WATER ABSORPTION OF FLY ASH AND RICE HUSK ASH BRICKS

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Abstract: *In India, brick is one of the most important building materials being extensively used in all types of construction activities. Bricks are made of a mixture of clay from ancient times. The entire clay consumed in this brick making process is taken out from the fields but the unlimited use of agricultural land is very harmful to society as it will gradually finish the top fertile agricultural land. This made the researchers to realize the urgent need of new and economical building materials in order to meet the demand of brick industry and at the same time achieve India's ambitious initiative of "Housing for All by 2022".The use of agricultural as well as industrial wastes instead of clay provides one of the practical solutions to this problem. These rice husk ash and fly ash have chemical composition almost identical to brick clay and are easily available. So, these ashes are potential substitutes for clay in brick making industry. In this research the author has made all attempts to use these alternative construction materials for brick production. The rice husk ash and fly ash containing bricks are investigated for Water Absorption.*

Key Words: *Bricks, Fly ash, Rice husk ash, housing for all.*

1. INTRODUCTION:

Brick is one of the most essential building elements known to mankind. In ancient times, bricks were made from clay bearing earth or mud and dried in sun to make them strong enough to be used in shelter structures. The history of this brick making art dates before. The earliest bricks were discovered from Jericho, Catal Hüyük, the ancient Egyptian fortress of Buhen, and the ancient Indus Valley cities of Mohenjodaro, Harappa, and Mehrgarh. Instead of drying in sun, the clay bricks can also be hardened through firing in kiln so that it can be used as strong building material and over time, these kiln-fired bricks have grown more popular than sun-dried bricks, even though both still find use globally. These fired bricks are reported to be used as early as 3000 BC in early Indus Valley cities. In ancient India, Babylon, Egypt and Roman civilizations burnt bricks were used and interestingly the use of burnt bricks finds mention in the Bible too e.g. the tower of Babel is an illustrious example built with these bricks. The popularity of these bricks is ascertained by many old constructions [1].

Nowadays, bricks composed of inorganic non-metallic material in various styles of architecture are extensively employed as constructing components all over the world. The requirement for locally manufactured construction materials has been emphasized in several nations of the world due to their easy accessibility and low cost. Bricks manufactured from locally available sources have also been considered as one of the strongest and longest lasting construction materials, used throughout history. In India, the construction sector contributes nearly 10% of the Gross Domestic Progress (GDP), thus registers an annual growth of approximately 9 percent. The kiln fired bricks forms the backbone of this construction sector. Even though the brick industry in India is unorganised but is growing enormously and India ranks as the second biggest brick producer in the world. It is constantly growing on account of a rapid increase in demand for bricks in infrastructure and housing sectors. In order to meet this demand, over 150,000 brick units provide direct employment to more than 8 million workers. During the eleventh Five-year Plan period (2007-2012), the annual demand of 220 million bricks per year was estimated to be generating revenues of over US$ 5.3 billion. India's ambitious initiative of "Housing for All by 2022" is expected to one of the major growth driver for the bricks industry of the country. The recent announcement of granting an "infrastructure" status to the "Affordable Housing" in Budget 2017 is expected to result in exponential growth in bricks sector to meet the existing deficit of 20 million housing units.

2. MATERIALS:

In this work, for the manufacturing of bricks [2, 3] to fulfill the desired aims and objectives of this research work agricultural (rice husk ash) as well as industrial waste (fly ash) material is used as a replacement of the cement for the manufacturing of the desired bricks and to test their performance. It presents in detail these materials used to carry out the performance analysis of the manufactured bricks.

2.1. Clay

Clay soils are compounds of silica and alumina. Generally two types of clay are used for the manufacturing of bricks. These are calcareous and non calcareous clay. Calcareous clays have calcium carbonate and will burn to a yellow or cream colour. Non-calcareous types of clay typically contain feldspar and iron oxides, and will burn to a brown, pink or red colour depending on the amount of iron oxide present in the clay. The silica in the clay, when fired at 900-1200 degrees C, will turn to a glassy phase. This process of turning silica present in clay into glassy phase is called as vitrification, which will turn the clay to a crystalline structure. Therefore, for the process of vitrification temperature is a very important factor. If under-fired, the bonding between the clay particles will be poor and the brick will be weak. If the temperature is too high, the bricks will melt or slump [4].

2.2. Fly Ash

Fly ash is a predominantly inorganic residue obtained from the flue gases of furnaces at pulverized coal power plants. When coal is burnt in pulverized coal boilers, the minerals, entrained in the coal, are thermally transformed into chemical species that are reactive or could be chemically activated, i.e. by the addition of calcium hydroxide. Fly ash is the by-product of coal combustion collected by the mechanical or electrostatic precipitator (ESP) before the flue gases reach the chimneys of thermal power stations in very large volumes. There are two primary sources of fly ash: fly ash from a pulverized coal power plant and fly ash from a municipal waste incineration plant. All fly ash contain significant amounts of silicon dioxide (SiO_2), aluminium oxide (Al_2O_3), iron oxide (Fe_2O_3), calcium oxide (CaO) and magnesium oxide (MgO). However, the actual composition varies from plant to plant depending on the coal burned and the type of burner employed [5]. Fly ash also contains trace elements such as mercury, arsenic, antimony, chromium, selenium, lead, cadmium, nickel and zinc. These particles solidify as microscopic, glassy spheres that are collected from the power plant's exhaust before they can fly away, hence the product is named as Fly Ash. Chemically, fly ash is a pozzolan.

2.3. Rice Husk Ash

Developing countries like India possess abundantly available agro based resources and their by-products from industries, many of which are under utilized along with a variety of low value products [6]. On the other hand, developed countries have accepted and followed the concept of “no waste” and all such materials are termed as “new resources” for new material development through value addition [7]. India is a major rice producing country and the rice husk generated during milling is mostly used as fuel in the boilers for processing paddy, producing energy through direct combustion or by gasification, about 20 million tonnes of rice husk ash (RHA) is produced annually. Rice husk ash (RHA) is obtained by burning rice husk. Figure 1 depicts Clay, Fly Ash and Burnt Rice Husk Ash after grinding.

Figure 1 a) Clay b) Fly Ash c) Burnt Rice Husk Ash

3. WATER ABSORPTION TEST

This test is also known as 24 hours Immersion Cold Water Test and hence the water absorption of the samples prepared was determined by 24 hour cold water immersion test. For the research 6 samples of each composition were tested and average of the results is as tabulated below. This test is carried out to determine the amount of water absorbed by the brick [8]. When immersed in water for a period of 24 hours it should not, in any case, exceed 20% of weight of dry brick. This test is carried out for all the samples of fly ash bricks, rice husk ash and clay bricks. A sensitive balance capable of weighing within 0.1 percent of the mass of the specimen and a ventilated oven are used to carry out this test [9].

3.1. Preconditioning

The specimen is dried in a ventilated oven at a temperature of 105 to 115°C till it attains substantially constant mass. Then, the specimen is cooled to room temperature and its weight (M1) is noted down.

3.2. Procedure

Completely dried specimen was immersed in clean water at a temperature of 27 ± 2°C for 24 hours. After that the specimen was removed from the water and wiped out any traces of water with a damp cloth and thenthe specimen was weighed. The weighing is completed 3 minutes after the specimen has been removed from water (M2). Water absorption, percent by mass, after 24 hour immersion in cold water is calculated.The Table 1 demonstrates the average water absorption of all the samples manufactured.

Table 1 Water Absorption Test results of all samples

Sr.No.	Sample Designation	Percentage of Clay	Percentage of Fly Ash	Percentage of Rice Husk Ash	Water Absorption (%age)
1.	M0	100	0	0	18.16
2.	F1	90	10	0	15.42
3.	F2	80	20	0	13.72
4.	F3	70	30	0	11.24
5.	F4	60	40	0	9.60
6.	R1	90	0	10	19.35
7.	R2	80	0	20	20.64
8.	R3	70	0	30	22.44
9.	R4	60	0	40	23.80
10.	FR1	90	5	5	17.52
11.	FR2	80	10	10	16.34
12.	FR3	70	15	15	14.60
13.	FR4	60	20	20	13.22

3.3. Results of Water Absorption of Bricks

Three types of bricks are manufactured. Initially testing is done on normal clay bricks. Then to compare the results with the bricks with added fly ash and rice hush ash, similar tests are performed on these bricks. Figure 2 presents the comparative plot of percentage of water absorption in case of normal clay bricks and fly ash bricks with varied proportion of fly ash. This clearly illustrates that with the addition of fly ash in normal clay bricks the percentage of water absorption of the manufactured bricks decreases and it is reasonably lowered compared to the normal clay bricks as it is 18.16% in case of normal clay bricks and it decreases to 9.60% when 40% of fly ash is added in the manufactured sample. On the other hand a reverse pattern is perceived on addition of rice husk ash instead of fly ash i.e. the percentage of water absorption increases. In brick sample R1 it is 19.35%, which increases up to 23.80% in R4 sample, this increase in water absorption is clearly depicted in Figure 3. Similar to fly ash bricks, when varied percentages of both fly ash and rice hush ash are added to the samples the percentage of water absorption decreases, it is observed to be 17.52% in case of sample FR1 while lowers to 13.22% for FR4 sample, which is clearly shown in Figure 4. The decrease in water absorption is more pronounced when fly ash is used in brick manufacturing, while decreases to slightly smaller extend when both (fly ash and rice hush ash) are added together in equal proportions but increasing pattern is obtained, when rice husk ash is added to normal bricks.

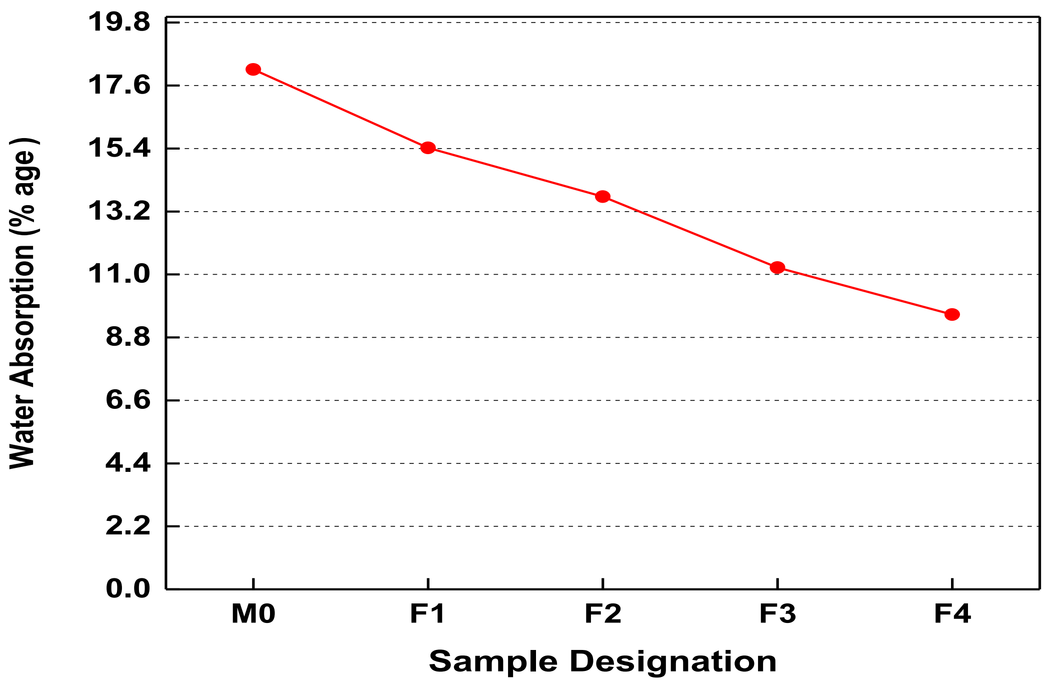

Figure 2 Water Absorption of Fly Ash Bricks

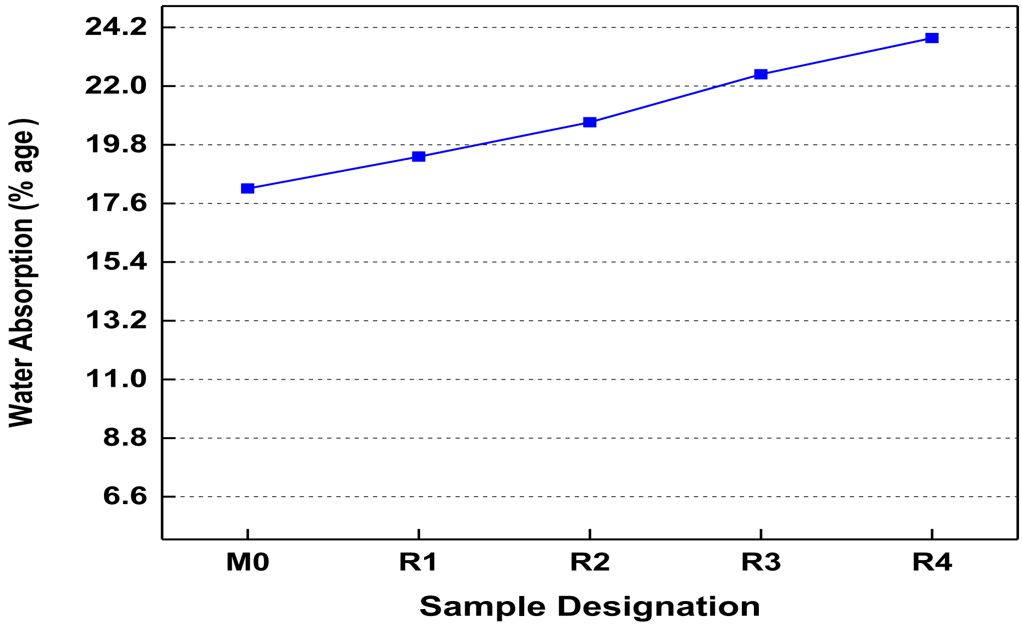

Figure 3 Water Absorption of Rice Husk Ash Bricks

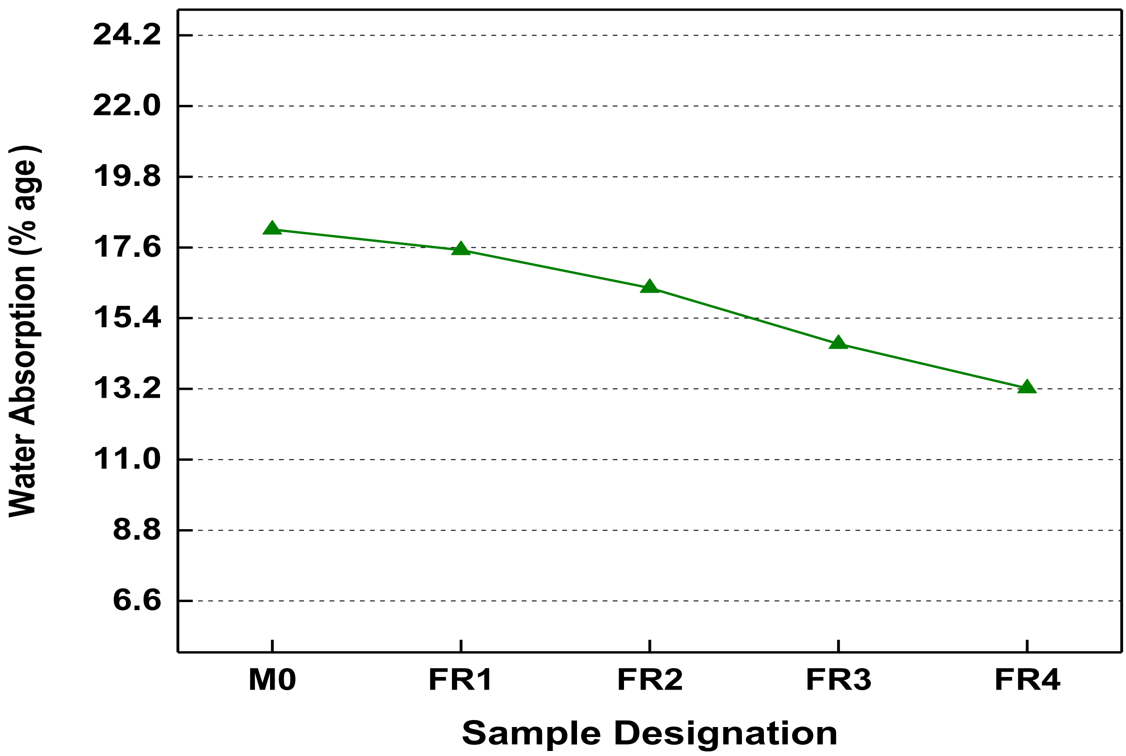

Figure 4 Water Absorption of Fly Ash and Rice Husk Ash Bricks

4. CONCLUSION:

In India the traditional method of brick making is adopted, which uses conventional firing techniques and has fuel requirement. Haryana, Punjab, Uttar Pradesh, Bihar and West Bengal are the major brick producing states in India. These states account for about 65 per cent of the production. The brick kilns are located in clusters around main towns and cities with a production capacity of over 2–10 million bricks per year. As the second largest producer of bricks, India produces over 10 per cent of the bricks that are globally produced. The conventional method consumes fertile soil, consumes a lot of energy (25 million tonnes of coal and 350 million tonnes of soil annually), is highly labour intensive and emits greenhouse gas which has led to the demand for green building materials. This made the researchers to realize the urgent need of new eco-friendly and economical substitutes of clay in order to meet the demand of brick industry and at the same time achieve India's ambitious initiative of "Housing for All by 2022". The use of agricultural as well as industrial wastes instead of clay provides one of the practical solutions to this problem. The rice husk ash and fly ash have chemical composition almost identical to brick clay and are easily available. So, these ashes are potential substitutes for clay in brick making industry and simultaneously serve two important purposes in very efficient, useful and profitable way i.e. maximum disposal of wastes and conservation of scarce resources and materials. Keeping this in mind, in the present work the author has investigated the effects of addition of fly ash and rice husk ash to clay and the exact optimal percentage of fly ash and rice husk ash required for manufacturing superior quality of bricks.

The average absorbed moisture content of clay bricks is found to be 18.16%. The results clearly illustrates that with the addition of 40% fly ash and both together (20% fly ash + 20% rice husk ash) in normal clay bricks a net decrease in percentage of water absorption was 47.13% and 27.20% respectively. While in case of rice hush ash bricks anet increase in percentage of water absorption was 31.05% .The percentage of water absorption for all investigated bricks was found to be greater or lower than that of conventional bricks but still within the prescribed maximum limit as per Indian Standards.(Maximum allowable water absorption as per Indian Standards is 25%). Hence these admixtures can be used with clay in manufacture of eco-friendly bricks.

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