

MINERALS AND ENERGY RESOURCES

SALT

Salt can be considered as the most widespread mineral in Eastern Africa and its recovery from the sea is a comparatively simple process given certain environmental conditions. The location of solar saltworks is controlled by the rainfall regime and the occurrence of suitable impermeable soils. These conditions occur from Ngomeni northwards to the Lamu area. Extensive saltworks have been established at the Gongoni-Fundi Is area and Kurawa. The total area dedicated to salt production is over 5,000 hectares that yield an average of over 170,000 tonnes of salt annually.

The method of salt production utilised by the five established companies is very much the same throughout the area. Seawater is introduced into the ponds which are run in series. Slight variations may occur in the method of filling the ponds which utilize tidal energy. In the first pond, undesirable salts of low solubility are removed and the water then flows into concentration, evaporation and crystallization ponds. Crystallized salt is gathered from the ponds, processed and taken to market.

While it is cheaper and more rational to utilize solar energy to evaporate water naturally, fires driven by fuelwood are sometimes still used to boil off the water and recover the salt. This method of salt production, rarely used nowadays, was a common and wasteful use of mangrove and other timbers that were used for fuel. Seven tonnes of wood were used to produce a tonne of salt.



Figure 46 : Saltworks at Ngomeni

LIMESTONE AND CEMENT

Limestone deposits are extensive along the coastal zone from the Tanzania border to the Malindi area. The resource is very abundant, forming a 4-8km wide band, some 70m thick, running parallel to the coast. North of Malindi, older limestone units occur further inland but only a few exposures of isolated limestone occur on the coast between Malindi and the Lamu area. North of Lamu and the islands, limestone units occur once more parallel to the coastal zone, however, these are not well mapped. Exploitation of the limestone is widespread and is governed by local variation in the limestone texture, composition and demand for the material. In the Bamburi area north of Mombasa, limestone is used for cement manufacture and in Tiwi for lime manufacture. However, all along the coast limestone is being exploited for building stone.



Figure 47 : Limestone quarry, Mariakani

Coral limestone, the basic raw material for cement production, is excavated in shallow, heavily mechanised, opencast mines adjacent to the factory. Due to seawater intrusion, exploitation is limited to the upper levels of the limestone layer but the quarries are expected to last for many years. Weathered shale and iron ore are also required as secondary raw materials for the production of cement. The former is available in large quantities in the Mombasa area and is mined in open pits near Bamburi; while iron ore is obtained from Kilifi. Pozzolana and gypsum, also needed for the process albeit in smaller quantities, are mined near Kilifi or imported. Coal and heavy fuel oil, the other important ingredients for cement manufacture, are imported.

Cement production at Bamburi was initiated in the early 1950's and, together with a number of related downstream activities, it is recognized today as one of the major industries on the Kenya coast. The Cement industry employs over 700 workers directly and many more indirectly through its need for raw material, transport, servicing, etc. Average cement production is over 1.2 million tonnes per year and although the local building industry continues to provide a local market for the product, a significant proportion of the production is exported.

REHABILITATION AT BAMBURI

A dense green forest with imposing towers of concrete above and beyond the trees greets the ever-increasing stream of visitors to the Bamburi Portland Cement Company near Mombasa. Large plantations of *Casuarina equisetifolia* hide tracts of dry, yellow quarry, some still being exploited by the excavating machines, others bare and abandoned and awaiting rehabilitation.

For 20 years the Company has implemented a rehabilitation policy which has turned barren, dusty, disused quarry into dense forest, secretive trails and cool lakes. The reclamation comprises an ecological process meticulously planned and based on an understanding of food chains and symbiotic relationships. The achievement is made all the more impressive by the fact that no artificial pesticide, fertilizer or other chemical has ever been used at Bamburi.

The South Quarry is nowadays known as the Bamburi Nature Trail where orphaned animals ranging from a porcupine to a hippopotamus are given natural surroundings to thrive and help educate and inform visitors. The Baobab Farm Ltd integrated aquaculture system is another success story. Through judicious water use and reuse, the system produces tilapia, catfish, prawns, crocodiles, rice, other vegetables and an income from tourism.

While generating an income is an important consideration, Bamburi also reinvests some of that income into various aspects of research and conservation such as - how to increase tilapia yield, how to convert the fish farm's sludge into biogas to be used as fuel, establishing a Bamburi kaya that will be of value to scientists, medicine and the surrounding communities, etc.

The Bamburi enterprise is an excellent example of how ecological principles can be applied to obtain sustainable resource use for economic advantage. The Bamburi Portland Cement Company is justly proud of its achievement which proves that mining need not necessarily ruin the natural environment.

OTHER MINERALS

Several mineral occurrences and shows have been recognised along the coastal zone. Some of the mineral occurrences are of economic significance and a few are being exploited. Mineralization at Murima hill in Kwale district comprises of an association of Pyrochlore, Apatite, Galena, Iron ore and Manganese. Of these, Pyrochlore appears to have the highest potential.

The Vitengeni deposits in Kilifi District are being exploited for Barytes, with Galena as a by-product. However, at Kinangoni, Galena is the dominant mineral with Barytes and Silver forming the subsidiary minerals. Gypsum is mined from sedimentary deposits at Roka in Kilifi District. Other Gypsum deposits of possible economic significance have been discovered in Tana River District. At Jaribuni in Kilifi District, iron ore is being mined to supply the cement factory at Bamburi.

Sand for building is mined in many localities along the coastal zone. Among the most important sites are Tiwi in Kwale District, Mazeras which supplies Mombasa and Ngomeni for the Malindi area. Silica sands for glass manufacture are obtained from deposits in Arabuko-Sokoke and Msambweni. Clay is mined for brick works in the Port Reitz area of Mombasa.



Figure 48 : Mining iron ore at Jaribuni

HYDROCARBONS

A thick sequence of sedimentary rocks, estimated to reach a maximum of 15,000m in some areas, accumulated along the continental margin in a geosynclinal setting that preceded the opening of the Indian Ocean. The opening of the Indian Ocean was associated with the development of a major north-south basin, probably with several comparatively smaller basins. These smaller depositional areas include the Mombasa, Malindi, Lamu and Anza basins. There is a close relationship between hydrocarbon potential and the occurrence of such ancient sedimentary basins which have the potential for good source rocks. In addition to the presence of good mature source rocks, the occurrence of hydrocarbon reserves depends also on the timely evolution of good reservoir rocks, and traps. Sandstones and carbonates are good reservoir rocks while shale horizons generate good traps.

From the limited data available in Kenya, analysis of hydrocarbon potential is difficult. However, if there was to be any potential, the most promising areas along the Kenya coast would be the Lamu Basin, the Malindi High and the South Anza graben. The sediment sequences in these areas vary from Recent to Triassic. However, good source rocks are anticipated at a depth of 3,000 m to 4,000 m in the Tertiary and Cretaceous sequences. The Tertiary deposits have been penetrated by many wells, but the Cretaceous has only been penetrated in a few places. The Cretaceous occurs at a depth of 3,450 m in Lamu and therefore good mature source rocks are anticipated.

Good source rocks and reservoir rocks for hydrocarbon deposits have been observed along the Kenyan coast, with conditions becoming more favourable offshore. The possibility of hydrocarbon reserves therefore exists, however, more detailed geophysical survey, exploration and drilling is required before there can be any certainty.



Figure 49 : Oil refinery at Mombasa