Strength and Durability Study of Bricks Using Marble Sludge Powder and Bottom Ash

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Abstract**—***Brick is one of the most common masonry units as a building material due to its properties. The rapid growth in today's construction industry has obliged the civil engineers in searching for more efficient and durable alternatives far beyond the limitations of the conventional brick production. Many attempts have been made to incorporate wastes into the production of bricks and recycling such wastes by incorporating them into building materials is a practical solution for pollution problem. So the proposed system is to the invention of waste marble sludge powder and bottom ash as the replacement of clay bricks regarding the strength and durability studies. In our project, totally 200 number of bricks are to be casted with partial replacement of marble sludge powder and the bottom ash. The percentage of replacement is carried out in this work as 0%, 15% and 30% by total volume. The strength and durability test of bricks is to be calculated. The world wide annual production of bricks is currently about 1391 billion units and demand of bricks is predicted to be continuously increasing. It is also for reduction in the use of natural resources, disposal of waste, prevention environmental pollution and also save energy.*

Keywords— Marble Sludge Powder. Bottom Ash, Sand and Brick.

I. INTRODUCTION

Brick is one of the oldest manufactured building materials in the world. As early as 14,000 BC, hand-moulded and sun-dried clay bricks were found in the lower layers of Nile deposits in the Egypt. Clay was also ancient Mesopotamia's most important raw material and most buildings during that time were made of clay bricks. The earliest use of bricks recorded was the ancient city of Ur (modern Iraq) that was built with mud bricks around 4,000 BC and the early walls of Jericho around 8,000 BC. Starting from 5,000 BC, the knowledge of preserving clay bricks by firing has been documented.

The development of different types of bricks continued in most countries in the world and bricks were part of the cargo of the First Fleet to Australia, along with brick moulds and a skilled brick maker. Bricks have continuously been used by most cultures throughout the ages for buildings due to their outstanding physical and engineering properties

The main raw material for bricks is clay besides clayey soils, soft slate and shale, which are usually obtained from open pits with the attendance of disruption of drainage, vegetation and wildlife habitat.

Clays used for brick making vary broadly in their composition and are dependent on the locality from which the soil originates. Different proportions of clays are composed mainly of silica, alumina, lime, iron, manganese, sulphur and phosphates.

II. MATERIALS USED

A. *Fine Aggregate*

Those fractions from 4.75 mm to 150 micron are termed as fine aggregate. The river sand is used as fine aggregate conforming to the requirements of IS: 383-1970. Sieve analysis was done using standard sieve analysis procedure and the sand conforms to Zone II

B. *Water*

Water is the most important constituent of a concrete mass which enables bonding between cementitious materials and the aggregates. A part of mixing water is utilized in the hydration of cement to form binding matrix in which the inert aggregates are held in suspension until the matrix has harden. The remaining water serves as a lubricant between the fine and coarse aggregate and makes concrete workable. Water Hardness maximum 100 PPM Need Industrial softer for hard water

C. *Bottom Ash*

Bottom ash is part of the non-combustible residue of combustion in a furnace or incinerator. In an industrial context, it usually refers to coal combustion and comprises traces of combustibles embedded in forming clinkers and sticking to hot side walls of a coal-burning furnace during its operation.

At a time when the riverbed sand is getting scarce and its price fast rising, the Neyveli Lignite Corporation has evolved a technology to use bottom ash, a residue being collected from the thermal power stations, as substitute for sand.

TABLE 1 Physical Properties of Bottom Ash

PROPERTY	BOTTOM ASH
Specific gravity	2.2
Bulk density	745 kg/cum
Plasticity	None
Absorption	1.2%

D. Marble sludge powder

Marble is a metamorphic rock resulting from the transformation of pure lime stone. Marble sludge powder is an industrial waste containing heavy metals as constitutes. Chemically, marbles are crystalline rocks composed predominantly of calcite, dolomite or serpentine materials.

Marble stone industry generates both solid waste and stone slurry. Whereas solid waste results from the rejects at the mine sites or at the processing units, stone slurry is a semi liquid substance consisting of particles originating from the sawing and the polishing processes and water used to cool and lubricate the sawing and polishing machines.

III. MIX PROPORTION AND MIX DESIGN

In order to know the best proportion of Marble sludge powder and Bottom ash, we make 200 different test bricks of dimension 19 x 9 x 9cm. The different eight proportions are as following

TABLE 2 Proportions of Materials

SAMPLE	**MARBLE SLUDGE (% in vol.)**
CS	0
S1	15
S2	30
S3	0
S4	15
S5	30
S6	0
S7	15
S8	30

TABLE 3 Mix Design

Sample	Marble sludge powder (Kg)	Bottom ash (Kg)	Water in % in weight
CS	-	-	10
S1	0.311	-	10
S2	0.623	10	10
S3	-	0.173	10
S4	0.311	0.173	10
S5	0.623	0.173	10
S6	-	0.346	10
S7	0.311	0.346	10
S8	0.623	0.346	10

IV. MAKING OF BRICKS

In recent years the brick industry has been facing an acute shortage of skilled molders, kiln setters, firemen,etc ,which resulted in a fall in production and deterioration in quality of bricks. Therefore the necessity of adopting so me mechanized. Means of shaping the bricks so as to make the process independent of individual skill was realized. Simple brick making plants in which only the shaping process is mechanized can be based on soft-mud, extrusion or semi dry process. At present only the extrusion machines are produced indigenously and some expertise in the manufacture of bricks by extrusion process already exists in the country. Therefore, the need of unifying the Practice being followed at present was also felt. This standard has been prepared to unify the practice followed by IS 11650:1991Guide for Manufacture of Common Burnt Clay Building Bricks.

- Preparation of brick sand.
- Mixing of waste with sand
- Moulding of bricks
- Drying of bricks
- Burning of bricks

Fig 1 Mixing of wastes

Fig 2 Moulding of Bricks

Fig 3 Drying of Bricks

Fig 4 Burning of Bricks

V. RESULTS AND DISCUSSION

TABLE 4 Compression Test

S.No	Sample	Compression Values (kN)	Compressive Strength (N/mm2)
1.	CS	100	5.76
2.	S1	150	8.67
3.	S2	145	8.57
4.	S3	170	9.06
5.	S4	130	7.60
6.	S5	115	6.40
7.	S6	140	8.00
8.	S7	110	6.50
9.	S8	120	6.80

TABLE 5 Water Absorption Test

Sl.no	Sample	Time (hrs)	Dry weight(kg)	Wet weight(kg)	Water absorption (%)
1.	CS	24	3.33	3.67	10.45
2.	S1	24	3.25	3.58	10.43
3.	S2	24	3.20	3.50	11.26
4.	S3	24	3.15	3.50	13.65
5.	S4	24	3.18	3.56	11.16
6.	S5	24	3.17	3.58	12.05
7.	S6	24	3.11	3.45	11.21
8.	S7	24	3.09	3.46	13.55
9.	S8	24	3.10	3.50	12.30

TABLE 6 Density Test

Sl.no	Sample	Mass (Kg)		Volume (m3)	Density (Kg/m3)
1.	CS	3.30	3.33	0.00154	2150
2.	S1	3.20	3.25	0.00154	2090
3.	S2	3.12	3.20	0.00154	2045
4.	S3	3.13	3.15	0.00154	2035
5.	S4	3.18	3.18	0.00154	2065
6.	S5	3.16	3.17	0.00154	2055
7.	S6	3.10	3.11	0.00154	2015
8.	S7	3.07	3.09	0.00154	2000
9.	S8	3.10	3.10	0.00154	2015

TABLE 7 Acid Resistance Test

Sl.no	Sample	Initial weight(kg)	Final weight(kg)	Loss in weight in (%)
1.	CS	3.02	3.09	8.4
2.	S1	2.95	3.05	7.8
3.	S2	2.92	3.01	6.1
4.	S3	2.97	2.98	5.0
5.	S4	2.98	2.99	5.9
6.	S5	2.93	2.95	6.3
7.	S6	2.85	2.87	7.6
8.	S7	2.82	2.84	8.0
9.	S8	2.85	2.83	8.2

A. Hardness and soundness test

- Scratch is made on the brick surface with the help of finger nail. If no impression on the surface, the brick is sufficiently hard.
- Two brick stuck with each other. Brick of good quality should not break and produce the ringing sound.

VI. CONCLUSION

Marble sludge and Bottom ash waste content up to 30 % by vol can be replaced in clay mixture, without degrading their mechanical properties. The presence of marble sludge and bottom ash allow one to obtain a clay brick with better properties as the conventional clay brick at low temperatures as the normally used for brick products in the brick industry, resulting in energy saving and waste reduction. The incorporation of marble sludge and bottom ash in brick production anticipates safe for the health an environmentally friendly recycling products.

Therefore, utilization of solid wastes has been encouraged as one of the most cost-effective alternative materials that could be used in fired clay brick manufacturing. Recycling industrial and urban waste in fired clay brick is useful if the correct percentages were incorporated and at the same time it would act as an alternative disposal method to the potential polluting wastes. Brick manufacturer will reduce the cost of raw materials, the usage of energy during firing and the improvement of the properties.

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