Palm Fatty Acid Distillate (PFAD) in biofuels

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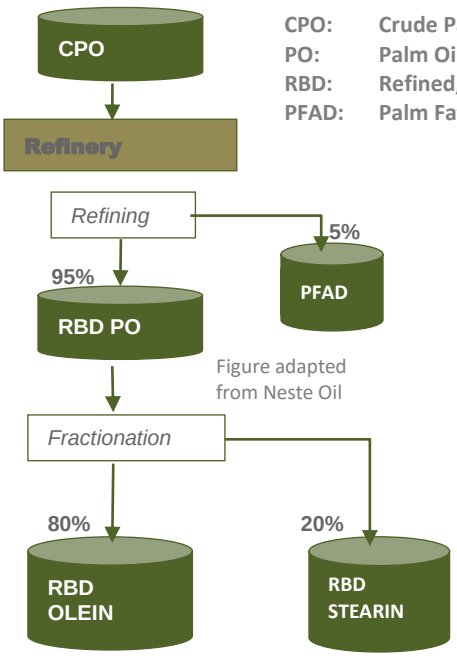
In this paper, we aim to provide some facts and assessments of Palm Fatty Acid Distillate (PFAD) as feedstock for renewable hydrotreated vegetable oil (HVO) diesel. The demand for HVO diesel has increased due to many companies wishing to change from fossil fuel to renewable fuel for their vehicle fleet. Changes in the taxation of the use of biodiesel in Norway in Oct 2015 has contributed to increased interest in biodiesel.

The Norwegian Environment Agency has recently categorised[1] PFAD as residue from the production process, in regard to the sustainability criteria for the mandatory obligation resulting in double counting in line with biofuels based on waste, residues, lignocellulose and cellulose. This creates an incentive to change to PFAD-based HVO within the mandatory obligation.

Several suppliers claim that there is currently not enough HVO diesel for the Norwegian market from feedstocks other than PFAD, and that HVO diesel with PFAD is necessary to meet an increased demand under the current regulatory framework and price on fossil fuel.

What is PFAD?



CPO: Crude Palm Oil
PO: Palm Oil
RBD: Refined, Bleached & Deodorised
PFAD: Palm Fatty Acid Distillate

Figure adapted from Neste Oil

Palm fatty acid distillate is a by-product from palm oil production. In the process of refining crude palm oil (CPO), the free fatty acids (FFA) must be removed. The amount of free fatty acids in the palm fruits is determined by how much of the fat in the fruit has been degraded by enzymes after harvest. The fat breakdown process is halted by sterilisation of the fresh fruit bunches (FFB). PFAD has a lower market value than palm oil (currently ~85%), therefore the palm oil producers attempt to minimise the accumulation of free fatty acids in the FFB. The concentration of free fatty acids in the crude palm oil is typically 4-5 %. This is distilled out in the refining process, and thus the output of the refining process is usually 5 % palm fatty acid distillate and 95 % refined, bleached and deodorised (RBD) palm oil. The RBD palm oil may then be further fractioned into RBD Olein (80 %) and RBD Stearin (20 %).

Although the PFAD is a by-product from the palm oil production, PFAD has considerable value, and is more or less 100% utilized. It is used as feedstock for many different products for animal feeds, laundry soaps, the oleochemical industry, and combustion for local power/process heat[2]. PFAD is

also a source of vitamin E, squalene and phytosterols - substances valuable for the nutraceutical (dietary supplements and functional foods) and cosmetic industries. These substances may be extracted and isolated from PFAD.

Global production of PFAD

It is difficult to find global production and trade data for palm oil and PFAD together. However, the Malaysian Palm Oil Board has palm oil production and trade statistics that are available to the public. The table below shows essential production data for palm oil and PFAD.

Table 1: Refining volumes (tonnes) and value of palm oil & PFAD in Malaysia[3]. 2012-2015 average.

	Refining output	Relative output (%)	Export price**	Relative price (%)	Value (theoretical)***	Relative value (%)
RBD PO*	13,966K ton.	100%	$774/ton.	100 %	$10,810Mill.	100 %
PFAD	678K ton.	4.9%	$657/ton.	85 %	$445 Mill.	4.1 %

* Refined, Bleached and Deodorised Palm Oil ** Free on board (FOB) $/tonne *** Value = Volume x Price

The total production of crude palm oil in Malaysia was 19.9 Million tonnes in 2015 (Malaysian Palm Oil Board)

As shown in the table, the volumes and the prices of the two products give a production value of PFAD at approximately 4 % to that of palm oil, while the current value of PFAD relative to palm oil per unit of weight is approximately 85 %. The global production volume of palm oil was 61.43 million tonnes in 2015[4]. Extrapolated from the statistics in table 1, a rough estimate of the global annual production of PFAD is 2.98 million tonnes with an approximate value of $1.493 billion in 2015.

PFAD and market effects of increased demand

The output and value of PFAD imply that the production of PFAD is inelastic: Producers are not likely to make new investments to increase production due to a price increase of a residue with a 4 % value to that of the main product. An increase in the PFAD price is not by itself likely to lead to an increase in the overall palm oil production. This is likely to stay the same at least as long as the PFAD price is lower than the palm oil price.

However, one might also consider displacement effects when a product like PFAD is to be utilised for new products. Since PFAD is presently more or less 100 % utilised and has a considerable value, and the volume is determined by the palm oil production, an increase in the use of PFAD for biofuel will increase the price of PFAD and/or the availability of PFAD for the other products.

Work done by the International Council on Clean Transportation (the ICCT) suggests displacement effects such as increased demand for primary vegetable oils for soaps and oleochemicals, increased demand for fossil oils for fuels and petrochemicals, increased demand for other feed materials, and reduced consumption of associated products. What the displacement effects will be depends on the choices all the existing users will make. If there are no sustainable criteria for soap etc., it might be increased use of palm oil in soap production. In such case, this will be a result of bad choices on the part of the companies producing soap, not failings on the part of the biofuel producers. However, since increased production of PFAD is simply a result of the expansion of palm oil plantations/production, this is a more relevant situation to consider for the use of PFAD.

The current situation in the international palm oil market is that major producers have been pushed to make decisions for a no-deforestation policy. However, the implementation of these measures has

not yet been effected. In Indonesia, the key parts of the authorities are actively working against measures to reduce the negative environmental impacts of palm oil production. The international Roundtable on Sustainable Palm Oil (RSPO), which should be one of the suppliers of terms on sustainable palm oil, is in a limbo where their environmental standards are less stringent than those of many large companies. Environmental NGOs are concerned that any increase in demand for palm oil or other oil palm related products may reverse initiatives and positive progress to make palm oil production more sustainable.

A brief look at producers of HVO diesel

HVO can be produced from many kinds of vegetable oils and fats. This includes triglycerides and fatty acids from vegetable oils (e.g. rapeseed, soybean and corn oil) and tall oil (a co-product from the pulp and paper industry), in addition to the use of animal fats[5].

Neste Oil is currently the largest producer of HVO diesel in the global and European market, with an annual production of 2.4 million tonnes and a market share of 69 %[6]. They produce HVO diesel based on waste and residual fats, such as waste animal fat, waste fish fat and PFAD and crude palm oil. In 2014, they used 38 % crude palm oil, and the residual waste and by-products (a grand total of 2.57 million tonnes of raw materials)[7]. According to Neste Oil, *"All Neste Oil's refineries producing renewable NEXBTL diesel have certificates approved by the European Commission and EPA approval. The [...] production of renewable diesel and sourcing of raw materials comply with the EU's Renewable Energy Directive (RED) and the regulations of the EPA."*[8] They demand that their palm oil suppliers be RSPO-certified, and that their PFAD suppliers be certified or have a time-bound plan to be certified.

Other producers of hydrotreated biodiesel in Europe are UPM (Finland)[9] and Preem (Sweden)[10] from tall oil. In 2013, roughly 101 million litres of HVO were produced in Sweden, based on esterified tall oil from SunPine in Piteå, which is hydrogenated to HVO at the Preem refinery in Gothenburg and blended with diesel and biodiesel. Other producers are ENI/UOP[11] and Total[12], who are augmenting their production. In the US, Honeywell, Dynamic Fuels LLC, ConocoPhillips and Petrobras have developed HVO refineries[13].

Certification

The Roundtable on Sustainable Biomaterials (RSB) is an independent and global multistakeholder coalition, which works with the sustainability of biomaterials. Their certification scheme is the strongest and most trusted of its kind. It verifies that biomaterials are ethical, sustainable and credibly sourced[14]. The RSB has members from different sectors and a large range of NGOs working with nature conservation, climate, human rights, food security and rural development[15].

RSB can be designated a "best-in-class" certifier for biofuels and other biobased products. ZERO has solicited their assessment of PFAD, and they are now conducting an evaluation of this feedstock.

Regulations of PFAD in biofuels in Norway

Today, the usage of biofuels in Norway has two incentive mechanisms within road transportation. One is the regulation that 5.5 % by volume of total traded quantity of fuel used in road transport per year shall consists of biofuels (increasing to 7 % from 1.1.2017). The other is that biofuel consumption above the trade volume requirement shall not be subject to road taxation[16]. The

biofuels used under these regulations are required to adhere to sustainability criteria adapted to the European Commission's sustainability criteria on the climate change impacts and acreage impacts of feedstocks for biofuels (RED directive). Any biofuel exempted from road taxation must adhere to these sustainability criteria. This is regulated in the FOR-2004-06-01-922, § 3-5 to § 3-9[17].

The Norwegian Environment Agency has recently classified palm fatty acid distillate (PFAD) as a residue from the production process. Due to the relative high price of PFAD compared to palm oil, they stated that they would take this classification up to a new evaluation within the next 1-2 years[18]. With this classification, the product is not charged by greenhouse gas emissions in the production process prior to collection (e.g. the greenhouse gases emitted during the harvesting process and refining process of crude palm oil); the sustainability criteria are limited to greenhouse gas emissions and mass balance, and not the acreage criteria for biodiversity and high carbon stock. In addition it receives a double count in fulfilment of the mandatory biofuel obligation.

This classification is in line with the classification done in Sweden and Finland, while the UK has decided to classify PFAD as by-product – as where PFAD need to be documented from palm oil production according to the sustainability criteria for biodiversity and high carbon stock, and no double counting.

Evaluation and conclusions

ZERO and Rainforest Foundation Norway see the classification from the Norwegian Environment Agency of PFAD, in the preferable feedstock – waste/residual product category, as an unfortunate decision. PFAD should be regulated to fulfil all the sustainability criteria, and should not receive double counting.

The double counting of PFAD in the mandatory trade mandate for biofuel gives an unfortunate advantage to PFAD. It makes PFAD a highly preferable feedstock for biofuel for the companies obligated by the mandatory biofuels requirement. If the demand for PFAD is sufficiently high, it *may* make PFAD even more valuable than crude palm oil (per litre). With the relative low price of PFAD as feedstock biodiesel, it may make this feedstock the only/totally dominant feedstock and potentially impede the development of the marked for other better feedstocks. ZERO and Rainforest Foundation Norway therefore urges the Norwegian Environment Agency to change the classification of PFAD to a by-product, as in the UK, to be not a special favoured feedstock, as should be possible within the legislation.

We urge the government to implement incentives in the biofuel policy for the use and development of the most sustainable feedstock with highest GHG reduction for biofuel production, in order to develop the market for increased feedstock supply, some of which at higher cost. We also urge the government to implement the same sustainability criteria for additional products, both biobased and fossil fuel-based, so as to ensure the same sustainability demand for acreage and biodiversity as for biofuels. Based on a purely scientific assessment, and given that the palm oil industry improves its performance significantly, PFAD originating from sustainable palm oil production may be designated a sustainable feedstock.

The global palm oil market has a large problem with deforestation linked to palm oil production. There is currently progress in inducing the palm oil industry to commit to no-deforestation policies.

This leads us to the conclusion that this is an unfortunate time at which to increase the demand for palm oil-related feedstock, including PFAD. Using PFAD and palm oil as feedstock for biofuel may lead to a significantly increased demand for palm oil and thus also may lead to further expansion of plantations into fragile tropical forest areas and peatland.

ZERO and Rainforest Foundation Norway therefore advise consumers, suppliers and authorities to demand biodiesel from other sources than PFAD (and palm oil), and to contribute to the development of increased supply from other feedstocks for increased biofuel production. The development of increased supply from other feedstocks is in any case necessary for the coming surge in biofuel use to replace fossil fuels. Compared to the need in the longer run, the global volume of PFAD is minor, and the biofuel development must continue to draw on other and larger feedstock for sustainable biofuels.

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