IOSR Journal of Engineering (IOSRJEN) **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719
Vol. 10, Issue 5, May 2020, ||Series -I|| PP 54-58

Enhanced Sludge Brick

Mohammad Aquib[1], Faique F. Ahmed[2], Likesh R. Neware[3],Himanshu P. Raut[4], Harsha M. Hatwar[5], Nikhil N. Khobragade[6], Rahul D. Hinge[7]
[1,2,3,4,5,6] *(Research Scholar, Department of Civil Engineering, G. H. Raisoni Academy of Engineering & Technology, Nagpur)*
[7]*(Associate Professor, Department of Civil Engineering, G. H. Raisoni Academy of Engineering & Technology, Nagpur)*
Corresponding Author: Mohammad Aquib
Received 9 May 2020; Accepted 22 May 2020

Abstract: The tradition of treating sewage in India is not very popular and the practice which is in use is direct discharge in various natural water bodies. Where ever the sewage is treated the main problem occur is dumping of sludge, as it dumped in an open environment which leads to pollution in environment. On other hand, brick is one of the important element in civil engineering and construction industry, so using sludge as primary brick manufacturing material will make the brick more economical as well as load of sludge for dumping will automatically get reduce. The work of using sludge as a brick manufacturing material is in progress all around the globe and India is also making a remarkable progress in this direction. We are trying to use sludge in various proportions with fly ash and with clay after performing all tests we will analyze the feasibility of sludge as brick manufacturing material.
Keywords: Sludge, Sewage, STP-Sewage Treatment Plant, Sludge Disposal, Clay, Brick

I. INTRODUCTION

Nagpur city generates approximately 525MLD of sewage, Maharashtra 8,143 MLD Sewage (maximum in India 13%) and entire country generates-61,948 MLD Sewage(Source-Ministry of Environment, Forests and Climate Change (MoEFCC)) taking only Nagpur city in account, the treating capacity of Sewage treatment plant Bhandewadi (Nagpur) is 200 MLD the plant is being further expanding to increase its capacity by 100 MLD in near future, though the total capacity will became 300 MLD but also then the 200 MLD sewage will remain untreated which means it will contribute to pollute the natural body by being get discharge into them. Focusing on other side of coin we know that the construction industry play very vital role in development of a city, state or country and India is one of the developing country which indicate towards a large scale construction at present and in near future, after concrete and steel, brick is the next big requirement for construction. Economical brick will lead to economical construction and sludge brick can achieve that in very significant manner. The sludge brick with some enhancement can contribute to the construction industry and environment. As the use of sludge will get regularized the waste sludge will be given more value and the trend of treating sewage will increase automatically.

II. INTERNATIONAL & NATIONAL STATUS

Since 1975, the use of water treatment sludge in various industrial and commercial, manufacturing processes has been reported in UK, USA, & Taiwan. 5 million tons of annual leftover bio solids production in Australia, New Zealand, the EU, the USA and Canada are used for making Sludge bricks. Port Elizabeth brickworks in South Africa has been making Sludge Bricks since 1979.The researches and the progressive work around the globe took a swift after 2010, the scholars of Norwegian University of Science and Technology (NTNU), Trondheim, Norway published their research on 2014, The National R&D Institute for Textile & Leather, Bucharest, Romania on 2018, University Tun Hussein Onn Malaysia, Malaysia on 2018 and Khulais University of Jeddah, KSA (Kingdom of Saudi Arabia) & National Research Centre, Dokki, Cairo, Egypt on 2018 except brick manufacturing the use of sludge in various industrial and commercial, manufacturing processes has been reported in UK, USA, Taiwan. Turning towards India, there are several research work has been done and many are in progress. V.V.P. Engineering college, Rajkot on 2014, Walchand College of engineering, Sangli, on 2015,School of Civil Engineering, SASTRA Deemed University, Thanjavur on 2017,Dr. D. Y. Patil School of Engineering & Technology, Lohegaon, Pune on 2017, D. Y. Patil College of Engineering, Akurdi, Pune, India on 2018 and Dr. Vithal Rao Vikhe Patil College of Engineering, Ahmednagar on 2019.

III. MATERIAL & METHODOLOGY

3.1 MATERIALS

3.1.1 Sludge-Sludge is a by-product of sewage, it's one of final products of wastewater treatment at sewage treatment plants. The Sewage treatment plants (STPs) accumulate and separate solid from water. The solid is known as sludge. The chemical composition of sludge extracted Nagpur city sewage is shown below.

Table 3.1: Chemical composition of STP Sludge

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	S
57.84%	7.65%	4.96%	23.92%	5.20%	0.16%

3.1.2 Fly Ash-Fly ash is a byproduct from burning coal which is inert chemically. The fly ash used as a mass in brick manufacturing and this is also one of the waste byproduct which is available in very large amount. The chemical composition of fly ash from Koradi Thermal power plant is shown below.

Table 3.2: Chemical composition of Fly ash

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	S
63.64%	20.39%	0.56%	12.69%	2.44%	0.07%

3.1.3 Gypsum-Gypsum is a mineral which found in layers that were formed under salt water millions of years ago. When water evaporated, it left the mineral behind. Gypsum is composed of calcium sulphate ($CaSO_4$) and water (H_2O). Its chemical name is Calcium Sulphate dehydrate ($CaSO_4.2H_2O$). Gypsum generally accelerate the time of setting.

Table 3.3: Chemical composition of Gypsum

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO
50% - 60%	20%-30%	$\leq$ 7%	2- 5%	less than 1%

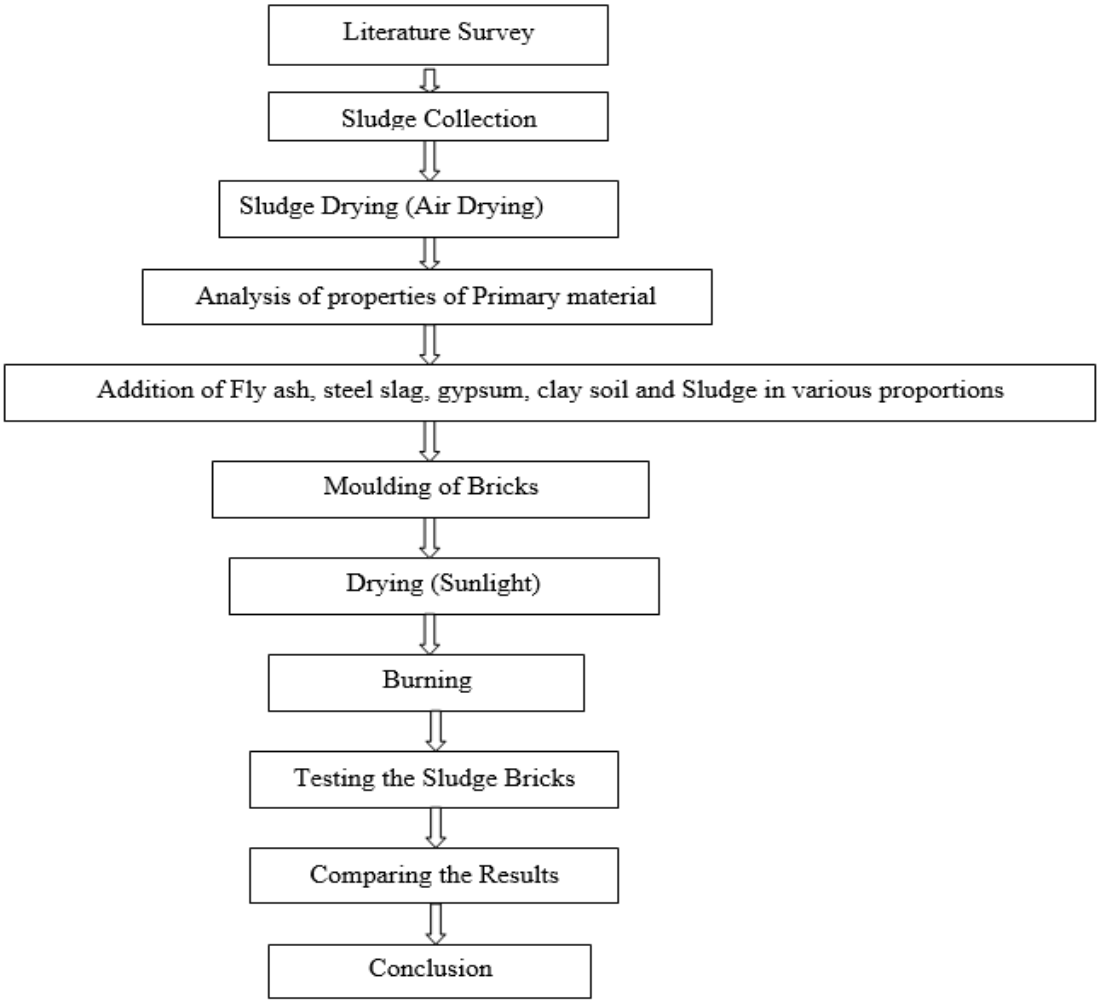
3.1.4 Soil- We have taken the liberty of using soil which is suitable and available for making red brick and it can be used along with the sludge. Sandy and loamy soils are considered good soils for making bricks. Pure clay mineral is formed from the erosion and weathering of primary igneous rocks. The clay mineral is transported away by the action of water, wind, ice etc., and re-deposited elsewhere. In the process it picks up a number of impurities, Quartz, mica, Calcium Carbonate (lime), Iron Oxide etc.

3.1.5 Steel Slag- Steel slag is by-product of steel making and it's produced during the separation of the molten steel from impurities in steel-making furnaces. Steel slag contains some toxic ingredients such as nickel, cadmium, chromium and strontium. These compounds could be harmful for environment as well as human health. The primary constituents of steel slag are limestone (CaO) and silica (SiO_2) in very small percentage.

3.2 METHODOLOGY

Casting and burning has been done in a manner such as conventional red bricks are manufactured in plant so that adoption of sludge as a primary constituent of brick can become more promising and the feasibility of brick can be determined when it's being manufactured in plant with regular plant practice. The following flow chart will give more distinct idea about the methodology.

3.2.1 Flow Chart of adopted Methodology



IV. PROPORTIONS

The art of determining quantity of number of materials in different percentage or ratio per unit volume is termed as proportioning. Three proportions were decided on the basis of previous studies along with minor changes towards an optimistic step of enhancement of properties of bricks by the modified proportions.

The bricks were casted of size 19cmx9cmx9cm by the mould at the brick manufacturing plant by the help of skilled workers and allowed to dry in sun at plant itself.

P-1: Sludge + Fly ash (85% + 15%)
P-2: Sludge + Soil +Fly Ash + Gypsum (45% + 35% + 18% + 2%)
P-3: Sludge + Soil + Steel Slag + Fly ash (40% + 35% + 20% + 5%)

V. TESTING RESULTS

5.1 COMPRESSIVE STRENGTH TESTING RESULTS

Table 5.1: Compressive Strength of P-1

Serial No.	Load at failure (KN)	Compressive Strength (N/mm^2)	Average Compressive Strength
1	**103**	**6.02**	**6.27 N/mm^2**
2	**112**	**6.55**	
3	**107**	**6.25**	

Table 5.2: ***Compressive Strength of P-2***

Serial No.	Load at failure (KN)	Compressive Strength (N/mm^2)	Average Compressive Strength
1	**121**	**7.07**	**6.72 N/mm^2**
2	**111**	**6.49**	
3	**114**	**6.60**	

Table 5.3: Compressive Strength of P-3

Serial No.	Load at failure (KN)	Compressive Strength (N/mm^2)	Average Compressive Strength
1	**99**	**5.78**	**5.74 N/mm^2**
2	**94**	**5.49**	
3	**102**	**5.96**	

5.2 WATER ABSORPTION TEST RESULTS

P-1(Sludge 85% + Fly ash 15%) -**20.3%**
P-2(Sludge 45% + Soil 35% +Fly Ash 18% + Gypsum 2%) - **19.2%**
P-3(Sludge 40% + Soil 35% + Steel Slag 20% + Fly ash 5%) -**23.8%**

VI. CONCLUSION

The analysis of result brought us into the conclusion that the first proportion (P-1) which have composition of only fly ash and sludge is feasible up to some extent and very easy to adopt and giving significant compressive strength as second class brick and water absorption is just above the permissible limit.

Whereas the second composition (P-2) which consist gypsum and clay along with sludge and fly ash is giving more satisfactory results in terms of compressive strength and water absorption and it can be perfectly termed under Second class brick. It also satisfies the other testing parameters more than other two.

The third proportion (P-3) is the proportion which didn't made to the expectations, the compressive strength and water absorption value was lesser than other two.

The brick from sludge will help us to achieve various environmentally and construction oriented objectives such as the trend of treating sewage will increase because the plant can earn from the end product after treatment of sewage which is considered as a waste at the same time sludge mass can be directly eliminated from the environment and load of dumping sludge will become negligible.

REFERENCES

[1]. P.Amsayazhi1, K.Saravana Raja Mohan,Use of Sludge Waste as Ingredient in Making of Brick,International Journal of Engineering &Technology, 7 (3.12) (2018) 419-422

[2]. Keerthana. S, Kavya. K, Pradeep.T, Sharmila.S, Study on Effect of Partial Replacement of Sludge in Bricks, International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, Volume-7, Issue-6, March 2019

[3]. Ponkarthikeyan P, Ganesh R, Sheerin Farzana A, Experimental Study on Bricks Using Water Treatment Sludge, International Journal for Research in Applied Science & EngineeringTechnology (IJRASET), Volume 4 Issue XI, November 2016, IC Value: 13.98 ISSN: 2321-9653

[4]. Govind Bikkad, Chetan Sontakke, Baliram Janwade, Gajendra Giri, Vaibhav Kalbhor, Rohini Khandelwal, Replacing The Fly Ash By Stp Dry Sludge In Manufacturing Of Fly Ash Bricks, International Research Journal of Engineering and Technology (IRJET), Volume: 05 Issue: 06 | June 2018

[5]. Yousif Algamal, N. M. Khalil1, Qayid M. Saleem, Usage of The Sludge From Water Treatment Plant In Brick-Making Industry, Journal of Chemical Technology and Metallurgy, 53, 3, 2018, 504-510

[6]. Hallvard Ødegaard, Bjarne Paulsrudand Ingemar Karlsson, Wastewater Sludge as a Resource :Sludge disposal strategies and corresponding treatment technologies aimed at sustainable handling of wastewater sludge, Aquateam- Norwegian Water Technology Centre A/S, Postbox 6875, Rodeløkka, 0504 Oslo, Norway , Kemira Kemwater, Postbox 902, SE- 251 09 Helsingborg, Sweden.

[7]. Sandeep Yadav, Suyash Agnihotri, Shivam Gupta, Rishabh Kumar Tripathi, Incorporation of STP Sludge and Fly ash in Brick Manufacturing: An attempt to save the Environment, International Journal of Advancements in Research & Technology, Volume 3, Issue 5, May-2014, ISSN 2278-7763

[8]. N R Jianu, I C Moga1, F Pricop and A Chivoiu, Wastewater Sludge Used as Material for Bricks Fabrication, IOP Conf. Series: Materials Science and Engineering 374 (2018) 012061 doi:10.1088/1757-899X/374/1/01206

[9]. Vivek Chaudhary and K.S. Gumaste, Effective Utilization of Water Treatment Plant Sludge for Brick Manufacturing, Journal of Civil Engineering and Environmental Technology Print ISSN: 2349-8404; Online ISSN: 2349-879X; Volume 2, Number 3; January-March, 2015 pp. 272-274

Mohammad Aquib, et. al. "Enhanced Sludge Brick." *IOSR Journal of Engineering (IOSRJEN)* 10(5), 2020, pp. 54-57.