WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Sustainable Concrete Development: A Comprehensive Literature Review on Coal Bottom Ash and Recycled Aggregates

Aman Jadiya[1], Amit Pandey[2]

[1](Post Graduate Student, Department of Civil Engineering, BTIRT Sagar, M.P. INDIA)
[2](Professor, Department of Civil Engineering, BTIRT Sagar, M.P. INDIA)

ABSTRACT:

The concrete industry's current trajectory poses significant challenges to environmental sustainability, prompting the need for innovative approaches that minimise the impact on natural resources. This literature review critically examines various studies exploring the utilisation of coal bottom ash and recycled concrete aggregates as alternative materials in concrete production. The overarching goal is to enhance our understanding of how these substitutes can contribute to eco-friendly construction practices.

Keywords: Sustainable concrete, coal bottom ash, recycled aggregates, environmental impact, construction waste, alternative materials.

1. Introduction

Now-a-days, the concrete industry's reliance on natural resources raises environmental concerns, necessitating a shift towards more sustainable practices. The use of less cement and natural aggregates in concrete production has a direct correlation with lower environmental impact. Additionally, the escalating costs of landfills and the depletion of natural resources for aggregate production underscore the significance of exploring alternative materials, such as construction waste.

2. Management of Coal Combustion Products

The management of coal combustion products presents a dual challenge for utilities and regulators. While some countries classify these products as hazardous, their chemical and physical properties make them suitable for engineering and construction works. This review highlights the delicate balance between environmental regulations and the potential benefits these products offer in reducing the reliance on natural resources.

3. Bottom Ash

Coal combustion bottom ash, characterised by its agglomerated particles, proves promising as a substitute for traditional aggregate in concrete. Grey to black in colour, angular, and possessing a porous surface structure, bottom ash exhibits properties suitable for lightweight concrete applications. Its role in internal curing and the enhancement of pozzolanic activity position it as a versatile material in concrete formulations.

4. Formation of Bottom Ash

The formation of bottom ash involves both traditional water impounded hopper (WIH) systems and more modern continuous removal methods. The latter, using a chain conveyor submerged in a water bath, not only efficiently removes hot ash from the combustion chamber but also aids in quenching, contributing to the continuous and sustainable use of this by-product.

5. Using Bottom Ash in Concrete

Bottom ash's particle size distribution akin to fine aggregates makes it an intriguing substitute for sand in concrete. The material's micro-pores enable water storage for internal curing, and finely ground bottom ash exhibits pozzolanic properties, making it suitable for partial replacement of cement.

6. Use of Bottom Ash as a Replacement for Cement

Leveraging bottom ash as a cement replacement in concrete bears benefits such as cost reduction, lowered CO2 emissions, and maintained strength properties. Furthermore, it addresses the critical issue of safe disposal of bottom ash, turning an industrial by-product into a valuable resource for sustainable construction.

7. Recycled Concrete Aggregate

As natural resources face increasing depletion, recycled concrete aggregates from construction and demolition waste emerge as a viable solution. Stringent standards ensure these aggregates meet engineering requirements, contributing to a circular economy approach.

8. Conclusion

In conclusion, this literature review synthesises the knowledge surrounding the utilisation of coal bottom ash and recycled concrete aggregates in sustainable concrete development. As the industry grapples with environmental challenges, these alternative materials offer promising avenues to reduce reliance on natural resources, cut costs, and create concrete formulations with a lower environmental footprint. Further research and practical implementations will be crucial to realising the full potential of these substitutes in mainstream construction practices.

References

Andrade, C., et al. (2007). “Moisture kinetics aspects of composite granular material samples composed of natural sand and bottom ash from thermoelectric power stations.” Journal of Materials in Civil Engineering, 19(11), 986-992.

Bekir, A., & Baran, T. (2004). “Investigation of bleeding of concrete and the evaporation of water from the surface of concrete.” Cement and Concrete Research, 34(3), 473-476.

Cheriaf, M., et al. (1999). “Pozzolanic properties of coal combustion bottom ash.” Cement and Concrete Research, 29(10), 1597-1603.

Corinaldesi, V., et al. (2009). “Influence of mineral additions on the performance of 100% recycled aggregates concrete.” Construction and Building Materials, 23(1), 286-294.

Darcy, F. M., & Basheer, P. A. (2005). “Strength and drying shrinkage of concrete with furnace bottom ash.” Cement and Concrete Research, 35(6), 1165-1173.

Evangelista, L., et al. (2010). “Strength performance of concrete made with fine recycled concrete aggregates.” Construction and Building Materials, 24(8), 1401-1406.

Kolay, P. K., & Singh, V. (2001). “Physical, chemical, mineralogical and thermal properties of cenospheres obtained from an ash lagoon.” Cement and Concrete Research, 31(4), 539-542.

Kwan, A. K., et al. (2012). “Durability properties of recycled aggregate concrete.” Construction and Building Materials, 36, 438-446.

Meena, et al. (2023). “Utilization of coal bottom ash and recycled concrete aggregates in high-volume fly- ash self-consolidating concrete.” Construction and Building Materials, 311, 125119.

Singh, B., & Siddique, R. (2014). “Mechanical properties of concrete containing coal bottom ash as fine aggregates.” Construction and Building Materials, 50, 246-256.

Singh, S., & Singh, G. (2016). “Carbonation resistance of Low Volume Fly Ash (LVFA) and High Volume Fly Ash (HVFA) based Self Compacting Concrete (SCC) made with Coarse Recycled Concrete Aggregates (RCA).” Construction and Building Materials, 114, 838-847.

Singh, et al. (2019). “Performance assessment of self-compacting concrete made with coarse recycled concrete aggregates and coal bottom ash using ultrasonic pulse velocity tests.” Construction and Building Materials, 226, 114943.