Technical description CPU1000

Nominal capacity 1.000l/h Biodiesel

Indice

1. Process and features

The CPU1000 is a complete modular methyl ester Production Machine installed in one 20` container frame, ready for start-up after connecting to the external tanks such as for methoate (within this document defined as mixture of an Alkoxyde and Methanol), oil, methyl ester and G-phases, water, washing solutions, compressed air, external ventilation lines and electric power.

CPU1000 features a continuous process system containing electronic proportioning systems, static mixers, decanter-reactors, vacuum distillation for removal of excess methanol and methanol recycling.

"Plug and Play" factory assembled and tested prior to delivery.

2. Standard Processing Capacity

Treatment step	Type	Capacity per CPU
methyl ester Production	CPU1000	24 m^3/d (21 t/d)

Under standard conditions the CPU1000 will process 1.000 liters oil / h (tolerance +-5%), during uninterrupted operation, after a process stabilization time of a minimum of 10 hours. The performance of the CPU is measured under BDTech standard process conditions using a low viscous (~ 25°C, <40mm^2/sec), fresh, degummed raw material (e.g. rape seed oil):

- minimum 1bar pre-pressure from external oil tank or external pump is required
- compressed air supply permanent ≥7 bar at connector on CPU during operation
- stable supply of electricity
- ambient temperature in production hall 18°C to 30°C (higher temperatures should be discussed) min. 12 hours before starting the CPU and permanent during production
- oil processed at ~ 55 – 65°C in CPU
- methoate to be produced and added according BDT standard recipe
- back pressure of tube reactor <30 bar

Divergent parameters or improper operation can cause lower yield or cause damage to the CPU.

3. Raw material

	Input
Multi-feedstock	oils and fats of vegetable and animal origin, used cooking oils
Temperature	> 40°C**, liquid, low viscous (< 40 mm^2/sec) during operation
Impurities	clean, free from solids (< 25 micron filter)
Other substances	free from other substances, namely emulgators, gums
Phosphorus	≤ 30 ppm
Transesterifiables	> 99,5%
Water	<0.1% H_2O
Acid Number / FFA	Acid No. < 3* (i.e. max. FFA content ~1,5 %)

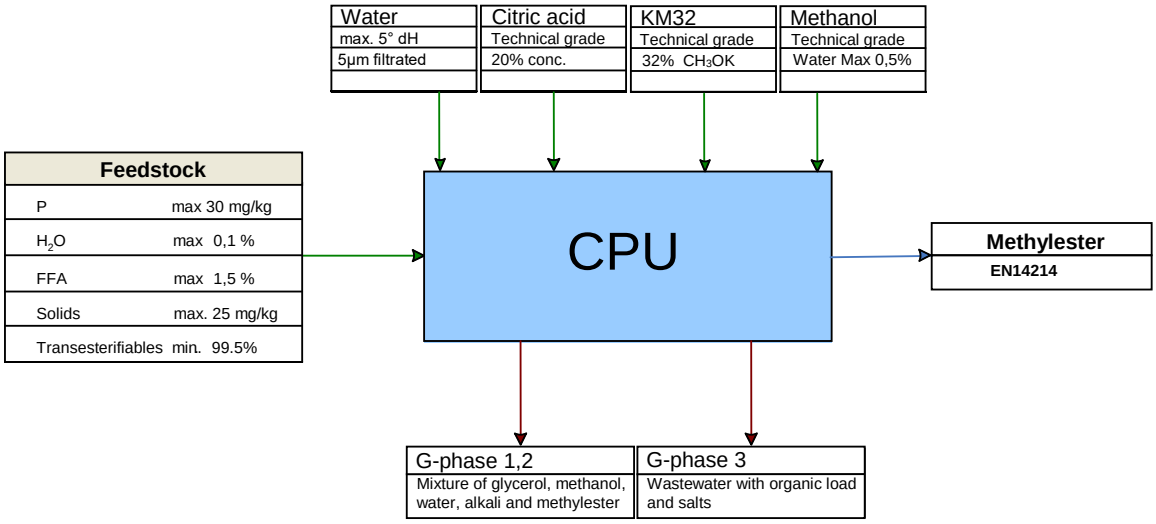
** 65°C for start up

4. Utility consumption Data

Media		Quantity	Specification
Compressed air for instrumentation		150 Nm^3 / h	dried, free of oil, 8 bar.g,
Electricity		Installed power: 120 kW consumption: approx. 70 kWh	3x400 V, 50 Hz
Citric acid		Approx. 4l/h	20 - 50% concentration (standard, possible other acids)
Water		50l/h	max. 5° dH 2.0 - 4,0 bar.g min. 10°C content of solids max. 5µm filtrated pH < 8.0 (preferably potable water)
Catalyst (Methoate) *	Methanol	112l/h	technical grade, pure, clean - max. 0,5% water practically free from other substances
	Alkoxide	34l/h	Potassium based alkoxide with 32% catalyst (e.g. KM32 or equal)

*KM32 can be substituted, if required, by KOH to be diluted in Methanol. If a mixing station is required for this purpose please contact BDTech. The mixing station requires additionally 50Nm³/h compressed air.

5. Mass balance using KM32 as catalyst



Inputs		
Oil	915kg/h	1001l/h
Methanol	89kg/h	112l/h
KM32	34kg/h	34l/h
Water	50kg/h	50l/h
Citric acid	4kg/h	4l/h

Outputs		
Biodiesel	915kg/h	1040l/h
G-phase 1,2	122kg/h	111l/h
G-phase 3	54kg/h	54l/h

Mass balance using KM32 as catalyst

CPU1000 produces biodiesel according to EN14214.
The following parameters can be affected by the CPU1000 operation: Flash point, Water content, Total contamination, Viscosity, Density, Ester content, Ash content, Acid number, Alcohol content, Monoglycerides, Diglycerides & Triglycerides, Group I. metals (Na + K), Free glycerine, Total glycerine, Phosphorous content and Conductivity.

The other EN14214 parameters solely depend on the properties of the raw material.

6. Process and detailed description

6.1. Transesterification process

The CPU is designed as a two-stage transesterification process using an alkaline catalyst.
The raw- and auxiliary materials are stored outside of the CPU from where they have to be transferred to the CPU.

First transesterification stage

Calibration tanks for Alkoxides (Catalyst) and oil provide a proper buffer for the further process steps.
The liquids are transferred by pumps to a first mixing tank (MT1). From the mixing tank the liquid is transferred by a high pressure pump through a static mixer to a buffer tank (BT1/1) which allows a proper reaction time. In the following buffer tank (BT1/2) the reaction products methyl ester and Glycerol are separated by gravity. The methyl ester is discharged from top part of the tanks (density approx. 0,88kg/m^3) while the heavier Glycerol (approx. 0,96 kg/m^3) is discharged from the bottom.

Second stage

The decanted methyl ester leaving the first process step is transferred to a calibration tank from where it is pumped to a mixing tank (MT2). The methyl ester is mixed with methanolat provided from the methanolat preparation station.
From the mixing tank the liquid is transferred through a static mixer to a further buffer tank (BT2/1) giving reaction time, the final reaction takes place. In the following buffer tank (BT2/2) the reaction products methyl ester and Glycerol are separated by gravity.

Coalescer

The system is supported by coalescers agglomerating glycerol from the reaction product after methanol is removed by distillation.

Glycerol (G-Phase 1/2)

The G-Phase separated in the first and second stage is transferred to the G-Phase 1/2 tank. It has to be discharged from the CPU to an external storage tank, a connection is foreseen.

6.2. Distillation (methanol)

The reaction product from the first and second stage, the methyl ester, is transferred from the buffer tank (BT2/2) to a thin film distilling unit (D10M). The evaporated methanol is extracted by a liquid-ring vacuum pump and will be condensed. The condensed methanol is collected in a methanol recovery tank from where it can be re-used in the process.

6.3. Washing

Distilled methyl ester is transferred to the washing section of the CPU. The washing process is carried out in three extractors (extractor 1-2-3). Under addition of water and acid (saltwater) undesired substances (such as remaining catalysts, salts, soaps, methanol, free glycerol, etc) are neutralised and dissolved in water. The extractors 1 and 3 are followed by centrifuges were the washing solutions are separated from the methyl ester.

Water Phase(G-Phase 3)
The G-Phase 3 (water phase) is separated during the washing process and is transferred to the G-Phase 3 tank. From this part of the CPU it has to be discharged to an external storage tank, a connection is foreseen.

6.4. Distillation (water)
After the washing process the methyl ester is collected in a small tank which serves as a buffer to the distiller feeding pumps. The product will be distilled in a further thin film distillation unit (D10W) from where the water is extracted by a liquid-ring vacuum pump. Final methyl ester quality will be reached.

7. By- Products

Medium	Quantity	Specification*	
G-Phase 1,2	Approx. 16 wt % of the weight of the oil input	Glycerol Alkalines Methyl ester Methanol Water and Used Catalysts Monoglycerides	60 % m/m 12 % m/m (mainly alkaline sovaps and hydroxids) 10 % m/m 14 % m/m 1 % m/m 2 % m/m 1 % m/m

* Depending on the quality of the input materials and the settings of the CPU 1000, some parameters of G-Phase 1,2, the raw glycerine phase from the CPU 1000, may vary

8. Usage and Mode of Operation

The CPU is a standardized transesterification unit which is the core processing element within the biodiesel plant.
The CPU is designed for 24 hour / day operation by qualified personnel. The process parameters shall be monitored constantly and adjusted as required. Interrupted operation may affect product quality and production yield.

9. Dimensions and connections

Dimensions	20´ Containers (dimensions according ISO standards)	
Weight	10.000 - 15.000 kg	
	Oil IN	0,5 - 5 bar pre-pressure

Connections

Methoate IN	0,5 -1 bar pre-pressure
Water IN	> 2 bar pre-pressure
G-Phase 1,2 OUT	1 bar pressure
G-Phase 3 OUT	>1 bar pressure
Methyl ester OUT	>2 bar pressure
Condensed MeOH OUT	>2 bar pressure
Ventilation Line	containing MeOH
Ventilation Line	containing no MeOH

All gas or liquid connections are terminated by BDTech quick couplings in the specified size. The connection from BDTech machines (CPU) to the peripherals (tanks, air, water etc.) on project site must be made by the customer, using flexible hoses (included in scope of delivery).

10. Automation concept of project

The CPU control system can be integrated into the overall project automation.
The CPU operating and performance parameters can be monitored from the plant control room.
BDT recommends a fully integrated control room to monitor all project related systems including the CPU, tanks farm, pumps, etc.

All components are hermetically sealed or connected to ventilation, pressure tanks or pressurized tank-type reactors are used in CPU; all parts with higher working pressure (< 40 bar) are respectively rated pumps, pipes or hoses.

11. Remark

- All mentioned data are calculated for maximal flows under standard conditions. Results may vary if operated under conditions deviating from BDTech standards and if feedstock qualities vary.
- All data are subject to change in case of technical requirements.
- All modifications to standard CPU module should be discussed prior to commencement of CPU construction.
- It is recommended that the client checks the local regulations for operating a biodiesel production project.