SepPure
Technologies

SepPure Technologies

CASE STUDY

Vegetable Oil Extraction and Refining

ENERGY-EFFICIENT VEGETABLE OIL EXTRACTION & REFINING

BACKGROUND

Vegetable oil production relies on energy intensive thermal processes for extraction and refining. Solvent recovery by distillation accounts for 50% of the energy usage in edible oil extraction.[1] Thermal based processes are also silent polluters as they release 32 million tonnes of CO_{2e} annually. Changing the driving force of separation from thermal to mechanical using membrane technology can substantially reduce energy consumption, CO_{2e} emissions and operating costs.

THE SepPure SOLUTION

Our chemically-resistant membranes have nano-sized pores that enable chemical separation at a molecular level with less reliance on heat. The nanofiltration membranes are fabricated from a high-performance polymeric material and chemically modified to produce chemical-resistant nanofilters that are stable in harsh organic solvents.

The highly selective layer of the membrane allows the smaller organic solvent molecules to permeate through, while larger oil molecules are rejected. The membranes are not only stable in organic solvents, but also resistant to acids and alkalis, and can withstand high temperatures. This presents an opportunity for the technology to be applied in processes that conventionally preclude membranes.

ADVANTAGES

SepPure's nanofiltration membrane technology reduces the energy consumption and waste generation of processes without compromising product quality. Our membrane solution can be combined with distillation units to provide significantly reduced thermal loads to realise:

- Up to **90%** reduction in energy consumption
- Up to **90%** reduction in carbon emissions
- Up to **90%** waste reduction
- Up to **50%** lower operating expenses
- ROI within **1-2 years**

SepPure GreenMem®

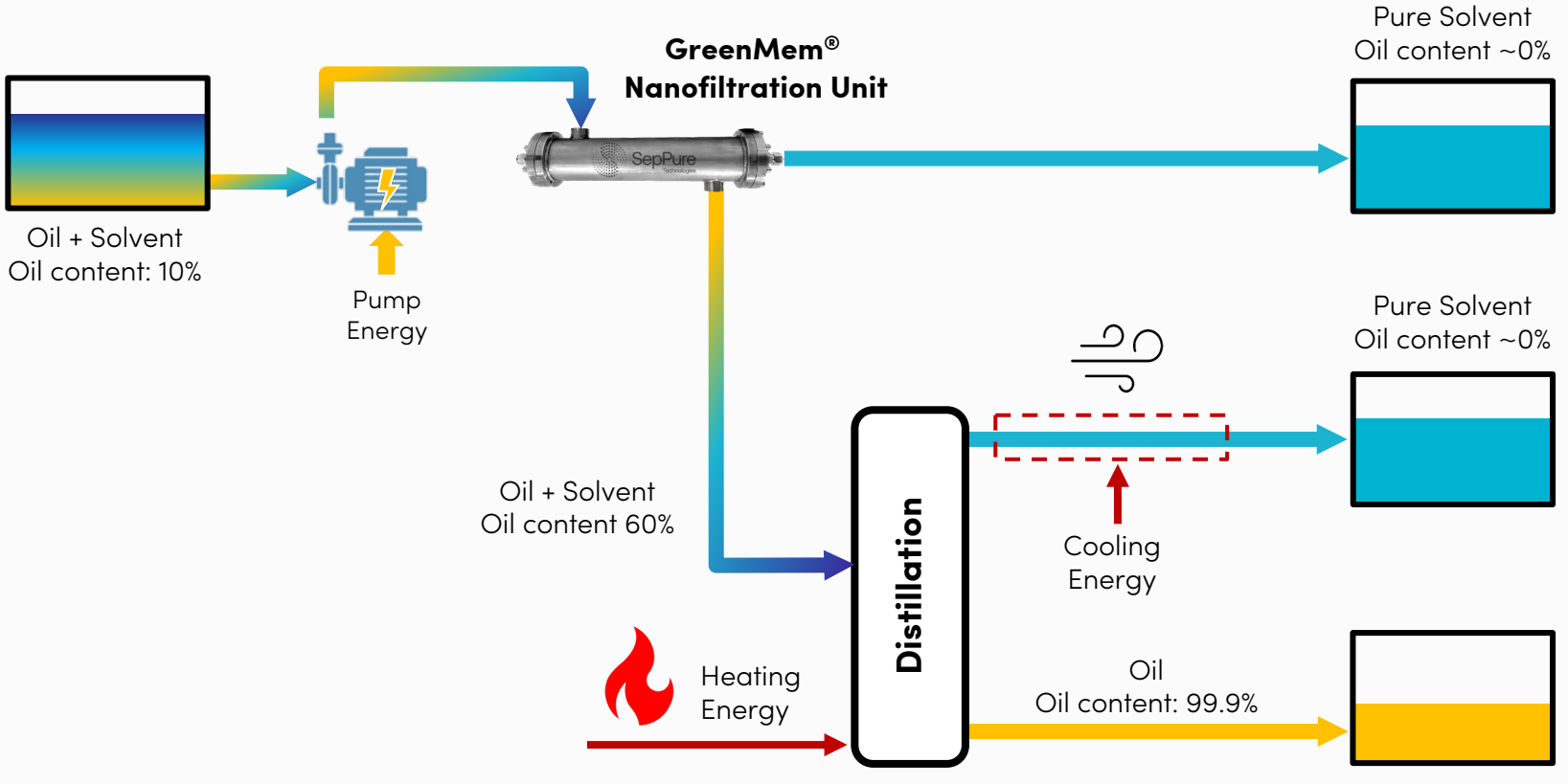
VEGETABLE OIL REFINING

A project with one of the leading producer of vegetable oil was successfully completed. SepPure GreenMem® membrane modules were used to separate the palm oil/acetone miscella. Results showed excellent membrane performance and positive environmental and economic impact of implementing the technology at the industrial scale.

[1]Darvishmanesh, S., et. al. (2012), JAOCS, 89(5), 959–960.

HYBRID SOLUTION GUARANTEES OIL QUALITY AND ENERGY SAVINGS

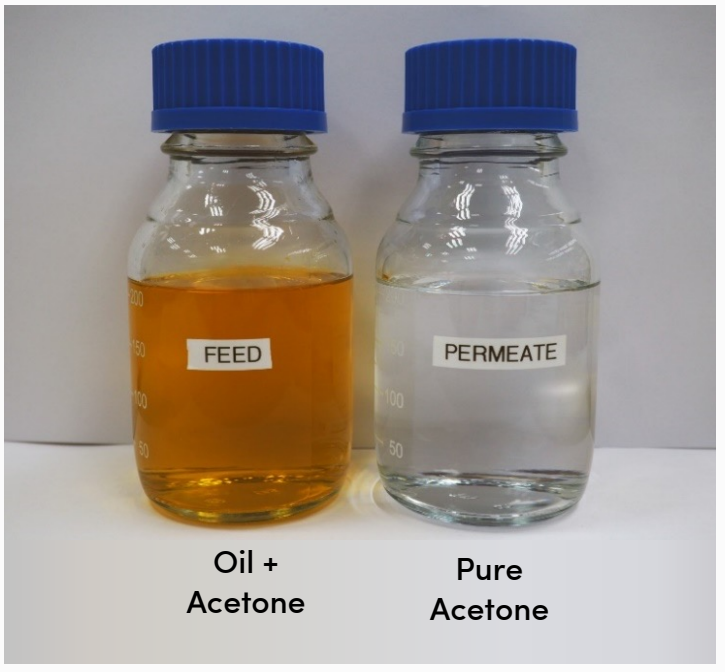
A practical use case of implementing SepPure's nanofiltration technology in a hybrid process to recover acetone during the extraction of RBD palm oil is illustrated below.



PERFORMANCE

10% Palm Oil , 90% Acetone
Temperature: 50°C, Pressure: 15 bar

Pressure (bar)	4040 Module Flow rate (LPH)	Oil Rejection (%)
15	1000	>99



SepPure vs MARKET LEADER

10% Oil , 90% Acetone

Membrane	GreenMem®	Market Leader*
4040 module flow rate (LPH)	950	150
Rejection (%)	99	86

* Journal of Membrane Science 588 (2019) 117202

Tests performed using GreenMem® showed an average oil rejection of ~99%. The GreenMem® products archived ~15% higher oil rejections and 6 times the permeance compared to the market-leading product performed under the same conditions.

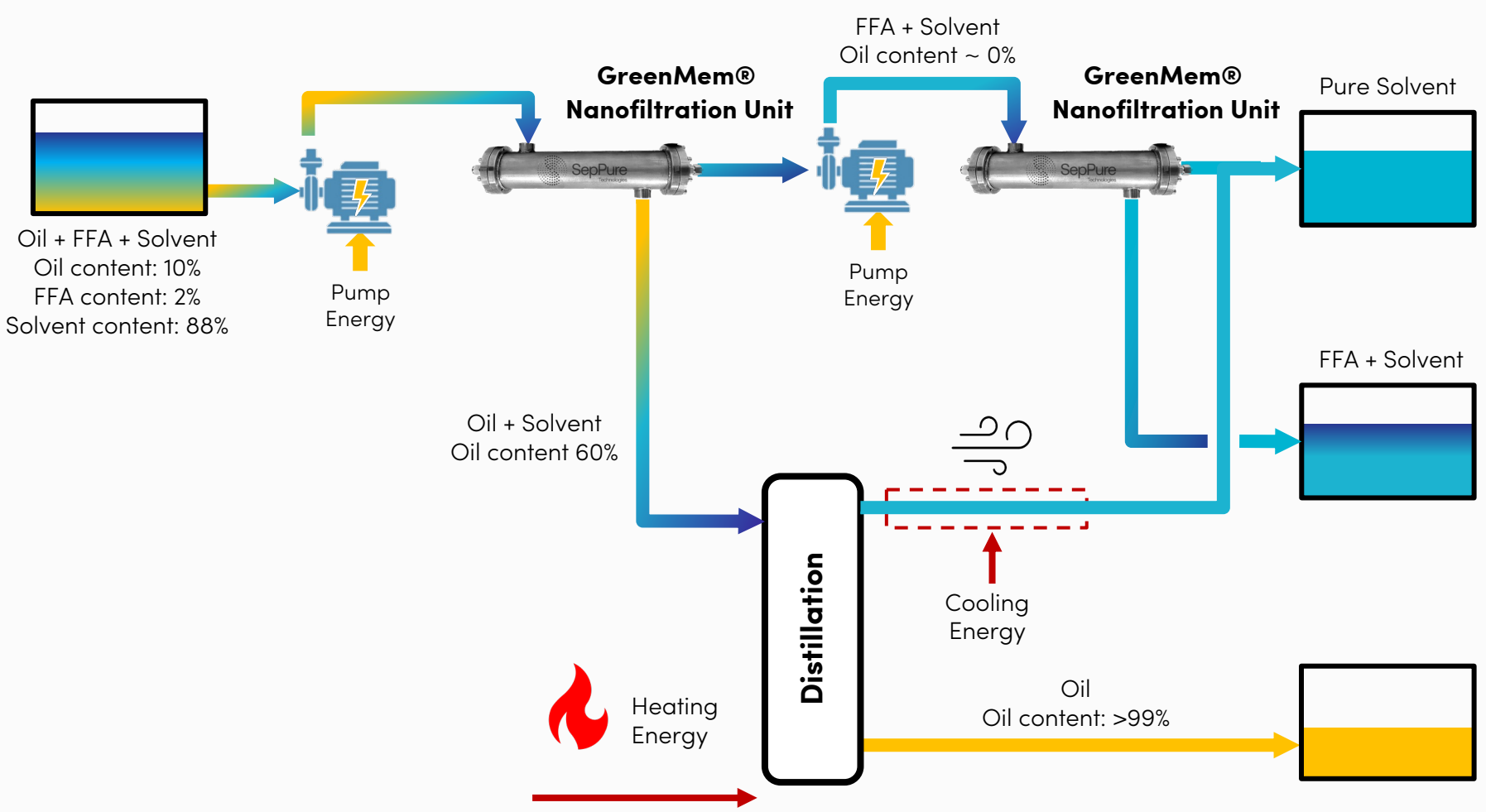
RESOURCE-EFFICIENT FREE FATTY ACID REMOVAL

Chemical deacidification using caustic leads to considerable oil loss due to hydrolysis of neutral oil and its occlusion by soap stock. The process effluent also needs to be chemically treated, adding further to the cost of production. The conventional alternative is not much better - physical deacidification uses steam and requires high energy-consumption and cost.

SepPure nanofiltration membrane technology offers a more resource-efficient method to remove Free Fatty Acids (FFA), while avoiding all the limitations associated with conventional processes. Hence, implementing SepPure nanofiltration solution help lower energy consumption and operating costs while minimizing yield loss.

FFA removal process:

1. Oil containing FFA is dissolved in solvent (10% oil in 90% solvent)
2. Oil/FFA/Solvent feed is sent to 1st stage nanofiltration unit to concentrate Oil to 60%-70%
3. Concentrated oil from 1st stage is sent to a distillation unit to remove the remaining solvent
4. Permeate from 1st stage, which is a mixture of FFA and Solvent, is sent to the 2nd stage nanofiltration unit which separates FFA from the solvent.
5. Solvent with high degree of purity is recovered and reused at the beginning of the process



10% FFA (Oleic Acid), 90% Acetone
Temperature: 45°C, Pressure: 10-15 bar

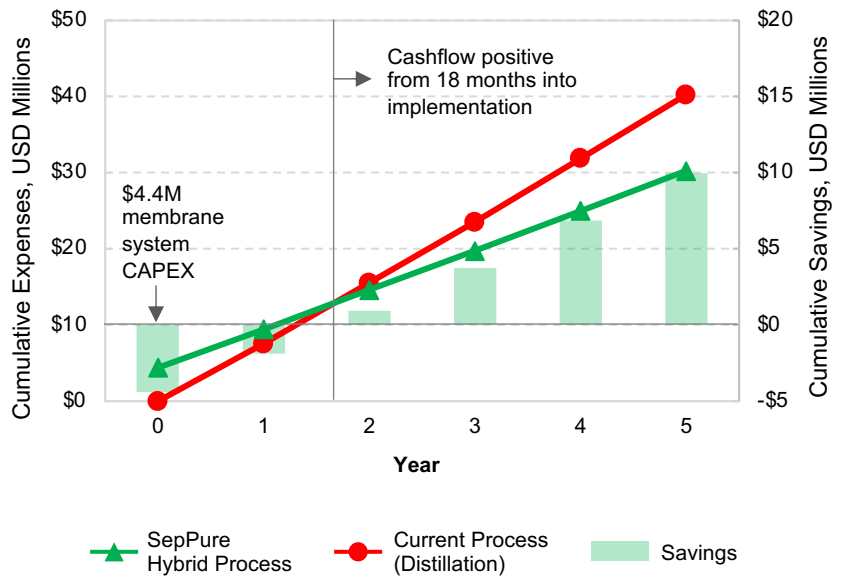
Pressure (bar)	Flux (LPH)	Oil Rejection (%)
10	200	>98

Benefits

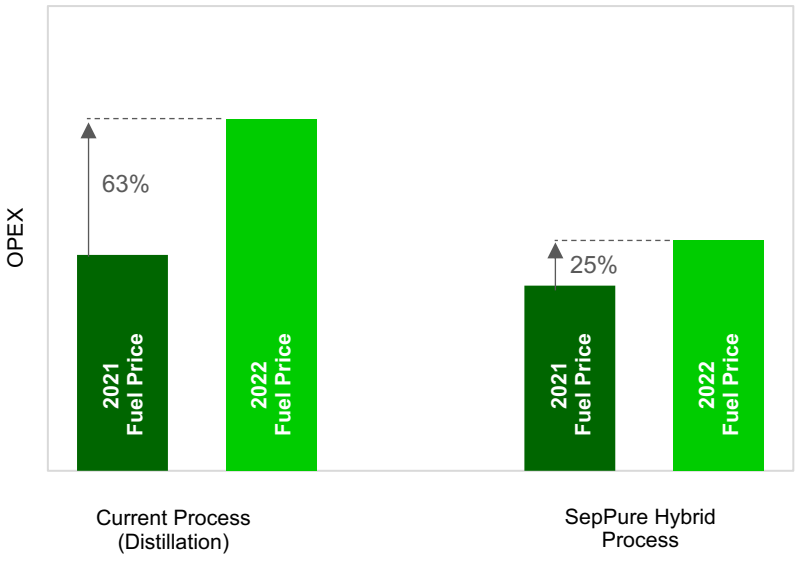
- No use of Caustic
- No oil loss to soap stock
- No effluent treatment
- Saves energy

ECONOMIC BENEFITS

SepPure hybrid process implemented in a 100K MT oil per year plant breakeven in less than 2 years with US$10 million in cumulative savings by Year 5



SepPure hybrid process is more energy-efficient and less reliant on fossil energy, cushioning operating expenses against dramatic changes in the cost of fuel

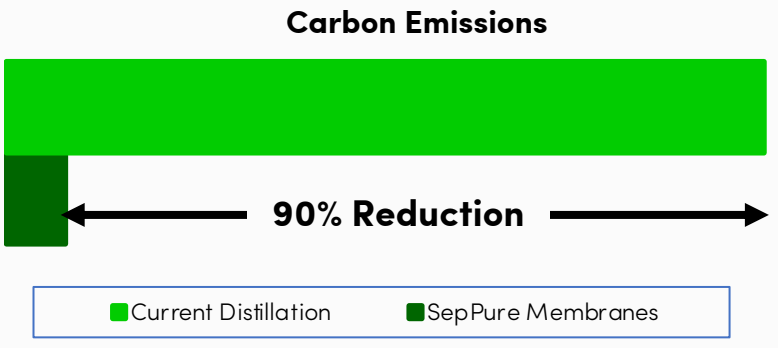


The producer can reap significant economic benefits with the implementation of a hybrid oil extraction process in its 100,000 metric tonnes of oil/year plant. We considered the fuel prices in 2021 and 2022 in the OPEX calculation whereby the fuel price for 2022 is double that of 2021. After an initial capital expenditure of $4.4 million for the membrane system, the investment will break even in fewer than 2 years and consistently generate positive cash flows in subsequent years.

Unlike distillation, SepPure hybrid process is less sensitive to large changes in fuel prices. When fuel prices doubled in 2022 from 2021 values, OPEX under the current distillation process jumped by 63%. In comparison, OPEX for the hybrid process only increased by 25%. As the vegetable oil industry operates on a thin margin, the reduced reliance on fossil energy and stable production cost are advantageous.

ENVIRONMENTAL IMPACT

SepPure's nanofiltration membrane solution lowers the carbon footprint in vegetable oil production. Tests conducted with vegetable oil producers have demonstrated that our innovative and energy-efficient hybrid process is able to reduce energy demand and carbon footprint by up to 90%.



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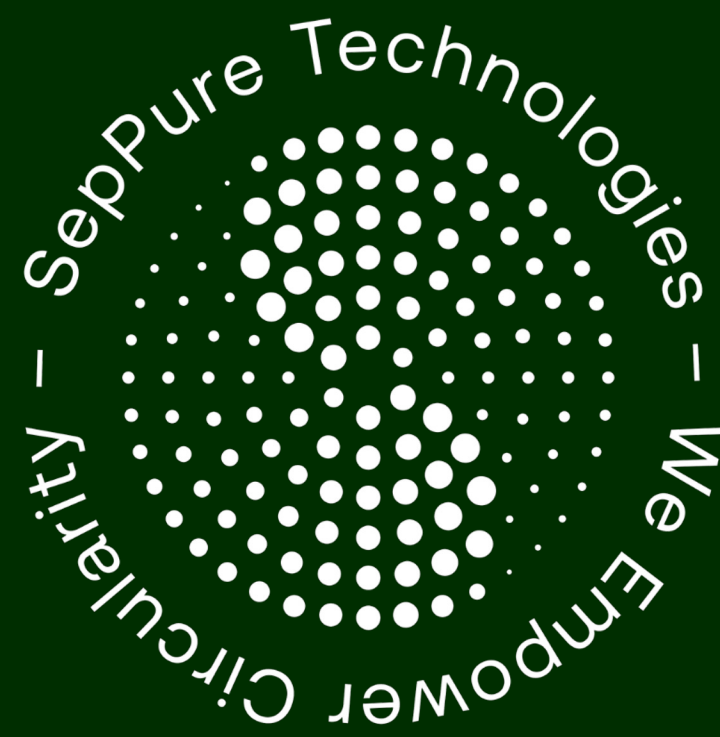
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We Empower Circularity