Analysis of Cow Dung Brick and Compare with Other Bricks

Guruprasad Sadashiv Sutar[1] Prof. P.D.Patil[2]
[1,2]Department of Civil Engineering
[1,2]Sharad Institute of Technology Polytechnic, Yadrav, India

Abstract — Brick is the building material of choice and is well known in our country as well as other countries for creativity, low maintenance, weatherproof etc. brick production emits gases include sulphur dioxide, carbon monoxide, carbon dioxide, oxides of nitrogen and suspended particulate matter (SPM) in the atmosphere which are harmful gases when they are present in excessive amount and lead to increase in temperature of atmosphere. Bricks are not preferred in high seismic zones due to its weight. Manufacture of brick through natural resources will lead to reduction of environmental pollution and reduction in its weight. In search of natural and renewable source which is easily available for us is Cow Dung (75%) which is waste material of animal and can be used for making bricks by adding lime (10%), clay (5%), guar gum powder (1.5%), gypsum (3%), Citric acid powder (0.5%) and sand (5%) all by volume. In this experimental analysis comparison between normal red brick, fly ash brick and cow dung brick with the help of compressive strength test, water absorption test and efflorescence test is done. Cost analysis of cow dung brick is done for comparative costs.

Keywords: Cow Dung Brick, Lime, Guar Gum, Citric Acid Powder, Gypsum, Compressive Strength Test, Water Absorption Test And Efflorescence Test, Gauthan (Place Where Cows And Buffaloes Are Kept), Normal Red Brick (Burnt Clay Brick)

I. INTRODUCTION

A. General

India is a developing country and every day new invention take place according to the need of people. In construction, brick act as a creative material which we are using since 4500 years ago and still basic of brick is soil. Agricultural soil is vastly used to make bricks which affect agriculture adversely, as in our Indian economy agriculture employed more than 50% work force and contributed almost 20% to country's GDP as per economic survey 2021-22. Now several studies are going on to replace the basic material of brick which is soil, in which cow dung is introduced as a natural material. It is easily available and light in weight as compared to soil.

In recent time several initiatives has been taken by the government of India regarding livestock like Rashtriya Kamdhenu Yojna for farmers to increase their income by dairy farming and a good initiative by Chhattisgarh government scheme Godhan Nyay Yojna depends on the 1.2crore cows and buffaloes in the state. Estimate shows a cow produces 10-15 kg of feces or manure daily. In this dung methane gas are produced which is a greenhouse gas and is produced about 40lit/kg. According to a recent assessment from the United Nations Environment Programme (UNEP) and the climate and the clean air coalition found that methane emission would be a key in the battle against climate change. Methane causes 1 million pre mature deaths every year, over a 20 year period it is 80 times more potent at warming than carbon dioxide. By using dung for manure or for building purpose it will be easy to convert waste in to usable form. At the same time quality of material should not be deteriorate.

1) Availability of Cow Dung

According to NATIONAL DAIRY DEVELOPMENT BOARD livestock population in India by species are given below:-

Data	In million	Increment % from last survey 2012
Total livestock population	535.78	4.6
Total bovine population (cattle, buffalo, mithun & yak)	302.79	1.0
Total no. of cattle in the country	192.49	0.8
Total no. of adult female cattle in the country (cows population)	81.4	6.1
Cow dung produced = 10kg avg. per cattle per day*192.49 = 1924.9 million kg per day		

Table 1: According to 2019 Survey in India

According to data only 20-30% of dung is used by the farmer for manure and fuel purpose and around 70% of cow dung is treated as waste material and disposed in improper manner. Nowadays government of Chhattisgarh is taking a good step for using bovine dung as manure by constructing Gauthan in each village.

Fig. 1: Cow Dung Thrown as Waste

II. FACTORS AFFECTING COW DUNG BRICK

- Excessive heat or temperature
- Heavy rainfall
- Absorption of water
- Construction techniques
- Quality of dung
- Material used in construction

III. ADVANTAGES OF COW DUNG BRICK

- Light in weight
- Helpful in seismic zone
- Reduces methane evolution
- Reduces Environment problem by reducing burning of bricks(CO_2 gas release)

All rights reserved by *www.ijsrd.com*

- Eco friendly
- Good impact on health
- Consume no or less energy in construction
- Reduction of soil usage in bricks
- Good thermal insulation capability
- Waste to best-way

IV. GUAR GUM POWDER

Guar gum belongs to bean or legumes family and their fruits are easily identified. In Chhattisgarh guar is known as "GAVAR" and is mainly used for vegetable purpose. Guar seed is a natural ingredient which is used in cow dung brick in powdered form so the paste made may be more workable and adhesive properties of guar gum can be used for binding materials present inside the paste.

V. REVIEW OF LITERATURE

Mohammad Ibrar et.al (2021) used cow dung logs for cremation in place of wooden logs to avoid air pollution. For making cow dung logs they made two types of machines first for creating logs and second for drying logs. Drying machine can dry 500 kg of dung and the weight of one log is up to 1 kg. Cow dung logs are mixture of cow dung, sugar cane bagasse and wood shavings. These logs can create 900ºC heat around. According to them 13% CO emission and 7% NO gas are reduced by using this cow dung logs.

Tara Radvand et.al (2020) analyzed the guar gum effect on concrete as an ecofriendly additive which enhances the mechanical properties of concrete like compressive and tensile strength when cement is removed by guar gum up to 0.8%. Slump test is carried out for fresh mortar and compressive and tensile strength were seen for fifteen different mixture designs with two different curing times. Scanning electron microscope (SEM) was used to see the bonding between guar gum and aggregates. Increase in water cement ratio has been noticed. Result shows the increase in mechanical properties of concrete as shown in SEM results which is due to formation of guar gum strings.

J Prnomo et.al (2019) experimented to think about the changes on compressive strength of concrete and the setting time of concrete in which they used citric acid as a retarder with different percentage like 0%, 0.15%, 0.3%, 0.45% according to weight of cement and the results show that citric acid extend the hardening of concrete and increase workability of concrete. The maximum value of compressive strength as found in sample added with 0.15% citric acid with increase compressive strength up to 82.2% as compared to normal concrete.

Pius Rodeny Fernando et.al (2019) created fire clay bricks with different percentage of cow dung ash like 0%, 5%, 10%, 15% and 20% by total weight of mixture and traditional dimension of brick is taken 18.5*8.5*6.5 cm3. This fire bricks are made of clay with partially constituted of cow dung ash and are low cost and durable. In this bricks are well mixed with suitable amount of water and then allowed to dry in sunlight for 2 days. Then bricks are fired in traditional kiln. Now the physical properties of bricks were tested with standard specification. Result shows that the average density of fire clay bricks was 1447 kg/m3, water absorption capability was 17%, compressive strength was 150 kg/cm2 and the flexural strength was 0.82 kg/cm2. This result was for 10% cow dung ash mixed clay brick.

Younoussa Millogo, et.al (2016) - Focused on producing low cost resistant and durable blocks with a good thermal comfort inside house. Dry cow dung is mixed at certain proportion of 1, 2, 3 (%) or without cow dung with lateritic clay which have low embodied carbon compared to conventional materials such as concrete blocks and burnt clay bricks. In this they studied the transformation and the physical and mechanical properties of adobe made with a raw clay material from Burkia faso (West Africa). First, the physical (Physical size distribution, Atterberg's limit) and mineralogical (X-Ray diffraction and thermal gravimetric analyses) characteristics of the raw material (soil and cow dung). Physical properties were measured by linear shrinkage, flexural strength test, compressive strength test and water absorption test. X- Ray pattern of mix shows evidence of the formation of new crystallized phases and proves that cow dung react with kaolinite and soluble quartz in a basic medium. It shows few homogeneous microstructures with denser material at many parts, having few pores.

Kartikey kumar gupta, et.al (2016) - Studied the current status of cow dung used in different sectors like medicine, agriculture, industry etc. cow dung is a source of energy and are used as fuel, mosquito repellent and cleansing agent which are already known in India. As per Ayurveda cow dung act as purifier for all wastes in the nature. Cow dung is one of the bioresource of this world which is available on large scale and still not fully utilized. Cow dung holds a great potential for sustainable development in near future.

Shiv Darshan malik (2016) focused on preparing plaster by mixing gypsum, guar gum, clay, lime powder etc. in the dung of indigenous cow and given a name called Vedic Plaster which acts as good insulator of heat. After this he made a cow dung brick block called Gocrete. Weight of brick is said to be 1.78 kilos which cost 4 rupees per brick. Crushing strength of brick is said to be 4-5 MPa and water absorption capability is very good as compared to red bricks. He provide a breathing wall concept in which pores of wall made by cow dung help in refining air and circulate fresh air inside the room. In his studies he got that cow dung brick act like sound proof, heat insulator and bio plastic type material. Cow dung smell is repellent of insects and many diseases like malaria, Tuberculosis etc. and also having radiation reducing properties which helps in improving health and environment.

VI. METHODOLOGY

Experimental analysis is carried out with 15 different samples of cow dung brick with traditional size of 220*105*75mm. Fly ash bricks and red bricks are also taken 15 samples each available in the market of size 190*100*90mm and 220*105*75mm respectively. Sample has been tested for compressive strength test, water absorption test and efflorescence test.

All rights reserved by *www.ijsrd.com*

Fig. 2: Gokasth and Cow Dung

properties	Cattle manure
Bulk density (kg/m^3)	750
Moisture content (%)	58.30
Water holding capacity (g water/g dry sample)	3.00
Porosity (%)	41.57

Table 2: Properties of Cow Dung

properties	Cattle manure
pH	8.1
Total organic matter	31.3
Total nitrogen	0.93
Total phosphorus	0.21
Total potassium	0.17
C/N Ratio	19.53:1

Table 3: Chemical properties of cattle manure

properties	data
Chemical formula	$C_{10}H_{14}N_5Na_2O_{12}P_3$
color	White to yellowish
odor	odorless
Water solubility	Easy
pH	5-7

Table 4: Guar gum properties

Fig. 3: Cow dung Bricks

Fig. 4: Compressive Strength of cow Dung Bricks

Fig. 5: Efflorescence test

VII. RESULTS

Compressive strength in (MPa)			
Sample	Cow dung bricks	Red bricks	Fly ash bricks
Sample 1	12.78	9.06	10.21
Sample 2	13.14	8.13	10.74
Sample 3	14.05	8.90	10.93
Sample 4	13.43	9.91	9.28
Sample 5	13.27	9.92	9.92

Table 5: Compressive Strength Test

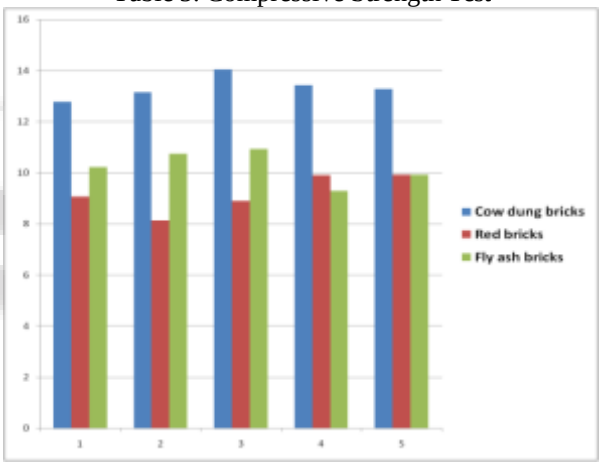

Fig. 6: Compressive Strength of Various Bricks

Water absorption in (%)			
Sample	Cow dung bricks	Red bricks	Fly ash bricks
Sample 1	18.24	20.57	22.56
Sample 2	17.56	22.10	22.14
Sample 3	17.20	21.63	22.82
Sample 4	18.63	21.78	20.75
Sample 5	18.05	20.95	21.86

Table 6: Water Absorption Test

All rights reserved by *www.ijsrd.com*

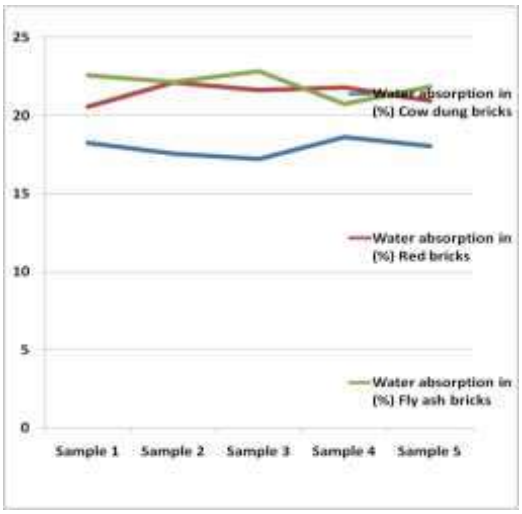

Fig. 7: Water Absorption Test

Efflorescence test results			
Sample	Cow dung bricks	Red bricks	Fly ash bricks
Sample 1	NIL	NIL	NIL
Sample 2	NIL	SLIGHT	NIL
Sample 3	NIL	NIL	NIL
Sample 4	SLIGHT	NIL	NIL
Sample 5	NIL	NIL	NIL

Table 7: Efflorescence Test

	Cow dung brick (Rs)	Red brick (Rs)	Fly ash brick (Rs)
Material cost	2554	1924	2760
Labour cost	1050	2023	1050
Equipment cost	100	200	100
Total cost	3704	4147	3742

Table 8: Cost Analyses

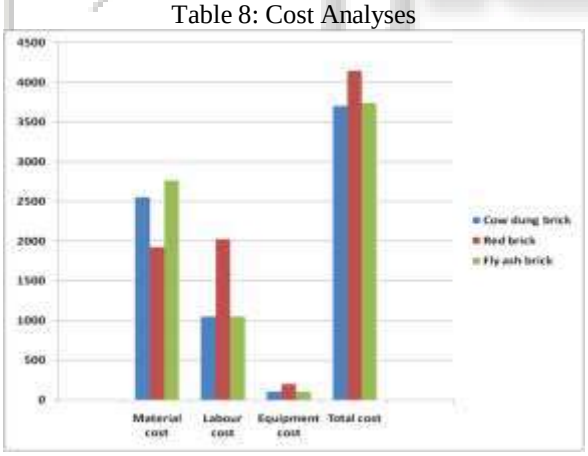

Fig. 8: Cost Analysis of Various Bricks

VIII. CONCLUSIONS

Compressive strength is more of cow dung brick as compared to normal red brick and fly ash brick which shows that cow dung brick form a layer profile inside it by the help of fibers or undigested residue present inside it.

1) Guar gum powder react with mix to thick the paste, lime and gypsum consolidate the paste which helps cow dung brick to withstand maximum load applied till its complete failure.
2) Soil present in cow dung helps to provide a proper shape and react with lime to harden the block.
3) Sand reduces the shrinkage in cow dung block and helps in layer formation by filling pores in between blocks which helps cow dung bricks to withstand in compressive strength test.
4) Fibers or undigested residue present inside cow dung help to avoid sudden failure in cow dung brick and the cow dung brick act as flexible material with respect to normal red brick and cow dung brick.
5) Cow dung bricks are light in weight as compared to normal red bricks and fly ash bricks which can be helpful in construction for seismic zones.
6) Cow dung brick have more heat insulating properties as compared to normal red brick and fly ash brick and act as coolant for room. Layers formed by the help of fibers resist maximum heat present outside and tries to maintain temperature of brick constant so that in winter warmness and in summer coolness will remain inside room.
7) Water absorption capacity of cow dung brick is less as compared to normal red brick and fly ash brick which shows that cow dung brick has less voids present inside them due to layer formation as seen in earlier studies.
8) Cow dung brick have capacity to withstand in rainy season as other bricks can, due to its less volumetric change expansion and contraction will be near to normal red brick and fly ash brick.
9) Efflorescence test shows that cow dung brick has 'slight' chances of reacting with salt as normal red brick is showing in the experiment but in fly ash brick efflorescence has not been seen.

REFERENCES

[1] Tara R advand and Vahab Toufigh (2020) European Journal of Environmental and Civil Engineering"Properties of concrete containing guar gum" https://www.tandfonline.com/doi/abs/10.1080/19648189.2020.1767217
[2] J Prnomo, S Sumarni, I N Saputro (2019)-effect of citric acid on setting time and compressive strength of concrete- https://iopscience.iop.org/article/10.1088/1757-899X/578/1/012077/meta
[3] Pius Rodeny Fernando, Somasundaram Krishanth, Nilantha Bandara Rathnayaka, (2019) Manufacturing, Physical and Chemical Characterization of Fire Clay Brick Value Added with Cow Dung Ash https://www.sciencepublishinggroup.com/journal/paperinfo?journalid=150&doi=10.11648/j.ajmsp.20190401.14
[4] Younoussa Millogo, Jean Emmanuel Aubert, A.D. Sere, Antonin Fabbri, Jean claude Morel (2016)- https://www.researchgate.net/publication/291554072/ Earth blocks stabilized by cow dung
[5] Kartikey kumar gupta, kamal rai aneja and Deepanshu rana (2016)-Bioresource and Bioprocessing- Current status of cow dung as a bioresource for suitable development- https://bioresourcesbioprocessing.springeropen.com/articles/10.1186/s40643-016-0105-9

All rights reserved by *www.ijsrd.com*