Oil Palm Processing in Nigeria

Keywords:
- oil palm processing in Nigeria, palm nut cracking, palm nut shellling, PKS briquetting, palm kernel shell charcoal, palm kernel shell briquette, EFB pellet, palm fiber briquette, palm oil extraction, red palm oil extraction, palm kernel oil extraction

Abstract:
Oil palm is an important crop tree in Nigeria, and there are many processing of oil palm, including palm oil extraction, palm kernel oil extraction, palm kernel shell briquetting, EFB pelletizing, etc.

Oil Palm Plantation in Nigeria

Nigeria has flat terrain, 71.2 million HA. arable land, and most of the plow-land is available for 2-season plantation per year. Its soil and climate conditions are good for planting various kinds of agricultural crops, especially for the tropical & subtropical economic crops, and the oil palm is one of its important economic crops.

Oil palm in Nigeria grows in the coastal belt which varies in depth from 100-150 miles and a riverine belt which follows the valleys of the Niger and Benue for a distance of about 450 miles from the sea, having migrated inland as a staple crop. For millions of Nigerians, oil palm cultivation is part of the way of life – indeed it is part of their culture.

Oil Palm Value in Nigeria

Usually the production cycle of palm trees is 25 years. The ripened fruit which is bigger than the grape is growing around tree trunks, available for picking until turning dark red.

In Nigeria, oil palm is an important tree because of the value of the crude palm oil, fronds, stems and leaves. Due to the magnitude of this industry, several residues are co-produced with palm oil.
These include: empty fruit bunches (EFB), palm fruit fiber (PFF), and palm kernel shell (PKS). The palm oil plants are found in most parts especially southern states of Nigeria. The different parts of the oil palm are adapted for different useful purposes. While the leaves provide brooms for tidying the environment, the kernel is a major source of red palm oil used for cooking. The seed is the source of palm kernel oil (PKO) used extensively in the pharmaceutical and cosmetic industries.

![Image of palm kernels](image)

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---Palm nut cracking and shelling

There is a large and sustainable market for palm kernel nuts in Nigeria, as the basic raw materials used in the production of palm kernel oil and palm kernel cake. The process of the palm kernel into palm kernel oil involves the cracking of the palm nut, separation of the shells from the kernels, washing, cleaning, kernel milling, and kernel oil extraction. The nut cracking and shelling are the issues which continues to be of great importance within the palm kernel oil industry.

Cracking palm nuts to release the kernels is a critical step that affects the quality of kernel oil. There are two widely-used methods for these processing: manual (traditional) method and mechanical method.
The manual method of palm nut processing is the traditional way of cracking and separating palm kernel. It is a method in which nuts are cracked using stone and kernels are separated by hand picking from the shell at the same time. This method is labor intensive, time consuming, low efficiency to meet the demand of growing industry.

There are two basic mechanical methods that can be used to crack the shell of the nut. The shock caused by an impact against a hard object and the application of direct mechanical pressure to crush, cut or shear through the shell. Palm nut cracking machine are developed on the principle of hurling of the palm nuts at fairly high speed against stationary hard surface. Generally, two types of nutcracker are used in palm oil mill: the roller cracker and the centrifugal impact cracker. In roller cracker the nuts are cracked between two fluted rollers revolving in opposite direction. The clearance between the rollers is invariable but the nuts are of different sizes, which make the machine operate at a reduced efficiency. The other cracker is a centrifugal impact cracker that uses principle of centrifugal force to flap the palm kernel nuts on the stationary hard surface. This method involves using a shock caused by a impact against hard objects to shear, crush or cut through the shell.

After the cracking, it is the separation of palm kernel and shell. At present, techniques employed in the separation of the mixture are of two types: wet and dry method. The wet method is implied when the separation of mixture in a liquid medium, based on the difference in specific gravities of the constituents; while in the dry method, no liquid medium is used. However, kernels recovered in the wet systems must be sterilized against the growth of moulds and re-dried for 14-16 h in silos to remove moisture absorbed during the separation process. In view of the limitation of the conventional wet separation, a rotary separator employing a multi-cyclic separation process is developed for the dry mixture of the palm kernel and broken shell of irregular shapes and comparable sizes.

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Oil extraction from oil palm in Nigeria

1. Palm kernel oil process
Palm kernel oil is an important and cheap source of oil for soap manufacturers, bio-fuel, cooking oil, vegetable ghee, Shortenings, Margarine, CBS, CBE, ice cream, dough, creaming, coating, and other specialty fats while palm kernel cakes are used in animal feed production. The market for palm kernel oil is very large. About 80% of all the edible vegetable oil consumed in Nigeria is made from refined palm kernel oil.

Traditional process: There are several methods of extracting palm kernel oil, but the traditional method is to heat the kernel in a dry pot till the oil shows up. The oil extracted in this way is blackish-brown and is not normally used in cooking but for traditional medicine and lubrication. Palm kernel oil is also extracted by the cold press method to give a light yellow to clear oil.

Mechanical extraction process: this processing method is suitable for both small and large capacity operations. And there are three basic steps: kernel pre-treatment, screw-pressing, and oil clarification.

Pre-treatment: it is for removing foreign materials. Usually magnetic separators are installed to remove metal debris, while vibrating screens are used to sieve sand, stones, or other undesirable stuffs.

Screw-pressing: the properly cooked palm fruit meal is the fed into the screw-press to get expelled oil and palm kernel cake.

Oil clarification: the oil from the presses is screened and filtered to remove the solid impurities in it in order to produce clear oil prior to storage.
Mechanical extraction of palm kernel oil.

Line A is for direct screw-pressing without kernel pre-treatment; Line B is for partial kernel pre-treatment followed by screw-pressing; Line C is for complete pre-treatment followed by screw-pressing.

Direct screw-pressing: some mills crush the kernels directly in the processes without any pre-treatment. Double processing usually is required to ensure efficient oil extraction.

Partial pre-treatment: the kernels are first broken down to small fragments by grinding prior to screw-pressing.

Complete pre-treatment: the full pre-treatment processes are carried out prior to screw-pressing. Plants with larger capacities choose complete pre-treatment.

Solvent extraction process: this method can be divided into three main unit operations: kernel pre-treatment, oil extraction and solvent recovery from the oil and meal. For the purposes of small-scales operations, it is sufficient to mention the solvent extraction is an alternative for high capacity mills. But the process is not recommended for small enterprises.

2. Palm oil (red palm oil) process
Palm oil is the main vegetable oil produced in Nigeria and the production is featured by low yields
and traditional methods. And Nigeria is the third largest producer in the world and its production accounts for 55% of the African output. The main palm oil producing states includes Ogun, Ondo, Oyo, Edo, Cross River, Anambra, Enugu, Imo, Abia, Ekiti, Akwa-Ibom, Delta and Rivers. The red palm oil is used both as a cooking material and as an ingredient in soups, sauces and a variety of local dishes. Consequently, there had long been a thriving market for palm oil both within the main areas of production in eastern and western Nigeria and between these regions and the non-palm oil producing northern region.

![Chart](image_url)

In Nigeria, as in most other West African countries, red palm oil has always been processed by women using the traditional primitive rural technique namely mortar and pestle, of cooking the palm fruits in a pot and pounding the cooked fruits in wooden mortar or mashing it using a vessel that resembles a canoe. (As documented in the case of Akwa Ibom State, women play an important role in the production, storage and commercialization of red palm oil.) The mash is then squeezed either by hand or any other method which will squeeze the oil out of the mash. And this method yields about 5% of the oil in the mesocarp. Some small farmers use mini-improved processing units which are semi-mechanized. The medium scale processors process the fruit with a screening machine, boiler, digester, press, clarifier and generator. They employ around 10 persons to operate. The large scale processors use industrial scale processing equipment.

Tips: Palm oil is an edible vegetable oil derived from the reddish pulp of the fruit of the oil palms. Palm oil is naturally reddish in color because of a high beta-carotene content. It is not to be confused with palm kernel oil derived from the kernel of the same fruit.

The differences between the palm oil and palm kernel oil are in color: raw palm kernel oil lacks carotenooids and is not red, and in saturated fat content: palm oil is 41% saturated, while palm kernel oil is 81% saturated.

--- Oil palm briquetting and pelletizing in Nigeria

Palm kernel shell is characterized for its useful application in bio-energy production. These results will enable oil palm producers to realize the value of being a potential bio-fuel which is environmentally friendly, to solve the energy problem in Nigeria. So the palm kernel shell briquetting is a booming industry in this country. Usually, the shells are converted into charcoal, pulverized, and then made to briquettes using cassava starch as a binder.

Making palm kernel shell charcoal: the palm kernel shells are carbonized using the simple drum
method. In this process, a metal container is perforated underneath. The shells fill about one-fifth of the container size. The container is placed on a stand and about 3ml of kerosene is sprinkled on the shells to facilitate ignition. This is followed by application of heat underneath the container. The shells ignite after about eight minutes and are allowed to burn until the flame became bluish and the shells turned black. The container is brought down from the stand and remained for 8 hours while being tightly covered to prevent the entry of air. After this period, the charcoal has formed with no ash.

Making of the palm kernel shell briquettes: the charcoal is pulverized using a manually operated blender. The charcoal fines are screened through a 250 micron sieve. Cassava starch is used as a binder. The starch is prepared from raw cassava root which is peeled, washed, and sun-dried. It is then pulverized. 50g of the cassava flour is dissolved in 100ml cold water. 400ml water is put to boil in a container. The cassava paste is added into the boiling water and mixed properly to get the starch gel. While the starch gel is still warm, 750g of the pulverized palm kernel shell charcoal are gradually added into the gel and mixed using a stirring stick until a thick, black compound is formed. Part of the thick paste is manually pressed into cylindrical molds. Another part of the thick paste is molded with the palm of the hand. The essence of using this type of pressure was to make the briquettes as it would be in the absence of costly briquetting machines. This procedure is targeted at the rural populace who may not have access to briquetting machines. The molded thick paste is sun-dried for 4 days.

--- EFB (palm empty fruit bunch) pellet processing in Nigeria

EFB pellet is the pressed pellet from EFB fiber, and EFB pellet resembles to wood pellet. The oil palm fruit bunch will go through a stream processes in order to dismantle the palm fruit from the bunch. The empty fruit bunch (EFB) discarded from the crude palm oil mill is at wet and hot condition. The wet EFB will delivered to press process in order to squeeze the water out from the empty fruit bunch. Later the pressed EFB will be send for shred process. And the pressed and shredded EFB turn out as fiber form but in large scale. The EFB fiber is sent to the wood pellet machine or the briquetting machine to produce EFB pellet or EFB briquettes as a kind of biomass fuel.
Other processing of oil palm in Nigeria

The oil palm is a versatile tree crop with almost all parts of the tree being useful and of economic value. The different parts of oil palm include: the fronds, leaves, trunk and roots. These parts can be processed into a wide range of products which are of benefit to mankind. The residue obtained after extraction of oil is called palm kernel cake, which is used in livestock feed production. The sludge from palm oil processing is used for making traditional soap and fertilizer. The empty bunches and fiber that remain after oil extraction can also be used for mulching, as manure and direct source of fuel.

The leaves of oil palm are used for making brooms and roofing materials. The thicker leaf stalks are used for walls of village huts. The bark of the palm frond is peeled and woven into baskets while the trunk (main stem) can be split and used as supporting frames in buildings. A sap tapped from the female flower is drunk as palm wine, which is a rich source of yeast. The palm wine can be allowed to ferment and then distilled into a local gin.