oleochemicals

desmet ballestra

Science behind Technology

Generating clean & sustainable energy

Biodiesel Technologies

#048

Desmet Ballestra : The right partner

Introduction

Desmet Ballestra is an engineering group operating all over the world in the oils & fats industry and various areas of the organic/inorganic chemical industry but with a special skill in the design and supply of process units for the production of surfactants, formulated detergents and other raw materials for personal and home care products.

In this field Desmet Ballestra holds the leading position with over 1,000 plants supplied in more than 100 countries and for clients ranging from small producers to large multinational companies.

Desmet Ballestra started the development of the Methylester Technology in the early eighties through an intensive R&D program in the field of the methylester production, mainly finalized to the production of a convenient raw materials for surfactant production as alternative to LAB and fatty alcohol.

As a logical consequence of the deep experience acquired in the esterification of surfactants intermediate products, Desmet Ballestra has developed a continuous transesterification process to produce Diesel-Fuel Substitutes (BIODIESEL) starting from a wide range of vegetables oils of various purity (crude/neutral/refined), including exhaust and “fried” oils from edible/food applications without the need for a full refining step up-stream.

This flexibility allows to use raw material cheaper than traditional processes based only on refined oils.

Desmet Ballestra is nowadays in a position to design and to supply Biodiesel production plants sized in a wide range of production capacities (from 10,000 up to 200,000 T/y), coping with the most stringent international standard specifications.

Optional units such as (upstream) Oil Refining and (downstream) Glycerine Upgrading can be added, upon customer request.

A continuous-type industrial plant of 30,000 tons/y has been then installed at the Estereco factory in Umbertide. This plant has been started-up in 1993 and since then it is producing biodiesel, meeting the latest and most stringent European quality standards.

Desmet Ballestra was also awarded a turn-key contract for another 30,000 tons/y methylester production plant form rapeseed oil to be installed in Germany and has developed the basic engineering for plants having capacity ranging up to 150,000 tons/y.

Desmet Ballestra has been recently awarded a contract for the design of a new biodiesel plant having a capacity of 100.000 TPY based on continuous transesterification technology to be installed in Livorno, Italy for Novaol (Bunge Group) which is the major biodiesel producer in Europe.

The new plant was started-up in November 2004.

In the mean time 2 new biodiesel plants are under construction in Greece and Portugal.

The biodiesel can be produced meeting the latest and most stringent European and/or US ASTM standard specifications.

desmet ballestra

.....for your Biodiesel Project

Technology

The Ballestra Technology is based on a 3-step Continuous Transesterification Unit that allows to operate under mild operating conditions with constant quality and minimised specific consumption of raw materials and energy.

The plant design is targeted also to reduce to a negligible extent the process effluents with consequent virtual elimination of pollutant and process wastes.

Overall scheme

The overall technological scheme offered by Ballestra for the production of Biodiesel and Glycerine starting from seeds and/or crude/neutral and/or refined vegetable oils, mainly:

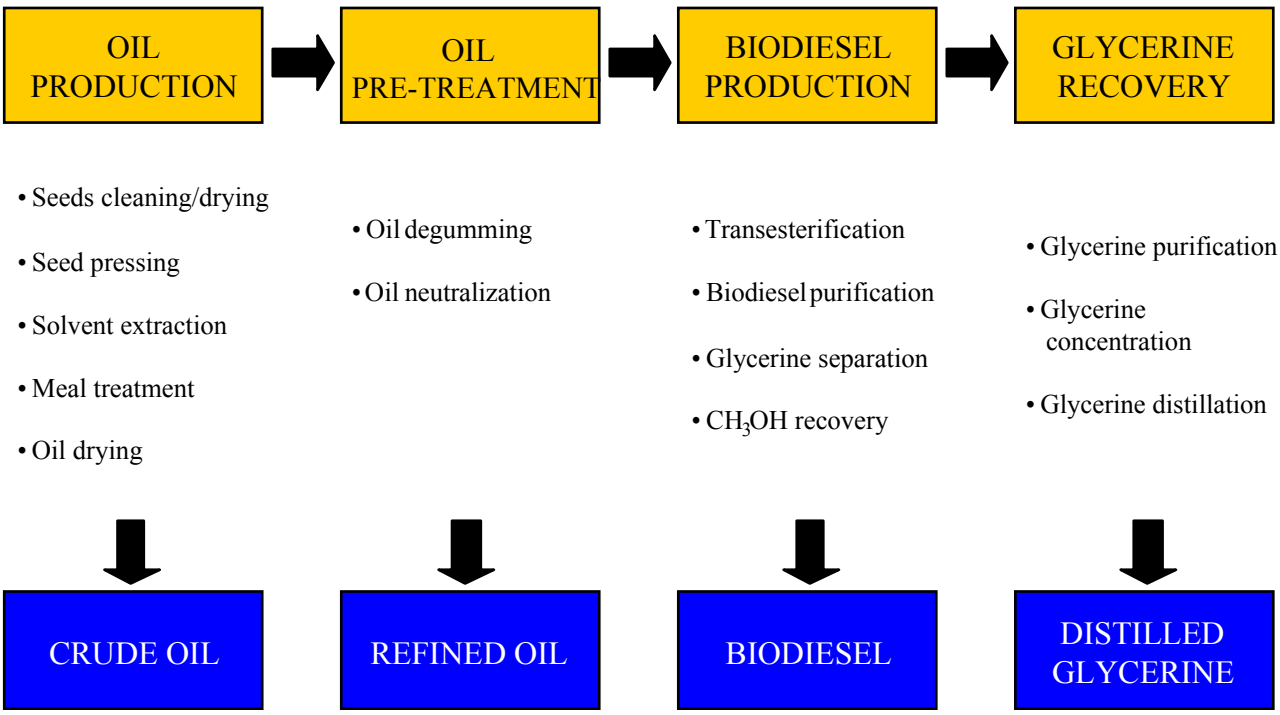
- rapeseeds
- sunflower
- soybean
- recovered fried oil

is summarised here below:

oleochemicals

desmet ballestra

DESMET BALLESTRA BIODIESEL TECHNOLOGY



OPERATING PRINCIPLES

How does it operate?

The Biodiesel production section, namely the Transesterification of Oils and the Biodiesel Purification step are characterised by unique features that with reference to the illustrated Process Block Diagram, are here below described:

The transesterification reaction is accomplished in 3 steps with a methanol surplus with respect to the stoichiometric quantity, using an alkali methylate in anhydrous methanol solution as a catalyst.

Methanol and catalyst are dosed and recycled to the 3 reaction steps within prefixed rates.

Reaction temperatures are lower than 60°C and pressure is max 0,5 bar(g). Overall residence time of the whole plant is 2 hours approx.

High yields

The yield of the continuous transesterification is 99,8% calculated as ratio of Neutral / Refined Oil fed to the transesterification versus the produced Biodiesel

At the end of the transesterification process, two phases are accurately separated.

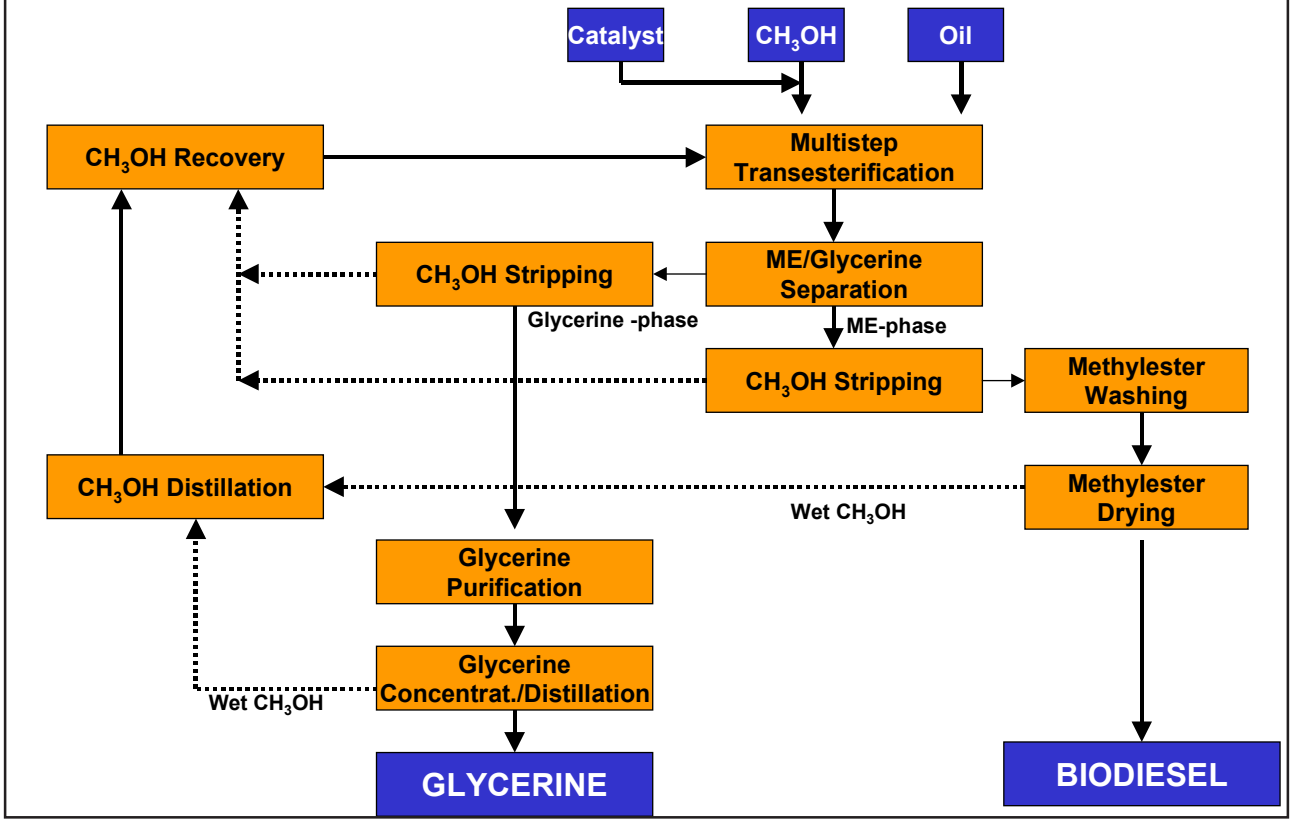
Purification of the upper methylester phase involves separation of unreacted methanol, washing with water solutions and final drying.

Purification of the lower glycerine phase involves: neutralisation, separation of unreacted methanol, dilution with wash liquid stream coming from methylester washing, splitting of soaps and final concentration up to 88 - 90%.

High Quality Glycerine

Partially refined glycerine can be delivered as such or sent to the upgrading-distillation section up to pharmaceutical grade meeting the most stringent pharmacopea specifications.

BIODIESEL PRODUCTION DIAGRAM



MAIN ADVANTAGES

These operations are performed by means of process sequence and equipment characterised by:

- Mild operating conditions
- Completely Computerised Process Control System
- Simple mechanical design of the process equipment and negligible maintenance demand
- Small overall dimensions of the Units and equipment

In particular the Transesterification step entails these peculiarities:

- Continuous operation-mode with multiple glycerine separation for each single step
- Enhanced reactor Kinetics due to the “Solvation” effect of the excess Methanol vs. the quantity of oil to be reacted
- Limited product hold-up
- Operation flexibility deriving from the possibility to dose the reactants to the 3 steps in variable and specifically pre-set quantities
- Possibility to process oils of widely variable quality and origin
- Easy and accurate control of the process key-parameters (temperatures pressures and flow rates)

When accounting for the kinetics aspects of the transesterification reaction, a continuous process shows peculiar advantages with respect to the traditional batch process, as herebelow detailed:

The initial step of the reaction consists in the solvation of the oil molecules by the excess reactant (methanol); this step is slow, due to the scarce affinity between the two reactants and is accelerated by the presence of methylester that, being a mutual solvent, acts as a “phase transfer agent”.

In a batch system, where no methylester is initially present in the reaction mixture, the transesterification reaction requires, therefore, a dwell time before appreciable amount of methylester are produced.
Conversely, in a continuous process, the two reactants are fed to a reaction mixture containing the steady state methylester amount, and the overall kinetics is enhanced by the resulting fast contact between the two reactants.

An almost tenfold viscosity reduction is observed when oil is converted to methylester; the steady state viscosity of a continuous reactor is, therefore, consistently lower than the initial reaction mixture viscosity of a batch system, which allows an overall higher mixing intensity at comparable mixing energy inputs.

The above aspects add up to the general advantages of a continuous process (reduced equipment sizes at given plant capacity thanks to the elimination of loading/unloading dead times, reduced energy and utilities consumption, easier automation of process control, higher product quality uniformity), making it almost a must, once the economics of a commercial scale plant are accounted for.

As for the plant safety management, the reduced reaction volumes imply that much lower methanol amounts are present at any time in the process sections, which greatly reduces the fire hazard.

A further feature, unique to the Ballestra continuous process, resides in the dedicated reactors design, which allows the continuous separation of the glycerine phase from the reaction mixture within each of the three reaction steps.

This allows shifting the reaction equilibrium toward the products, so maximising the yield, and to minimise the catalyst consumption.

As for the downstream Methylester purification unit, the Ballestra technology foresees the following steps:

- Evaporation (BEFORE the Methylester washing section) of most (85% approx.) of the unreacted methanol in dry form, suitable for direct recycle to the transesterification section.
- Washing of the residual glycerine and soaps by means of water; the water phase leaving from this section is recycled to the glycerine purification section
- Final Methylester drying; the wet methanol stream separated in this section is sent to a rectification unit, in order to recover it to the transesterification section.

KEY-FEATURES of BIODIESEL PRODUCTION

1)Continuous **Multistep**Transesterification of oils with multiple glycerine separation

2)**Mild** Operating Conditions and **High Operation Safety**

3)Complete **Computer Control** of the Process

4)Equipment of **simple** mechanical design, with high efficiency and negligible maintenance

5)Well **proven** technology for oil production and refining

6)**State-of-the-Art** Technology for Glycerine purification, concentration and distillation.

KEY-FEATURES of TRANSESTERIFICATION

1)**Small** overall dimensions of process unit and equipment

2)**Three steps** reaction section

3)**Limited** product hold-up

4)**Easy and accurate** dosing of reactants

5)Glycerine **recuperation** at each reaction step.

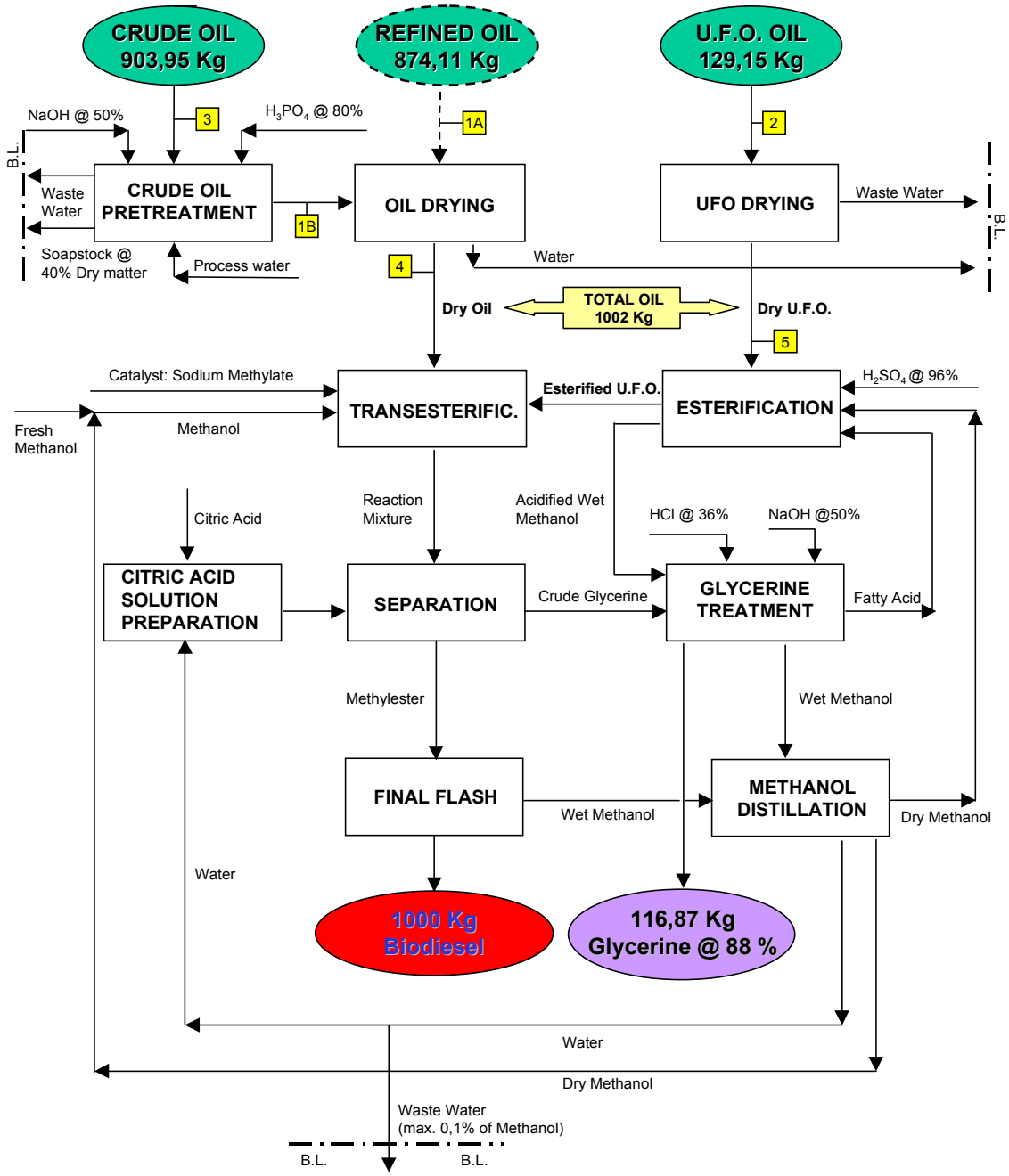
6)Enhanced reaction kinetic thanks to **"solvation"** effect of excess CH3OH versus oil to be reacted.

7)Possibility to process a **wide** range of natural oils.

Biodiesel according to european specification EN 14214

		Limits		
Property	**Unit**	**Min**	**Max**	**Test Method**
Density at 15°C	kg/m	860	900	EN ISO 3675+12185
Viscosity at 40°C	mm^2/s	3,5	5.0	EN ISO 3104
Flash point range	°C	120	-	ISO/CD 3679
Cold Test CFFP		Summer max 0°C Winter max.-20°C		
Sulphur content	mg/kg	-	10	
Carbon residue	% (m/m)	-	0.3	EN ISO 10370
Acid value	mg KOH/g		0.5	prEN 14104
Cetane number		51.0		EN ISO 5165
Ash Content	% (m/m)	-	0.02	ISO 3987
Water content	mg/kg	-	500	EN ISO 12937
Sediment	Vol.%		0.05	
Total contamination	mg/kg	-	24	EN 12662
Copper corrosion	rating	Class 1		EN ISO 2160
Oxidation Stability	hours	6	-	prEN 14112
Ester contact	% (m/m)	96.5		prEN 14103
Methanol content	% (m/m)		0.2	prEN 14110
Monoglycerides content	% (m/m)		0.8	prEN 14105
Triglycerides Content	% (m/m)		0.2	prEN 14105
Free glycerine Content	% (m/m)		0.02	prEN 14105+6
Total glycerine content	% (m/m)		0.25	prEN 14105
Iodine number			120	prEN 14111
Phosphorus	mg/kg		10	prEN 14107
Alkali content (Na+K)	mg/kg		5	prEN 14108+9

BIODIESEL PRODUCTION PLANT
BASE PLANT CONFIGURATION



Stream 1A + 1B
Refined oil: Rape-Soy-Sun

FFA:	0.1% max
Moisture:	0.1% max
Impurities:	0.1% max
Phosphor:	10 mg/Kg max
Unsaps:	1.0% max

Stream 2
U.F.O.: Used Frying Oil

FFA:	5% max
M&I:	0.5% max
Susp.solids:	0.5% max

Stream 3
Crude Oil: Rape-Soy

FFA:	2% max
M&I:	0.3% max
Phosfor:	300 mg/Kg max

Stream 4
Dry oil

FFA:	0.1% max
Moisture:	0.03% max
Impurities:	0.1% max
Phosphor:	10 mg/Kg max
Unsaps:	1.0% max

Stream 5
Dry U.F.O.: Used Frying Oil

FFA:	5% max
M&I:	0.03% max
Susp.solids:	0.5% max

Worldwide presence... close to you

On line info on our new Website

desmet ballestra

Global Solution Provider
for the edible oils and fats, oleochemical, surfactant, detergent, soap and chemical industries

press release | communiqué
comunicato | persbericht
nota de prensa

Science behind Technology

oils & fats	oleochemicals	detergents & surfactants	chemical plants	soap
desmet ballestra	desmet ballestra	desmet ballestra	desmet ballestra	desmet ballestra
oils & fats	oleochemicals	detergents & surfactants	chemicals plants	soap

www.desmetballestraoleo.com

600 People operating in 27 languages

Produced for Desmet Ballestra Oleo S.p.A, 2004/12.
Via dei Castelli Romani, 2L - Pomezia 00040, Rome
Tel.: +39 06 911 821 Fax.: +39 06 910 6762 http://www.desmetballestraoleo.com