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PROCESSING AND APPLICATION OF ADVANCED MATERIALS IN KENYA EMPHASIS ON CERAMIC AND SOLAR ENERGY*

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Introduction

Kenya is among the developing countries that have experienced rapid economic growth.

Policy planners have realized that the application of advanced materials is one of the most essential input that will sustain the tempo of economic activities.

In this growth process Kenya has seen growing science based on economic production combined with the impact of radically new generic technologies, such as micro electronics, computers, new materials, and biotechnology. In the field of computers for instance, the first computer was introduced in Kenya in 1961. By 1981 there were 121 mainframes and since then, growth in numbers and change in technology have progressed apace. By 1985 there were 1800 computers of various types and capacities. The introduction of micro-computers in the 1980s, currently numbering over 100, has greatly contributed to the expansion of research activities in several fields of advanced materials.

In the fields of industrial automation systems, such as electronics, interphasing of operations can now be done in industries and other concerns with fairly accurate warning signals. Productive facilities in limited areas of new materials and research activities in materials analysis are ongoing in various public institutions in the country. These include ceramics, materials for solar collectors, geological and biological materials, etc. Accurate state-of-the art picture of application and processing of these materials would, however, be determined by a proper assessment of the use, alternatives and other country-specific details on current and forecast end-use consumption, supply and conversion pathways etc.

Energy

Biomass represents about 75% of the total national energy consumption. The rest of the consumption is met by petroleum products, coal and electricity. The current rate of growth of energy demand is 4.4% per annum. A situation, as the one in Kenya's energy balance, calls for the identification and evaluation of additional options which can held reduce wood fuel and oil dependence and help in solving some shortterm problems. Such opportunities will include solar applications, biogas production, and more refined ceramic based stoves.

Kenya's current five year National Development Plan recognizes that the long-term aim of energy development is to achieve greater self-reliance and intensive energy generation, where appropriate. One of the outstanding objectives of this strategy is the introduction of alternative energy sources to broaden the national energy mix and lessen reliance on imported energy.

It is said that man has been associated with ceramics for more than 200 years. Since then, clay or ceramic science has developed steadily and more applications have been discovered. The scope has now widened from ordinary cooking and water storage pots and vases to electronic and electricity ceramics.

In Kenya, when the fuel crisis became a serious problem, experimentation with ceramics began with the view to improve stoves for domestic cooking and heating. The Kenya Renewable Energy Development Project began its research on stoves through a USAID funding in 1982. The result was the designing, testing and consequent manufacturing of the highly successful stove which came to be known as Kenya Ceramic JIKO (KCJ). Research has been ongoing in this area to further improve the stove and minimize cracking of ceramic liners. Several problems are still being experienced in establishing correct temperatures and chemical composition of delay. The lack of technical expertise to help with preparation and firing of the liners and the various tests required for ceramic materials has hindered more advanced development of this art.

Further scientific development of ceramics into magnetic materials ferro-electrics, nitrides, silicides etc. is still a nascent subject in Kenya. The technological innovation in ceramics in Kenya is still limited to traditional ceramics, comprising of pottery, building materials and refractories. Antique or craft ceramics is practiced by local people whereas more refined ceramics using high technology is applied on porcelain products, hotel ware, tiles and sanitary ware, furnace materials etc. About five firms are currently involved in the manufacture of high technology ceramics. The missing gap is largely due to the limited capacities of assimilating the technologies and the lack of finances required for the development of the materials.

Extensive surveys in Kenya have, however, established the existence of more than 10 million tons of raw materials including koalin, ball clay, silica deposits, feldspar, wollas tonite, limestone, gypsum, bentonite, soda ash, magnesium, talc, chronite, kyanite, and corrundum.

Chemical analyses and physical tests in various laboratories including Kenya Industrial Research and Development Institute (KIRDI) have shown that the raw materials meet the minimum requirements for processing. Sand deposits of grades necessary for the production of optical ware and domestic glassware have also been identified.

As mentioned earlier, however, lack of adequate numbers of ceramists has hindered more advanced innovations in this area. It is estimated that Kenya has no more than four trained ceramists. Further advancements will require that technical assistance is extended to help with geological surveys, technological research, industrial verifications and elaboration of manufacturing technologies and their transfer.

Although electrical solar applications are widely in use in commercial, institutional premises and households, from the standpoint of the National Power Development Plan, its future contribution to the total energy requirement of Kenya seems pessimistic. The costs of manufacturing flat plate collectors, photo-voltaic cells or heat engines appear to be fairly prohibitive and their repair and maintenance costs also pose serious problems. Consequently, manufacturing operations are limited to the assembly of solar devices rather than manufacture of components. Two companies are successfully involved in the assembly of solar energy devices. Research has however been ongoing in this area with a few experimental externally funded projects.

Further research will have to be aimed at adopting the solar collectors to conditions prevailing in Kenya. The Government has in the past considered protection for local manufacture of solar collectors by raising import duty on the imported items, but this cannot become operational until strong developments are made in this area.

The Kenya Government had proposed a wide scale energy project aimed at exploiting all areas of renewable energy in the country. The solar energy component involved the development of solar thermal energy conversion and photovoltaic conversion. The project included carrying out activities like optical surface sample construction, evaluation of optical surfaces characteristics, special measurement of photovoltaic cell, demonstration of solar tests facilities etc. This project never took off due to inability to secure the required funds. The total cost of machinery for solar and wind component at the time was estimated at US$1.05 million. Therefore photovoltaic cells and flat-plate collectors are basically being imported into the country. The kind of assistance that would be appropriate for Kenya is the establishment of manufacturing capacity through the provision of technical experts and funds necessary for such a venture.

Nuclear Science

Kenya has also ventured into other areas of advanced material analysis like nuclear science techniques. Research is currently ongoing in various areas of peaceful utilization of nuclear technology in the country. A center for Nuclear Science Techniques established by the Kenyan Government with the assistance of the International Atomic Energy Agency (IAEA) can now use nuclear analytical techniques in analysis of a wide variety of metals. Local manpower is also being trained by the center. The center can also provide repair and maintenance of nuclear as well as other scientific instrumentation in the country and within the Eastern African region. The center is equipped with detectors to perform nuclear spectroscopy measurements. X-ray and neutron excitation sources are available to enable one to perform elemental analysis on a wide range of materials including, geological materials, biological materials, industrial products and environmental pollution samples. The techniques for quantitative analysis used has an accuracy of up to 5% and better. Elements beyond aluminium including uranium are analyzed.

There are plans to introduce X-ray emission, mossbauer spectroscopy, mass spectroscopy, nuclear magnetic resonance, electron microprobe and other non-destructive testing methods.

The Environment

Sufficient know-how exists in Kenya and is in use in the analysis of effluent discharge in sewerage and water using modern instrumentation. Analysis of toxic matter caused by air pollution is however an area which has not been very successful. The method currently in use involves sucking air by an air pump through an exposed area. The samples are analyzed for heavy metals by energy dispersive x-ray fluorescence method of the samples. The analysis is done by the use of micro computer and various softwares. It has been realized that pollution control activities in Kenya need serious quality control measures. The tonnage of dust smoke, acid rain and other industrial effluents being discharged into the ecosystem is enormous and there is great need to introduce modern technologies for water and air pollution to protect the Kenyan ecosystem.

Countries which have experienced a high degree of success in their growth are those which have consciously used state power to target and orchestrate economic development.

The government has to stimulate the development of generic technologies, for technological change has now become crucial in spurring economic growth. The realization that an understanding of major new technologies must of necessity form an integral part of the policy making process has prompted the creation of the Ministry of Science, Research and Technology in Kenya.

High on Kenya's policy agenda is the introduction of measures that are intended to foster its own indigenous technological capabilities. The problem however is that Kenya as in most developing countries has not established effectively science and technology systems which are well integrated into the socio-economic fabric. Commercialization of research findings remains a serious problem in Kenya. The development of interferon capability in Kenya has illustrated the fact that even though major advances may be made in new material technology research, the result may not be able to be commercialized due to limited chemical engineering capability.

A strategy is still required in Kenya as in other developing countries for developing new materials in those aspects of technology which show greatest relevance for future long-term development. In the process, the strengths, weaknesses, opportunities and threats must be established for each potential. The potential application must also be narrowed down to what is most relevant to the country.

In the energy sector in Kenya, utilities are plagued by overwhelming chronic shortages of trained staff, poor management, inadequate maintenance and inadequate financial performance. Affected areas included the environmentally sound technologies like the Kenya Ceramic Jiko and the solar water heaters. Information exchange between countries within the subregions and the developed countries should be encouraged to avoid the need to finance the requisite R&D from scratch. An example of this is the improved ceramic cookstove which has been a subject of research in most of the countries of Sub-Sahara Africa. It is necessary that national agencies with the requisite know-how are established, to ensure effective information exchange in the area of energy.

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