USE OF INDUSTRIAL WASTE SLUDGE IN CONCRETE PAVING BLOCKS

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The interdependence of a nation's economic momentum with the dynamism of its manufacturing sector is evident. The era of rapid industrialisation brings with it an escalated output of waste. Addressing this surge, particularly regarding the proper management, disposal, or recycling, is paramount, especially when we contemplate the long-term repercussions on both environmental sanctity and public health. While suppressing industrial expansion or sanctioning unchecked waste release might seem like solutions, they are not in the best interests of sustainable economic and environmental goals. Given these challenges, there's a pressing international drive toward converting waste into purposeful, usable products.

In the vast spectrum of industrial waste, sludge emerges as a significant player. This semi-fluid substance, replete with solids and liquids, is a by-product of various water treatment processes. Its nature, whether organic or inorganic, hinges on the kind and extent of contaminants it contains. Through dehydration, one can transform sludge into a more manageable powdered form.

This research casts its lens on the potential of this powdered sludge, a derivative of industrial waste, in concrete paving block construction. The vision here is twofold: advancing towards a greener paving methodology and finding a viable solution to the ever-present sludge disposal issue. The initial stages of the study focused on meticulous chemical scrutiny of the sludge, followed by a sieve assessment to understand its granular composition. Notably, while the granular profile resonated with that of typical fine aggregate, the chemical analysis underscored the dominance of organic particles. Acting on this knowledge, experimental blocks were crafted, with the sludge powder replacing traditional materials like cement and sand. However, these modified blocks manifested a noticeable reduction in compressive strength when juxtaposed against standard concrete blocks. For a deeper dive into the composition, tools like Scanning Electron Microscopy (SEM) were employed to decipher micro-level structures, and Energy-Dispersive X-ray Analysis (EDAX) was used to identify elemental makeup. These sophisticated analyses pinpointed weaker components that did not bolster the material's inherent strength. In a promising turn of events, refining the sludge to purge these weaker elements led to a notable enhancement in block strength, aligning it with industry benchmarks. With these findings at hand, the recommendation is to broaden the scope of research, perhaps by exploring diverse mix ratios, to further optimise the efficiency and application of this innovative approach.

Keywords: Industrial waste sludge, Sustainable paving block, Organic matter in concrete

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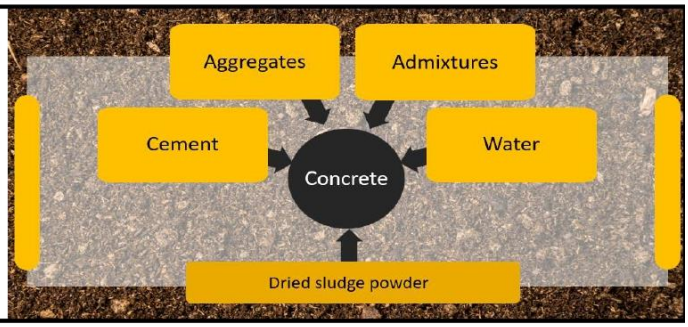
✓ AIM

study the use of industrial waste sludge in concrete paving blocks



Material

Dried waste sludge from the industrial wastewater treatment plant in Unilever Sri Lanka (PVT) LTD.

Mix ratio

	Sludge powder (Kg)	Cement (Kg)	Sand (Kg)	Gravel (Kg)	Water ($m^3 \times 10^{-3}$)
Control sample	-	3.65	8.11	7.3	1.825
Cement replacement (5%)	0.095	3.467	8.11	7.3	1.825
Cement replacement (10%)	0.191	3.285	8.11	7.3	1.825
Fine aggregate replacement (10%)	0.383	3.65	7.3	7.3	1.825
Coarse aggregate replacement (10%)	0.383	3.65	8.11	6.57	1.825

Results of 3 sets of samples

	Compressive strength(N/mm²)					
	Sample 01(18 blocks)		Sample 02(12 blocks)		Sample 03(24 blocks)	
	07 days	28 days	07 days	28 days	07 days	28 days
Control sample	24.60	29.7	-	-	17.54	28.85
Cement replacement(5%)	-	-	5.01	8.81	7.52	16.13
Cement replacement(10%)	9.59	14.9	-	-	5.15	10.04
Sand replacement(10%)	1.3	2.12	-	-	1.63	3.79
Gravel replacement(10%)	-	-	0.52	3.98	-	-

Sludge was treated to increase the strength of the blocks

Conclusion

- ✓ The direct use of dried sludge powder in concrete paving blocks is not feasible
- ✓ 5% of cement can be replaced after heating the dried sludge powder up to 550^0c

Final result