

# Review of Flexural and Fatigue Test on Rigid Pavements Constructed By NRM Concrete

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**Abstract-** *This paper deals with the comparative study of Flexural and Fatigue Test on Rigid Pavements Constructed Partially replacing the Cement by neutralized red mud. During cement, manufacturing process tremendous emission of airborne pollution in form of dust, gases, noise & vibrations takes place, which damages Environment and the excessive amount of CO<sub>2</sub> emissions during cement manufacturing directed in atmosphere causes the global warming. Therefore, there is, need to find the replacement of the Cement. Massive amount of red mud obtained from Bayer's process during the production of alumina. The huge quantity of red mud production require a safe disposal and large areas for disposal. This red mud creates environmental problems as well as the deposing cost the red mud is also high and very much difficult. So that, we decided that using the red mud as a replacement to the cement. It is much needed for the environment and making the construction cost lesser by using it.*

**Indexed Terms-** *Flexural, Fatigue, rigid pavement, neutralized red mud, cement, Bayer's, CO<sub>2</sub>, environmental problems.*

## I. INTRODUCTION

Development of country depends on the connectivity of important places with adequate road network. As the infrastructure, development is on zenith. In a developing nation like India, the construction and improvement of high quality roads plays an important role. Where roads constitute the most important mode of transportation. From the past few years, the reliance is shifting more on rigid pavements from flexible pavements because of its low maintenance cost, long service life and the smoother riding surface. In the Bayer's process of extraction of alumina from bauxite,

the insoluble product generated after bauxite digestion with sodium hydroxide at elevated temperature and pressure is known as red mud. More than 4 million tons of red mud is generated annually in India only & 70 million tons worldwide. Due to the characteristics of fine particles, high alkalinity (ph. 10–12.5) and trace metal content, enormous quantity of red mud is generated every year posing a very serious environmental and human risk. The huge quantity of red mud production require a safe disposal and it needs large areas of land for disposal and creates environmental problems. The disposal programs and its implementation cost is huge, accounting for about 2% of the alumina price.

According to the various reports, the global Portland cement market will reach 5.2 billion tons by 2020 in terms of volume due to Rapid urbanization. India is the second-largest producer of cement. Which leads to huge demand of cement nowadays, which badly effects on environment. During cement, manufacturing process tremendous emission of airborne pollution in form of dust, gases, noise & vibrations due to machineries & blasting in quarries takes place, which damages the countryside harmfully. In addition, the excessive amount of CO<sub>2</sub> emissions in cement industries directed in atmosphere causes the global warming. To reduce the demand of cement and for the prevention of environment we need to give some replacement for it. Hence, we are partially replacing cement with neutralized red mud.

## II. LITERATURE REVIEW

2.1 M.P. Sureshkumar, S.K. Gowtham (2014)

This study describes utilization of red mud in concrete and reduces its impact on environment. This paper points out that Red mud is a waste obtained from production of alumina using Bayer process the

production of 1-ton alumina generates 1–2 ton of red mud. Thus, the storage of these massive amounts creates economically as well as environmental related issues. This paper is an overview of effective utilization and usage of red mud in concrete and reduces its impact on environment. This paper concludes that the study and experiment have identified the optimum percentage of red mud that can be replaced in concrete to get the high strength by the compression test and split tensile test. From the test results, it is clearly understood that red mud can be replaced on cement for various proportions such as 0, 5, 10, and 15 percentage to the weight of cement. The choice of selecting red mud as a partial replacement material not only increases the strength of concrete, but also protects the environment from red mud impact.

2.2 Pratik Singh Bhardwaj, Sumit Gupta (June 2019)  
Aim of this paper is to investigate the strength characteristics of dry red mud under Laboratory conditions and objective of this work is to study the effects of red mud on properties of concrete of M25 grade and suitability, future scope of red mud in the construction. Various Experiments have been conducted under laboratory condition to assess the strength characteristics of the aluminum red mud. This paper conclude based on the experimental results. The compressive Strength is decreased by increasing the replacement percentage in each set. Finally, the author conclude that red mud can be used as alternative for cement in construction industry with good quality supervision.

2.3 Maneesh Singh. S. N. Upadhyay and P. M. Prasad (1996)  
This paper investigated the Preparation of three varieties of cements aluminoferrite, aluminoferrite and sulfoaluminate. In addition, this paper states that Red mud obtained from HINDALCO (Hindustan Aluminum Corporation) Industries Limited, located in Renukoot, India, contains significant quantities of alumina, iron oxide and silica. Presence of these constituents makes it a suitable ingredient for the preparation of special cements.

Conclusions emerged from the investigations that it is possible to prepare cements having 28-days strength comparable to that of OPC using raw mixes containing

lime + red mud + bauxite or lime + gypsum + red mud + bauxite and obtained high strengths compared to OPC by firing at 1300 C.

2.4 P. Syam Sai and Chandana Suresh.(March 2017)  
This paper contains the research conducted to study the properties of concrete by using red mud as replacement of cement in concrete. This paper points Presence of soda in the red mud which when used in clinker production neutralizes the sulfur content in the pet coke that is used for burning clinker enrooted cement production and adds to the cement's setting characteristics. This paper research focuses on the stability of red mud obtained for construction. This paper concludes that Due to increase in the red mud leads to decrease in the quantity of cement results in increase in the workability of concrete and Red mud did not effect of the cement properties, rather improved the cement quality by way reducing the setting time & improved compressive Strength. Finally Red mud can be effectively used for replacement material of cement and replacement create the large utilization of waste product reducing the impact on environment

2.5 Mr. Amol B. Sawant, Niraj S. Parsekar, Nilesh Sadashiv Mane (Mar 2019)  
This paper states that Red mud is industrial waste obtained as by product from Bayer method of aluminum extraction and covers significance of neutralized red mud over Portland cement by partial replacement of cement up to certain extent. In this paper study results after testing that the cost of M 30 grade NRM Concrete with 15 % Replacement is around 5.81 % which is less than the Conventional Concrete, additional Compressive strength is increased to 21.712 % in the 28 days

2.6 Kuldip Singh, R K Pandey, C S Mishra, A K Rai, Dr Y K Bind.( August 2014)  
The objective of this study paper is to research Unconfined compressive strength, split tensile strength and California bearing ratio of Red mud and Cement Kiln Dust (CKD) mix and to evaluate whether the red mud and Cement Kiln Dust (CKD) mix can be used as a sub base and sub grade material in road construction. This paper concludes that Unconfined Compressive Strength of Red mud with different percentages (2, 4, 6, 8, 10, and 12) of CKD is checked.

Paper further explains addition of higher percentage of CKD has shown higher values up to 8% addition further addition of CKD does not play any vital role in increasing the strength. Moreover, after 28 days curing period the mix has shown maximum values.

2.7 Sanket Bajirao Sutar, D.N.Mudgal , A.V.Karvekar (Dec 2018)

The aim of this research paper to investigate the experimental utilization of Neutralized Red Mud in plain cement concrete. The Portland cement is replaced by 15%, 20% and 25% Neutralized Red Mud in M20 concrete and finally economy analysis is done for optimum percentage. According to the results and analysis obtained there is a slight increase in the Compressive Strength, Flexural Strength and Split Tensile Strength in Concrete mix designs of M20 with the percentage of cement by NRM upto 20 % replacement. Paper further recommends for factor of safety and higher strength the optimum percentage of NRM should be 20% of cement weight in kg.

2.8 K. D. Raithby.

The author highlights that concrete can fail under repeated loading at stresses less than its ultimate static strength has been recognized since the early 1900s. In this study paper some of the conditions which affect the flexural fatigue behavior of typical concrete mixes are discussed which may affect serviceability and repair costs rather than safety.

This paper concludes that Results of simple flexural fatigue tests on three types of concrete including a wide range of moisture conditions and further paper suggest that fatigue behavior reflects closely the behavior under conventional “static” loading.

2.9 Jayant Damodar Supe and Dr. M.K.Gupta. (November-2014)

In this paper, behavior of flexural strength of concrete pavements is studied. Flexural strength is calculated by loading concrete beams and results are determined by standard test methods ASTM C 78 (third point load). This Study paper concludes that during initial stages there is high gain of flexural strength of concrete. After knowing suitability of demolished concrete waste in fresh concrete deposits of demolished concrete are reduced and new exaction of

new is minimized. Which reduces harmful impact on environment.

2.10 Suresh Kumar K.S, Kamalakara G.K., Sagar Kamble, Amarnath( November 2012)

This paper studies the fatigue strength of High Performance Cement Concretes subjected to flexural loading. Cement concrete pavements are designed for flexural fatigue loading due to traffic. After the test the data obtained S-N curves are developed using linear regression models. From the experimental studies carried out, the number of repetitions to failure is determined for three stress levels. Prisms of size 100 mm x 100 mm x 500 mm are casted and static flexural strength tests conducted to determine the static failure loads on the specimen. The model developed in this study can be used for estimating the cumulative fatigue life while considering high performance cement concrete pavements.

## CONCLUSION

So we conclude that, the Neutralized red mud can be used as a construction material as a partially replacement of the cement in construction of rigid pavement. That will help making Eco-friendly Roads and conserves resources, which lead to a safe sustainable and economical Construction. As per the research papers we will further cast the concrete blocks and beams 0%, 5%, 10%, 15% and 20% replacement of Cement by Neutralized red mud as per the requirement and various tests as well as flexural and fatigue Test will be conducted after curing period of 7 days and 28 days.

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