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ASSESSMENT OF PROPERTIES OF MAGNESITE BRICK

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ABSTRACT-In construction industry, brick is one of the major building materials. Traditionally for making brick, top layer of fertile soil is dug out and used as primary raw material. The conventional brick making requires large quantity of red and clay soil. These soils are most suitable for cultivation of rice, cotton etc.

In order to prevent the fertile soil degradation and to overcome the present-day demand for the brick, an attempt was made to manufacture brick using different waste material. To minimize environmental impact of soil in brick manufacturing industry, an innovative material is introduced. In our project the waste Magnesite soil from Salem is used as the alternative material to make the bricks where, fertile soil is replaced by various percentage of Magnesite soil. The Magnesite soil is obtained during magnesite exploration.

Magnesite ($MgCO_3$) is a carbonate of magnesium. Magnesite deposits in India, generally occur as crystalline mass, amorphous and massive. Calcium and silica are the most common impurities found in magnesite along with Fe_2O_3 and Al_2O_3. It is a very important mineral for the manufacture of basic refractories. The other industries where raw magnesite is used are mosaic tiles, electrodes, chemicals and manufacture of magnesium metal. Magnesite is also used in fertilizers and by Food Processing Industry.

The main objective of the project is replacing the conventional material for making bricks by an alternative material which is locally available in our region. The other objectives are to arrive cost effective brick production, to studyphysical properties of manufactured brick, and to reduce the amount of waste from magnesite exploration.

KEYWORDS: Magnesite soil, Brick

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Paper:37 43

1. INTRODUCTION

One of the most vital components for the building sector is brick. The traditional brick-making process has evident flaws. Bricks were made using earth-based elements like clay, shale, and sand, which used energy and depleted resources while damaging the environment. Mine zones remain undisturbed while virgin materials are extracted from riverbeds and slope surfaces for the brick business. Such mining activities also alter the terrain and cause air pollution that lasts after the mines are closed.

In the past, raw materials were combined, moulded, dried, and fired to form bricks. The utilisation of post-consumer waste and industrial leftovers in the production process is a key component of the present trend in the brick business. In order to improve the quality and properties of clay bricks, the majority of studies concentrated on blending clay with various recycled wastes, such as foundry sand, granite sawing waste, harbour sediments, perlite, sugarcane bagasse ash, clay waste and fine waste of boron, sewage sludge, waste glass from structural walls, and other wastes.

Building materials make up about 70% of the total cost of creating a home in developing nations like India. When it comes to building materials, brick remains one of the most important ones in India. The brick industry presents a number of important problems, such as soil erosion, emissions from coal burning, and firewood use that contributes to deforestation. The top layer of soil is removed in order to make bricks. For the construction of conventional bricks, enough red and clay soil is required. Crops like rice and cotton do well in these soils. Since there is currently a great demand for these soils, the cost of creating traditional bricks is roughly 50–60% accounted for by the cost of the soil. The study's solution to the aforementioned problems was to offer a replacement. The alternative bricks can be created using magnesite soil. The project's main objective is to replace the conventional brick-making material with a locally accessible alternative. The process of discovering magnesite involves massive trash dumps.

2. MANUFACTURING PROCESS OF BRICKS

In the process of making bricks, four distinct procedures are involved:

(i) Preparation of clay
(ii) Moulding
(iii) Drying
(iv) Burning

2.1PREPARATION OF CLAY FOR BRICK MANUFACTURING

There are six processes in the preparation of clay for the manufacture of bricks:

Forthe creation of bricks, pure clay is required. The clay in the top layer of soil, which is roughly 200 mm deep, is discarded because the top layer of soil maycontain pollutants. Unsoiling is the term for this.

Digging is the process in which the clay is extracted from the ground and scattered on the bare ground once the top layer has been removed.

In the cleaning process, the clay is cleansed of stones, plant materials, etc. at this stage. If there is a significant amount of particle matter, the clay is cleaned and screened.

In weathering,the clay is washed and then allowed to air dry to soften it.

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Blending, changing the clay loose and sprinkling the elements on it is how we add any ingredients to the clay at this stage.

Tempering, in this phase, clay is combined or crushed with water. The clay now has aplastic nature and can be moulded as a result.

Fig. Clay after blending

2.2 MOULDING OF CLAY

We can use hand moulding if brick production is done on a small scale and labour costs are low. The rectangular moulds are made of steel or wood and have openings both above and below. Molds' longer sides are protruded from the box and used as handles. Place the wet mould in the ground, fill it with tempered clay, and firmly push the clay into the mold's corners.

Wire, wood, or metal strikes are used to remove extra clay. The mould is then removed, leaving behind unfinished brick.

Afterward, wet the mould once more by immersing it in water, then carry out the same procedure. The method of repeatedly dipping a brick-making moulds is known as slop moulding. A depth of 10 to 20 mm is possible. When bricks are laid over it, the frog mark serves as a handy container to store mortar in addition to serving as the manufacturer's trademark. Similar to ground moulding, table moulding involves moulding bricks on a table that is 2 meterby 1 meter in size. Plastic clay machines and Dry clay machines are the two sorts of equipment we have available here. When we insert the tempered clay into one of these machines, it will exit through a rectangular opening that is present in the machine. Wires are now used to cut the rectangular strips coming out of the hole into the desired brick thickness.

2.3 DRYING OF RAW BRICKS

Following moulding, the bricks still have some moisture in them. In order to prevent them from cracking during burning, they must be dried. Raw bricks are dried using a natural process. Bricks are stacked and then laid. Eight to ten stairs make up a stack. These brick stacks must be constructed in such a manner that air may freely circulate among the bricks. Drying time might range from three to ten days. The state of the weather is another factor. To prevent bricks from being damaged by rainwater, drying yards are also set up at a higher elevation than the surrounding terrain. In some circumstances, artificial drying is used in conjunction with hot gases or specific dryers.

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Fig. Drying of bricks

2.4 BURNING OF BRICKS

During the burning process, the dried bricks are burned in clamps (on a small scale) or kilns (on a large scale) to a predetermined temperature. This phase of brick production is crucial since the bricks will become stronger and harder throughout this time. Burning occurs at temperatures of 1100oC. They would become fragile and simple to shatter if they burned past this point. If they burned below this threshold, they wouldn't reach their full potential and might even pick up moisture from the air. As a result,correct burning is necessary to produce high-quality brick.

3.MAGNESITE SOIL FROM TAMIL NADU MAGNESITE CORPORATION (TANMAG)

In our initiative, a variety of percentages of waste magnesite soil from the Salem-based Tamil Nadu Magnesite Corporation (TANMAG) is utilized as an alternate material to build bricks in place of rich soil. About one in fourteen pieces of Magnesite are recovered from blasted ground. Magnesite is picked, and any leftover rejected material is mechanically removed using large earthmoving equipment. This rejected waste Magnesite soil is then utilized in our project. The outcomes of the experiment will provide the characteristics and other necessary information.

Types of properties		Magnesite soil
Physical properties	Colour	Dull white
	Size	0 to 6 mm
Chemical properties	Alumina (Al_2O_3)	0.20 to 1%
	Silica (SiO_2)	6 to 14%
	Loss on ignition	42 to 48%
	Ferric oxide (Fe_2O_3)	0.20 to 2%
	Calcium oxide (CaO)	0.20 to 2%
	Magnesium oxide (MgO)	0.20 to 1%

4. OBJECTIVE

- Replacing the conventional material for making bricks by an alternative material.
- To study mechanical properties of manufactured bricks by conducting various tests.

Volume 6- Issue 2, August 2023
Paper:37 43

- To develop an innovative way of recycling the waste resulting from magnesite exploration

5.LITERATURE REVIEW

Alaa.A.Shakir et al. reviewed recycling various waste material in bricks production.Utilization of waste in bricks manufacturing may contribute to the conservation of natural resources, environmental protection and saving in land for construction. This review highlights the effects of various waste material on thebricksproperty like physical and mechanical properties as well as thermal insulation.

Sandra Espuelas et al. investigated the applicability of a MgO rich industry byproduct as a binder for the production of unfired clay bricks. The MgO was observed to show ability to enhance the mechanical properties of a clay brick in much the same way as lime does. The results obtained in this research suggest the suitability of the magnesium oxide as additive for the production of more sustainable and with high performance construction materials.

P. Balamurugan et al.introduced an innovative material to minimize environmental impact of soil in brick manufacturing industry. The rejected waste soil obtained during magnesite exploration was used in this experimental investigation.Results shows up to 30% replacement of red soil bymagnesite soil is possible and the water absorption values is within the limit and satisfy thespecification.

Amin Al-Fakih et al. studied the latest research updates on utilizing waste materials in bricks manufacturing. The mechanical and physical properties of the bricks incorporating waste materials are highlighted as well. Various studies concluded that utilizing waste materials to produce masonry bricks can contribute to sustainable construction materials and eco-friendly building products.

Kalaimani Ramakrishnan et al.examined various waste materials,includingfly ash, quarry dust, marble dust, eggshell powder (ESP), and rice husk ash(RHA), in varyingpercentages to avoidusing clay in manufacturing bricks. It was observed that the compressive strength and water absorption values met the relevantstandardsneeded for standard construction bricks.Finally, it was concluded that the brick industry could become moresustainable and economically feasible byusing specific waste materials in manufacturing bricks.

Akash Hemant Jadhav et al. studied the standard process of brick manufacturing and also analysed grain distribution of collected soil sample as per IS codes. They also used waste tea and paper pulp asingredients of brick and observed the benefits of waste management.It was observed that after adding 10% sand in collected soil sample, its properties such as compressive strength, water absorption, hardness were improved from another sample. It was also concluded that papercrete bricks are light weight as compared to normal bricks and have less but sufficient strength.

Anteneh GEREMEW et al. investigated the properties of clayed soil properties by using laterite soil for the manufacturing of bricks for masonry units. In this researchnon probability sampling techniques are used to collect samples. The density of brick decreases with an increase in laterite contents. Lightweight bricks can

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Volume 6- Issue 2, August 2023
Paper:37 43

thus produce without any deterioration in the quality of the bricks. Modified clay bricks showed an increase in compressive strength up to a particular percentage. Water absorption decreases with an increasing percentage of addition laterite soil. In order to recognize the long-term effects of the clay laterite block on the toughness of bricks and to examine the chemical composition of clay-laterite soil materials, more research needed.

6. TESTS ON BRICKS

6.1. COMRESSIVE STRENGTH TEST

Bricks are placed in a compression testing equipment to assess the crushing strength of the material. Apply pressure on the brick until it breaks after inserting it in the compression testing equipment. Make a note of the failure load value and research the bricks crushing strength. Brick has a minimum crushing strength of $3.5 N/mm^2$.It is useless for construction purposes if it is less than $3.5 N/mm^2$.

$$Compressive\ Strength\ ({}^{N}/{}_{mm^2}) = \frac{maximum\ load\ at\ failure}{Average\ net\ area\ of\ the\ two\ faces\ under\ compression}$$

6.2. ABSORPTION TEST

To determine how much moisture a brick will absorb under extreme circumstances, an absorption test is performed on the material. Sample dry bricks are gathered and weighed for this test. These bricks are weighed first, then immersed completely in water for 24 hours. The wet brick is then weighed, and its worth is recorded. The amount of water absorption can be determined by comparing the weights of dry and wet bricks.

Water absorption shouldn't be more than 20% of the dry bricks weight for a high-quality brick

$$\%\ Absorption = \frac{Difference\ in\ weight}{Original\ weight} \times 100$$

$$= \frac{W^1 - W}{W} \times 100$$

6.3 HARDNESS TEST

A sturdy brick should withstand cuts from pointed objects. Therefore, a sharp object or fingernail is needed to scratch the brick forthis test. Brick is said described as being hard if there are no scratch marks on it.

6.4. EFFLORESCENCE TEST

There shouldn't be any soluble salts in a high-quality brick.Brick surfaces will exhibit efflorescence if soluble salts are present. Place a brick in a water bath for 24 hours, then dry it in the shade to detect the presence of soluble salts. Once the brick surface has dried, carefully inspect it. It includes soluble salts and is not suitable for building if there are any deposits of a white or gray tint.

6.5. SOUNDNESS TEST

Bricks are tested for soundness to determine their resistance to rapid impact. Two randomly selected bricks are struck against one another in this test.
Brick shouldn't shatter, and the sound produced should be a crisp bell ringing sound.
It is then regarded as a nice brick.

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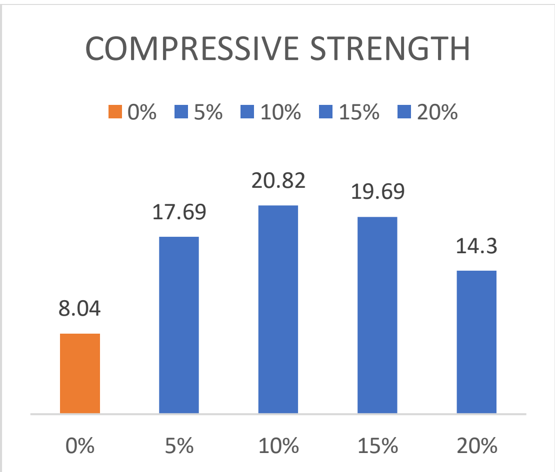
Paper:37 43

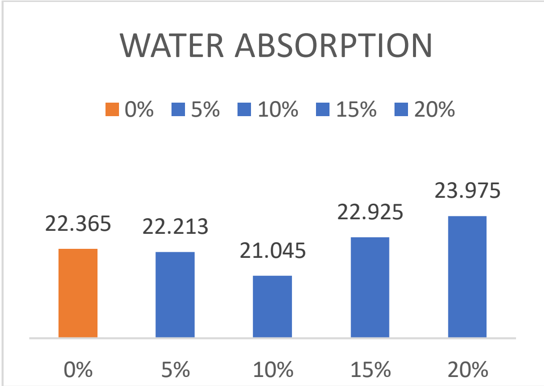
Percentage of magnesite soil added (%)	Water absorption (%)
0	22.365
5	22.213
10	21.045
15	22.925
20	23.975

7. RESULTS

7.1. Comparing the results for compressive strength.



7.2. Comparing the results for water absorption



Percentage of magnesite soil added (%)	Compressive strength (N/mm^2)
0	8.04
5	17.69
10	20.82
15	19.69
20	14.30

7.3 Efflorescence

Efflorescence was determined to find the alkaline salt content in bricks. The test conducted asper IS 3495 (part III) – 1992. In this experimental work, no noticeable deposit has observed on themajority of samples.

8. CONCLUSION

Brick manufacture mostly uses clay as a raw material. However, using clay lowers the water table and contributes to erosion. In this project, an effort was made to replace clay with magnesite soil for making bricks.

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Bi-Annual Online Journal (ISSN : 2581 - 611X)

Volume 6- Issue 2, August 2023
Paper:37 43

For the purpose of making bricks, various ratios of magnesite soil were used. The quality of the bricks was evaluated using tests for compressive strength, water absorption, efflorescence, and dimension. The test findings were contrasted with those of regular clay bricks. The results showed that bricks made from waste materials could be produced economically and generated bricks with a high compressive strength. Future research will concentrateon conducting the economic,technical, and environmental sustainability assessment of manufactured bricks made from waste resources.

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