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Andersen Process Consulting as

FACT SHEET
MARINE FEED OILS FROM OMEGA-3 BIOFUEL BY-PRODUCTS

The Omega-3 industry makes a lot of low cost by-products such as glycerol and biofuel as shown in Figure 1.

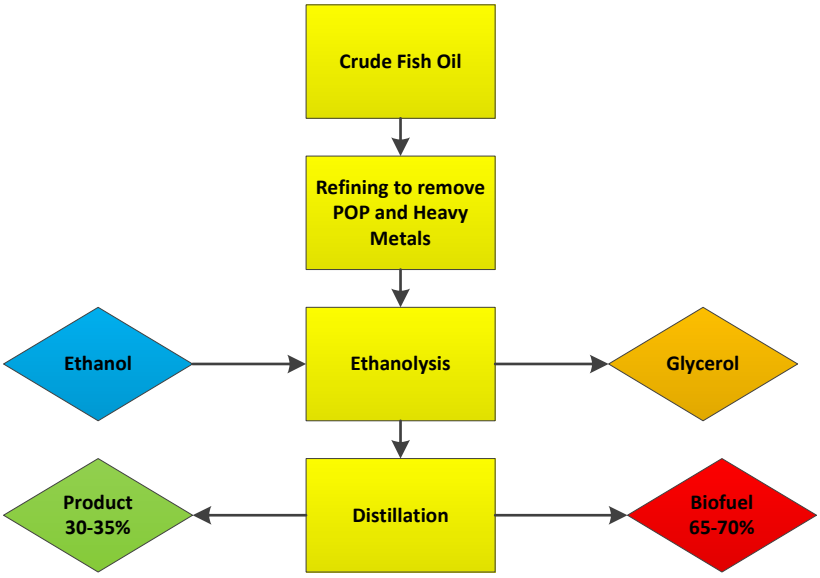

Figure 1 Typical production of Omega-3 Concentrates

The biofuel by-product from the Omega-3 industry is a rich source of polyunsaturated marine fatty-acids for Omega-6 and Omega-3. These fatty acids have high nutritional value and should not be discarded as fuel - which sadly is the case today.

The by-products come from a highly refined source and contain low levels of contaminants. The heavy metals and POPs concentration in these fractions are comparable to what is found in edible oils/food supplements.

The challenge for better utilization of this fraction is that the fatty acids are present as ethyl ester, and not as glycerides as in natural fats and oils and thus cannot be used for feed.

APC has developed a process to cost efficiently transforming the ethyl esters and glycerol into glycerides. This makes it possible to sell these fractions into feed and pet-food market and dramatically increase the value and margins for these volumes.

Andersen Process Consulting AS
P.O. Box 1027 Valaskjold - 1705 Sarpsborg – Norway
Tel: +47 69 52 04 91 – apc@apc-as.com - www.apc-as.com

A by-product of this process is absolute ethanol, which may be reused by the Omega-3 producers in their ethanolysis process step.

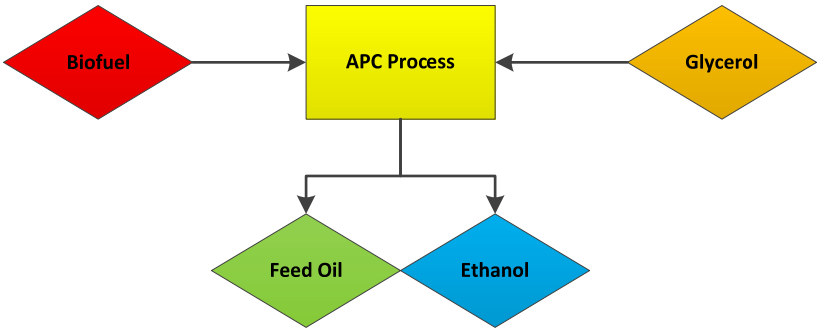

Figure 2 APC process for making feed oil

The conversion cost for the process is estimated to EUR 0,12 per kg EUR/kg feed oil, excluding depreciations. The yield of the process is in the range 120% of the ethyl esters into glycerides and approx. 90 - 100 kg of absolute ethanol will be produced during conversion. The ethanol can be collected and recycled as a raw material for ethanolysis.

Typical Product Specification of Feed Oil

Parameter	Typical
Tri-glycerides (TG)	70 %
Di-glycerides (DG)	20%
Mono-glycerides (MG)	5 %
Ethylester	3 %
FFA	1 %
Omega-3	Approx. 10%
PCBs	Max. 0.09 mg/kg
PCDDs / PCDFs	Max 2 pg WHO-PCDD/F-TEQ/g
Dioxin-like PCBs	Max 3 pg WHO-PCDD/F-TEQ/g
Heavy Metals	Pb < 0.1 mg/kg Cd < 0.1 mg/kg Hg < 0.1 mg/kg As < 0.1 mg/kg (inorganic)

For more information please contact:

Knut Lage Andersen
Managing Director
Direct call: +47 69 52 04 91
Mobile: +47 900 98 967
E-mail: knut.lage.andersen@apc-as.com

Thoralf Engebretsen
R&D Manager
Direct call: +47 69 52 04 96
Mobile: +47 91 35 20 09
E-mail: thoralf.engebretsen@apc-as.com