SAW DUST AS PARTIAL REPLACEMENT FOR SAND AND SAW DUST ASH AS PARTIAL REPLACEMENT FOR CEMENT IN THE PRODUCTION OF MASONRY SOLID BLOCKS

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INTRODUCTION

Cement mortar is an artificial and man-made construction material used as binder in masonry solid blocks consisting of natural fine aggregate (sand) ie "cement paste comprising cement and water as the binder". Naturally existing river sand, fast becoming scarce, is used as fine aggregate for masonry in Sri Lanka and needs to be replaced. The search for an alternative binder or partial cement replacement has led to the use of waste materials believed to have the potential of exhibiting cementitious properties. Saw dust is reused in many applications but some amount remains as waste in the environment. This study investigates the strengths of cement mortar masonry mixes with partial replacement of cement with saw dust and partial replacement of sand with saw dust ash as a way towards eco-friendly construction.

MATERIALS

Cement

The cement as the binding material used in all mortar mixtures for masonry work was ordinary Portland cement (OPC) complying with SLS 107, which belongs to the strength class of 42.5.

Fine Aggregates

Fine aggregate used was in nominal size of 2.36mm (river sand)

Saw dust

A major use of sawdust is for particleboard; coarse sawdust may be used for wood pulp. Other practical uses are, as a fuel and in the growing of mushrooms.

Saw dust ash

Sun-dried saw dust samples were burnt for 2 hours in a muffle furnace at 600 °C for producing saw dust ash."

Chemical and physical properties

Chemical properties of saw dust ash

Chemical composition of saw dust ash is shown in table (3.1). Pozzolanasity of saw dust ash was checked by using ASTM C 618. The average percentage composition of SiO_2 + Al_2O_3+Fe_2O_3 was measured. It was carried out as reported by Rerth and Hanson (2007).

Table 1. Physical properties of saw dust and sand (BS882_199 (B) Percentage passingGrain size(mm)

Chemical properties of saw dust ash	
Chemical constituents	Percentage composition %
SiO_2	17-25
Ai_2O_3	20-25
Fe_2O_3	0.5-6
MgO	0.1-4
SO_3	1-2.75
K_2O	1-2.75
Na_2O	1-2.75

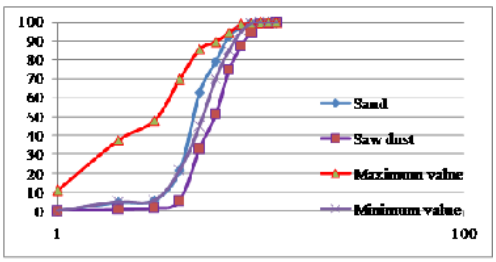

Figure1. The Grading curve of sand and saw dust

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MIX PROPORTIONS

Weights of cement , sand and saw dust

Table 2. Weights of cement, sand and saw dust in the manufactured samples

Material	Control sample	5%	10%
Cement(g)	1250	1250	1250
Sand (g)	7500	7125	6750
Saw dust (g)	0	375	750

Table 3. Weights of cement, sand and saw dust ash in the manufactured samples

Material	Control sample	5%	10%	15%	20%
Cement(g)	1250	1187.5	1125	1062.5	875
Sand (g)	7500	7500	7500	7500	7500
Saw dust ash (g)	0	62.5	125	187.5	375

Preparation and Casting of Test Specimens

Mixing of the materials was carried out in the following sequence; Design sand amount, cement and saw dust and sand amount, cement and saw dust ash was placed into the mixture separately. During the mixing, design water content was poured into the mix. Masonry blocks were cast for each mix proportion. 3 blocks of 390mm*190mm*100 mm

RESULTS AND DISCUSSION

Compressive Strength (SLS855 part 1)

Blocks were placed in Universal Testing Machine (U.T.M), and load was applied. The readings on dial gauge were recorded and compressive strength was calculated. The results are presented in Table 4 and Table 5.

Compressive Strength = Maximum load/Cross Sectional Area……1

Table 4. 28 days Compressive strength

Saw dust percentage %	Compressivestrength (N/mm^2)
0	1.92
5	1.79
10	0.81

Table 5. 28 days Compressive strength

Saw dust ash percentage %	Compressive strength (N/mm^2)
0	1.92
5	1.80
10	1.84
15	1.14
20	0.77

Variation of compressive Strength of control sample and saw dust samples

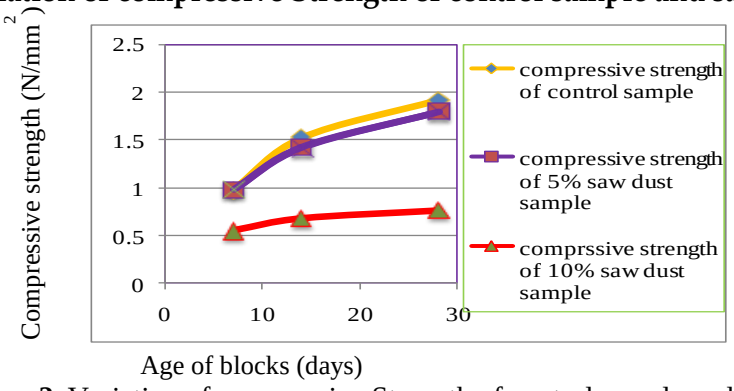

Figure 2. Variation of compressive Strength of control sample and saw dust samples

Variation of compressive Strength of control sample and saw dust ash samples

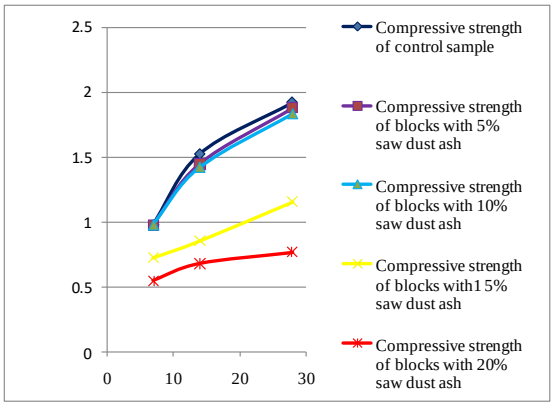

Figure 3. Variation of compressive Strength of control sample and saw dust ash samples

Water absorption of a block (BS5628 part 1)

$W_a = \frac{W_s - W_d x100}{W_d}$ = Water absorption of a block

W_s = Mass of wet block W_d = Mass of dried block

Table 6. 28 days water absorption with % saw dust

Saw dust percentage %	Water absorption (%)
0	3.75
5	4.02
10	4.32

Table 7. 28 days water absorption with % saw dust ash

Saw dust ash percentage %	Water absorption
0	3.75
5	5.09
10	5.58
15	5.97
20	6.48

Density of a block

Weight of a block / Volume = Density

Table 8. 28 days density with % saw dust

Saw dust percentage %	Density(kg/m^3)
0	1749.90
5	1742.20
10	1739.00

Table 9. 28 days density with % saw Dust ash

Saw dust ash percentage %	Density (kg/ m^3)
0	1749.90
5	1728.00
10	1703.10
15	1673.00
20	1651.10

Specific gravity of materials (ASTM D-854)

Specific gravity
$G_s = M_o/((M_o+(M_a-M_b))$
G_s - Specific gravity
M_o – Mass of sample of oven dry saw dust ash
M_a – Mass of pycnometer filled with water
M_b – Mass of pycnometer filled with water and saw dust ash

Table 10. Specific gravity of materials

Material	Specific gravity
Sand	2.50
Saw dust	0.60
Cement	2.83
Saw dust ash	2.05

CONCLUSIONS

Physical properties of saw dust conforms BS_ 882_199B. Standard compressive strength value is 1.2N/mm^2. Compressive strength value of samples with 5% replacement of saw dust, are satisfied but 10% replacement are not satisfied. Compressive strength of 5% and 10% replacement of cement with saw dust ash samples are satisfied but 15% replacement are not satisfied. Water absorption test results are seen from tables 6 & 7. Water absorption of control sample is 3.75%. The test result values conforms BS5528: part 1.The density of masonry blocks decreases as the saw dust increases but increases as curing days increase.

The results from this research suggest that saw dust can be applied as partial replacement for fine aggregate in masonry blocks, to a limit of 5%, suitable for non- load bearing walls. Saw dust ash can be applied as a partial replacement for cement masonry blocks, to a limit of 10%, suitable for non- load bearing walls. It is recommended that this research be extended with a view to producing low strength building blocks using reduced percentage fine aggregate (sand) replaced by saw dust and reduced percentage of cement replaced by saw dust ash.

REFERENCES

British Standards Institution, testing aggregate guide to sampling and testing aggregates, BS 812-103.1 and BS _882_199(B)

Raheem AA and Sulaiman OK, 2013, Saw dust ash as partial replacement for cement in the production of sandcrete hollow blocks.

Jerath and Hanson, N(2007) " Effect of fly ash content and aggregate gradation on the durability of concrete pavement. " Journals of material in civil engineering,19(5), pp367-375

ACKNOWLEDGEMENT

Authors wish to express their sincere gratitude, to the Technical and laboratory staff of the Department of Civil Engineering, The Open University of Sri Lanka for their assistance and support. Thanks and gratitude is also extended to Research Engineer and Technical Assistant, Material Laboratory of Industrial Technology Institute (ITI) for their cooperation and assistance in carrying out relevant laboratory experiments for this study.