to drive the demand for GGBFS even further during the forecast period, opening up new possibilities and applications for GGBFS in the field of construction materials.

Key Market Drivers

1. Growing Use of Ground Granulated Blast-Furnace Slag (GGBFS) in Road Construction

GGBFS has emerged as a highly sought-after and versatile material in the construction industry, particularly in road construction. It possesses several beneficial properties that make it an ideal alternative to traditional construction materials. One primary reason for its increasing use in road construction is its remarkable ability to improve the strength and durability of concrete. When incorporated into cementitious mixtures, GGBFS enhances both immediate and long-term mechanical properties, resulting in concrete that is more resistant to cracking, abrasion, and chemical attacks. This leads to extended road surface lifespan, reduced maintenance costs, and enhanced road quality.

GGBFS also offers sustainability benefits, aligning with the industry's focus on environmental considerations. By utilizing a byproduct that would otherwise be discarded, GGBFS reduces waste sent to landfills and minimizes the environmental impact of iron-making processes. Additionally, GGBFS requires less energy for production compared to traditional construction materials, resulting in lower carbon emissions and a more eco-friendly construction industry. Its unique physical and chemical properties enhance the workability and performance of concrete mixtures,

making it easier to handle and place during road construction.

The use of GGBFS in concrete mixtures also reduces the heat of hydration, mitigating the risk of thermal cracking and ensuring superior construction quality. Overall, GGBFS has revolutionized the construction industry, particularly in road construction, by offering enhanced strength, durability, sustainability, and workability.

2. Growing Demand for Strong and Durable Concrete Structures

The construction industry is witnessing a significant increase in demand for robust and long-lasting concrete structures capable of withstanding various environmental conditions and providing exceptional performance throughout their lifespan. To meet these evolving requirements, there has been a notable surge in the utilization of GGBFS as a fundamental component in concrete mixtures.

Concrete structures must endure heavy loads, extreme weather conditions, and chemical attacks over their operational lifespan. By incorporating GGBFS as a partial replacement for cement in concrete mixtures, remarkable improvements in strength and durability can be achieved. GGBFS enhances compressive strength, flexural strength, and resistance to sulfate and chloride attacks, resulting in the creation of more robust and durable concrete structures.

One of the common challenges faced by concrete structures is the occurrence of cracking and shrinkage, which can compromise their durability and structural integrity. However, the use of GGBFS can effectively mitigate these issues by reducing the heat of hydration during the cement hydration process. This reduction in heat generation significantly minimizes the risk of thermal cracking and shrinkage, ensuring the long-term stability and performance of the concrete.

3. Expansion in Production of Steel and Iron

The production of steel and iron has experienced steady growth worldwide, driven by infrastructure development, urbanization, and industrial expansion. In recent years, emerging economies, particularly in Asia, have witnessed a significant rise in steel and iron production due to the construction of new buildings, bridges, roads, and other essential infrastructure projects accompanying rapid urbanization. As the demand for steel and iron increases, so does the availability of the byproduct known as blast-furnace slag, which can be further processed into GGBFS. By utilizing blast-furnace slag in the manufacturing of GGBFS, the industry not only reduces waste but also

transforms it into a valuable construction material.

The use of GGBFS in construction projects has gained recognition from regulatory bodies worldwide, leading to standards and regulations that promote its use. These regulations often require the incorporation of GGBFS in construction projects, creating a favorable environment for the growth of the global GGBFS market. The sustainable practices associated with utilizing blast-furnace slag and producing GGBFS contribute to reducing the environmental impact of steel and iron production.

With the continuous expansion of infrastructure projects and the increasing adoption of sustainable construction practices, the global GGBFS market is poised for further growth. As countries prioritize the development of robust and long-lasting infrastructure, the demand for GGBFS is expected to rise, creating new opportunities for the steel and iron industry and contributing to a more sustainable future.

Key Market Challenges

1. Initial Investment and Cost Considerations

One of the primary challenges in adopting GGBFS as a construction material is the significant initial investment required to set up the necessary infrastructure for its production. The manufacturing process for GGBFS involves grinding blast-furnace slag into a fine powder, which demands specialized equipment and facilities. These capital expenditures can pose a substantial barrier to entry for new players in the market, potentially limiting the availability and accessibility of GGBFS in certain regions.

Another crucial consideration for potential users of GGBFS is the cost comparison with alternative construction materials. While GGBFS offers numerous benefits, including enhanced strength and durability, reduced environmental impact, and improved workability, it may be initially priced higher than conventional cementitious materials. This cost differential can deter some construction projects from opting for GGBFS, particularly when short-term budget constraints take precedence over long-term benefits.

Moreover, the availability and fluctuating demand for GGBFS can also impact its cost and pose challenges in the global market. The supply of GGBFS is directly linked to the production of steel and iron since it is a byproduct of these industries. Variations in the production of steel and iron can lead to fluctuations in the supply of GGBFS, potentially impacting its pricing. Additionally, the demand for GGBFS varies across different

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regions, affecting its market dynamics and overall cost.

Despite the growing awareness of the benefits of GGBFS, market penetration remains a challenge. The construction industry often exhibits resistance to change due to established practices and familiarity with conventional materials. Overcoming this challenge requires not only educating but also creating awareness among architects, engineers, contractors, and other stakeholders about the advantages and long-term cost savings associated with GGBFS.

By highlighting its superior qualities and promoting its sustainable attributes, the adoption of GGBFS can be encouraged, leading to a more environmentally friendly and efficient construction industry.

2. Compatibility with Concrete Mixtures

The chemical and physical properties of GGBFS play a crucial role in shaping the overall characteristics of concrete. The optimization of concrete mix design requires a careful balance between the desired strength, workability, and durability properties. Achieving this balance can be a challenging task that involves considering various factors, such as the water-cement ratio, aggregate gradation, and dosage of GGBFS, to attain the desired performance of the concrete mixture.

When GGBFS is incorporated into concrete mixtures, it can have a significant impact on the development of compressive strength. While GGBFS generally enhances long-term strength, it may exhibit a delayed initial strength gain compared to conventional cementitious materials. This balancing act between the desired early-age strength requirements and the long-term strength benefits of GGBFS presents a challenge in achieving the desired compressive strength in concrete mixtures.

Moreover, the workability of concrete mixtures can also be influenced by the addition of GGBFS. The high fineness and specific surface area of GGBFS particles can increase the water demand and reduce the workability of fresh concrete. In order to maintain the desired workability while incorporating GGBFS, adjustments in the water-cement ratio and the use of chemical admixtures may be necessary. It is crucial to ensure the compatibility of GGBFS with other components to achieve the desired workability without compromising the overall performance of the concrete.

In addition to optimizing the mix design, consistent quality and standardization in GGBFS production are vital to ensure compatibility with concrete mixtures. Variations in

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GGBFS properties, such as chemical composition, fineness, and specific surface area, can significantly impact its behavior in concrete. Therefore, implementing robust quality control measures is essential to ensure that GGBFS consistently meets the required standards and specifications, providing a reliable and compatible material for concrete mixtures.

Key Market Trends

1. Surge in Research and Development

The surge in Research and Development (R&D) activities has led to significant advancements in the production and utilization of GGBFS. Researchers and manufacturers are continually exploring innovative ways to optimize GGBFS properties, including fineness, chemical composition, and particle size distribution, to further enhance its performance in concrete mixtures. These developments aim to improve the strength, durability, workability, and environmental sustainability of GGBFS-based concrete structures and ensure their compatibility with various construction requirements and specifications.

Moreover, R&D efforts have expanded beyond traditional construction materials, as researchers are now exploring new applications and uses for GGBFS. Its potential in areas such as soil stabilization, road construction, and waste management are being actively investigated. By diversifying its applications, the GGBFS market can tap into new industries and markets, fostering further growth and adoption.

The increased emphasis on sustainability has propelled R&D to identify even more innovative ways to enhance the environmental benefits of GGBFS. Researchers are actively exploring methods to further reduce the carbon footprint of GGBFS production, such as the utilization of renewable energy sources and the implementation of carbon capture and storage technologies. In addition, alternative sources of blast-furnace slag, including industrial by-products, are being evaluated for their suitability in GGBFS production. Furthermore, the incorporation of recycled materials into GGBFS-based concrete mixtures is being studied to enhance its overall sustainability and circular economy principles.

These ongoing initiatives align with global sustainability goals and firmly position GGBFS as a more environmentally friendly alternative to conventional cementitious materials. By continually pushing the boundaries of research and development, the GGBFS industry strives to unlock the full potential of this versatile material, ensuring its

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widespread adoption and contributing to a more sustainable and resilient built environment.

Segmental Insights

Type Insights

Based on the category of type, the Alkalinity Blast-Furnace Slag segment emerged as the dominant player in the global market for Ground Granulated Blast-Furnace Slag (GGBFS) in 2022. Alkalinity blast-furnace slag, a byproduct of the iron and steel production process, is abundantly available. Its ready availability as a raw material ensures a steady and consistent supply, making it a cost-effective and reliable option for manufacturers and end-users alike. This consistent supply and reliability have contributed to its dominance in the GGBFS (Ground Granulated Blast-Furnace Slag) market. The use of alkalinity blast-furnace slag not only provides economic benefits but also helps to reduce waste and promote sustainability in the iron and steel industry. With its versatility and positive environmental impact, alkalinity blast-furnace slag continues to play a significant role in various construction applications and infrastructure development.

Application Insights

The Portland Cement and Concrete segment is projected to experience rapid growth during the forecast period. Portland cement acts as the binder in concrete mixtures, while GGBFS is commonly utilized as a supplementary cementitious material. The chemical composition and physical properties of GGBFS complement Portland cement, thereby enhancing the overall performance of concrete. GGBFS improves workability, reduces heat generation, increases long-term strength, and enhances resistance to chemicals and environmental factors. The compatibility of GGBFS with Portland cement and concrete contributes significantly to the dominance of this combination in the global GGBFS market.

Regional Insights

Asia Pacific emerged as the dominant player in the Global Ground Granulated Blast-Furnace Slag (GGBFS) Market in 2022, holding the largest market share in terms of both value and volume. The Asia Pacific region is currently undergoing a significant surge in urbanization and substantial infrastructure development. Nations such as China, India, Japan, and South Korea have made substantial investments in various

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construction projects, encompassing residential, commercial, and infrastructure development. The growing need for sustainable and long-lasting construction materials has consequently bolstered the prominence of GGBFS in the Asia Pacific region.

Key Market Players

JSW Cement Limited

Sagar Cement Limited

TATA Steel Limited

Boral Limited

JFE Mineral & Alloy Company,Ltd.

Lafarge Group

Super Cement Manufacturing Company LLC

Ecocem

AfriSam South Africa Pty Ltd.

ArcelorMittal S.A.

Report Scope:

In this report, the Global Ground Granulated Blast-Furnace Slag (GGBFS) Market has been segmented into the following categories, in addition to the industry trends which have also been detailed below:

Ground Granulated Blast-Furnace Slag (GGBFS) Market, By Type:

Alkalinity Blast-Furnace Slag

Acidic Blast-Furnace Slag

Ground Granulated Blast-Furnace Slag (GGBFS) Market, By Application:

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- Portland Cement and Concrete
- Bricks and Blocks
- Road Construction
- Soil Stabilization
- Waste Treatment
- Others

Ground Granulated Blast-Furnace Slag (GGBFS) Market, By Region:

- North America
  - United States
  - Canada
  - Mexico
- Europe
  - France
  - United Kingdom
  - Italy
  - Germany
  - Spain
- Asia-Pacific
  - China

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India

Japan

Australia

South Korea

South America

Brazil

Argentina

Colombia

Middle East & Africa

South Africa

Saudi Arabia

UAE

Competitive Landscape

Company Profiles: Detailed analysis of the major companies present in the Global Ground Granulated Blast-Furnace Slag (GGBFS) Market.

Available Customizations:

Global Ground Granulated Blast-Furnace Slag (GGBFS) Market report with the given market data, Tech Sci Research offers customizations according to a company's specific needs. The following customization options are available for the report:

Company Information

Detailed analysis and profiling of additional market players (up to five).

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