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Case Study For Use of Laterite as Additive in Kilns for Cement Manufacturing

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Abstract: Laterite is a soil and rock type rich in iron and aluminium, and is commonly considered to have formed in hot and wet tropical areas. Nearly all laterites are of rusty-red coloration, because of high iron oxide content. They develop by intensive and long-lasting weathering of the underlying parent rock. Tropical weathering (laterization) is a prolonged process of chemical weathering which produces a wide variety in the thickness, grade, chemistry and ore mineralogy of the resulting soils. The majority of the land area containing laterites is between the tropics of Cancer and Capricorn.

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I. INTRODUCTION

Laterite is a soil and rock type rich in iron and aluminium, and is commonly considered to have formed in hot and wet tropical areas. Nearly all laterites are of rusty-red coloration, because of high iron oxide content. They develop by intensive and long-lasting weathering of the underlying parent rock. Tropical weathering (laterization) is a prolonged process of chemical weathering which produces a wide variety in the thickness, grade, chemistry and ore mineralogy of the resulting soils. The majority of the land area containing laterites is between the tropics of Cancer and Capricorn.

Laterite has commonly been referred to as a soil type as well as being a rock type. This and further variation in the modes of conceptualizing about laterite (e.g. also as a complete weathering profile or theory about weathering) has led to calls for the term to be abandoned altogether. At least a few researchers specializing in regolith development have considered that hopeless confusion has evolved around the name. There is no likelihood, however, that the name will ever be abandoned; for material that looks highly similar to the Indian laterite occurs abundantly worldwide, and it is reasonable to call such material laterite.

Historically, laterite was cut into brick-like shapes and used in monument-building. After 1000 CE, construction at Angkor Wat and other southeast Asian sites changed to rectangular temple enclosures made of laterite, brick and stone. Since the mid-1970s, some trial sections of bituminous-surfaced, low-volume roads have used laterite in place of stone as a base course. Thick laterite layers are porous and slightly permeable

Structure, Composition and Properties of Laterite

Laterites vary greatly in structure, but can be reduced to the following three structural patterns:

(a) The indurated elements form a continuous, coherent skeleton;

(b) The indurated elements are free concretions or nodules in an earthy matrix;

(c) The indurated elements cement pre-existing materials.

These structural patterns exhibit great variability in relation to the shape and size of the elements involved and the degree of induration. The degree of hardness ranges from products that are practically unconsolidated and scarcely coherent to the hardest blocks which can be broken only with a hammer. Induration is an empirical criterion, as it is impossible to give quantitative expressions to any character related to the mechanical properties of the material. The usual definition of induration is a state in which the hard brittle consistency of the medium is not affected by humidity. Induration, which involves the precipitation of goethite in a reticular network, is influenced by composition and the extent of crystallization of the components in the soil: the higher the sesquioxide content, the greater the induration. In other words, hardness increases as the iron content increases; the hardest laterites are also the least hydrated [1,4].

Laterites vary in color, but are usually brightly colored. The shades most frequently encountered are pink, ochre, red and brown; however, some occurrences are mottled and streaked with violet, and others exhibit green marbling. A single sample may exhibit a whole range of colors merging more or less perceptibly into one another in a variety of patterns and forms. Laterites owe their color to iron oxides in various states of hydration and sometimes also to manganese [1]. Their mineralogy generally involves quartz, kaolinite, hematite, goethite [3,5,6], and sometime maghemite. Kaolinite is always present with iron oxides.

The physical properties of lateritic soil vary according to the mineralogical composition and particle size distribution of the soil. The granulometry can vary from very fine to gravel according to its origin, thus influencing geotechnical properties such as plasticity and compressive strength. One of the main advantages of lateritic material is that it does not readily swell with water.

II. PROPOSED WORK

Use of Laterite instead of iron ore to achieve the following

1. Cost reduction of Raw material by replacing Iron ore & Bauxite
2. Grinding cost reduction
3. Reducing in Transportation cost
4. Reduction in Diesel consumption
5. Reducing carbon footprints

Methodology

This study is to be carried out for Chanda cement works, a cement manufacturing unit of ACC LIMITED.

The existing raw materials like iron ore & bauxite will be checked against various parameters to deliver the results as mentioned in the proposed work.

Information of existing additives being used in ACC chanda works cement plant.

A. Additives Used in Cement plant for production of clinker

1. Iron ore – specification Fe_2O_3- 65% minimum
2. Bauxite - specification Al_2O_3- 40% minimum

B. Requirement of Additives

1. Iron ore – Monthly 5000- 6000 MTs
2. Bauxite - Monthly 2000 -3000MTs

C. Cost & Distances

Cost of Low grade Iron ore (50% Fe)– Rs 500- 650/MT
Transportation cost – Rs 1300 /MT
Availability- Near Jabalpur Region (550Kms)

Cost of Bauxite (40% Al_2O_3)– Rs 500- 700/MT
Transportation cost – Rs 1500 /MT
Availability- Near katni Region (600Kms)

Information about Laterite that can substitute the existing Additivies.

D. Types of Laterite – that can be used as additives in Kiln for production of Clinker.

1. Iron rich laterite - specification Fe_2O_3- 42- 45% , Al_2O_3 – 10-12%, SiO_2- 20-25%
2. Alumina Rich laterite - specification Fe_2O_3- 30-35% , Al_2O_3 – 14-16%, SiO_2- 25-30%

E. Availability : Jivti region in chandrapur
Distance – 50 Kms
Basic Price of Laterite – 350-400/-
Transportation cost – Approximate – Rs 450/-

III. LITERATURE SURVEY

From Indian Minerals Yearbook 2013
(Part- III : Mineral Reviews) , 52nd Edition - LATERITE

IV. CONSUMPTION

Laterite is used as an additive in cement industry. The industrial end-use consumption of
laterite in 2010-11, 2011-12 and 2012-13 was approximately 3.74 million tonnes, 3.89 million
tonnes and 4.02 million tonnes, respectively.
Other consuming sectors are building construction and road metal.

V. FUTURE OUTLOOK

Though vast resources of laterite are available in India, systematic exploration and estimation of resources need to be taken up.
There seems to be no major change in the enduse pattern of laterite. The consumption of laterite in cement has increased due to increased demand of cement in the country. In future, laterite could be used as a source of metallic minerals like iron, aluminium, chromite and of trace elements like gallium and vanadium.

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