International Journal of Scientific Research in Civil Engineering
© 2021 | IJSRCE | Volume 5 | Issue 6 | ISSN : 2456-6667

Experimental Analysis on The EFECT Of Partial Replacement of Cement By Waste Bio Product of Bauxite Residue : A Review

Mohammed Rizwan Raza[1], Ajay Swarup[2]

[1]P.G. Scholar, Department of Civil Engineering, Sri Satya Sai University of Technology and Medical Science, Sehore, Madhya Pradesh, India

[2]Professor, Department of Civil Engineering, Sri Satya Sai University of Technology and Medical Science, Sehore, Madhya Pradesh, India

Article Info
Volume 5, Issue 6
Page Number : 12-21

Publication Issue :
November-December-2021

Article History
Accepted : 01 Nov 2021
Published : 05 Nov 2021

ABSTRACT

An increasing amount of red mud (RM) is being generated globally due to the growth in aluminium production. In general, 0.8 to 1.5 tons of RM can be generated per ton of produced alumina. With the rapid development of the aluminium industry, approximately 1.7 billion tons of RM is generated per year globally. The pH of RM is typically 10.5–12.5 owing to the hydroxide (NaOH) added during aluminium production. The case for reusing red mud is not without challenge – the toxic nature of the mud has served as a barrier to reuse. And while more research is needed, recent studies have brought to light the promising potential for red mud to be reused in a variety of applications within the construction industry. In addition to providing an outlet for mass quantity utilization of red mud, studies have found that in many cases, red mud can even offer improvements to the end product.

In this paper we are presenting review of literatures related to concrete technology and utilization of waste in construction industry.

Keywords: Red mud, Compressive strength test, waste material, concrete technology, concrete, physical properties.

I. INTRODUCTION

Red mud, created by the Bayer cycle, is a mechanical waste acquired during the creation of aluminium for every huge load of alumina created, roughly 1.6 huge a lot of red mud are delivered, and it is assessed that in more than 66 million plenty of this waste is yearly produced round the world. The red mud is usually released into marine or arranged into land dirtying the encircling water, air, and soil, particularly within the spaces where this industry is found. Along these lines, steps should be taken to reuse this loss in an eco-accommodating way. insight of monetary aspects even as natural related issues, tremendous endeavours are done worldwide towards the executives red mud in use, stockpiling and removal. Presently red mud is made nearly at

equivalent mass proportion to metallurgical alumina and is arranged into fixed or unlocked fake impoundments like landfills, prompting significant natural issues. Within the task, an exertion is formed to gauge the strength qualities of the aluminium red mud as fractional trade for concrete in concrete. By supplanting the red mud as a substitution for concrete in rates from 0% to 40% at an enclosed of 10%. To upgrades, the limiting properties of hydrated lime included alongside everything else this study is particularly focused on the compressive strength, split lastingness, flexural strength properties of concrete, which are the important parameters to be studied in concrete production of the varied proportions of raw materials. [15]

This paper presents review of literatures related to concrete technology:

Though various efforts have been made for geotechnical characterization of red mud, but no attempts have been made in the geotechnical characterization of modified/stabilized red mud. But in other branches of engineering and science, few efforts have been made towards the Bioneutralisation of red mud for reducing the alkalinity of red mud. As discussed in the previous chapter, Bioremediation is a technology that utilizes biological activity to reduce or eliminate environmental hazards resulting from the accumulation of toxic chemicals and other hazardous wastes. This chapter discusses the different investigations for effective bioremediation of red mud in different applications in general. Thereafter, specific literature pertaining to bioremediation application is presented. The literature pertaining to geotechnical investigation on red mud is also presented at the end. The section presents the work of examines the likelihood of supplanting Portland cement with red mud. As a result of putting away the issue, the waste contrarily influences the earth. To tackle this issue, Portland cement was supplanted with up to 40% of red mud by the weight of cement. The properties of the concrete, like compressive, tensile and flexural strength of red mud concrete were evaluated by different researchers and their research is summarized below

II. LITERATURE SURVEY

Kim Hyeok-Jung et al (2018) research paper investigated efflorescence characteristics in pavement containing red mud which can be affected by strong alkaline through various tests such as compressive strength, porosity, absorption, efflorescence area, alkali leaching content, and properties of the efflorescence compound.

The compressive strength of pavement was evaluated to be higher over 15.0 MPa in all cases regardless of replacement ratio of red-mud and binder type, which can provide a reasonable strength for walking and bike lanes. The pavement with red mud was applicable to parking lots only when the replacement ratio of red mud is within 10%. The efflorescence area increased with a higher replacement ratio of red mud and its propagation appeared though the efflorescence was removed through evaporation of moisture. The result further stated that the area of efflorescence gradually decreased with the repetition of the test.

Ramesh R. Rathod et al (2013) the aim of the research work was to investigate the possibility of replacing the Portland cement by red mud. Because of storing issues, the waste negatively affects the environment. To solve this problem, Portland cement was replaced up to 40 % RM by wt of cement. And evaluating its compressive and splitting tensile strength of red mud concrete. This study examines the effects of red mud on the properties of hardened concrete.

Results stated that with increase in red mud content their decreases the compressive as well as tensile strength of concrete. Optimum percentage of the replacement of cement by weight is found to be 25%. By this replacement results were nearly equal to the results of controlled concrete. Concrete prepared by

using red mud is suitable in ornamental works and gives aesthetically pleasant appearance. Workability of concrete may get affected with increase of red mud but it can be improved by adding superplastcizers.

Kedar S. Shinge et al (2015) parent objective of the research was to suggest possible percentage of use of red mud and rice husk ash along with cement which will help to reduce the cement consumption in construction industry. Red mud and rice husk ash was used in partial qunatitites with the cement in mortar. With the ambit of the mechanical strength of the cement, the compressive, tensile and flexure behavior of the mortar specimens was investigated.

10% replacement of the red mud for cement was possible from compressive, tensile and flexural strength point of view with a littile compromising in compressive strength. However, from compressive strength point of view, rice husk ash was best alternative materials for replacement of cement in moratar and can be used upto 10% to 15 %. Morever, tensile and flexural strength reduced to some extent even for 5% rice husk quantity.

P.Ashok and M.P. Suresh kumar (2019) the objective of the research paper was to identify various industrial wastes suitable for utilization in cement manufacture and investigate it Physico-chemical and mineralogical characterization. Such industrial solid waste can be compatible as raw material/blending material/ admixture. Therefore, red mud was investigated for its suitability in construction industry.Five test groups were constituted with the replacement percentages 0%, 5%, 10%, 15%, 20% of red mud and 5% of hydrated lime with cement in each series. To achieve Pozzolanic property of red mud, hydrated lime was added.

Results after testing of 5 blended cement samples (5% to 25 % replacement of Cement by NRM) with an increment of 5 %, stated that the optimum use of NRM is 15% as a partial replacement of cement by NRM. The cost of M 30 grade NRM Concrete (i.e. 15 % Replacement) was around 7.48 % less than the Conventional Concrete, with an increase upto 21.712 % in the 28 days Compressive strength. The percentage economy increased with the increase in the grade of concrete but at the same time there was a reduction in the percentage increase in the Compressive Strength. The optimum utilization of Neutralized Red Mud in concrete was 15 % as a partial replacement of cement by NRM. Red mud can be effectively used as replacement material for cement and replacement enables the large utilization of waste product. Red mud did not effect of the cement properties, rather improved the cement quality by way reducing the setting time & improved compressive strength.

Mahin Sha O B et al (2016) in the research paper, physical properties of blended cement (Portland cement replaced by 0%, 5%, 10%, 15%, 20% & 25%) red mud with constant water ratio concrete design mix of grade M25 was prepared and design mix was investigated for Compressive strength.

For each percentage replacement up to 20% the compressive strength values of the red mud concrete coincide with that of conventional concrete. But beyond 20% there was a reduction in the strength of conventional concrete. Results stated that an increase in red mud content(greater than 20%) decreases the compressive strength as well as the tensile strength of concrete. The optimum percentage of the replacement of cement by weight is found to be 20%. By this replacement results got are nearly equal to the results of conventional concrete. The conclusion stated that the optimum utilization of Red mud in concrete was 20% as a partial replacement of cement. This study concludes that Red mud can be innovative supplementary cementitious materials but judicious decisions must be taken by expert engineers.

N.K. Mhaisgawl et al (2021) aim of paper was to investigate the chance of partially replacing Portland

cement in concrete with red mud and evaluating its compressive and splitting tensile strength. Five experimental groups were comprised with the substitution rates 0% To 40% of red mud and 5% of hydrated lime with concrete in every arrangement in concrete.

Results concluded that Red Mud within the range 0%, 5%, 10%, 15%, 20% as a replacement can simply achieve the characteristics of concrete. Use a mixture of red mud & cement for nonstructural work. there's the future scope for the utilization of red mud concrete from a structural point of view.

Supriya Kulkarni (2018) The objective of this study is to investigate a green alternate material for conventional concrete using geo-polymerization of industrial wastes. In this study geopolymer concrete using Red mud, Fly ash and Ground Granulated Blast Furnace Slag (GGBFS) was tested for various physical and mechanical properties. The properties that were tested include water absorption, compressive strength, flexural strength, tensile splitting strength.

Experimental results concluded that geopolymerization of red mud, fly ash and GGBFS can be used as a sustainable alternative material for conventional concrete. Compressive strength of geopolymer concrete is found to be 89.4% of conventional concrete. Split tensile strength of geopolymer concrete is found to be 84.26% of conventional concrete. Flexural strength of geopolymer concrete is found to be 81.21% of conventional concrete. Water absorption of geopolymer concrete is found to be greater than of conventional concrete. Heance, the results indicates that the geo-polymerization of industrial wastes can be a good and sustainable alternative to conventional concrete.

Gowsalya. R and Bhagyalakshmi. A (2015) in the research paper, considering cementitious behaviour of the red mud into account, an experiment was carried out to partially replace the cement by red mud in concrete for different percentages (0%, 5%, 10%, 15%, 20%, 25%) and also its effects on the strength and other properties of the concrete was investigated by compressive strength, split tensile strength for M30 grade concrete.

Results stated that an increase in red mud content decreases the compressive, as well as tensile strength of concrete Optimum percentage of the replacement of cement by weight, is found to be 20%. By this replacement results got are nearly equal to the results of controlled concrete. Workability of concrete may get affected with an increase of red mud but it can be improved by adding superplastcizers. The decrease in initial setting time at 5% and 10% may be due to the light weight of neutralized red mud and finer particles of mud which fills the voids of the cement by which there may be increase in the density of the mix.

Nevin Koshy et al (2019) the research paper explored the use of two untreated industrial wastes, Class-F fly ash and red mud, for synthesizing geopolymeric material at ambient synthesis conditions. The high alkalinity present in the red mud was exploited for the dissolution of silica in the fly ash and red mud. The mechanical, mineralogical, microstructural, and pore characteristics were analyzed and the contributions of curing period, Si/Al, Na/Al, and liquid-to-solid (L/S) ratios on the compressive strength of the end products was investigated.

The strength of the end products synthesized under ambient conditions using fly ash and red mud, without the addition of alkali such as NaOH, continues to increase significantly from 7 to 28 days with UCS = 6.19 MPa after 28 days. The stiffness increases with the increase in the curing time and there is a transition from ductile to brittle behavior with the increase in both fly ash content as well as curing time. For the same synthesis conditions, a higher quantity of fly ash with same amount of red

mud yields better strength and stiffness values as seen by E = 0.63 GPa at 28 days. The amount of fly ash affects the formation and distribution of various types of pores in the geo-polymeric matrix, wherein a high starting Si/Al ratio gives rise to interstitial pores in the final geo-polymeric matrix. For a curing period of 7 days, the end product showed 6.6 MPa at L/S of 0.35. Results conlcuded that the unconfined compressive strength of the end products and the L/S ratio follow an inverse exponential relationship similar to the porosity characteristics, and the minimum L/S ratio of 0.35 was found to be optimum for obtaining higher strength fly ash–red mud-based aluminosilicates materials with lesser porosity.

Tejaswini. C and Anupama Natesh (2019) the project made an effort to assess the strength characteristics of the aluminum red mud as partial replacement for cement in concrete. Specimens were prepared by adding the red mud as replacement for cement in percentages from 0% to 60% at an internal of 10%. To enhances the binding properties hydrated lime of 5% was added to the mix.

The test consequences of fresh properties that affinity to water increments with the increasing the amount of red mud. This expansion in demand of water was expected to the way that the red mud being marginally lighter in weight has better particles and possesses more volume which need more water for a similar consistency. The incrementing the content of red mud reduces the strength properties of the concrete; however there was possibility of utilizing red mud in concrete in sustainable development. Carbonation rate reduces with the expansion in red mud content. Such results stated that red mud exhibited higher resistivity to corrosion. The addition of red mud makes the concrete resistive to sulphate attack. The optimum content of the red mud replacement was 20%. The use of red md in concrete can be a best option to reduce the environmental pollution and the reduction of carbon foot print by the construction industry.

D. V. Ribeiro and M. R. Morelli (2011) aim of the research was to investigate the possibility of adding red mud, an alkaline leaching waste that is obtained from bauxite during the Bayer process for alumina production, in the raw meal of Portland cement mortars. The properties of Portland cement mortars incorporating high amounts of red mud was evaluated: pH variation, fresh (setting time, workability or normal consistency and water retention), and hardened state (mechanical strength, capillary water absorption, density and apparent porosity).

The addition of red mud promotes an increase of pH of fresh paste due to a higher concentration of hydroxyl ions (OH-), from the sodium and aluminium hydroxides detected in the red mud. The mortar workability considerably reduced by adding the red mud. Moreover, water retention is reasonably increased. These two phenomena occur due to the high fineness of red mud particles, which require greater amount of water for wetting and kneading. The red mud addition promotes an initial increase of density and axial compressive mechanical strength of the mortar, while sorptivity tends to diminish. This is due to a better packing (filler effect). Above a certain level (15- 20 wt% mud) the behaviour is reserved, due to extra difficulties in moulding and shaping the samples caused by the loose of workability.

Kusum Deelwal et al (2014) the research paper described the characteristic properties of Red Mud and possible use as a geotechnical material. Basics properties like Specific gravity, Particle size distribution, Atter Berg's limit, OMC and MDD are determined. Engineering properties like shear strength, permeability and CBR values are also determined in conformity with the Indian Standard Code and test results are discussed in geotechnical point of view. It revealed that the behavior of red

mud is likely as clay soil with considerably high strength compared to conventional clay soil.

Specific gravity of the red mud is 3.04 which is very high compared to the soil solids. So the density of red mud will be more and so the strength is more. From the Atter berg's limits it was concluded that the plasticity Index of the red mud is13.2. So, according to the IS classification based on plasticity A-line, the soil falls under ML. Means it was silt with low compressibility. The maximum dry density and optimum moisture content of the red mud was 1.53gm/cc and 33.5% Respectively Co-efficient of permeability of red mud was 5.786e-7cm/s which shows that permeability is very low. Low permeable materials can be used for construction of earthen dams, road embankments etc. The cohesive strength and the angle of shear resistance obtained from the triaxial test are 0.123kg/cm2 and 26.80. The strength value of the red mud is higher than the conventional clay material. CBR value of the red mud in soaked condition was 4.2% which was greater than the 3%, so it can be use the red mud as a road material in village side.

Sara Ahmed et al (2020) the research paper presented the effect of composition optimization and Nano-strengthening on the properties of a binder based on Red Mud (RM). Thermal analysis, settling time test and compressive strength test was conducted in the samples. In the later stages, XRD spectra analysis, FTIR spectra analysis, SEM morphology analysis and SEM-EDX analysis was done for micron investigation of the test samples. Experimental study intended to synthesize a kind of geopolymer binder using RM as primary solid source which was thermally activated by NaOH and mixed with sodium silicate. In addition, composition optimization and Nano-SiO2 were used to improve the binder properties.

Modifying the chemical compositions of RM has a close relationship with the geopolymer binder specifications. Increasing SiO2/Al2O3 was found to increase the compressive strength while decreasing Na2O/Al2O3 could improve the workability. The W/S ratio has a significant effect on compressive strength and setting time. The ATA process improved the RM properties and created an alkaline environment that helped decomposing of aluminosilicate and stimulated the emerging of some mineral phases such as Larnite, Hatrurite and Sodium Magnesium Aluminium Silicate which could be key phases in forming the binder. The samples with high strength showed a greater decline in the intensity of these minerals, indicating formation of more binder gel. The addition of 1.0% of Nano-SiO2 adversely affected the strength of the binder. Increasing Nano-SiO2 content may cause an increase of the positive charges unbalanced by alkaline, leading to a reduction in compressive strength, this may can be solved by raising the ratio of alkaline in the mixture. Moreover, all samples were suffered from eorescence due to the release of an estimated amount of alkalis, confirming the reason for non-reacted silicate ions especially for samples with 1.0% of Nano-SiO2.

Jaspal Singh (2019) the research paper recapitulated the investigation on utilization of red mud as partial replacement of cement and its effect on mechanical and durability properties in mortar and concrete.

The conclusion stated that red mud generated in the production of alumina is a worldwide problem as it creates a nuisance. The production of red mud in India is more than 4 million tonnes while in world, it is 120 million tonnes. By partially replacing cement with red mud, problem of surface and ground water pollution can be reduced to a great extent. 2. The properties of red mud are analogous to the properties of cement, hence it can be effectively used as a partial replacement for cement which in turn decreases the production of cement followed by the subsequent decrease in the CO2 emissions. Compressive strength, tensile strength and flexural strength of red mud mortar/concrete goes on increasing up to 20% of red

mud used for the partial replacement of cement and then it is decreased. Hence, results stated that the optimum percentage of red mud may be recommended as about 20%.

Kaliprasanna Sethy et al (2019) the research paper focused on the effective use and suitability of locally available red mud for the partial replacement with cement for various civil engineering constructions. The red mud percentage for replacement of cement was varied from 0% to 20%. Trials mixtures were prepared to obtain target strength of minimum grade of 20 MPa for the control mixture at 28 days. Five different mixtures (RM00, RM05, RM10, RM15 and RM20) were developed to examine the influence of red mud on concrete mechanical properties. The control mixture (RM00) does not contain red mud. In mixtures RM05, RM10, RM15and RM20, cement content was partially replaced with 5%, 10%, 15% and 20% red mud (by weight) respectively. The binder consists of cement and red mud.

For each percentage replacement up to 10% the compressive strength values of the red mud concrete showing greater strength value than conventional concrete. But beyond 10% there was reduction in the strength of conventional concrete. Replacement up to 15% the compressive strength values of the red mud concrete coincides with that of conventional concrete. But beyond 10% there is a reduction in the strength value of the concrete. Optimum percentage of the replacement of cement by weight is found to be 10%. By this replacement obtained results were greater than to the results of conventional concrete.

Rameez Ahmad Mantoo et al (2021) the research paper aim was to investigate the use of red mud in road construction as sub grade. All other necessary properties of the soil sample have been determined in the laboratory such as consistency limits, specific gravity, grain size distribution compaction characteristics and CBR value in accordance with Bureau of Indian standards (BIS) specifications. CBR value is one of the important parameters which indicates the strength of soil sub base of road pavement.

Red mud is widely available in Chittorgarh. IRC 37 – 2012 provides guidelines for design of flexible pavements. As per the guidelines, the soil forming the subgrade should have a minimum CBR of 8% for roads having traffic of 450 commercial vehicles per day or higher. From the California bearing ration test of the soil sample is 37.03%, which meet the required specification. So, it was concluded that red mud can be used in road construction as subgrade.

Collin G. Joseph et al (2020) research paper reviewed the current efforts made in the utilization of red mud as a valuable industrial by-product, which in turn should minimize its harmful impact on the environment. This detailed review compiles and highlights a variety of novel applications of modified red mud as a coagulant, an adsorbent for wastewater treatment, as well as, its use in catalytic processes and in building materials. The physico-chemical properties of red mud can be tuned by a range of treatment methods including acidification, neutralization and heat treatment. As revealed from the literature reviewed, modifications on red mud for the removal of various types of contaminants have shown promising results. However, further amendment and modifications on red mud are needed to utilize this industrial waste in many other industrial applications.

The hydroxides content in red mud make it highly caustic and current disposal practice in landfills creates ecological problems. Red mud has been observed to be a useful by-product for the removal of various types of metal ions, inorganic ions, and dye molecules from wastewater, however, fewer studies have focused on the removal of phenols and other organic water contaminants. It is a well-known fact that the red mud works far superior for pollutants

removal if it is first activated with acids, CO2, H2O2 and by calcination at high temperatures. The modifications of unprocessed red mud with strong acids or heat treatment below 700ºC have been found to remarkably enhance the sorption capacities in numerous studies. Among different parameters, pH is an essential factor influencing the sorption process. There are still a few issues that need more consideration, such as improvement of sorption limit through alteration and assessment of sorbent for multi-component pollutants.

Ahmed Abdelazim Khalifa et al (2021) Red mud (RM), the by-product generated during the alumina extraction process, is considered a valuable secondary raw material, since iron (20–54%) represents its major constituent. Accordingly, the suitability of recycling this RM in the sintering process of Egyptian iron ore was studied. The effect of adding different amounts of RM to the sinter charge mixture (0–10 wt.%) on the sintering process performance as well as the chemical, physical and mechanical properties of the produced sinter was investigated. The results revealed that increasing the amount of red mud in the sinter charge mixture leads to a high improvement in the strength of the produced sinter till reaching a maximum at 7% addition, which deteriorates thereafter. Meanwhile, owing to the fine nature of the red mud, increasing its contents in the sinter charge mixture leads to reduced speed of the sintering process, which consequently affects the productivity at the blast furnace yard. The sinter produced with the addition of 3% red mud shows the highest reducibility. These results indicate the suitability of recycling RM in the Egyptian iron ore sintering process with an amount not higher than 3 wt.% of the total sinter mixture charge.

Lihua Wang (2020) the research paper conducted experiment configuration based on red mud iron tailings, mixed with desulfurization gypsum, lime, cement, activator new cementitious materials and analyzed the interaction mechanism of coagulant admixture for iron tailings from red mud separation, and determines the optimal proportion of coagulant admixture through experimental analysis. Then, the whole tailings are used as aggregate and new cementitious materials are added to prepare filling materials. The influence of cement sand ratio and mass concentration on the bleeding rate, fluidity and compressive strength of filling materials is analyzed through experimental study. According to the relevant engineering requirements and the analysis of relevant experimental data, the final configuration of paste filling slurry is determined.

According to the experimental data, when the mortar ratio is 1:3 and the mass concentration is 68%, the fluidity of the filling slurry is 280mm, the bleeding rate is 2.8%, and the uniaxial compressive strength of 8h is 0.15MPa, 3d The uniaxial compressive strength is 1.9MPa, the uniaxial compressive strength of 7d is 3.0MPa, and the uniaxial compressive strength of 28d is 5.2MPa, which meets the relevant engineering requirements. Through comprehensive consideration, the performance index of the filler slurry is finally determined: mortar ratio 1: 3. The mass concentration is 68%.

III.CONCLUSION

- Red mud concrete can be utilized for structural work with a mix of various proportion where compressive strength is to be determine
- There is future scope for the use of red mud concrete from a structural point of view. Concrete prepared by using red mud is suitable in ornamental works and gives an aesthetically pleasing appearance. Used for road construction as an embankment landfill is an attractive option with a high potential for large volume reuse.

IV. REFERENCES

[1]. Kim Hyeok-Jung, Suk-Pyo Kang, and Gyeong-Cheol Choe, [Effect of Red Mud Content on Strength and Efflorescence in Pavement using Alkali-Activated Slag Cement], International Journal of Concrete Structures and Materials, ISSN 1976-0485 / eISSN 2234-1315, 2018.

[2]. Ramesh R. Rathod, Nagesh T.Suryawanshi and Pravin D. Memade, [Evaluation of the properties of Red Mud Concrete], IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), ISSN: 2278-1684, PP: 31-34, 2013.

[3]. Kedar S. Shinge, Bhagyashree B. Warad, Shreyans B. Rathod and Sandeep S. Pendhari, [PARTIAL REPLACEMENT OF CEMENT IN MORTAR BY USING RED MUD AND RICE HUSK ASH], International Journal of Scientific & Engineering Research, Volume 6, Issue 9, September-2015, ISSN 2229-5518.

[4]. P.Ashok and M.P.Sureshkumar, [Experimental Studies On Concrete Utilising Red Mud As A Partial Replacement Of Cement With Hydrated Lime], IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), 2019.

[5]. Mahin Sha O B, Remya C P, Salja P A and Shifal K S, [RED MUD CONCRETE], International Research Journal of Engineering and Technology (IRJET), Volume: 03 Issue: 04 | April-2016.

[6]. N.K. Mhaisgawl, Rohit Bhosle, Aniket Sakhare and Duryaab Danish H Wali, [Study of Concrete Strength Parameters using Red Mud as Partial Replacement of Cement with Hydrated Lime], INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN TECHNOLOGY, Volume 7 Issue 12 | ISSN: 2349-6002, 2021.

[7]. Supriya Kulkarni, [Experimental Study on Red Mud, Fly Ash and GGBFS based Geopolymer Concrete], International Journal of Engineering Research & Technology (IJERT), ISSN: 2278-0181, Vol. 7 Issue 12, December-2018.

[8]. Gowsalya. R and Bhagyalakshmi. A, [Experimental Study on Partial Replacement of Cement by Red Mud], International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181, Special Issue - 2015.

[9]. Nevin Koshy, Kunga Dondrob, Liming Hu, Qingbo Wen and Jay N. Meegoda, [Mechanical Properties of Geopolymers Synthesized from Fly Ash and Red Mud under Ambient Conditions], Crystals 2019.

[10]. Tejaswini. C and Anupama Natesh, [Study and Analysis of Concrete Strength Parameters Using Red Mud as Partial Replacement of Binder Content with and without Hydrated Lime], International Journal of Science and Research (IJSR) ISSN: 2319-7064, Volume 8 Issue 7, July 2019.

[11]. D. V. Ribeiro and M. R. Morelli, [USE OF RED MUD AS ADDITION FOR PORTLAND CEMENT MORTARS], 55º Congresso Brasileiro de Cerâmica, 29 de maio a 01 de junho de 2011, Porto de Galinhas, PE, Brasil.

[12]. Kusum Deelwal, Kishan Dharavath and Mukul Kulshreshtha, [EVALUATION OF CHARACTERISTIC PROPERTIES OF RED MUD FOR POSSIBLE USE AS A GEOTECHNICAL MATERIAL IN CIVIL CONSTRUCTION], International Journal of Advances in Engineering & Technology, July, 2014, Vol. 7, Issue 3, pp. 1053-1059.

[13]. Sara Ahmed, Tao Meng and Mazahir Taha, [Utilization of red mud for producing a high strength binder by composition optimization and nano strengthening], Nanotechnology Reviews 2020; 9:396–409.

[14]. Jaspal Singh, [Effect of red mud as cement replacement on the properties of concrete], International Journal of Innovations in

Engineering and Technology (IJIET), ISSN: 2319-1058, Volume 15 Issue 1 December 2019.

[15]. Kaliprasanna Sethy, Rajesh Ku. Sitha, Swati Barpanda and Bishal Ranjan Bhoi, [Experimental Investigation of Strength Properties of Red Mud Concrete], AIP Conference Proceedings 2158, 020015 (2019).

[16]. Rameez Ahmad Mantoo, Dr. Esar Ahmad and Govind Singh Chauhan, [A Study on Use of Red Mud as Sub-Grade in Road Construction], International Journal of Engineering Research & Technology (IJERT), ISSN: 2278-0181, Vol. 10 Issue 07, July-2021.

[17]. Collin G. Joseph, Yun Hin Taufiq-Yap, Vigneswar Krishnan and Gianluca Li Puma, [Application of modified red mud in environmentally benign applications: A review paper], Environ. Eng. Res. 2020; 25(6): 795-806.

[18]. Ahmed Abdelazim Khalifa, Vladimir Yurievich Bazhin, Kuskova Yana Vadimovna, Ahmed Abdelrahim and Yasser Momtaz Zaki Ahmed, [Study the Recycling of Red Mud in Iron Ore Sintering Process], Journal of Ecological Engineering 2021, 22(6), 191–201.

[19]. Lihua Wang , Jie Zhang and Gaochao Sun, [Research and analysis of new paste filling material based on red mud iron tailings], E3S Web of Conferences 198, 01017 (2020).

Cite this article as :

Mohammed Rizwan Raza, Ajay Swarup, "Experimental Analysis on The EFECT Of Partial Replacement of Cement By Waste Bio Product of Bauxite Residue : A Review", International Journal of Scientific Research in Civil Engineering (IJSRCE), ISSN : 2456-6667, Volume 5 Issue 6, pp. 12-21, November-December 2021.
URL : https://ijsrce.com/IJSRCE215603