# GLYCEROL PRODUCTION UNIT

### for biodiesel capacity 25 000 tons/year

# Description

## 1. Process and Features

Glycerol Production Unit (GPU) is a complete glycerol separation unit, featuring also the methanol recovery from G-phase as well as generation of MONG and salt. The unit capacity is designed for the G-phase production capacity up to 3 500 tons/year (biodiesel production capacity 25 000 tons/year), ready for start-up after connection to the external tanks, such as storage tanks for G-phase, methanol, mineral acid and for the products (glycerol, MONG and salt), compressed air, external ventilation lines and electric power.

Glycerol Production Unit (GPU) features a continuous process system containing methanol recovery, automatic acid solution dosing, propeller mixer-reactor, special filtration, settling tank, glycerol vacuum drier and final filter.

## 2. Standard Processing

G-phase, secondary product of transesterification, is pre-heated to 80°C during normal operation (during the start up, G-phase is heated to the working temperature). The working temperature is achieved by recovering waste heat from the process by plate heat exchangers. G-phase flow-rate is metered by a flow-meter and controlled by a PLC.

G-phase first enters a distiller, where methanol is recovered. If methanol would be attempted to recover at the end of the process, it would be wet and methanol rectification unit would have to be included. If potassium methylate is designed for transesterification, there is low water concentration in G-phase; thanks to this as well as the advanced distillation system, the recovered methanol from G-phase does not have to be dried. In addition, as methanol is removed at the beginning of the whole process, the potential foaming problems are eliminated and all products (glycerol, MONG, salt) are free from of methanol.

After de-methanolysis, mineral acid solution is dosed into the G-phase by a dosing pump. The dosing rate is controlled by a pH meter. The media are mixed in the following propeller mixer/reactor, where G-phase is split into three products – Glycerol, MONG and salt.

Salt is removed in the following specialised duplex deep bed filter. After the pressure drop in the working filter reaches a pre-set value, the filtration is re-directed to the other filter. The plugged filter is regenerated by flushing it with water. Removed salt is dissolved in water and transported into a storage tank. It can be utilized as a liquid fertilizer.

The remaining liquid mixture flows into a decanter where Glycerol settles down and MONG floats in the upper part of the tank. MONG is collected from the top and sent into the storage.

Glycerol, as a polar compound, attracts majority of water coming from the acid solution and G-phase. Hence, it has to be dried in a vacuum distiller. Precipitated salts after drying are filtered out.

The requirements for the proper running of GPU are as follows:

- minimum 1 bar pre-pressure from the external G-phase and acid tank or external pump
- compressed air supply permanent ≥ 7 bar at connector on GPU during operation
- stable supply of electricity
- ambient temperature in the production hall 18°C to 30°C (higher temperatures should be discussed) min. 12 hours before starting the GPU and permanent during production
- mineral acid concentration to be added according to the BDT recipe

Divergent parameters or improper operation can cause lower quality or cause damage to the GPU.

## 3. Raw Material

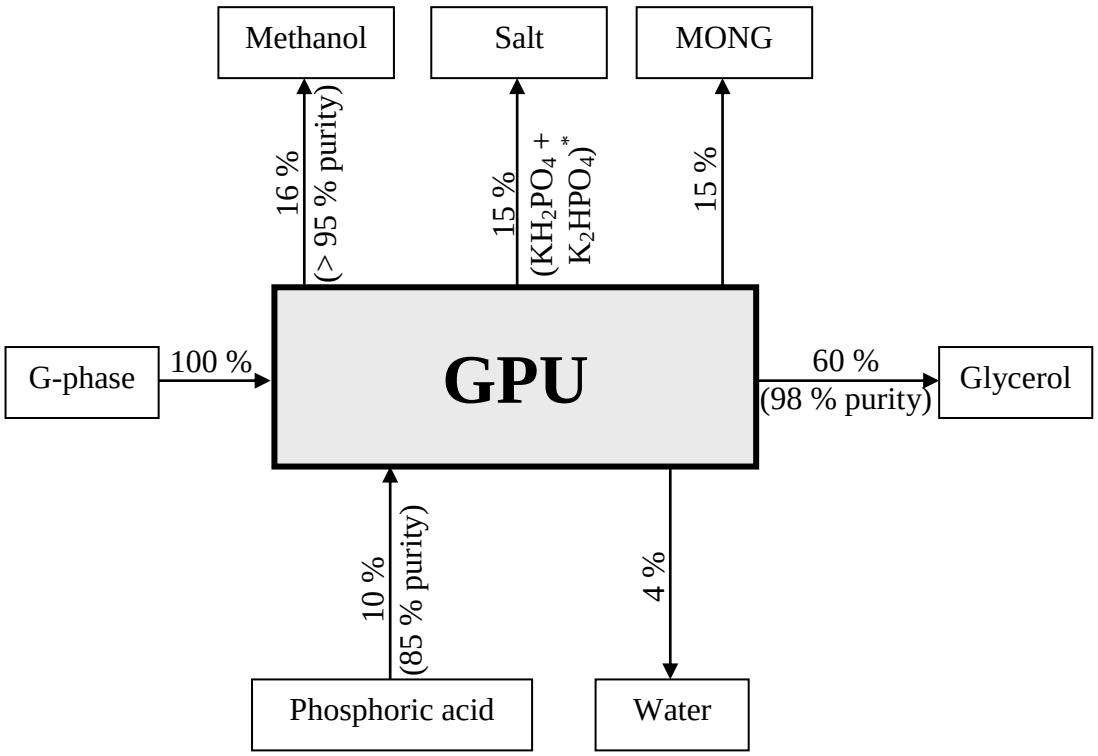
The G-phase from CPU being fed into GPU has the following expected composition:

| | |
|---|---|
| • Glycerol | 56 % - 73 % |
| • Methylester | 8 % - 20 % |
| • Methanol | 5 % - 12 % |
| • Alkalines (soaps and catalyst) | 14 % - 16 % |
| • Water and other impurities | 0.5 % - 2.0 % |

Apart from the G-phase, the other input material is:

- Mineral (phosphoric) acid fed with at the concentration of 75 - 85 % (type and concentration can be altered according to the customer request). Its feeding rate is expected to be approximately 10 % of the G-phase feeding. The exact rate depends up on the input G-phase quality (and selected acid concentration).

## 4. Typical Mass Balance




[*] *Salt is shown as pure. In reality it is dissolved in water for easy transportation and a potential to apply it directly as a liquid fertilizer.*

## 5. Utility Consumption Data per 25 000 t biodiesel

| | Quantity per 50 000 t biodiesel | Specification |
|---|---|---|
| G-phase | 3 500 t | See Section 3 : Raw Material Spec |
| Compressed air for instrumentation | 75 $kNm^3$ | Dried,<br>free of oil, 8 bar.g, |

| | | |
|---|---|---|
| Electricity | 70 kW* | 3x380 V,<br>50 Hz |
| Mineral acid | 350 t | Preferable acid is phosphoric with 85 % concentration |

* Installed power requirements will vary depending on the project capacity, please consult BDTech for precise information concerning your individual project

## 6. Usage and Mode of Operation

The GPU is a standardized G-phase splitting technology, which is the auxiliary processing element within the biodiesel plant. The GPU 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 the product quality and the production yield.

## 7. Heating & Cooling Demand

Heating and cooling is part of the Glycerol production unit. Heating is provided by the electrical heating elements. It can be retrofitted to the heating system requested by the customer. Heating demand is approximately 46 kW depending on the ambient temperature, G-phase retention time before processing, etc.

Generated vapours are condensed by an advanced closed loop cooling unit. As it is a closed system, no water evaporates during cooling hence water does not have to be regularly fed. Owing to the advanced system and application of the potassium methylate for biodiesel production, the recovered methanol does not have to be rectified and the purity is more than 95 %. As the methanol rectification unit is not needed, the capital as well as the operating costs is cut down. The cooling of the water vapour is performed by the second cooling loop of the same cooling unit. The cooling demand is approximately 50 kW depending on the ambient temperature, etc. and the electric power needed for the cooling is only 17 kW thanks to the advanced cooling system.

The output Glycerol and MONG deliver the heat to the input material via plate heat exchanger recovering heat and saving appreciably operating cost. The Glycerol and MONG output temperature is around 40 – 50 °C.

## 8. Connections

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

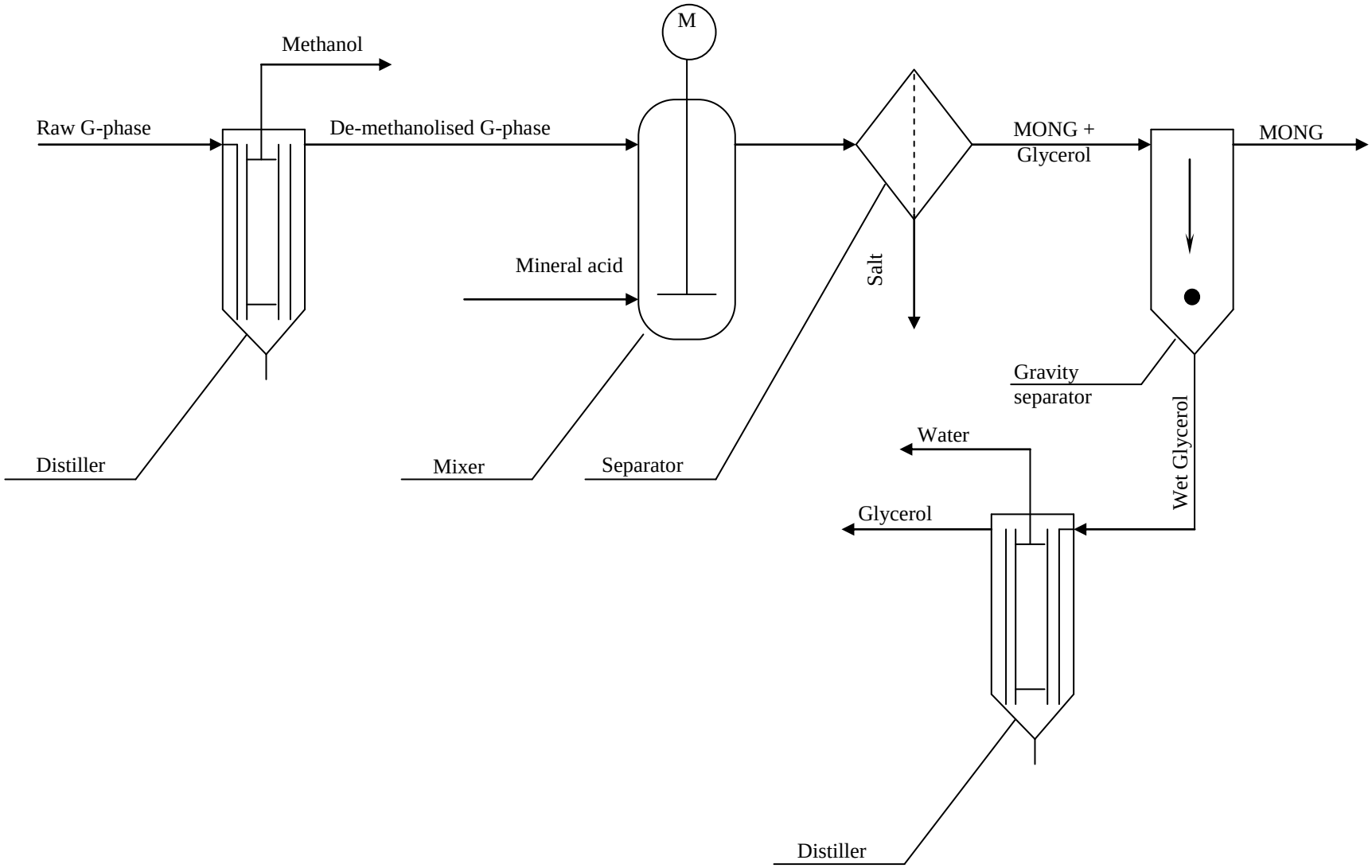
## 9. Automation Concept of Project

The GPU control system can be integrated into the overall project automation. The GPU 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 GPU, tank farm, pumps, etc.

All components are hermetically sealed or connected to ventilation. Pressure tanks or pressurized tank-type reactors are not used in GPU.

## 10. 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 GPU module should be discussed prior to commencement of GPU construction.
- It is recommended that the client checks the local regulations for operating a biodiesel production project.


M
Methanol
Raw G-phase
De-methanolised G-phase
MONG +
Glycerol
MONG
Mineral acid
Salt
Gravity
separator
Distiller
Mixer
Separator
Water
Glycerol
Wet Glycerol
Distiller