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AN EXPERIMENTAL STUDY ON USE OF RECYCLE PAPER MILL WASTE IN LIGHT WEIGHT BRICK

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ABSTRACT : This experimental study investigates the use of recycle paper mill waste in brick. This investigation is mainly focused on making use of waste materials into a construction material. Nowadays the availability of construction materials become expensive due to increase of its need and over exploitation. This affects the middle class peoples as overall construction cost increased. In India annual production capacity of recycle paper industry is 2.345 million tons and waste generated thereof is 15%. These wastes can be used in light weight brick with mix of Rpmw, cement and flyash varying composition of cement and flyash of (20-35%).Our experimental investigation the use of recycle paper mill waste in light weight bricks. This reduces the overall construction cost to reasonable extent and it will improve the compressive strength. This type of brick will able to form a temporary structure and the sense of using waste materials in brick not only reduces the economic factor but the more significant aspect is to protect the environment. Since more solid waste are produced day by day. The utilization of recycle paper mill waste from paper mill industry will reduces the environmental problem. From experimentation it is observed that waste-create brick (WCB) prepared using RPMW-cement-flyash combination is light weight, shock absorbing and meet compressive strength requirements of ASTM C 63-03a.

Keywords : Recycle paper mill waste, Light weight, Compressive strength, Shock absorbing.

1.Introduction

Brick is one of the important materials for construction industry.The con-entional method of manufacturing bricks has left this important material aloof in advanc-ementt. The infrastructure such as buildings for housing and industry, and the facilities for handling water and sewage requires large amounts of construction materials. Since the large demand has been placed on building material industry especially in the last decade owing to the increasing population, there is a mismatch between demand and supply management of these materials. Hence to meet the continuously increasing demand, researchers are attempting to design and develop sustainable alternative solutions for the construction material. The increase in the popularity of using environmental friendly, low cost and lightweight construction materials in building industry has brought about the need to investigate how this can be achieved by benefiting to the environment as well as maintaining the material requirement affirmed in the standards. Brick is one of the most accommodating masonry units as a building material due to its properties. Attempts have been made to incorporate
waste in the production of bricks; for instance, the use of paper processing residues, cigarette butts, fly ash, textile effluent treatment plant (ETP) sludge, polystyrene foam, plastic fiber, straw, polystyrene fabric, cotton waste, dried sludge collected from an industrial waste water treatment plant, rice husk ash, granulated blast furnace slag, rubber, kraft pulp production residue, limestone dust and wood sawdust, processed waste tea,

petroleum effluent treatment plant sludge, welding flux slag and waste paper pulp. Thermal conductivity can be reduced by addition of pore-forming agents (waste material) to the bricks before firing. Another advantage of lightweight bricks is reduced transportation costs. The by-products and residues from pulp and paper industry are managed using several approaches including land filling, incineration, use in cement plant and brickworks, agricultural use and composting, anaerobic treatment,recycling and others .The needs to conserve traditional building materials that are facing depletion have obliged engineers to look for alternative materials. Recycling of such wastes by incorporating them into building materials is a practical solution to the pollution problem.The major pollution problems being faced by small-scale process industries is due to huge amount of solid and sludge waste generation and the limited treatment facilities. The use of waste as brick material is a sustainable solution to solid waste management. The bricks thus manufactured using these wastes are lightweight due to presence of tiny air pockets inside. These pockets also help in thermal insulation and shock absorption.The present paper focuses on development of waste-create bricks using RPMW-cement combination which are useful for the sustainable development of construction industry. The low cost hand operated mixing and molding machinery has been designed and fabricated. Optimal composition of the waste-create blocks with respect to RPMW-cement has been determined for various proportions by evaluating the properties. The ASTM recommended all the performance testes have been carried out on the waste-create bricks.

2.Material and methods

Fly Ash

Fly ash is the waste obtained as a residue from burning of coal in furnaces and locomotives. It is obtained in the form of powder. It is a good pozzalona the colour of fly ash is either grey or blackish grey.

Table.1 Properties of Fly ash

SI No	**Property**	**Value**
1.	Specific gravity	2.43
2.	Fineness	227.8 g/m^2
3.	Fineness modulus	5
4.	Density	1025.7 Kg/m^3

CEMENT

Ordinary portland cement of 43 grade manufactured by ultratech cement was used for the experiment. portland cement is most common type of cement in general used around the world because it is a basic ingredient of mortar , stucco and most non-specially grout. It is manufactured in the form of different grades; the most common in india are Grade-53, Grade-43.OPC is manufactured by burning siliceous material like limestone at 1400°C and thereafter grinding it with gypsum. The OPC Grade-43(used in this project) is known for its rich quality and high durability.

RECYCLE PAPER MILL WASTE

The process of waste paper recycling involves mixing used paper with water and chemicals to break it down. It is then chopped and heated, which breaks it down further into strands of cellulose, a type of organic plan material, this resulting mixture is called pulp. Recycle paper mills (RPM) contribute 30% of total pulp and paper mill segment in India. With 85% average efficiency of RPM, 5% waste (RPMW) is produced annually. RPMW which otherwise is land filled has been utilized to make construction bricks that serves a purpose of solid waste management, new revenue generation and earning carbon credits.

Table 2

Chemical compostion of RPMW

Component	Mass %
O	15.83
Ca	14.94
Si	60.57
Al	2.06
Mg	3.59
S	1.07
Ti	0.15
K	0.16
Fe	0.92
Na	0.22
cu	0.05

3.Experimental Procedure

In this experimental work, The standard size of brick mould used in this project is 225mm X 105mm x75mm. the average amount of water is used for mixing.

Mixing are made by hand mixing. Various proportions of RPMW, and flyash are 60%,50%,40%,30% and 20%,25%,30%,35% is added with OPC.

3.1 Methodology

First all the proportions are weighed. Clean the surface without any dirt, for mixing of all materials in proper proportions. Then the mix has done with using trowel. Add water 10 to 15% to the mix proportion.Size of the mould is 230 X 110 X 70mm

3.2 Mixing

The five different types of mixtures are prepared to the requirement of BS 6073 in laboratory trials. The water proportions in the mixes are taken as constant to determine the effect of various combination of Rpmw and flyash.

3.3 Casting of bricks

The non modular brick sample of size 230 X 110 X 70 mm. where casting lab using the OPC , flyash , Rpmw in the proper proportion. For hand moulding , the mixed proportions is forced in the mould in such a way that is fills all the corners of the mould.

The proper compacting must done. The surplus mix was removed either by frame with and top surface was leveled. Finally the mould is lifted up and raw bricks is left on the ground. Above process repeated till sufficient raw bricks are ready when such bricks become sufficiently dry for two days in direct sun light.

3.4 Drying of bricks After the bricks are moulded they are dried. This is done on specially prepared drying yards. Bricks are stacked in the yard 8 to 10 bricks in each row. Bricks are dried for a period of 5 to 12 days.

During drying it must be protected from wind, rain. Sometimes bricks are dried artificially by hot gases from kiln. But here is change of warping of bricks in case of artificial drying.

3.5 Curing of bricks

Proper curing is done for 7 days to 28 days for require the strength of the bricks.

Table.3

Mix proportion

RPMW(% added)	**Flyash (% added)**	**OPC (% added)**
60	20	20
50	25	25
40	30	30
30	35	35

4. Results

4.1 water absorption

Brick specimen are weighed dry. Then they are immersed in water for a period of 24 hours. The specimen are taken out and wiped with cloth. The weight of each specimen in wet condition is determined. The difference in weight indicates the water absorbed. Then the percentage absorption is the ratio of water absorbed to dry weight multiplied by 100. The average of five specimens is taken.the result are shown in graph 2

Table 4.

Result of water absorption

	Clay brick	Fly ash brick	Rpmw brick
Water absorption rate	20-25%	8-12%	40-30%

4.2 Efflorescence test

The soluble salts if present in bricks cause efflorescence on the surface of brick. Brick is immersed in water for 24h. It is then taken out and allowed to dry in shade. The absence of grey or white deposits on its surface indicates absence of soluble salts. The observation is made with naked eye. Here efflorescence is nil.

4.3 Compressive strength

Specimen brick is immersed in water for 24 hrs. and after is dried up with normal temperature. The specimen is then placed between plates of compression testing machine.

Load is applied axially at uniform rate till failure. Maximum load at failure divided by average area of bed face gives compressive strength**.** The compressive strength of brick was 6.94 Mpa, which is approximately equal to the combined compressive strength of commercially available fly ash brick

(7.55 MPa) and double the combined compressive strength of commercially available burnt clay bricks. The result of compressive strength are shown in graph1

5. Discussion and conclusion

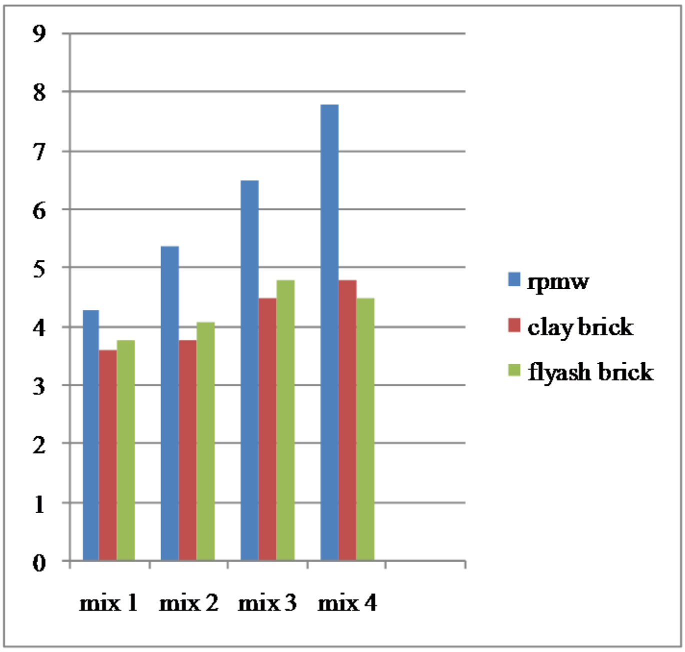
Based on the results obtained in the experimental investigation, the following conclusions are found.

The RPMW holds the moisture in these pores and fibrous envelopes providing obstacle for moisture to move towards the surface .fibrous nature gives very high energy absorbing ability and hence the high compressive strength. The dry compressive strength of brick samples is determined using Compression Testing Machine. All brick samples shows excellent compressive strength (5-8 MPa) as compared to conventional brick (3.5 MPa). Because of fibrous nature of the RPMW the brick under compressive load shrunk but did not break. The reported values are the maximum load the Compression Testing Machine can apply on the pulp brick sample. However with change in RPMW-cement composition compressive strength does not change considerably and practically remain constant. There is no shrinkage at 3.5 MPa however maximum shrinkage of 20% is reported at 7 Mpa.

The two water absorption terms corresponding to the volume and the mass of samples are calculated. Because of high voidage and cellulosic nature the water absorption is directly proportional to RPMW content.

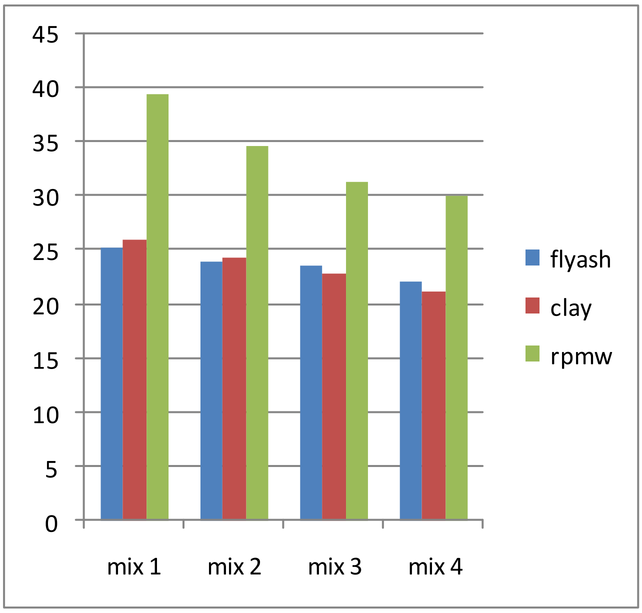
The below graph shows the compressive strength of developed brick with other bricks.

Graph1



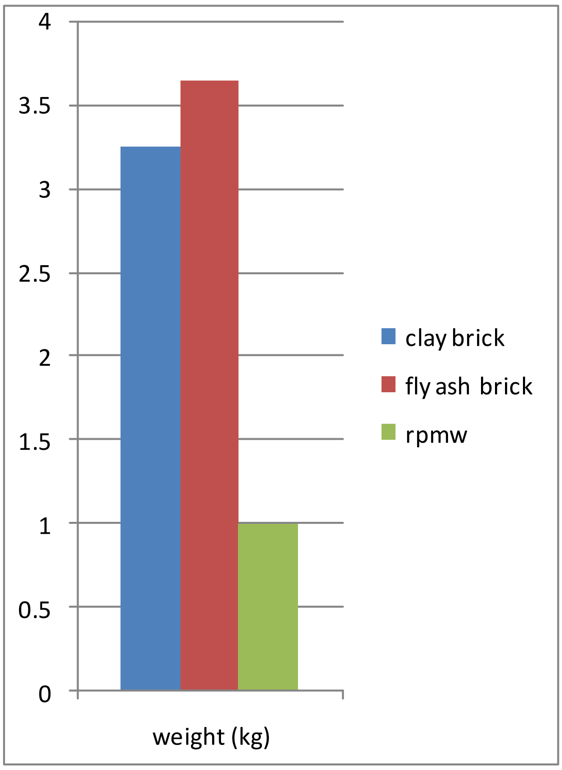
The below graph shows that rate of perentage of water absorbed by brick

Graph 2



This shows about the weight of brick

Graph 3



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