National Institute of Technology Rourkela

Departmental Seminar

Seminar Title	: Sustainable Geopolymer Mortar: Strength and Durability Enhancement Using Copper Slag
Speaker	: Aman Deep, Roll No – 521ce1018
Supervisor	: Prof. Pradip Sarkar
Venue	: CE Seminar Hall
Date and Time	: 11 Jul 2025 (09:30AM)
Abstract	: Geopolymer mortar (GPM) has emerged as a promising sustainable alternative to traditional Portland cement-based materials, addressing concerns over carbon emissions and environmental degradation. Unlike conventional cement, GPM relies on aluminosilicate precursors, including metakaolin, volcanic ash, fly ash (FA), and ground granulated blast furnace slag (GGBFS), to form a robust and durable binder. However, despite its advantages in reducing cement consumption, GPM still relies on natural aggregates, primarily natural sand, which contributes to resource depletion and ecological imbalance. To mitigate this issue and promote sustainable construction practices, researchers have explored the feasibility of substituting natural aggregates with industrial by-products. Copper slag (CS), a waste material generated from the copper smelting process, presents a viable alternative to natural sand due to its inert, non-toxic, and non-leachable nature. This study evaluates the influence of CS as a fine aggregate replacement in FA-GGBFS-based GPM, focusing on key mechanical and durability properties. The findings indicate that incorporating CS at an optimal 60% replacement level significantly enhances the performance of GPM. The compressive strength exhibits an improvement of 30-34%, while slake durability increases by 8-11%. Additionally, water absorption is reduced by 18-40%, contributing to lower permeability and enhanced resistance to moisture-induced deterioration. The study also observes a 26-47% reduction in wear depth, indicating superior abrasion resistance, making CS-incorporated GPM well-suited for applications with high levels of wear and tear. Furthermore, the alkali-silica reactivity test confirms that the inclusion of CS does not lead to excessive expansion, maintaining values well below the critical threshold of 0.1%. This ensures the long-term stability and durability of the mortar, making it a reliable choice for structural applications. Overall, the research highlights the potential of CS as a sustainable fine aggregate in GPM, effectively addressing both environmental and performance concerns. By replacing natural sand with CS, this study contributes to resource conservation, waste management, and the development of durable, eco-friendly construction materials.