PREMIUM OIL SEGREGATION USING NEAR-INFRARED (NIR) ONLINE SYSTEM

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704

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The importance of monitoring crude palm oil (CPO) quality cannot be over-emphasised when we consider the fact that good-quality refined oils must be produced from high quality CPO. The trend to produce CPO with low (<1.5%) free fatty acid (FFA) has increased among the millers as it commands a premium price due to its hygienic food grade quality. CPO normally contains FFA which need to be removed as part of the refining process. The FFA levels can vary from the time of harvesting to the milling processing and storage. Lipase activities causes increment in FFA levels in CPO. FFA is formed when the bound fatty acid in triglyceride molecules are split either by chemical or enzymatic hydrolysis. Currently, the premium oil at the mill is manually collected every 30 min after checking FFA content and switching the flow of CPO into the clarifier tank. The common practice to determine the FFA content in CPO is the wet chemical method. To meet this demand, it will be of great advantage to use the near infrared (NIR) system, which is more efficient, much faster and solvent-free compared to the titration method. With the NIR system, the FFA of the CPO can be analysed instantaneously where the result is conveyed as an electrical signal to operate a two-way valve that switches the CPO flow into separate tanks. As a result, mills can segregate automatically the low and from high FFA CPO.

OBJECTIVE

The technology is an automatic segregation system for producing low FFA premium oil.

NIR CALIBRATION

NIR spectroscopy is a fast analytical technique using non-destructive wavelengths of 800 nm to 2500 nm and no sample preparation is required. The system is calibrated using similar product samples. The values obtained using standard laboratory method and the calibration are tested for goodness of fit based on R^2, standard error coefficient (SEC) and standard error of prediction (SEP) (*Figure 1*). Calibration models are downloaded into the analyser for sample analyses. The NIR Online system is used to monitor FFA content during the palm oil milling process.

PROCESS DESCRIPTION OF NIR Online SYSTEM

- The NIR sensor detects the FFA content in CPO and send a signal to the Programmable Logic Control (PLC) (*Figure 2*).
- The signal is amplified and interfaced to give an indication on the computer monitor; and also operate the control valves located on the pipeline to the clarifier tank.
- The clarifier valve (*Figure 3*) opening is dependent on the signal given by the controller. The threshold value is set to a maximum of 1.5% FFA for premium oil (clarifier A) and above 1.51% FFA for standard quality oil (clarifier B).
- The system is linked to a computer for continuous monitoring of FFA.

BENEFITS

FFA content of CPO is always used as an indicator of quality by palm oil refiners. Higher prices are paid for better grade CPO.

Advantages of low FFA content:

- lower refining losses of oil;
- lower usage of bleaching earth;
- lower dosage of phosphoric acid; and
- increased income.

By increasing the quality of the CPO, the Malaysian palm oil industry is able to compete in the world oil market and bid better prices.

ECONOMIC EVALUATION

The total investment for the system is expected to be below RM 400 000. Based on the assumption of 30% of the CPO with FFA below 1.5 % can be

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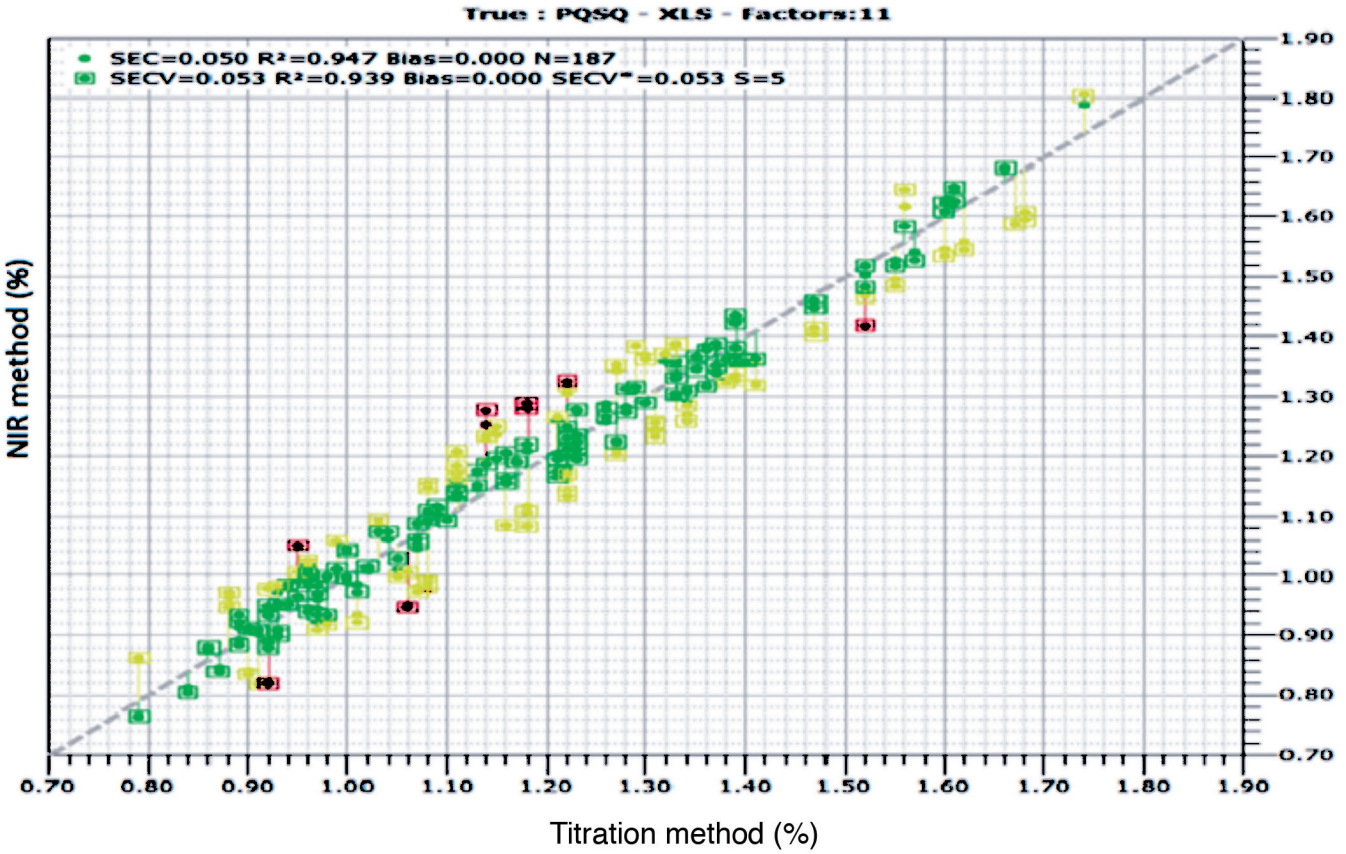

Figure 1. NIR calibration curves for free fatty acid (FFA) content.

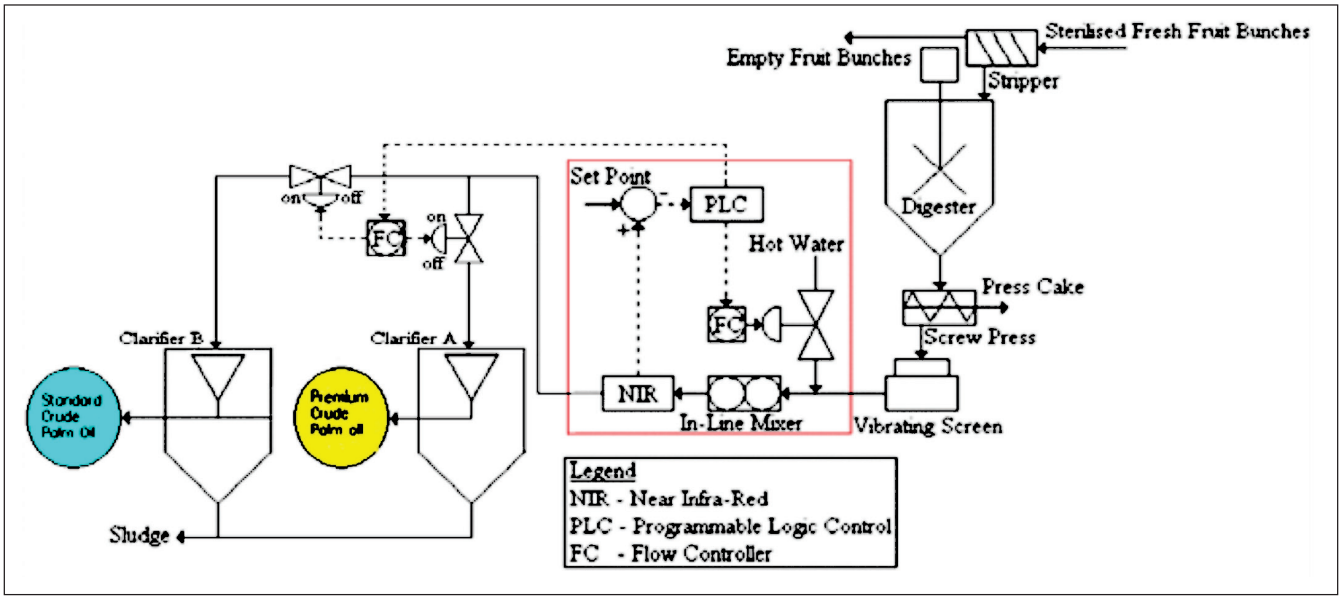

Figure 2. Schematic diagram of automatic premium oil segregation using NIR system.

Figure 3. NIR Online system in the mill.

segregated and increased in market price by 5% to 10%. The economics in using the NIR Online System is shown *Table 1*.

TABLE 1. ESTIMATED COST FOR PREMIUM OIL SEGREGATION USING NIR SYSTEM

Assumption	
For 60 t hr^{-1} FFB mill processing	300 000 t yr^{-1}
Oil extraction rate (20%)	60 000 t of CPO yr^{-1}
30% obtained as premium oil	18 000 t yr^{-1}
Normal price (average price in 2014)	RM 2 955
Premium oil price + 5% (RM 147)	18 000 t x RM 147 = RM 2 646 000
Operating Cost	
NIR Online system	RM 350 000
Maintenance	RM 50 000
Total	RM 400 000
Profit (per year)	RM 2 246 000
Payback period	2.2 months

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