Photobioreactor FMT 150

Photobioreactor FMT 150 features a unique combination of the cultivator and computer controlled monitoring device. The Photobioreactor FMT 150 combines a flat cultivation vessel with the built-in fluorometer and densitometer. It is primarily designed for high-content, precise phototrophic cultivation of algae, cyanobacteria and bacteria. Light intensity and spectral characteristic as well as temperature and aeration gas composition can be set with high accuracy. Cultivation conditions can be dynamically varied according to user-defined protocol and continuously online monitored. Programmable light, temperature, gas, and medium regime can oscillate with various amplitudes and frequencies according to user-defined time steps from milliseconds to hours. Continuous-flow turbidostatic cultivation can be used for the stabilization of the suspensions and optical density control. In addition to the turbidostatic pump, up to 7 peristaltic pumps for different chemostat or pH-stat cultivation can be linked to the Photobioreactor for highly precise control of cultivation conditions.

The growth of the cultures is monitored by the integrated densitometer (OD680, OD720). Chlorophyll content of the culture can also be monitored continuously by the difference of optical densities at 680 and 720 nm. The instantaneous physiological state of the culture is measured by the Photosystem II quantum yield F_V/F_M.

Photobioreactor function can be enhanced by the additional gas modules: Gas Mixing System GMS 150 providing optimal control of input gas concentration; and gas analyzer MS GAS-100 intended for complex analyses of gases and volatiles including isotopes, solvents and volatile organics in headspace and liquid phase as well.

KEY FEATURES – MONITORING

- Integrated Double-Modulation Fluorometer with online measurement and recording of chlorophyll fluorescence parameters, such as F_0, F_T, F_M, F'_M, $(F'_M-F_T)/F'_M$
- Integrated online optical density measurement (OD680, OD720)
- Continuous temperature control
- Continuous pH monitoring
- O_2 electrode to measure concentration of dissolved O_2 (optional)
- CO_2 electrode to determine dissolved CO_2 concentration (optional)
- Highly precise gas mixing system for aeration (optional)
- Monitoring of medium consumption during a turbidostatic cultivation (optional)

CULTIVATION

- Autoclavable flat glass cultivation vessel: 400 ml, 1,000 ml or 3,000 ml
- Programmable light, temperature, gas, and medium regime. Time steps from milliseconds to hours
- Both static and changeable temperature
- Bubble humidifier for stable culture volume
- Controlled flow rate and composition of the sparging gas with GMS 150
- Magnetic stirring
- Anaerobic cultivation via gas tight lid and N_2 sparging
- Turbidostat, chemostat or pH-stat cultivation control

TECHNICAL SPECIFICATION

- **Online Measured Parameters:** Chlorophyll fluorescence, OD, pH, temperature, O_2, CO_2, medium consumption during turbidostatic cultivation
- **Vessel Capacity:**
  400 ml (FMT 150/400)
  1,000 ml (FMT 150/1000)
  3,000 ml (FMT 150/3000)
- **Precision Controlled Temperature (depending on ambient conditions):**
  5–75 °C (FMT 150/400)
  10–75 °C (FMT 150/1000 and FMT 150/3000)
- **Cooling and Heating System:**
  200 W Peltier element (FMT 150/400 and FMT 150/1000)
  400 W Peltier element (FMT 150/3000)
- **LED Lighting:** Light intensity adjustable in the full range up to 1,500 $\mu mol.m^{-2}.s^{-1}$ (optionally up to 3,000 $\mu mol.m^{-2}.s^{-1}$). Bi-color light panels available (separate color control)
- **Light Path:** 24 mm (FMT 150/400); 61 mm (FMT 150/1000 and FMT 150/3000)
- **Light Regime:** Static or dynamic
- **Optical Density Measurement:** Real time measurement of OD by two far-red LEDs (680 nm, 720 nm). Time intervals of OD measurements may be specified
- **Chlorophyll Fluorescence Measurement:** Blue excitation light and red-orange excitation light
- **Optical Path for OD and Chlorophyll Fluorescence Measurement:** 24 mm
- **Controlled Flow Rate and Concentration of Sparging Gas:** Optional
- **Pumps:** Up to 8 peristaltic pumps
- **Optional Probes:** O_2, CO_2 and others
- **BIOS:** Upgradeable firmware
- **Communication Port:** USB A-B
- **Material:** Glass, stainless steel, silicon gasket
- **Dimension:**
  41.5 × 35 × 31 cm (FMT 150/400 and FMT 150/1000)
  50 × 35 × 31 cm (FMT 150/3000)
- **Weight:**
  15.5 kg (FMT 150/400)
  17.5 kg (FMT 150/1000)
  28 kg (FMT 150/3000)
- **Electrical:** 90–240 V AC

CONTROL SOFTWARE

- User defined protocol writing
- Real time data visualization and analyses in graphs
- Remote control of the experiment via internet

LED ILLUMINATION

- Bi-color LED panel (white-red or blue-red typically) with separately controllable channels. Other color combination on request
- Homogeneous illumination over the whole flat vessel
- Controllable light intensity up to 1,500 $\mu mol.m^{-2}.s^{-1}$ (optionally up to 3,000 $\mu mol.m^{-2}.s^{-1}$)
- Both static and fluctuating light regimes. Day/night cycles
- Additional front light panel for higher intensity or different light color

APPLICATION

- Precision cultivation of photoautotrophic microorganisms
- Cultivation conditions optimization and yield improvement
- Photosynthesis research
- Stress physiology, detection of biotic and abiotic stress
- Study of diurnal or metabolic rhythms
- Study of secondary metabolites production
- Ecotoxicological research
- Ecological research, microorganisms interactions, population dynamic
- Environmental modeling