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POTENTIALITIES AND CONSTRAINTS FOR USING POZZOLANAS AS ALTERNATIVE BINDERS IN KENYA

Table of Contents.

1. Introduction.
2. Binders in Kenya.
3. Research Methodology.
4. Rice Husk Ash.
5. Production Procedure.
6. Technical Characteristics.
7. Economic Feasibility.
8. Natural Pozzolanas.
9. Conclusions.
10. Acknowledgements.
11. Bibliography.

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POTENTIALITIES AND CONSTRAINTS FOR USING POZZOLANAS AS ALTERNATIVE BINDERS IN KENYA

A B S T R A C T

Expenditures on Ordinary Portland Cement (OPC), the most widespread binder produced in Kenya, are accounting for a very important cost in the large majority of the residential buildings. After having concentrated on alternatives for walling and roofing materials, the Housing Research and Development Unit of the University of Nairobi has started, with the help of GTZ, to develop alternative binders in order to increase the use of local resources for binders and to reduce the dependency on cement.

In the domain of artificial pozzolanas, Rice Husk Ash (RHA) has been found suitable as an OPC extender. Kenya produces about 10,000 tonnes of rice husks annually. This amount is expected to triple by the end of this decade. Several attempts have already been made to use the husk for animal feed or fuel, but none of these has been implemented yet. Extensive chemical tests and physical experiments reveal that, when properly processed, the ash can replace up to 25% of OPC without losing the strength of the cement mortar. Other characteristics of the RHA binders show better performance than comparable conventional binders. Feasibility calculations further indicate that, depending on the specific conditions of the rice area considered, RHA can be produced at between 20% and 35% of the price of OPC. The cost savings on mortars based on RHA will therefore be important for the consumer. Also on macro-economic level, there will be definite savings on foreign currency since there is no fuel involved in the production process and since the grinding equipment is manufactured locally.

In the field of natural pozzolanas, some five types of volcanic ash, tuffs and diatomite have been compared as to their reactivity, accessibility, workability and other characteristics. Although the reserves of these natural pozzolanas are enormous, their quality and reactivity is much more variable than RHA and the resulting product is more difficult to control.

Using pozzolana binders gives clear advantages in terms of cost and quality of the final building element. However, the hesitant attitude towards any new building product could compromise the whole idea, unless proper marketing strategies are adopted. Production units attached to the rice mills and managed by rice growers cooperatives could be one way of ensuring the viability of the product. Even if the proposed new binders fully succeed to their maximum potential, they will only partly contribute in meeting the increasing demand for binders in Kenya. This can not be solved alone by the setting up of small scale production units at district level, but also requires major investments in the sector of conventional binders.

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1. INTRODUCTION

One of the main fields of action of the Housing Research and Development Unit (HRDU) of the University of Nairobi, is the research, development and dissemination of cost effective building materials for housing in Kenya. After having concentrated mainly on walling (especially stabilized soil blocks) and roofing materials (especially fibre concrete roofing tiles), the HRDU has started up a research component focusing on binders.

The reason behind this is quite evident, knowing that for a typical conventional low income housing unit, the binder is the single most costly building material, occurring in walls (blocks, mortar and plaster), roofs (if cement tiles are used), floors (concrete floor or stabilized floor) and foundations. Cement, which is the most widespread binder in Kenya, is sometimes unnecessarily used for applications where other binders could easily perform the necessary requirements. A cheaper solution for cement would be one of the most cost-effective modifications which could be imagined in terms of building materials for the low-cost bracket of the housing market in Kenya.

Of course, the importance of a new binder largely depends on the availability, variety and the relative costs of existing binders in a region and the prevailing building practice in a certain context. In several countries, the development of cheaper binders has already received considerable attention from research institutes and private entrepreneurs. Different paths have been followed, but the main direction has been the (re-)introduction of lime and pozzolanic materials. The purpose is generally to increase the local production of binders and to reduce the cost of binders while ensuring the same or better quality of the end-product. Within the field of pozzolanic binders, the largest experience has been gathered from experiments with blended cements and lime-pozzolana binders. This direction has also been followed in Kenya, both with natural and artificial pozzolana.

The present paper is mainly concentrating on the technical and economic conditions of producing such binders in Kenya. The information for this paper was collected through :- (a) visits to relevant institutions and companies producing raw materials and waste products, (b) documentation and literature, (c) laboratory test programmes including physical and chemical characteristics of pozzolana, and (d) economic feasibility calculations.

2. BINDERS IN KENYA

PORTLAND CEMENT

Portland Cement is currently produced in Kenya by two factories. East African Portland Cement (EAPC) is located at Athi River and produces a cement consisting of 80% clinker, 15% pozzolana and 5% gypsum. The rated capacity of the factory is 350,000 tonnes per year. Bamburi Portland Cement

Company (BPCC) is located near Mombasa and produces a cement consisting of 95% clinker and 5% gypsum. The rated capacity of the factory is 1,200,000 tonnes per year.

There is a clear imbalance between the location of the cement producers and the location of the consumers. About 35% of the cement is consumed in areas which are between 200 and 400 kms distant from the nearest cement factory.

In view of minimizing transport costs EAPC would normally have to cater for the demand of Nairobi, Central, Rift Valley, Western and Nyanza provinces, representing about 81% of the total market, currently estimated at 1,200,000 tonnes per annum, which is impossible in view of the current capacity of EAPC. A study commissioned by the Kenya Government has concluded that it is impossible to increase the capacity in view of technical, economical and financial reasons. One of the reasons is that the limestone quarry is located at a distance of more than 100 km from the factory.

On the other hand, the BPCC factory (capable of producing 1,200,000 tonnes per year) has a clear over-capacity, in view of the export problems caused by current international price levels. Therefore the surplus of the BPCC is used for supplying parts of Kenya West of Nairobi. However, the BPCC has experienced financial constraints for which the company is citing stiff price controls by the Government as the core of the problem. This however means that this cement has to be transported over between 500 and 1,000 km. So as to prevent the penalization of the distant consumers, the Government controls the selling prices by fixing a standard price per tonne in all towns on the Railway. If one considers the difference in production cost per tonne (1984) between EAPC (KShs 1,030/=) and BPCC (KShs 650/=) it is clear that this difference is utilized to cover the transportation and distribution costs of the BPCC factory.

Below, an overview is given of the local consumption of cement and the consumption per inhabitant in Kenya since 1980 (Table 1) (Ref. 23, Ref. 24, Ref. 25).

Table 1 : Consumption of cement in Kenya (1980-1994).

Year	Consumption (x 1,000 tonnes) EAPC	BPCC	Total	Population Inhabitants	Consumption kg/inhab/year
1980	292	398	691	16,700,000	41.4
1982	299	280	579	18,000,000	32.2
1984	310	236	546	19,600,000	27.9
1986	331	441	772	21,200,000	36.4
1988	322	646	968	23,000,000	42.1
1990			1,178 (*)	24,900,000 (**)	47.3
1992			1,425 (*)	27,000,000 (**)	52.8
1994			1,724 (*)	29,300,000 (**)	58.8

(*) Extrapolations on the basis of an increase of 10% per annum.
(**) Assumed population increase is 4.1% per annum.

Source : Own computations on the basis of Ref. 9.