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MITIGATION OF THERMAL POWER PLANT GENERATED FLY ASH THROUGH FaL-G BRICK

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Abstract - *As we are heading to the first quarter of 21st century, there is a growing concern about the environmental impact of various conventional construction activities; in the wake of removal of topsoil for the manufacture of conventional burnt clay bricks, the FaL-G bricks came into existence and has played a significant role in reducing the problem ever since. This paper provides an investigative insight into the various aspects of replacement of conventional Burnt-Clay Bricks with Fly ash-Lime-Gypsum (FaL-G) bricks as a wall construction unit. The main concerns of this investigation includes the benefits by mitigation of constituent ingredients from environment through utilization in manufacture of Fal-G bricks, structural and economical aspects of replacement of burnt clay bricks by FaL-G bricks, various ingredients used in the manufacture of FaL-G bricks and the manufacturing process along with its environment impact. Such a paper will be fruitful for a construction industry which proposes to reduce the environmental impacts by utilization of such products and for the promoted use of FaL-G bricks.*

Key Words: FaL-G Bricks, Bricks, Environmental Impact, Burnt Clay Bricks

1. Introduction

The very existence of brick, was based on the improvement of earlier construction unit-Stone-and considered to be a huge leap in technological advancement in construction technology. The introduction of Burnt Clay Bricks made it easier for a mason to construct a wall as the brick was far lighter than the stone previously used. This not only reduced the cost of construction but made quality construction available for all. This made Burnt Clay Brick popular in that time and that continued till recently we began to realize its impact on environment. Even though, government has drafted guideline for production of Burnt Clay Brick, but, those guideline are usually not adopted satisfactorily, which ultimately results in certain ill effects on the environment. Some of which includes erosion of fertile top soil as for soil used in making bricks, air pollution from the furnaces used to bake the bricks, etc. Keeping in mind such huge demerits in present scenario use of Fly ash-Lime-Gypsum Bricks is becoming increasingly popular as once was the case with Burnt Clay Bricks. However, the major difference being that this time the replacement of convention isn't only taking place from functional point of view but from ecological and environmental point of view also which is in itself a great motivator for the industry.

2. Environmental Impact of Conventional Burnt Clay Brick manufacturing process:

The core issue begins at the very initial stage of the whole process, that is, the collection of soil to be used for making bricks. Due to a large number of unorganized manufacturers coming into the scenario, earlier studies (Khan & Vyas, 2008) reveal that it has become difficult for the government and the agencies to control their actions. These unorganized manufacturer are often observed to follow malpractices such as illegal exploitation of land, the farmers are forced by such manufacturers to give up their fertile land, etc. However, there are organized and legal brick manufacturer who operate within the guidelines, but still, the process of manufacture even with the advent & inclusion of modern eco-friendly practices cannot be deemed eco-friendly, as still the process results in loss of fertile topsoil which is an irreplaceable asset for the farmers of a country whose more than half population that translates in to more than 600 million is still dependent on activities like farming.

2.1 Impact on Soil and Agriculture:

From the study [1], Figure 1, it was observed that soil was being excessively dug out to meet the requirement of production from the allotted field. These dug out patches of land are being left unattended and unplanted. Such malpractices cause the degradation of land which is of utmost importance to a farmer. Upon further investigation, Figure 2, it was known that often farmers are forced to give up land to kiln operators. Usually, the removed soil from one field creates such a difference between adjacent fields of land that the adjacent farmer's irrigation is affected, and then that farmer is indirectly forced to give up his land for removal of soil. Such fertile land is used to grow crops which are a major contributor to our country's economy and her growth, and such actions are gradually causing erosion of fertile topsoil.

Fig – 1(a): Wastage of Good Quality Fertile Soil during Brick manufacture.

Fig -1(b): Excessive digiing of Agriculture Grade Soil

2.2. Impact on Air:

The same study further revealed, that the quality of air surrounding the area was not within standard limit as prescribed by Government and other related agencies. In order to access the quality of air, certain control parameters including suspended particulate matter, NOx and SOx were checked and the results revealed significant difference in actual and control values. In fact, the average values of various parameters were found to be multiple folds higher than the control limits.

Such increase in quantities of these parameters results in drastic increase in air pollution and its negative impact on human health and environment.

2.3. Impacts on Water Quality & Health:

Based on the study (Khan & Vyas, 2008), it is concluded that even though further studies are required in the field, to detect and report the influence of Burnt Clay Brick manufaturing kilns over water and Health of the workers and residents of surrounding regions, there have been apparent impact of this activity over water quality and literature studies show the frequent occurrence of respiratory diseases (D.N, et al., 2001), musculoskeletal disorders , silicosis and pneumonocosis in kiln workers.

3. Impacts of Fly Ash dumping near Thermal Power Plants:

Thermal power plants produce a huge amount of fly ash as a by-product from the process of electricity generation. As depicted in Figure 3 and Figure 4, this quantity of fly ash is dumped to large fileds resulting in wastage of large usuable area of land. This dumping doesn't only affect land usage but also this causes a disturbance in environment of surrounding area. During the monsoon season this dumping land becomes marshy and almost causes formation of quick sand, this naturally affects the habitat of various native and non-native species of birds. This causes a situation of imbalance in environment of that place.

As per investigation and Data Availaible as of 2015 through "Report on Fly Ash generation by coal/lignite based power stationsand its utilization in the country" prepared by Central Electricity Authority, Total Fly Ash generation in the 145 Thermal Power Station across the country was 184.14 million tonnes and its overall utilization was only 102.54 million tonnes, leaving 81.6 million tonnes fly ash unattended and left to waste thus, causing aforementioned problems. However, this issue can be cecked by promoting Growth of Fal-G brick manufature.

Current share of this industry in utilization of Fly-Ash is 11.72%, which can be raised significantly keeping in view with the current Scope and Boom in Construction Industry.

Figure 3. Large trucks hauling fly ash from power plant to dumping sites,

Figure 4. Qasimpur Thermal Power Plant Fly Ash Dumping Ground

In Uttar Pradesh alone, 24.37 million tonnes of Fly Ash was generated in Thermal Power Stations of which only 10.79 million Tonnes was utilized.

Important noticeable point being the allowance for new Plants to operate with 50% Fly Ash Utilization during first year subsiquently increasing to a minimum of 100% target after five year of operational time. Site under observation was commisioned on 31st of July, 1977, clearly having an obvious target of 100%.

Data gathered during invstigation at Harduaganj Power Station revealed that around 0.99 million tonnes of Fly Ash was produced during 2014-15 of which almost all was utilized and target set by government for this power station was well achieved before time of study. But as data suggest in the country 55.69% of overall flyash was left useless this flyash if utilized will not only prevent harm to environment but also save for Capital Profits of the government that can be invested for major humanitarian causes and invested into research for more efficient clean renewable energy production.

Figure 5. Pipelines carrying fly ash in the form of slurry..

4. Comparative Benefits of Using FaL-G Bricks over Burnt Clay Bricks:

Key ingridients of FaL-G Bricks are fly ash, lime, gypsum and sand. Due to various underststated reasons the use of FaL-G bricks becomes far more suitable then conventional Burnt Clay Bricks.

1. The FaL-G bricks are lighter in weight.
2. Fal-G Bricks are comparatively stronger.
3. As fly ash is being accumulated as a By-product in large quantity from various thermal power plants and creating serious environmental hazards, and it acts as a major ingridient in FaL-G bricks, their use in construction is considered eco-friendly. That is the main reason why the government has supported the use of FaL-G bricks.

In addition to aforesaid reasons, following key factors are also in support of the replacement of Burnt Clay Bricks by FaL-G Bricks, as shown in Table 1.

Table 1. Comparison between FaL-G Bricks with Burnt Clay Bricks

FaL-G Bricks	**Burnt Clay Bricks**
Can be made of higher density.	Density depends on of baking tempreture and time.
No need of plastering.	Plastering or pointing required.
Due to lighter ingridients, bricks becomes lightweight.	Heavy in weight.
Compressive strenght is 90 kg/cm^2	Compressive strenght is 35 kg/cm^2
Due to higher density these are less porous.	Due to presence of voids and low density these are highly porous.
Due to low porosity, water absorption is around 6-12%	Due to higher porosity, water absorption is around 20-25% in first class briks.
Due to abundane of key ingridients, their cost is comparatively low.	due to expensive key ingridients and lenghty manufaturing process, their cost is high.
With use of FaL-G bricks we are able to save Fertile topsoil and prevent its loss.	The key ingridient is obtained by digging of important Fertile topsoil.
The whole manufaturing process is eco-friendly.	The manufacturing process causes release of various pollutants in atmoshere.
The manufaturing process causes no health hazards.	Apparent health issues related to manufacturing.

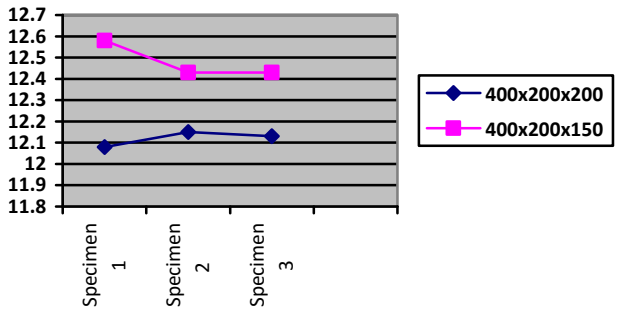
Figure 6. Finished quality Fal-G bricks and Blocks

STRENGHT DATA
(TYPE: CEMIX FAL-G BRICK AND BLOCKS)

SIZE (mm)	W(kg)	P(N/mm²)	γ(kg/cu.m)	F.R. (hrs.)	S.I. (db)
400x200x200	22.88	12.12	1430	4	47
400x200x150	19.08	12.48	1590	4	47

Where,
W Weight of block.
P Ultimate Compressive strength of block.
γ Mass Density of Block.
F.R. Fire Resistance.(+)
S.I. Sound Insulation.(+)
(+) obtained from manufacturer.

Chart 1 Compressive Strength.



5. Conclusions:

Taking in view with the current economical and environmental aspects of infrastructure industry, the utilization of Fal-G bricks for the inchoative replacement of conventional burnt clay bricks will prove beneficial. Structurally sound Fal-G bricks are now increasingly being used in industry due to two reasons:

1. They are cheaply available due to initiatives of governing agencies for mitigation of fly ash.
2. And due to modern trend of RC Structures becoming increasing popular.

During the course of study one may encounter a large number of factories and establishments taking advantage of current situation on this context. This has not only proven to be a better investment for brick manufacturers but also for local native population by providing employment in bulk.

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BIOGRAPHY

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