



KUMBANGO OIL REFINERY

ABSTRACT

Oil and fats are basic foodstuff and raw materials for a wide range of industrial purpose. Palm oil for its physical properties, have the important solid component making it suitable for margarine, bakery shorting and some confectionery fats. The natural anti- oxidant present in palm oil gives it longer shelf life.

Refining and fractionation are the initial stages in the utilization of palm oil.

In this article, certain aspects of the N.B.P.O.L Kumbango Palm Oil Refinery are presented. The complex consist of a physical refinery (German) and a fractionation (Belgium) plant each processing about 300mT a day. Employment of a strict QC scheme the quality of oil produced were within specification since the production started.

A summary of the Environmental System Management of the refinery is also included.

1.0 PHYSICAL REFINING OF PALM OIL

As a raw material, CPO, apart from the triglyceride base component, there are other materials-impurities present. Free fatty acids, moisture and volatile matter, gums and trace metals *e.g.* Copper and iron, are some of which that is removed. Pigments (carotenes, responsible for the red color) are also reduced considerably.

Pretreatment.

From storage temperature range of 30-50°C max, the raw material temperature is raised to 110°C essentially vaporizing all moisture. The dried oil is mixed with food grade phosphoric acid and bleaching earth. Phosphoric acid, dosed at a 0.01-0.02% of CPO (throughput) is used to degum or loosen the oil. Once loosened impurities, (like phospholipids, trace metal) in the oil get adsorbed onto the bleaching earth-dosed at 0.8-1.0. *Refer to schematic diagram of unit process, Attachment 1.*

The resulting mixture is then treated with live steam of 0.1bar under vacuum (optimum vacuum pressure of 720mmHg). The steam agitates the mixture and also raises the temperature to 110-120°C.

Oil is separated from the spent bleaching earth through a series of filter leaves in the filtration vessel. The Bleached Palm Oil, BPO temperature is increased to an average of 260°C by steam from the High Pressure Generator, before steam refining.

Steam Refining

Up to this stage, most of the impurities such as trace metals and phospholipids and traces of soap have been removed from the oil. In steam refining or deodorization, free fatty acids, mono- and diglycerides and oxidation products are removed, collectively called PFAD Palm Fatty Acid Distillate, the byproduct.

In physical refining, high temperatures 240-270°C and low pressure – vacuum of 3.0mbar are utilized to remove unwanted components from the pretreated oil.

The temperature of bleached oil free of moisture, being raised to about 260°C is sprayed into the deodorizer. It descends through the column filling up the first tray and overflows to the second and third, as it moves, steam of 0.1bar is injected, continuously stripping the volatile components, which are sucked out by vacuum.

Maximum vacuum 4.0mbar, achieved by a vacuum system made up of the main booster utilizing cooled water of pressure 2.0bar, and distilled fatty acid circulation. Depending on the vapor load, almost 99.9% of free fatty acids are removed from oil. The oil passing out of the deodorizer is refined bleached deodorized palm.

Before the oil is cooled to about 40-50°C for storage it is polished and the final product of the refinery - RBDPO is stored in 500mT stainless steel tanks at a maximum temperature of 50°C and at normal atmospheric pressure.

2.0 FRACTIONATION OF REFINED PALM OIL

Refined palm oil is a mixture of saturated and unsaturated components (glycerides). To add value to this refined product, the oil is fractionated by crystallization to achieve a separation of the two components. *Refer to schematic diagram of unit process, Attachment 2.*

Refined palm oil has IV ranging from 50-53. From storage tanks, the oil is loaded into the crystallizers, whereby the oil temperature is raised to 90-100°C and cooled to 50°C before it is chilled.

Crystallization

As the oil temperature is lowered, the unsaturated component (stearin- IV 32-38) of the oil having higher melting point than the liquid fraction, will begin to crystallize and grow to maturity. The matured fat crystals are then separated from the more saturated fraction by filtration. Usual chilling time about 8-10 hours for standard olein (IV56 and 10-12 hours for superolein (IV 62).

After specified chilling time is reached the slurry is ready for filtration. Membrane filters are employed in filtering; the slurry is pressed against the filter separating the solid and the liquid fractions. The solid is melted and pumped to storage, whereas the liquid part is straight to storage.

3.0 PRODUCTIVITY

Refinery

The refinery processes, on average 300mT a day of Crude palm oil (CPO), with an extraction of 95% of Refined palm oil (RPO), 4% of byproduct Palm Fatty Acid Distillate (PFAD) and the remaining 1% maximum account for losses.

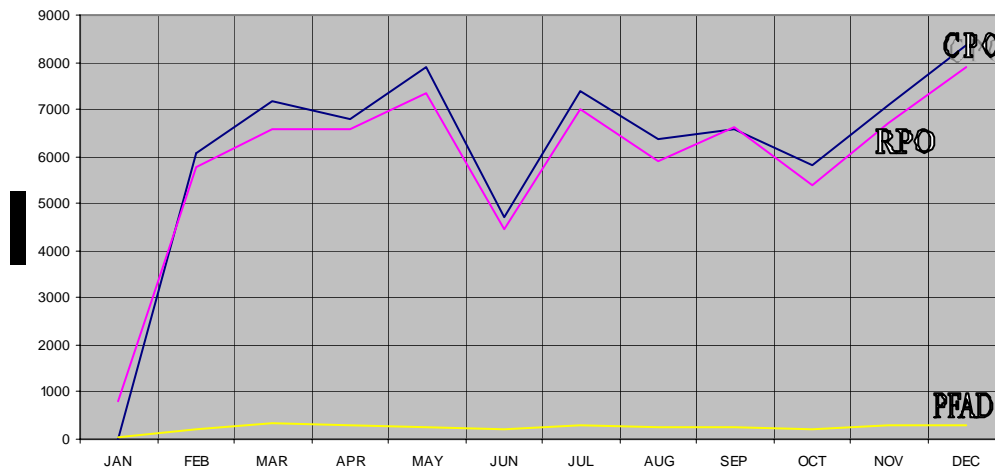


Figure 1: Shows the annual refinery production of 2003. Notice the difference between RPO extraction and by-product.

Fractionation

For the fractionation, we also fractionate up to 300mT per day. Extracting approximately 78% olein and 22% stearin, that is, 234 mT and 66 mT respectively.

Production targets however are affected by down time due to mechanical break down and other technical hold ups as in any industrial setting. To avoid such and to maintain maximum productivity, preventive maintenance plans for equipment are employed, whereby equipment are checked and maintained on a weekly basis.

An effective and continuously efficient relationship established with our supplier of equipment and technical support, especially for specific plant equipment has been vital in the company's daily effort of maintaining maximum production.

4.0 QUALITY

Quality of oil refined and fractionated is very important in maintaining marketability.

Quality control and assurance measures taken to ensure that every oil product/ batch passing out from the plant is within required quality specifications.

Raw material is tested prior to processing and plant parameters are set accordingly to produce oil of desired quality. Oil quality is controlled throughout the stages of production. At

storage, oil qualities are monitored daily to ensure the oil stability is maintained until the commodity reaches the customer.

Some of the quality of oil monitored, are Free Fatty Acid (FFA), Iodine Value (IV) and color.

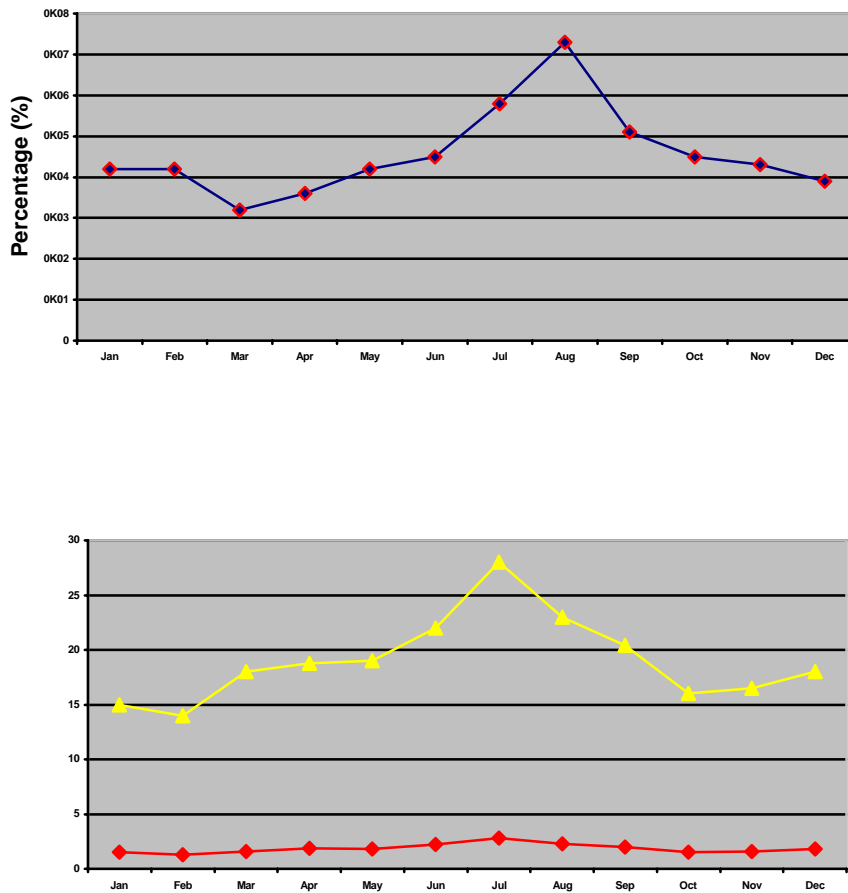


Figure 2. Graphical indication of qualities of RPO extracted in 2003. FFA is kept below 0.08%; while oil color maintained below 3.0 Red and 30 Yellow.

5.0 KOR EMS SUMMARY

NBPOL achieved ISO 14001 Systems Certification in April 2004.

The prerequisites involved weeks of hard work that produced important safety facilities such as *spill kits, safety bunding, signboards, documentation* and so forth.

Kumbango Oil Refinery (KOR) also contributed to this achievement through active accomplishments of the KOR Non-Conformance List surveyed and compiled by NBPOL Environmental Affairs Office.

The KOR Non-Conformance List contained suggestions that would improve the current system of work procedures and their impacts on the natural environment here at KOR. Weeks of dedicated work resulted in KOR passing the ISO 14001 Audit with satisfactory results.

The ISO 14001 Environmental Management Systems (EMS) was quite effective in educating KOR employees about environment conservation.

As a result of this program, much information regarding EMS has been clearly disseminated to all employees. The following list summarizes KOR's physical set up;

- Spill Kits installed at Pump Sheds, Chemical Warehouse, Storage Tank Bunds, Diesel Engines area, and at certain locations inside the plant.
- All spill trays outlets, equipment drain lines etc. diverting into the main building drain that ends up in the effluent pit. All KOR effluent is pumped into KOM Effluent System.
- All Storage Tank bunds outlets valves have locking units.
- All Storm water Drains have emergency spill containment slush gates and Overflow/Underflow units.
- Riegellman Smoke Charts installed for Boiler emissions.
- Safety signage, emergency showers, safety gear etc. installed/issued for Safe Work Practices.
- Documentation System of all checks, incidents etc.

The responsibility now lies on all KOR employees to ensure that this profitable system is exercised and maintained at all times.

6.0 RECRUITMENT AND TRAINING

KOR currently has 29 employees, consisting mainly of plant operators, QC, a trainee engineer and the Refinery manager. A general maintenance artisan, general workers and a production clerk are among those employed.

The Refinery manager normally does the recruitment of process workers. Most of the operators employed are Grade 10 and 12 leavers.

Plant operators were given initial technical training by JLLurgi's team of commissioning engineers for 2 weeks. After a year of practical training under the Refinery manager, operators have achieved standard knowledge in plant operation and operational techniques by which they can run the plant to meet production targets. However, there are areas that they still have to learn and experience, especially troubleshooting.

As part of its commitment to human resource development, the company through its Personnel Department, schedules training for employees according to their year of service.

7.0 CONCLUSION

Physical refining of crude palm oil is new to Papua New Guinea. The first Palm Oil Refinery is New Britain Palm Oil Limited 300TPD Kumbango Oil Refinery in Kimbe, West New Province.

Since its commissioning in January 2003, about 75000 tons of crude palm oil have been refined.

Kumbango Oil Refinery has operated exceptionally well in 2003, in terms of financial budget.

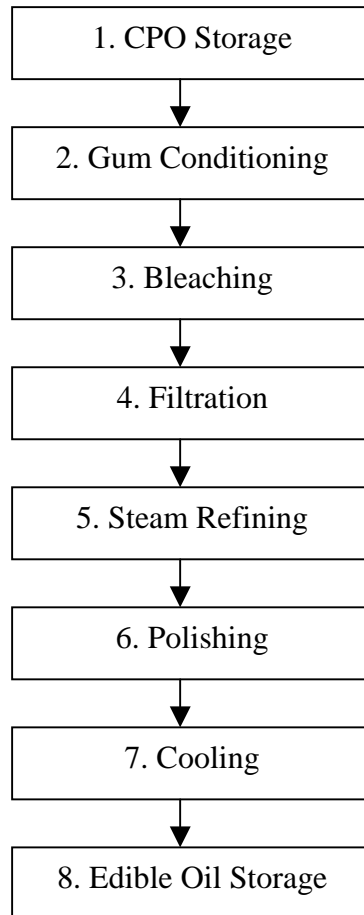
That is;

Budget	K59.61/ ton
Actual	K59.41/ ton

Kumbango Oil Refinery is new; currently operating well and management will continue to ensure that it prospers.

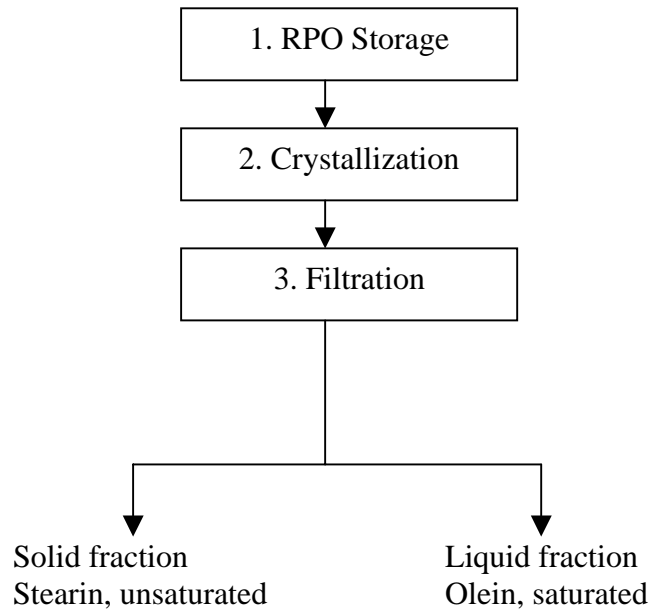
Attachment 1 - Refinery

Unit Process: Stages in Palm Oil Refining.



Attachment 2 – Fractionation

Unit Process



The Iodine Value is a measure of the degree of unsaturation in oils and fats, thus IV measurement is carried out extensively in this section. IV results are used for quality analysis and also production yield predictions.

KOR MANAGER
SUPPIAH.M.

