Industrial Scale Bioreactors

and Systems for Process Intensification

Figure 1: FRINGS PROREACT 300 and PROREACT 75

PROREACT Large Scale Bioreactors

for the Production of

- ✓Biomass und Starter Cultures
- ✓Organic Acids
- ✓Food Ingredients
- ✓Savory Flavors
- ✓Enzymes and other Proteins
- ✓Fine Chemicals
- ✓Biopolymers
- ✓Cosmetic Agents
- ✓Biopharmaceuticals

Products for Biotechnology

Industrial Scale Bioreactors

and Systems for Process Intensification

HEINRICH FRINGS GmbH & Co. KG
Jonas Cahn Str. 9
53115 Bonn, Germany
Phone +49 228 98 33 0
Fax +49 228 98 33 195
marketing@frings.com
http://www.frings.com

Turnkey Bioreactors with FRIBORATOR Mixing and Aeration Systems and Mechanical Defoamer FOAMEX

Systems equipped with the innovative turbine aeration and foam separation technology achieve outstanding results in processing low and slightly viscous mediums in microbial systems.
Stirring devices and complete units can be customized for mono-product reactors.
Standard stirring equipment for multipurpose reactors or alternative cell systems is also available.

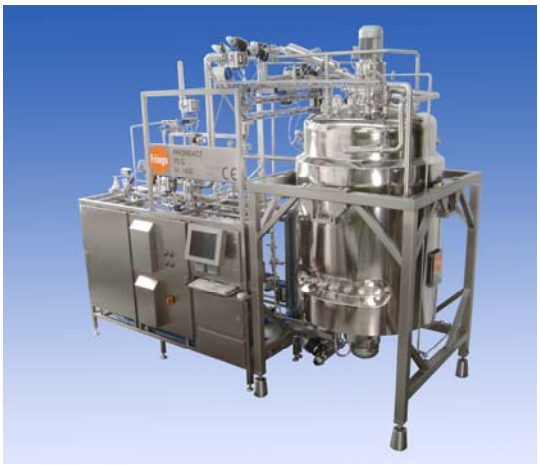

Figure 2: FRINGS PROREACT 75
with foam centrifuge FOAMEX on top

Figure 3: FRIBORATOR TRG
drive and tank view

Retrofit of Existing Bioreactors with FRIBORATOR TRG Systems

Most standard industrial scale fermentation reactors for biocommodity production require a large portion of energy. On the other hand, oxygen is very often the limiting factor in aerobic bio processes. FRINGS rotor/stator FRIBORATOR turbines are designed to reduce energy consumption at a constant OTR or to improve the OTR at a constant energy consumption. For processing mediums with higher viscosity, the FRIBORATOR system can be used as an additional device for primary bubble dispersion.

Table 1: Comparison of energy consumption and oxygen transfer rate for FRIBORATOR TRG system and standard Rushton stirrer (without Head Pressure)

	FRINGS TRG Measured Data	**DISK BLADE STIRRER (Published Data)**
Working volume m^3	100	100
Tank diameter m	4,8	4,8
Head pressure (abs.) mbar	1013	1013
$d_{Stirrer}/d_{Reactor}$	0,22	0,33
Stirrer stages	1	3
Blades	6 star	6 x 90^0
Frequency	348	100***
Flow rate Nm^3/h	6600	6600
Compression power kW	**96**	**126**
Stirrer power kW	**135**	**304**
Stirrer torque Nm	3567	29050
Reynolds number	$1{,}84 \cdot 10^6$	$0{,}84 \cdot 10^6$
Newton number	0,43	13,82
Differential pressure mbar	170	0
Dynamic viscosity** Pas	0,004	0,004
Density kg/m^3	1070	1070
O_2 saturation* mg/L	6	6
Mixing time t_{90} s	**55**	**45 - 60**
OTR $kgO_2/m^3/h$	**5,1**	**2,9 – 4,5****
Efficiency kgO_2/kWh	**2,2**	**0,7 *- 1,1**

* atmospheric pressure
** dependency on coalescence behaviour
*** 'flooding' at lower frequency