USE OF BOTTOM ASH FROM WASTE TO ENERGY PLANT IN MANUFACTURING CEMENT BLOCKS

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Bottom ash (BA), a byproduct of coal or solid fuel combustion in power plants, poses environmental and health risks due to inadequate disposal methods. Bottom ash from waste to energy plants contains recoverable materials like metals and coal power plant bottom ash consists mainly of silicates and oxides, with fewer recoverable materials and more toxic substances, limiting its reuse and posing environmental risks. Bottom ash from waste to energy plant offers greater recycling potential. Utilizing bottom ash in manufacturing cement blocks offers a promising solution. This study investigated the optimal water/cement ratio for producing cement blocks using bottom ash as a substitute for fine aggregate. It assessed bottom ash characteristics and examined the mechanical and durability properties of the blocks. The research produced solid cement blocks measuring 300 mm x 100 mm x 150mm, using a mixture of 1:4:2:3 cement: sand (60% sand and 40% bottom ash): quarry dust: quarry chips volume ratio, with water/cement ratios ranging from 0.8 to 1.4 in conventional table vibratory method and 0.6 to 1.4 in hydraulic compaction method. Conventional table vibratory compaction and hydraulic compaction method were employed for casting the blocks. To assess the wet and dry compressive strength of the blocks and the modulus of rupture, a CTM-2000 digital compression testing machine was used. Compressive strength tests were conducted after the 14^{th}, 28^{th}, and 56^{th} days. The spray erosion test was carried out as per SLS 1382-2: 2009 to determine the erosion resistance of bottom ash cement blocks. The modulus of rupture test was conducted in accordance with ASTM C293 to assess the tensile strength of BA cement blocks. The moisture content and water absorption values of blocks were determined on the 14^{th}, 28^{th} and 56^{th} days in accordance with SLS 855-1: 1989's specifications. In accordance with the specifications provided in SLS 855-2: 1989, drying shrinkage tests were done. The results suggest that manufacturing cement blocks using bottom ash for small and medium-scale conventional cement block production for loadbearing walls of residential buildings up to four storeys using the conventional table vibratory method and up to five storeys using the hydraulic compaction method is an effective way for utilizing bottom ash. According to this study, it's viable to replace up to 40% of fine aggregate with 5 mm sieved waste-to-energy plant bottom ash. According to the study, BA from a waste-to-energy plant can be replaced with fine aggregate in cement blocks and satisfy the requirements with a replacement level of 40% BA with 1.0-1.2 water/cement ratio with a compressive strength of 5.42 N/mm^2 and 5.49 N/mm^2 (more than the minimum required value of 5.2 N/mm^2) is better for conventional table vibratory method and 0.8-1.0 water/cement ratio with a compressive strength of 8.57 N/mm^2 and 8.80 N/mm^2 (more than the minimum required value of 6.5 N/mm^2) is better for hydraulic compaction method. The limitations for water absorption, moisture content, drying shrinkage and spray erosion tests are satisfied with the above water/cement ratios. No health hazards are linked to the handling or use of BA cement blocks. Hence, cement blocks incorporating 40% BA as a sand-replacing material are deemed safe and appropriate for construction purposes.

Keywords: Bottom ash, Cement blocks, Water/Cement ratio, Conventional table vibratory method, Hydraulic compaction method

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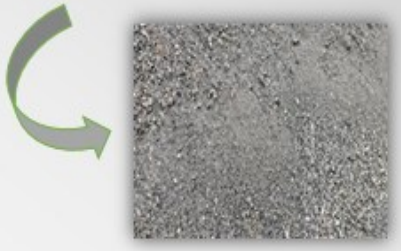
Bottom ash?

Bottom ash has a sand-like or gravelly appearance which is a by-product generated from the combustion of coal or other solid fuels in power plants.



MIX PROPORTION

Cement	Sand	Bottom ash	Quarry dust	Quarry chip
	60%	40%		
1	4		2	3

Water/cement ratios ranging from 0.8 to 1.4 in conventional table vibratory method and 0.6 to 1.4 in hydraulic compaction method

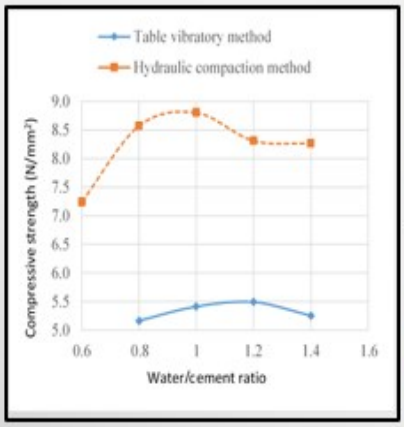
Block Manufacturing

Standards used for tests

Compressive strength, Water absorption, Moisture content, Drying shrinkage - SLS 855: Part 1: 1989

Modulus of rupture - ASTM C293-00

Spray erosion test - SLS 1382-2: 2009



Compressive strength vs water/cement

CONCLUSIONS

- Bottom ash (BA) from a waste-to-energy plant can be replaced with fine aggregate in cement blocks and satisfy the requirements with a replacement level of 40% bottom ash with 1.0-1.2 water/cement ratio with a compressive strength above the required value of 5.2 N/mm^2 is better for conventional table vibratory method and 0.8-1.0 water/cement ratio with a compressive strength above the required value of 6.5 N/mm^2 is better for hydraulic compaction method.
- The limitations for water absorption, moisture content, drying shrinkage and spray erosion tests are satisfied with the above water/cement ratios.
- No health hazards are linked to the handling or use of bottom ash cement blocks.