



TOGETHER
for a sustainable future

OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.



TOGETHER
for a sustainable future

DISCLAIMER

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries, or its economic system or degree of development. Designations such as “developed”, “industrialized” and “developing” are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of firm names or commercial products does not constitute an endorsement by UNIDO.

FAIR USE POLICY

Any part of this publication may be quoted and referenced for educational and research purposes without additional permission from UNIDO. However, those who make use of quoting and referencing this publication are requested to follow the Fair Use Policy of giving due credit to UNIDO.

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org



05608



United Nations Industrial Development Organization

Distr.
LIMITED

ID/WG.179/18
19 June 1974

ORIGINAL: ENGLISH

In-Plant Training Workshop on
the Production of Refractories

Pilsen, Czechoslovakia

11-28 June 1974

A SURVEY OF THE REFRACTORY INDUSTRY
IN NIGERIA^{1/}

K. Oniya*

* Federal Ministry of Industries, Lagos, Nigeria.

^{1/}The views and opinions expressed in this paper are those of the author and do not necessarily reflect the views of the secretariat of UNIDO. This document has been reproduced without formal editing.

id.74-4290

We regret that some of the pages in the microfiche copy of this report may not be up to the proper legibility standards, even though the best possible copy was used for preparing the master fiche.

INTRODUCTION

Refractories are ceramic products which can withstand very high temperatures without melting. They are used for lining industrial furnaces, fire boxes and in other locations where they are exposed to severe heating.

A search of contemporary technical literature of Nigerian industries reveals nothing about the early users of refractories in this country. It is known, however, that Nigerian blacksmiths use refractory retorts for casting domestic and agricultural tools such as knives, cutlasses, hoes, chairs, etc. Since Nigeria has joined the world club of industrialisation, different types of industries have been established all over the country. A large number of these industries use refractory bricks in the construction of their kilns and furnaces. Unfortunately, Nigeria still buys all her refractory products from overseas markets. In 1972, Nigeria Trade Summary recorded an import of 7,300 tonnes of refractory bricks valuing N1,026,594 in foreign exchange.

USES

The heating temperature in modern industrial furnaces may be anywhere between 1,000 and 1800°C. To be able to withstand the action of high temperatures without melting, refractoriness is required. A quick survey of Nigerian industries reveal that refractory bricks are used at present by the following categories of manufacturers:-

- (a) Portland Cement: the lining of a rotary kiln has not only to withstand heavy wear due to abrasion but must also be resistant to chemical attack by the cement mix at the high temperatures prevailing in the clinkering zone. Ordinary firebricks are used in the back part of the kiln where temperatures are relatively low, high alumina (over 50% AL_2O_3) bricks or magnesite bricks are used at the burning zone.
- (b) Glassmaking: glass pots used for melting glass is usually lined with fireclay-grog bricks.
- (c) Ceramics: Different types of kilns are used in the ceramic industry for firing pottery, stoneware and refractory goods. The refractories used for construction such kiln is fireclay brick, using low or intermediate-duty brick for heavyclay products kilns and high-heat-duty or super-duty brick for the highest temperature kilns.
- For saggere otherwise known as kiln furniture, fireclay is a popular raw material. Special talc bodies as well as bodies containing alumina and silicon carbide have also been used satisfactorily.
- (d) Foundries: Moulds used for melting scrap iron are made of fireclay.
- (e) Boilers: Refractory tiles or bricks are used for lining steam boilers and fireclay bricks for the construction of industrial chimneys.

- (f) Iron and steel Industry: Recently, a decision was taken by the Federal Military Government to set up an Iron and Steel Industry in the Kwara state of Nigeria where suitable iron ores have been found.

It is necessary that the iron ores have to be melted to effect a chemical change from which metallic pig iron is obtained. It is the pig iron by different processes that is used for the manufacture of iron and steel on which virtually the construction of all materials supplying human comfort is based.

On the other hand, it is practically impossible to produce iron and steel without the aid of a melting furnace. To construct a furnace that will melt iron, a temperature above 1500°C is required. Refractory bricks of different types have been found suitable for lining such furnaces. To be able to operate, the new Iron and Steel Industry will therefore require the following grades of refractory bricks:

- (1) Blast Furnace: Firebricks are the main materials required in the hearth, the bosh, the stack and the stoves. Although modern trend is to use carbon bricks in the hearth to prevent 'breakout' but all the same, firebrick is still popular if the oxidation effect in the hearth does not offer serious problems.
- (2) Cupola: To make cast iron, the pig iron is treated in the foundry cupola. The type of refractory material used in the cupola is fire-clay blocks made to a dense structure by hard pressing or by deairing. Kaolins and suitable fireclays can be found in Nigeria.

- (3) **Open-hearth Furnace:** The pig iron either in solid or molten form is charged into the open-hearth furnace which is a reverberatory type to produce steel. Silica, magnesite and chrome bricks are used in different parts of the furnace. Except the chromite mineral, the other raw materials are available in Nigeria.
- (4) **Bessemer Converter:** This is a furnace in which molten pig iron is converted into steel. Silica brick, sandstone, ganister or mica schist are used for lining this type of furnace. There are large deposits of quartzite and mica schist in Nigeria.
- (5) **Electric Arc Furnace:** The arc furnace is used for melting iron and steel. The roof is usually made of silica brick. Fireclay, kaolin and mullite can also be used. They have the advantage of spalling resistance over silica bricks, Quartzite, fireclay and kaolin can be mined locally.

MARKET SITUATION

Before anything at all can be sold, a market for it must be found. It follows, therefore, that the market assessment of any commodity should be based on the consumer demand as measured in various areas. In the introduction, it was stated that over 7,000 tonnes of refractory bricks were imported in 1972. A potential market capacity of the order of 10,000 tonnes of output per annum may be assumed to exist.

The iron and steel Industry is the largest single consumer of refractory materials.

This industry will soon be established in Nigeria. Expansion of existing cement works, ceramic industry, glass factories and the establishment of new furnace-based industries are anticipated. The market should be so extensive as to be able to absorb refractory products in economic quantities.

AVAILABILITY OF RAW MATERIALS

The large annual import of refractory goods into Nigeria and the prospect of increased demand stimulated the idea of looking into the possibility of local manufacture of refractories. One of the essentials of this exercise is the raw material situation. The Federal Institute of Industrial Research in conjunction with the Iron and Steel Corporation started early in 1973 to investigate the extent to which refractory raw materials occur in Nigeria. Samples of clays and clay minerals were obtained from Geological Survey Department and from State Governments for evaluation. Table I shows some of the raw materials which have been examined.

Table I

Sample	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	CaO	MgO	Loss on Ignition
Jos kaolin	45.94%	37.49%	0.46%	0.02%	0.38	13.86%
Onibode kaolin	54.74	35.52	1.35	-	-	14.10
Bamajo kaolin	56.90	34.75	0.91	-	-	12.00
Minna kaolin	51.64	35.01	0.53	-	-	12.61
Ogbette fireclay	76.05	21.66	0.55	-	-	7.76
Oke-Elefun clay	31.83	35.28	0.36	-	-	13.29
Zaria kyanite	n.d.	n.d.	n.d.	-	-	n.d.
Abokuta quartzite	F	u	r	e		Silica
Burum dolomite	4.07	0.26	0.28	31.02	20.76	43.45

Looking at table, the raw material situation shows that fireclay bricks of moderate heat duty to intermediate heat duty

can be made from local clay deposits. Abeokuta quartzite provides a good raw material for making silica bricks. The kyanite mineral can be used to manufacture sillimanite bricks of good quality. There is a Government plan to import hauxite from Ghana. This can be used for making aluminous bricks. For the basic refractories, magnesia can be produced by treating sea water with limestone. There is no information yet about the occurrence of the mineral chromite in Nigeria. It has, for the time being, to be imported.

WORK DONE BY F.I.I.R.

The Federal Institute of Industrial Research realising the importance of refractory bricks in industrial development, has been investigating the technical feasibility with particular reference to the availability of suitable raw materials. This is done by:

- (a) testing the raw materials and evaluating their physical and chemical characteristics.
- (b) body formulation of different refractory bricks and firing.
- (c) testing of the finished product to British Standards.
- (d) compiling a technical data on raw materials found to be suitable.
- (e) preparing a feasibility report where appropriate.

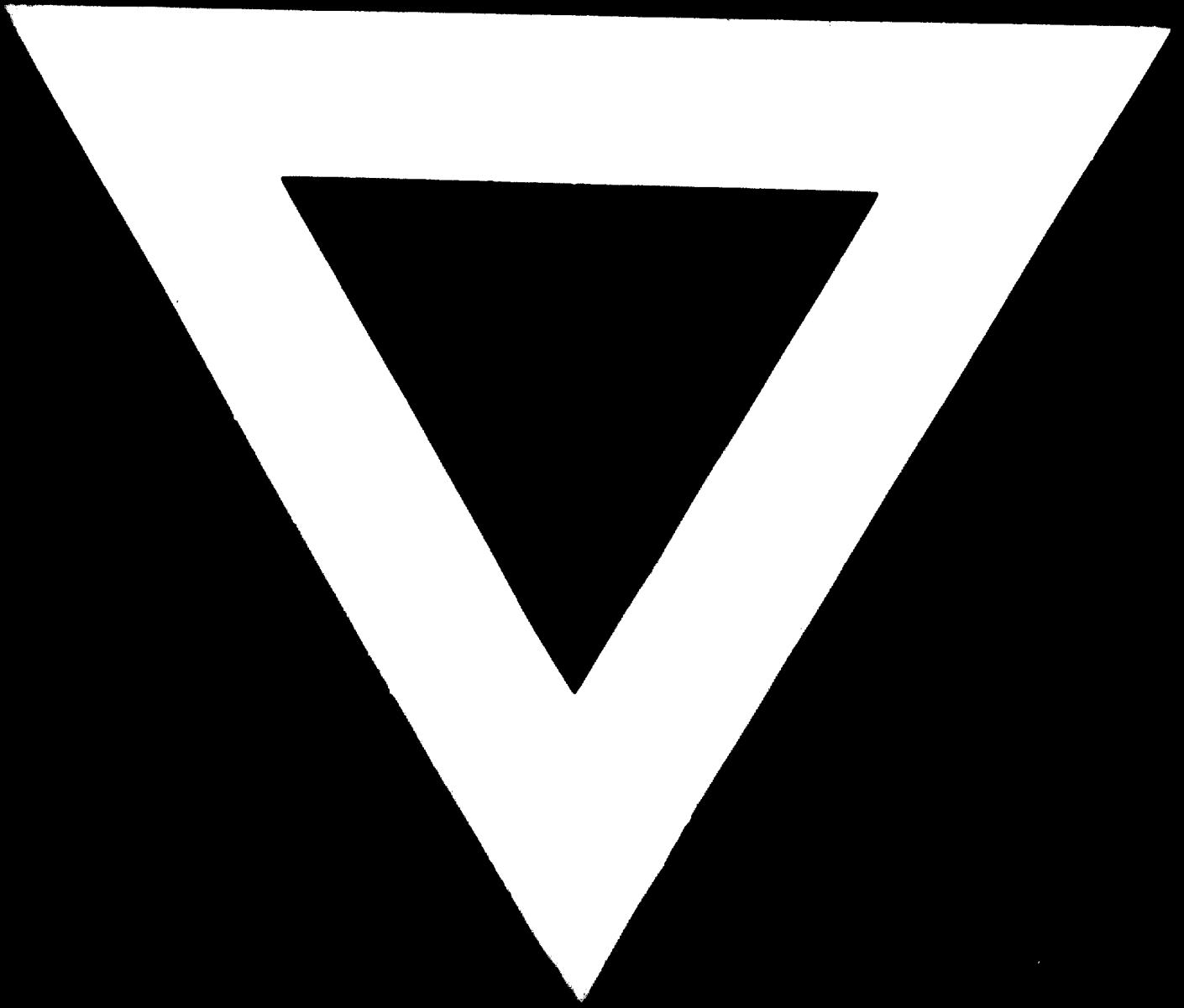
Apart from the formulation of an insulating brick from Nigerian kaolin, work at the moment is on the screening of the raw materials as to their suitabilities for the manufacture of refractory wares.

CONCLUSION

From the spade work which the F.I.I.R. has done and the satisfaction that suitable raw materials for the manufacture of refractory bricks occur in Nigeria, there does not seem to be any difficulty in the establishment of this industry in Nigeria.

There is need, no doubt, to do more research work and to come out at the end with a detailed report on technical and economic feasibilities.





74.09.30