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FEASIBILITY STUDY ON SMALL SCALE PRODUCTION OF BUILDING LIME IN NIGERIA

FOREWORD

A lime mortar has remarkable properties that make it particularly suitable for rendering block walls. Although the rate of gain in strength is low, nevertheless the mortar continues to gain strength and improve with time. More importantly, the lime mortar is resilient and can more easily accommodate differential settlements than a cement mortar. Hence a wall rendered with a lime mortar is usually free of cracks.

Unfortunately lime is only produced locally in very small quantities for private and specific users. Thus a large bulk of lime used locally is imported and is very expensive. The high cost of lime makes it difficult to introduce lime mortars into the building industry. Further more, with the increasing cost of cement, there is an additional incentive to consider the use of alternative binders. Accordingly the Nigerian Building and Road Research Institute undertook the lime project.

This report describes the preliminary investigation into the manufacture of lime in Nigeria. The report gives useful data on the distribution of limestone deposits in the country, methods of manufacturing lime and describes a low capacity vertical shaft kiln for manufacturing building lime at a small scale. Entrepreneurs interested in the manufacture of building lime will find this report most useful.

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ABSTRACT

The paper reviews the types and occurrence of Limestone in Nigeria. Calcination of Limestone and hydration of quick-lime are discussed. Method of manufacture of lime including the detailed procedures of loading and firing have been given. Limestones from Nkalagu, Sokoto and Ewekoro were chemically analysed and the strength and other properties of hydrated lime produced from Nkalagu limestone were investigated.

A 2.5 tonne capacity vertical shaft kiln was designed for construction at the permanent site of the Institute in Ota, Ogun State to further investigate the cottage production of lime on a pilot plant scale.

1. INTRODUCTION

Before the advent of portland cement, lime was the principal cementitious material used for construction purposes in many parts of the world. It was largely used for plastering, white washing, soil stabilization and in the manufacture of sand lime bricks. In addition to its use in the building industry, the chemical grade of lime is used by many industries such as sugar, paper, rubber, ceramics, glass, water treatment plants, iron and steel industries, pharmaceutical and many other chemical industries. However, in Nigeria its production and use in the building industry has practically been non-existent. There are two reasons: firstly, lime is imported and therefore expensive and secondly, portland cement gives high and early strength as compared to lime.

The ambitious housing programmes and shortage of portland cement in recent years have compelled most developing nations to give serious consideration to finding alternative materials to cement. With the present production of 3.5 million tonnes of portland cement in the country, it is very difficult to meet domestic requirements estimated at 7 to 8 million tonnes. Nigeria is endowed with massive deposits of good quality limestone, the basic raw material for the manufacture of lime. Many valuable surveys had been carried out in the past to locate limestone deposits in the country to set up cement plants (1). No consideration was ever given for the production of lime. However, with the present foreign exchange difficulties, the production of lime cannot be ignored. Lime has an important role in the building industry in respect of minimising the demand for cement and reduction of construction cost.

Lime with cement or pozzolanic materials can be used in building construction in different situations.

Lime possesses better workability and plasticity as compared to cement. It has high water retentive property. Lime mortar exhibits better building properties than cement mortars (2). It possesses autogenous healing properties and shows low shrinkage cracks. Lime can be used in the production of sand-lime (Calcium silicate) bricks.

2. TYPES OF LIMESTONE IN NIGERIA

Limestone occurrence in Nigeria (3) may be grouped into Pre-Cambrian limestone (marble), Cretaceous limestone and Tertiary limestone. The pre-Cambrian marbles are ancient limestone which have been recrystallised by the action of heat and pressure. They usually occur as discrete particles surrounded by gneissic country rock. The larger deposits are white relatively pure marbles. The Cretaceous limestones are sedimentary rocks and non-crystalline limestone and are usually associated with thin shales siltstone and fine-grained sandstones. These are usually hard, grey and shelly. They sometimes have an oolitic texture and are often partly recrystallised. Many contain sandy fractions also. The Tertiary limestone consists of beds containing limestones and marls. They usually consists of soft pale grey or buff, marly materials with lenses or bands of hard limestone interbedded. They contain a variable proportion of clay.

The other type of limestones found in Northern Nigeria is the concretionary limestone "jiglin". Its formation is attributed to the leaching of the calcium carbonate in the form of calcium bicarbonate by rain water from calcareous deposits and subsequent deposition as calcium carbonate around some nucleus upon contact with alkaline soil. Repeated deposition increases the hardness, density and size of the Jiglin.

3. OCCURRENCE OF LIMESTONE IN NIGERIA

Although limestone occurs in almost every state of Nigeria, only a few deposits have been economically utilized. Figure 1, shows the distribution of limestone deposits in Nigeria (4). In general, they are found in thin beds in terrain of low relief; thus quarrying is not easy. However, some of these deposits are already being exploited for the manufacture of cement such as Ashaka in Bauchi State, Yandev in Benue State, Sokoto in Sokoto State, Ukpilla in Bendel State, Calabar in Cross River State, Ewekoro and Shagamu in Ogun State and Nkalagu in Anambra State. Other major deposits of limestone and marble which are not yet being exploited for any industrial applications include those in Agala-Igumale and Makurdi areas both in Benue State. These deposits have estimated reserves of 20 to 100 million tonnes of reasonably good quality limestone. Smaller deposits include those near Gombe, Anga, Igbetti, Jakura, Elebu, Kwakuti, Itobe, Igara, Kanawa, Okeluse, Odomoke, Jigalin, Osara, Ubo, Luwa, Taka, Lafia Obugu, and Kalambaina (5).

The occurrence and distribution of limestone in various parts of the country are summarised below (1).

3.1 Benue and Gongola States

The Cretaceous limestone-shale series runs up the plain of the Benue to almost Yola. The whole area from eastwards to Namtari is underlain by limestone shales. Further downstream on the Benue at Kumbrial near Amar, siliceous limestone deposits are found. Small deposits are also found in Igumale and on the bank of Yola river.

A series of limestone and shales is exposed around Arafu and Akwana to the South of Benue. Quantity and quality of limestone in Benue State are good.

3.2 Borno and Bauchi States

Cretaceous limestone outcrops are found on both sides of river Gongola, between Debe Hobe and Nafada and around Mutue and Bularaba in Southern Borno.

In Bauchi, only secondary limestone deposits occur but they are usually small and very gritty. However, near the village Foli, 18km east of Gombe town, small lime kilns have been used to burn residual limestone. Small deposits of Jiglin are also found in Borno State.

3.3 Bendel State.

Two outcrops of calcareous rocks occur in the Osse and Owan rivers. A limestone deposit of good quality has been discovered in the bed and bank of the river Awle on the Agbor - Auchi road, and also along Ubo River Ukpilla limestone is already being used for cement production.

3.4 Cross River State.

Limestone of Cretaceous age is recorded from several localities in this State. At Odukpani on the Calabar river, there is a thick series of sandy limestone. Sandy limestone deposits are also found in north of Odukpani. At Ikpopo Hill between Arochukwu and Ono Ito, there are outcrops of good limestone. On the Akpa Jaja river, east of Calabar on the Cameroon's border, a thin bed of limestone occurs which produces lime of fairly good quality.

3.5 Kwara State.

A number of thin beds of limestone outcrops occur between Bode Sadu and Elebu. It appears to contain magnesium. Smaller deposits of limestone are found around Jakura. Beds of limestone in the precambrian rocks have also been reported in several localities in Kabba where thick bed of crystalline limestone is exposed for about 50 metres along a hill 3km east of Hobe. It is a mixture of dolomitic limestone.

3.6 Kano State.

Deposits of secondary limestone occur in many parts of the State more especially in the east but they are limited in size and are very impure.

3.7 Plateau State.

This State is very poor in limestone, however there are small uneconomic deposits between Agwatashi and Makurdi.