

BPS

Biodiesel Production System



TERMOGAMMA

WHO WE ARE

1985

1987

1994

1997

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2012

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2018

Termogamma Group specializes in **custom-built energy efficiency SOLUTIONS** for industrial processes and non-industrial buildings. Our company is noted for its Termogamma-brand high-efficiency INTEGRATED ENERGY technologies (heating, cooling and on-site electricity). Our core systems are based on the principles of cogeneration, trigeneration, free-cooling, waste heat recovery, and biomass to energy.

Our origins can be traced back to Lombardy, Northern Italy, where Giovanni Cavaliere established the first company of the group in 1985. It was the natural development of his passion for energy technologies, which he shared with his father while working side by side with him in field maintenance of heating systems. Keeping **maintenance in the core** of his company, he expanded the activities with engineering design, consultancy and construction of energy SOLUTIONS.



We consider ourselves a partner for our clients, providing competitive advantage, consistent quality and superior service. While reducing their energy costs and contributing to a cleaner environment, we foster our client's sustainable path towards a clean energy transition and circular economy.

Today Termogamma has two official branches in different countries and presence, through reliable partners, in 14 countries on 3 different continents. Thanks to our team made up of specialized technicians, we are able to thoroughly understand our client's needs, offering them an integrated approach, from the very first approach to their requirements and needs, technical solution engineering, complete manufacture of the proposed solution, up to installation, commissioning and maintenance of the system, even up to the whole life-cycle of the system, with extended warranty.

"Empowering Passion"

FOREWORD

This document presents the general characteristics of our BPS system for the production of Biodiesel using Vegetable Oil. BPS system is also able to produce Biodiesel from UCO (Used Cooking Oil), animal fat, oleins, ... integrating in the system some extra components and optionals. In this document, only the Biodiesel production system starting from already refined vegetable oil is described. Please do not hesitate to contact us to explore options with UCO or other optionals for this kind of technology.

SHORT INTRODUCTION TO BIODIESEL

Biodiesel refers to a **vegetable oil or animal fat-based diesel fuel** consisting of long-chain alkyl (methyl, ethyl, or propyl) esters. Biodiesel is typically made by chemically reacting lipids (e.g., vegetable oils, soybean, rapeseed, cotton and animal fat) with an alcohol producing fatty acid esters. Biodiesel has similar characteristics to diesel fuel. However, the raw material used for its production is a so-called



biological re-growing source of energy, instead of crude oil (used for traditional diesel fuel). Thus, biodiesel is a **RENEWABLE** fuel, **NONTOXIC** and **BIODEGRADABLE**. Compared to petroleum diesel fuel, biodiesel combustion produces fewer air pollutants such as particulates, carbon monoxide, sulphur dioxide, hydrocarbons and air toxics.

Biodiesel is produced by the transesterification of a vegetable oil or animal fat feedstock, and other non-edible raw materials such as refined fried oil, etc. There are several methods for carrying out the transesterification reaction including the common batch, with a homogeneous catalyst. Chemically, trans-esterified biodiesel comprises a mix of mono-alkyl esters of long chain fatty acids. The most common form uses methanol to produce methyl esters (commonly referred to as Fatty Acid Methyl Ester – FAME) as it is the cheapest alcohol available.

A by-product of the transesterification process is the production of glycerine. For every 1 tonne of biodiesel that is produced, about 100 kg of glycerine are obtained. This by-product has a market for itself, and an extra-economic income can be obtained (selling price depends on glycerine purity grade).

Biodiesel is basically a **renewable energy source**, thus contributing to **save primary energy** (fuel) and **consequently reducing CO₂ emissions into the atmosphere**. It is clear that biodiesel has **significant environmental benefits in terms of decreased global warming impacts, reduced emissions, greater energy independence and a positive impact on agriculture**.



Various studies have estimated that the **use of 1 kg of biodiesel** leads to the **reduction of some 3 kg of CO₂**. Several official entities consider biodiesel as carbon-neutral, assuming that the plants used as feedstock sources absorb as much CO₂ while they grow as the CO₂ produced during the combustion of the biodiesel. Hence, the use of biodiesel results in a **significant reduction in CO₂ emission** (65%-90% less than conventional diesel). Biodiesel is also **extremely low in sulphur** and has a **high lubricity** and **fast biodegradability**. These are all advantages which have been confirmed by various EC Commission programmes and tests of independent research institutes.

TERMOGAMMA's BPS SYSTEM SHORT DESCRIPTION

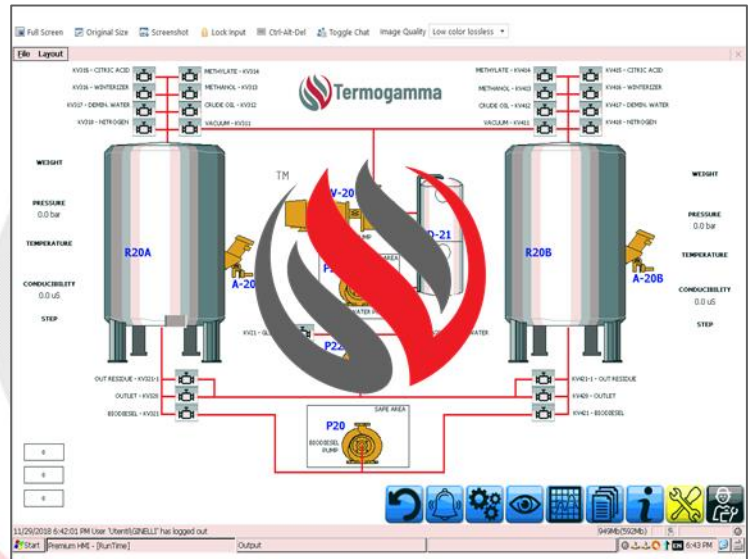
Our **BPS** (Compact Technological Plant for Biodiesel Production) is a completely prefabricated system designed and constructed with **PLUG&PLAY philosophy**. The control and monitoring system included allows a fully automatic operation, with possibility of remote control and supervision. The system is thought to operate automatically following a batch approach, with minimum operator supervision.

Our standard base BPS system is manufactured including all needed components for its operation. All these components are placed and connected inside the special box in our workshop (pumps, valves, sensors, PLC, electric boards, pipes, heat exchangers, reactors, temporary biodiesel tanks, ...) and the system is delivered to our client **READY** for operation. This manufacturing approach strongly reduces installation and connection time and works at client's site. Only external tanks and final connections between the BPS system and tanks at client's facilities are to be done on-site.

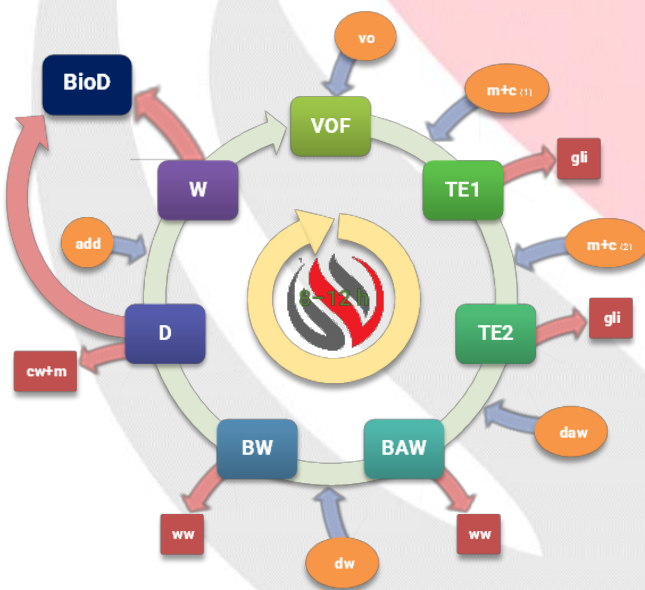


Our BPS system production capacity starts from 5.000 l/day (on a 24hour/day production basis) and can go up to 30.000 l/day, considering the single container supply. Thanks to our MODULAR approach to construction, our BPS systems, can be composed by multiple containers, reaching a daily production of 30.000 l/day. Our engineering and manufacturing process and philosophy allows us to adapt our BPS system to the needs and requirements of the client.

BPS system production is based on a batch production approach (each batch is programmed to last in between 8 to 12 hours, depending on the raw material quality parameters and characteristics), with automatic transition from one batch to the other. So, the system needs minimum operator presence, as it is thought and designed to operate continuously and automatically. Supervision of the system can be done both locally and remotely, as the monitoring and control software is already set for remote control and supervision. The client can check any time and everywhere (only an internet connection is required) the status of his system and can even modify set-up and set-points. It includes also historic record of parameters (temperatures, batch history, etc...) to allow constant monitoring performance of the system, and automatic signalling of alarms (via e-mail).



OVERVIEW OF PRODUCTION CYCLE



The production cycle starts with the mixing of vegetable oil with methanol and various catalysts (usually potassium hydroxide, sodium hydroxide and alcoholates).

Under normal pressure and temperatures around 60°C the ester bonds of triglycerides of the vegetable oil are broken up and thereafter the fatty acids are esterified with the methanol (trans-esterification).

The glycerin that is formed is then removed from the biodiesel.

After the simple or multiple trans-esterification, several clarifying steps are carried out in which, amongst others, the excess methanol and catalyst is removed by a combination of neutral and acidic washings. Due to the water addition during the previous washing steps, a distillation at the end of the process is necessary to get rid of the water in the biodiesel.

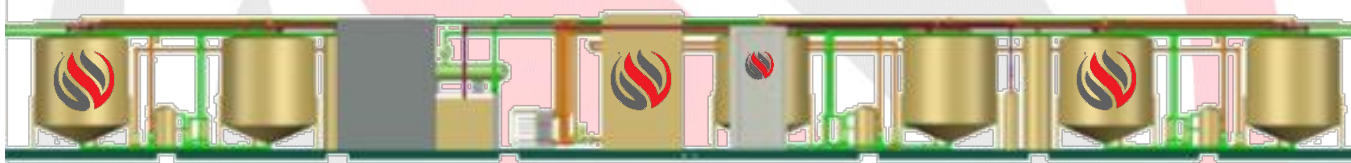
The byproducts (glycerin and washing water) can be used for instance as a substrate in biogas plants and sewage plants, or even sold in the market (glycerin).

This ensures that the total inherent energy of the raw materials is used.

AVAILABLE STANDARD SIZES

The following model sizes are just an indication of potential combinations. Each project has its own characteristics and needs. We at Termogamma are happy to design the best size for your project, adapting our technology to your needs.

Model name	Max Capacity (l/day)	Nr. of Reactors	Nr. Of Containers	Containers Type
BPS-1R/S	5.000	1	1	20"HQ
BPS-1R/O	7.000	1	1	20"HQ
BPS-2R/S	10.000	2	1	40"HQ
BPS-2R/O	15.000	2	1	40"HQ
BPS-4R/S	20.000	4	2	20"HQ + 40"HQ
BPS-4R/O	30.000	4	2	20"HQ + 40"HQ
BPS-nR	CUSTOM	CUSTOM	CUSTOM	CUSTOM



CONTACTS

Please do not hesitate to contact us to share with us your project idea. We will be glad to support you and design the best solution for your application.



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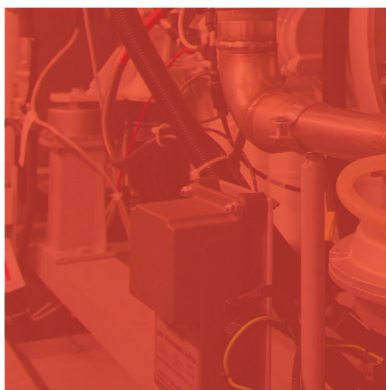
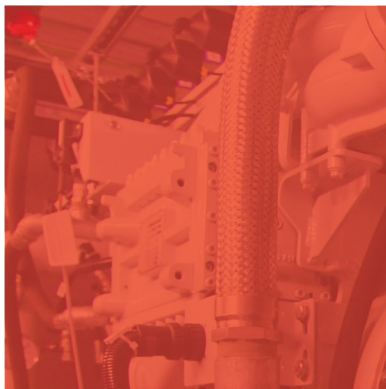
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