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Biodiesel from Low Grade Feedstock

IChemE

Palm Oil Processing
Special Interest Group

Science behind Technology

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DESMET BALLESTRA

The Desmet Ballestra Group is a company involved in developing, engineering and supplying technologies, processing plants and proprietary equipment for the following business divisions:

Oils & Fats
Oleochemicals
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OFO
Oils & Fats
Oleochemicals & Biodiesel
Technologies

Detergents
Surfactants
Soap &
Chemicals
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DSSC
Detergents, Surfactants
Soap & Chemicals
Plants

Rosedowns
Stolz
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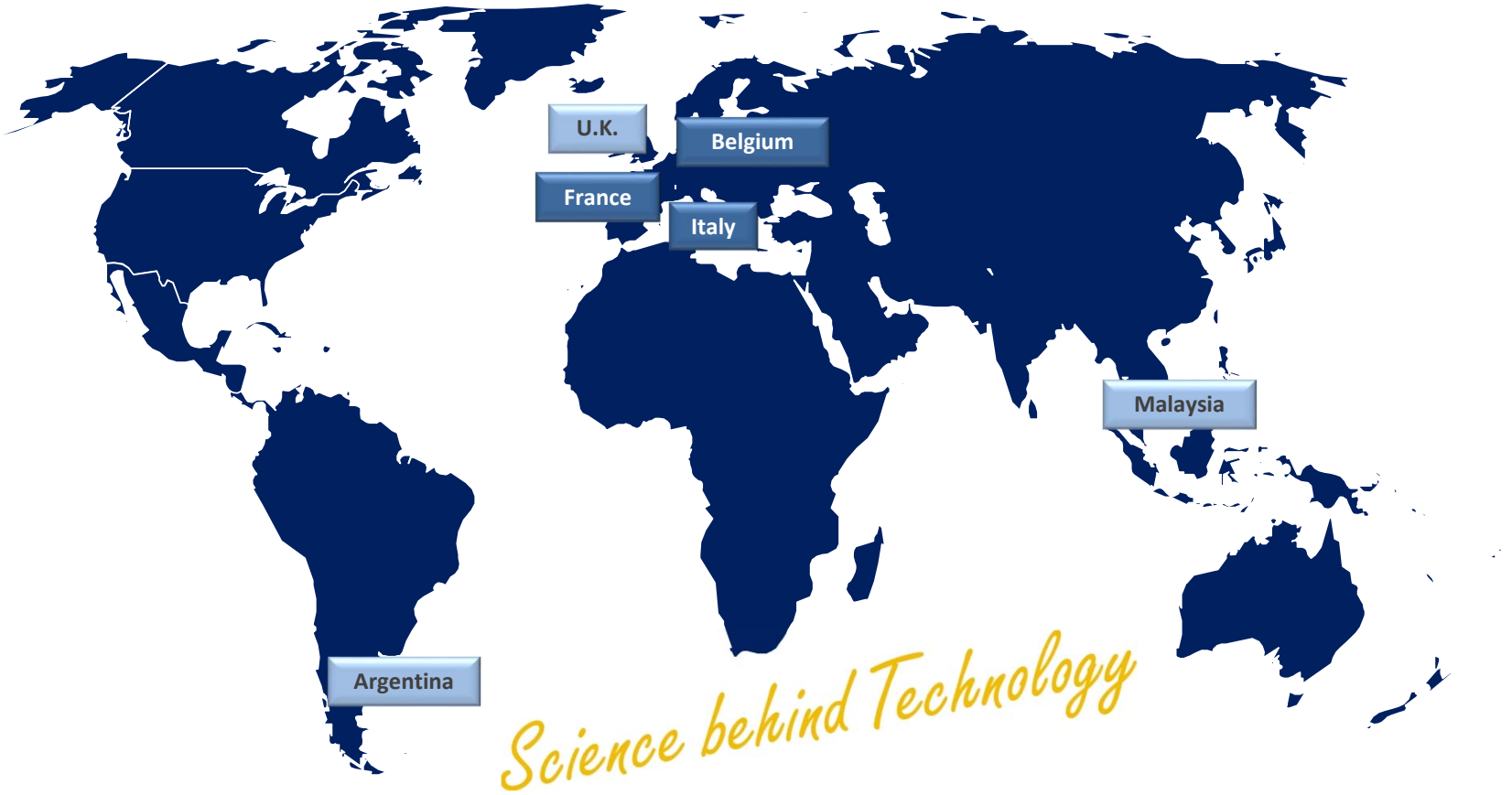
OSFE
Rosedowns Pressing
Stolz Animal Feed & Agro
Food Equipment

Strong R&D and Innovation: R&D centers



R&D centers with Pilots Plants

Pilot Plants Facilities

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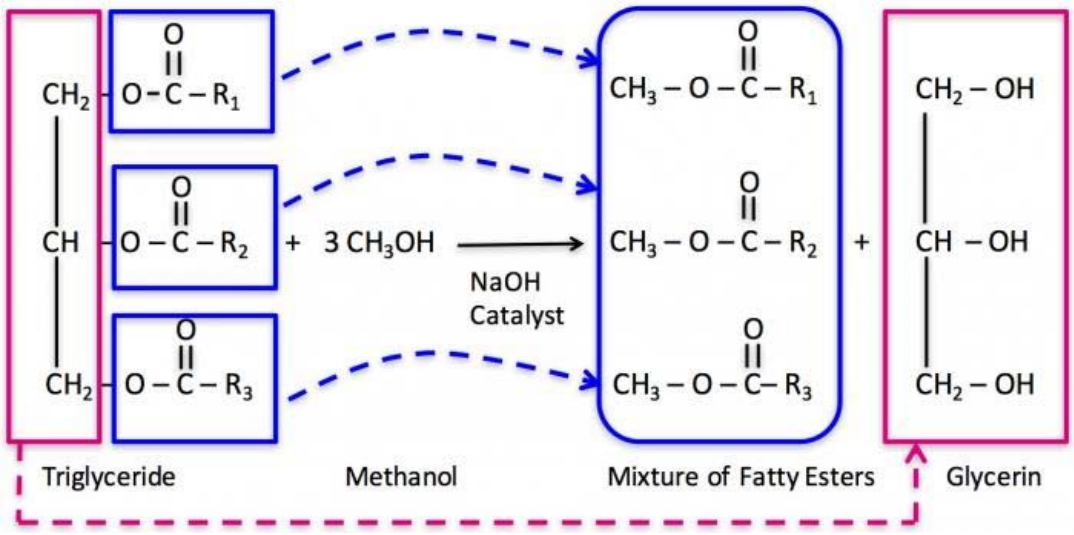
What is Biodiesel ?

"Biodiesel" is an alternative fuel similar to conventional fossil diesel, which meant to be used in standard diesel engines.

It can be used alone or blended with fossil diesel in any proportions.

There are 2 generations of Biodiesel.

Refined Vegetable Oil



Food Applications

1ST Generation Biodiesel

- Sustainability in question. Feedstock did not served the ***"food"*** purpose.

However …..

The increasing criticism of the "sustainability" of first-generation biodiesels has raised attention to the use of so-called "**second-generation biodiesels**"

The **“second generation Biodiesel”**, differentiate from first generation since the feedstock used are generally not food crops.

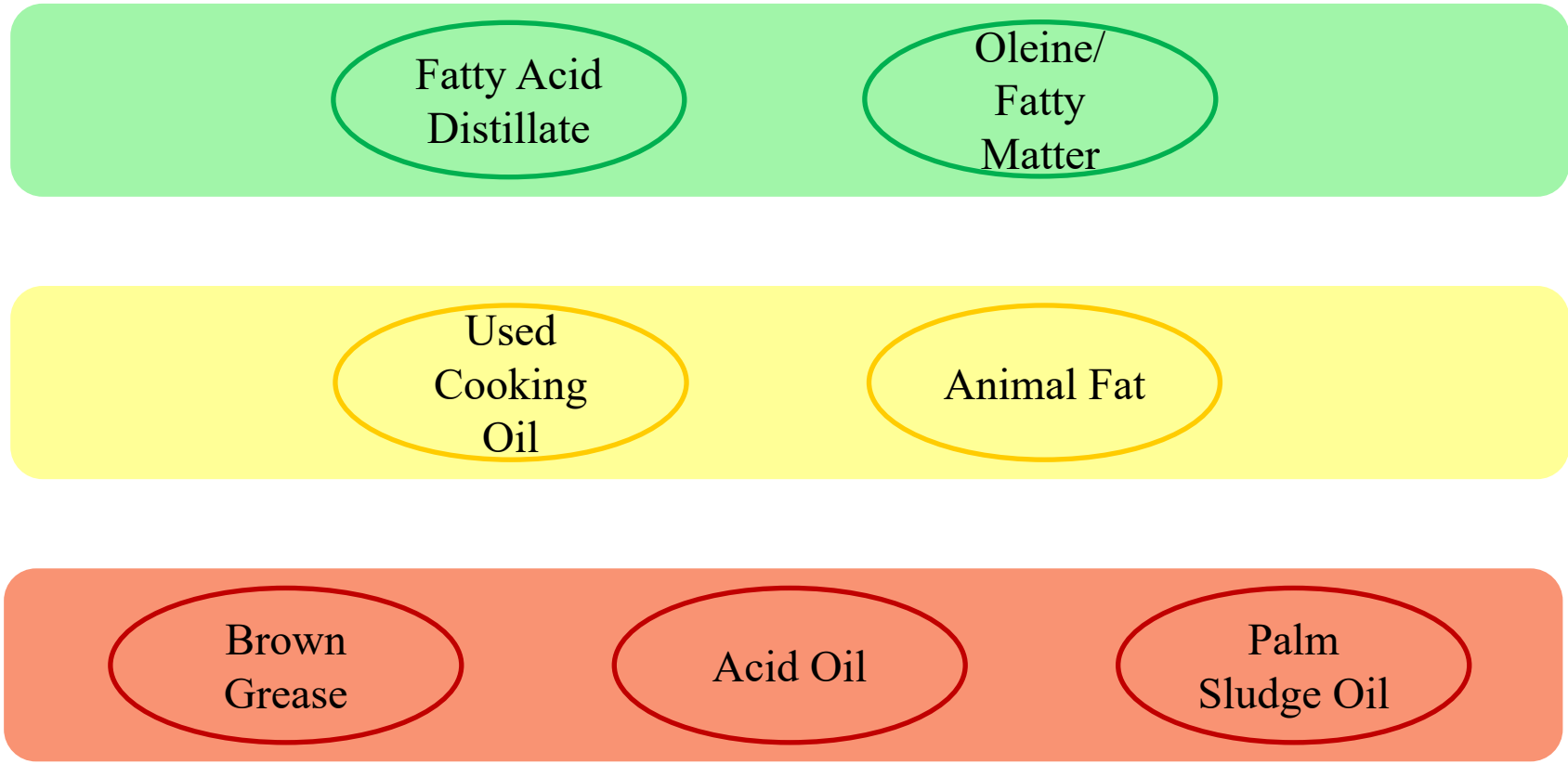
The only time the food crops be used to produce second generation biodiesel is if they have already fulfilled their food purpose.

Based on this, used cooking oil can be considered as one of the **“Low Grade Feedstock”** for second generation biodiesel since it has already been used and is no longer fit for human consumption.

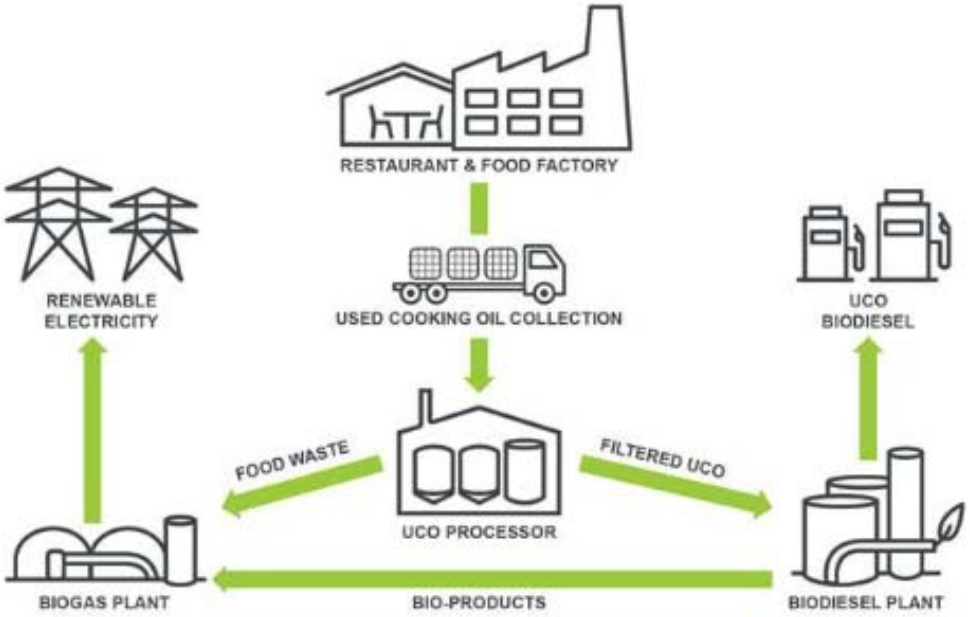
Moving towards Low Grade Feedstock

- Competition with food crops that in addition may be shortly (partially) banned
- Contribution to higher food price
- Limited GHG reduction (deforestation)
- Is an expensive product taking into account total production cost
- The economical sustainability is only given by government grants and subsidies

Common Low Grade Feedstock



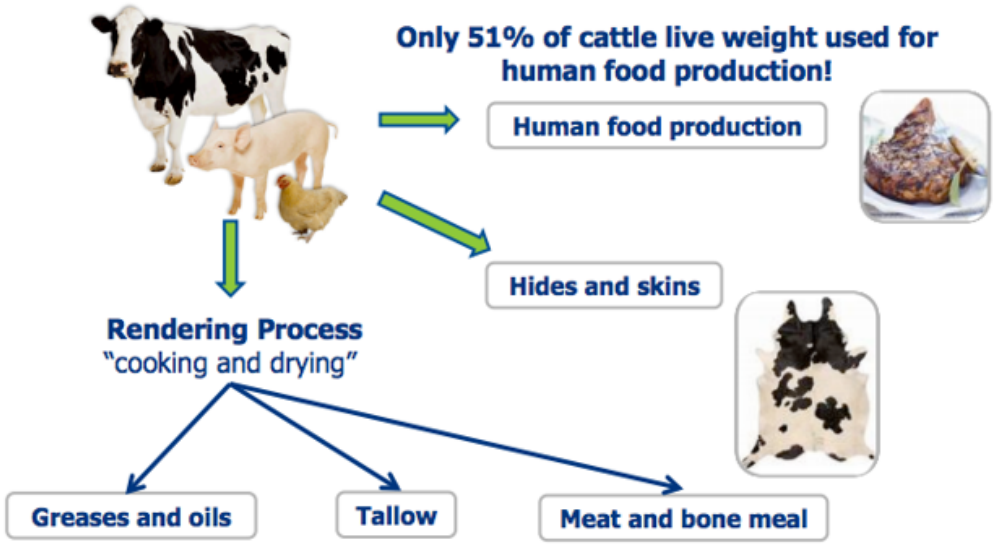
Used Cooking Oil (UCO)



UCO are oils and fats that have been used for cooking or frying in the food processing industry, restaurants, fast foods and at a consumer level, in household.

They are normally collected and recycled for other uses, one of which being the Biodiesel production. Common UCO are palm and soybean oil based.

Animal Fats (AF)



AF are waste fat from animal obtained during rendering process:

Category 3 Fat: Animal fat suitable for use in animal feeds

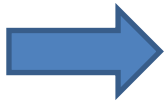
Category 2 Fat :Animal fat suitable for use in industry

Category 1 Fat : Animal fat suitable for generating energy

Common AF are beef tallow, pork lard and chicken fat.

Common Conversion Techniques for Biodiesel

Processing Technique	Targeted Feedstock	Conversion Condition	Remark
Base - catalyzed (Transesterification)	Refined Oil (very low FFA)	Mild	Best direct conversion
Acid - catalyzed (H_2SO_4/ LC-MSA)	High acidity oil	High temp & pressure	Post CTE/ Distillation
Acid - catalyzed (Cation exchange resin)	High acidity oil	Moderate temp & pressure	Post CTE/ Distillation
Enzymatic Transesterification (ETE)	Crude/ Partially Refined Oil	Low	Good direct conversion



Clean feedstock are required !

The request to use Low Grade Feedstock, on difference from standard vegetable oil, is extremely challenging since we are not dealing with well defined feedstock (soybean, rapeseed, palm oil and etc) in terms of properties and composition but…

- With a wide range of feedstock of as well wide range of properties and composition… that in addition may vary truck after truck on receiving.
- Even operator does not have clear mind on the feedstock they are going to treat; usual request is, any waste available on market in any possible blend.
- This request a very tailor made Process Design and relevant Operating Unit.

Low Grade Feedstock: Critical Specifications

Parameter	Critical Impact
FFA	Soap formation (reaction with catalyst)
P	Emulsion problem; Biodiesel spec.
Ca+Mg	Interphase problem; Biodiesel spec.
Fe	Catalyst for oxidation
S	Biodiesel spec.
Polymeric material (only in UCO)	Biodiesel distillation yield

How to produce In-Spec Biodiesel out of this extremely contaminated Low Grade Feedstock?

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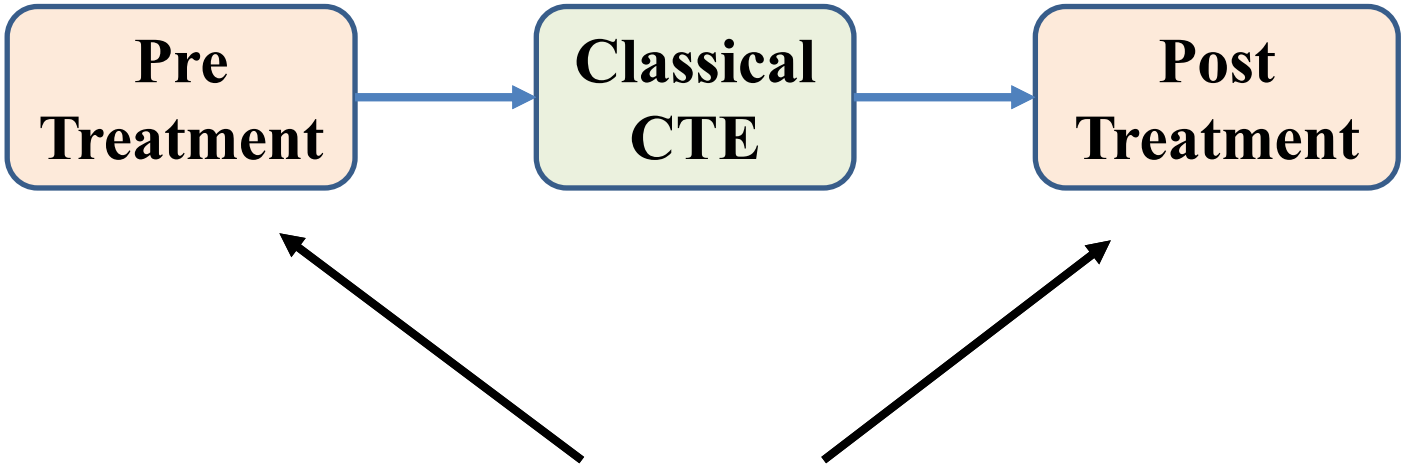
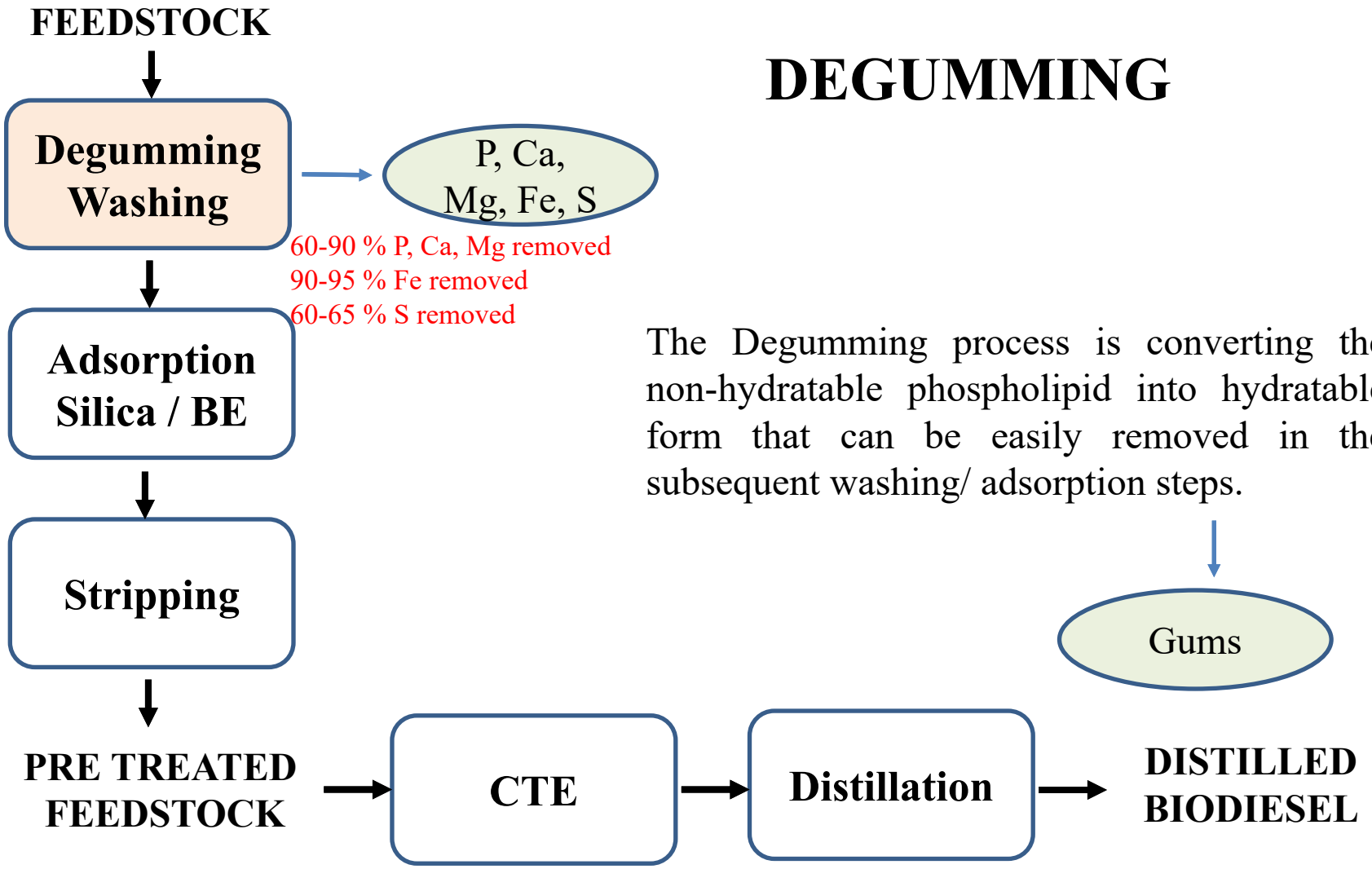
Standard Biodiesel Plant remain unchanged



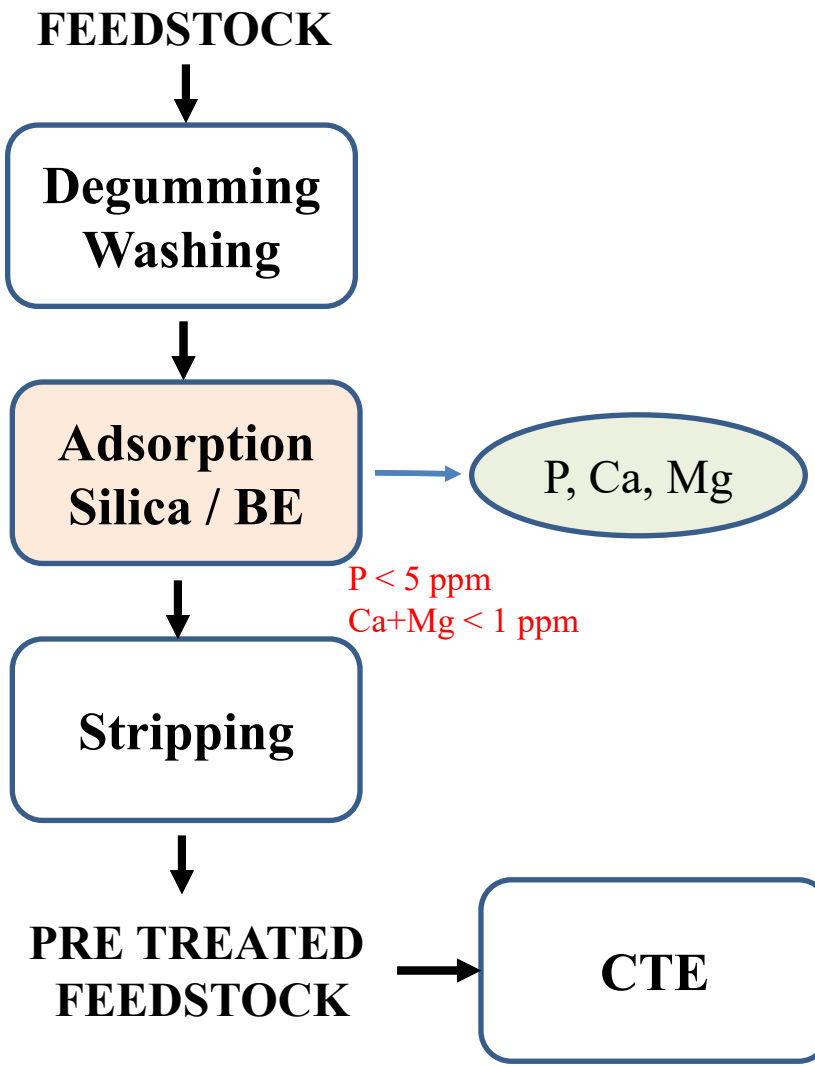
Additional Unit required to remove impurities

DEGUMMING

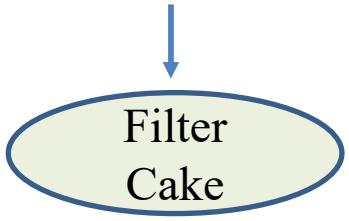


The Degumming process is converting the non-hydratable phospholipid into hydratable form that can be easily removed in the subsequent washing/ adsorption steps.

ADSORPTION

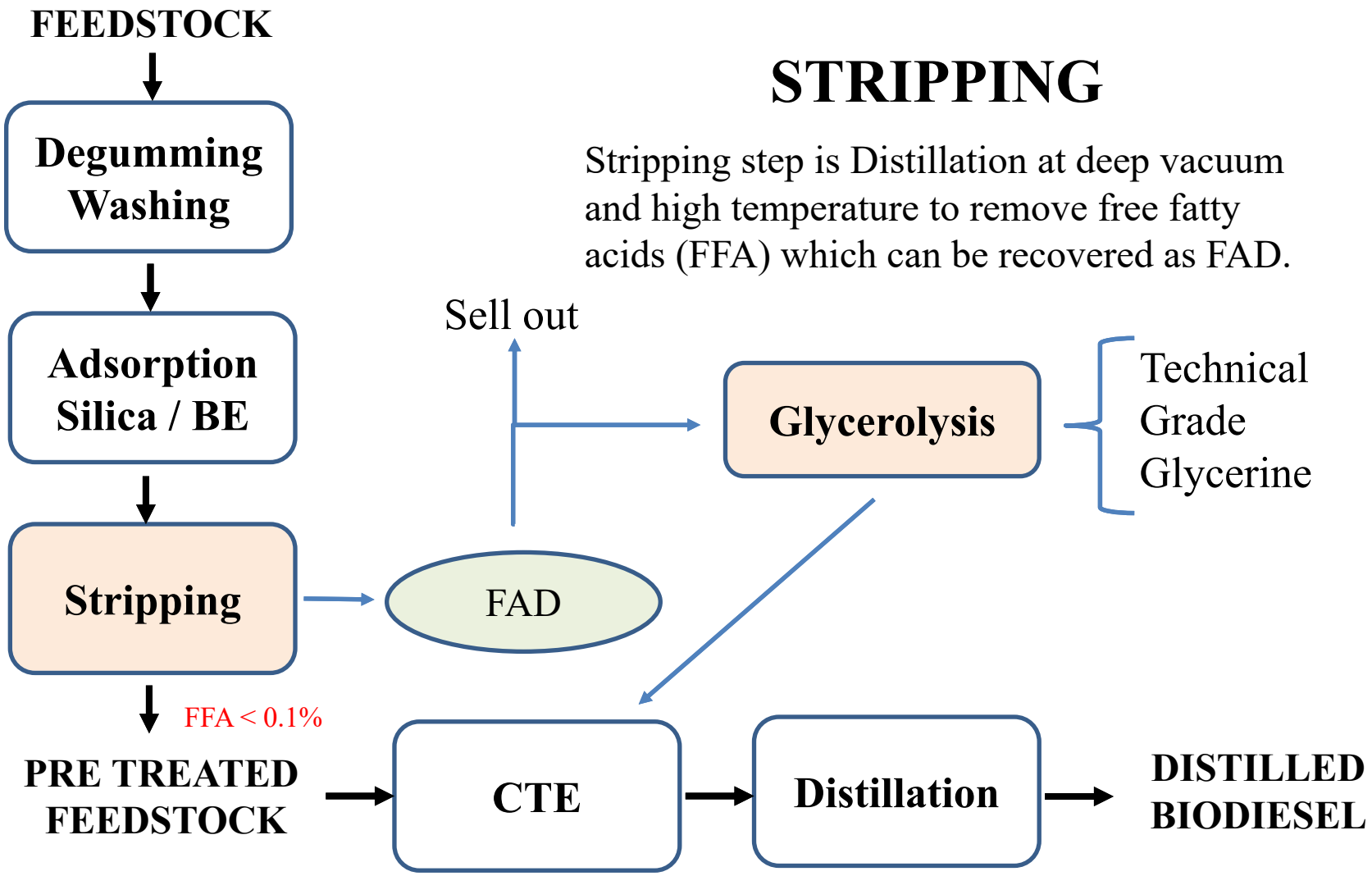


Adsorption by Silica or Bleaching Earth in combination with filtration is a crucial step to remove impurities (soaps, phospholipids, oxidation agent, trace metals and other contaminants) prior to subsequent stripping step.



STRIPPING

Stripping step is Distillation at deep vacuum and high temperature to remove free fatty acids (FFA) which can be recovered as FAD.



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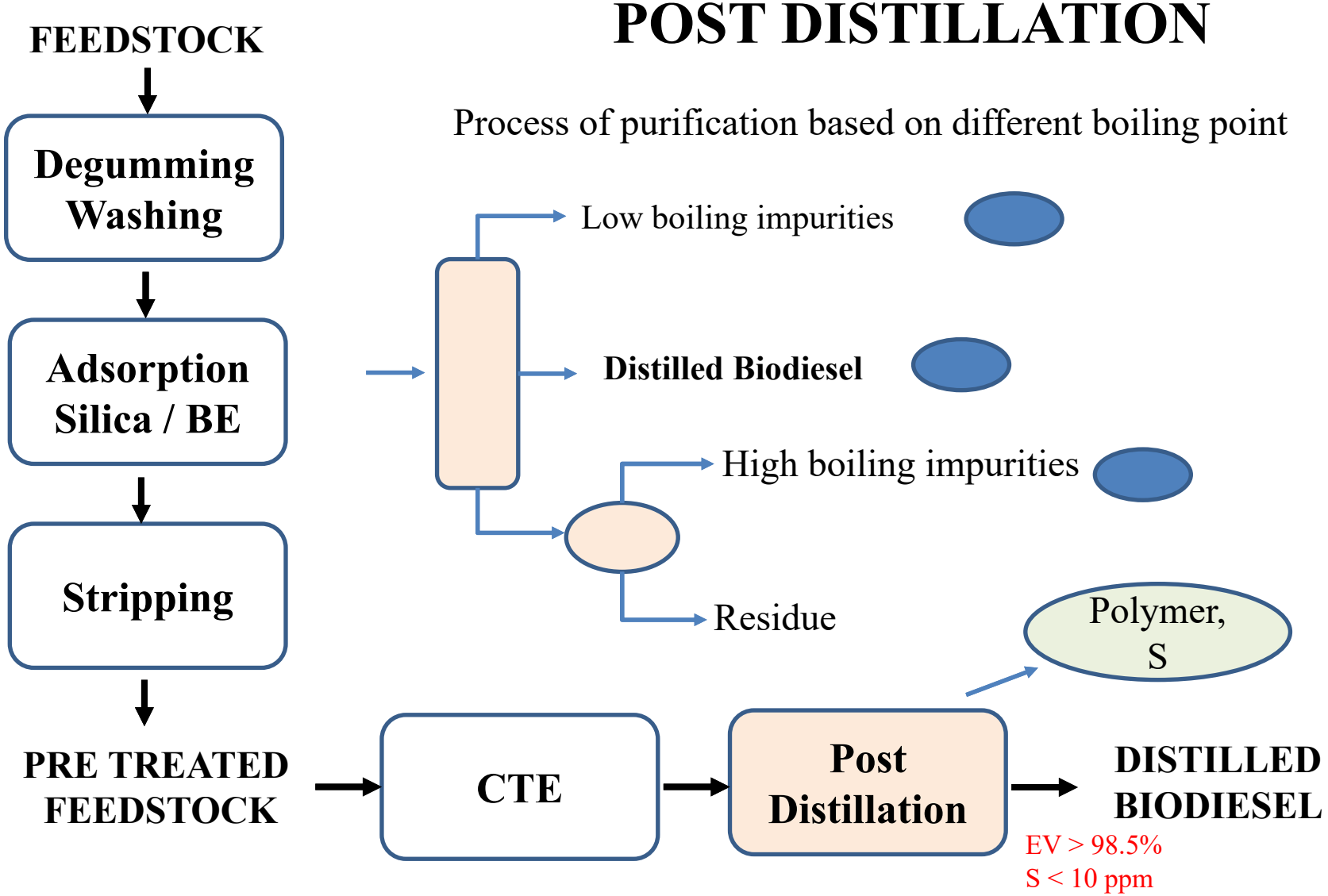
POST DISTILLATION

Process of purification based on different boiling point



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Challenges of processing UCO/ AF in Biodiesel

- ✓ Much higher impurities compared to standard vegetable oils.
- ✓ Inconsistency / variation of incoming feedstock specification.
- ✓ Difficulties in standardizing the process configuration & consumption.
- ✓ Difficulties in fixing the feedstock pricing and operating cost.
- ✓ Needs of experience to design the most suitable and flexible process

Benefit Working with Desmet Ballestra

- ✓ More than 115 Biodiesel plants installed worldwide.
- ✓ Experienced project execution and process engineer available.
- ✓ Specialized R&D centre and scientists; conducted hundreds of trials on Low Grade Feedstock conversion to Biodiesel. This help client to faster define the tailor made processing unit and estimation of CAPEX/ OPEX.

Thank you

for your attention!

Science behind Technology

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