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Technology Description (TD) for

Anaerobic Digestion Technologies

Contact Information:

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	Date (of filling the TD):	23.05.2018		

Technology Description:

NAME OF TECHNOLOGY	Reactor with pneumatic mixing system
ASSIGNMENT OF TECHNOLOGY	Reactor for micro-biogas plant
TECHNICAL READINESS LEVEL **TRL 1** - basic principles observed **TRL 2** - technology concept formulated **TRL 3** - experimental proof of concept **TRL 4** - technology validated in lab **TRL 5** - technology validated in relevant environment (industrially relevant environment in case of key enabling technologies) **TRL 6** - technology demonstrated in relevant environment (industrially relevant environment in case of key enabling technologies) **TRL 7** - system prototype demonstration in an operational environment **TRL 8** - system completed and qualified **TRL 9** - actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space)	1 2 **3** 4 5 6 7 8 9
What is the core innovation? (Please explain here what is innovative on this	The solution works without mechanical parts. No need to use electricity. Very low operating costs.

technology and which problem does the technology solve.)		
Vision of the innovation (Please describe here what impact you see for the future)		Competitive for micro installations. It can be used for organic fraction of waste fermentation as well as agricultural organic wastes.
What are the R&D needs for your technology? (Are there any barriers or challenges which still need to be overcome?)		The solution for sealing the reactor cover should be further developed
TECHNOLOGY/EQUIPMENT AVAILABILITY		
PATENT RIGHTS		~~YES~~/NO
METHOD OF MAKING THE TECHNOLOGY AVAILABLE	*Licence selling*	YES/~~NO~~
	Licence granting	YES/~~NO~~
POSSIBLE END USERS OF TECHNOLOGY	*Please name end users/ contacts that should be invited to project workshops*	This technology is recommended for micro biogas plant. Different kind of substrates can be used.

Description of the technology/equipment:

Reactor has a form of cylindrical tank with diameter 2.6 m and height 6 m. The active height is 4 m. Walls of the reactor are made of concrete while the cover is made of steel. Substrates are fed periodically into the tank (3), then, using a pneumatic plug (4) the tank is sealed, and the substrates are pushed into the reactor's fermentation chamber (1). The reactor is covered with a movable cover (2). The lower edge of the cover goes below the level of the sludge in the fermentation reactor. The resilient bumper protect the cover from dropping into the reactor (5). The post-fermentation sludge is periodically discharged (6) to the retention chamber (7). The biogas is discharged via a valve (8) that opens at elevated pressure.

The reactor is stirred as a result of the circular motion taking place along the road in which the reactor is placed. Moving on the cover causes downward movement, which leads to compression of the gas, which moves the liquid in the reactor. The springing bumpers and the biogas again lift the cover to the initial position.

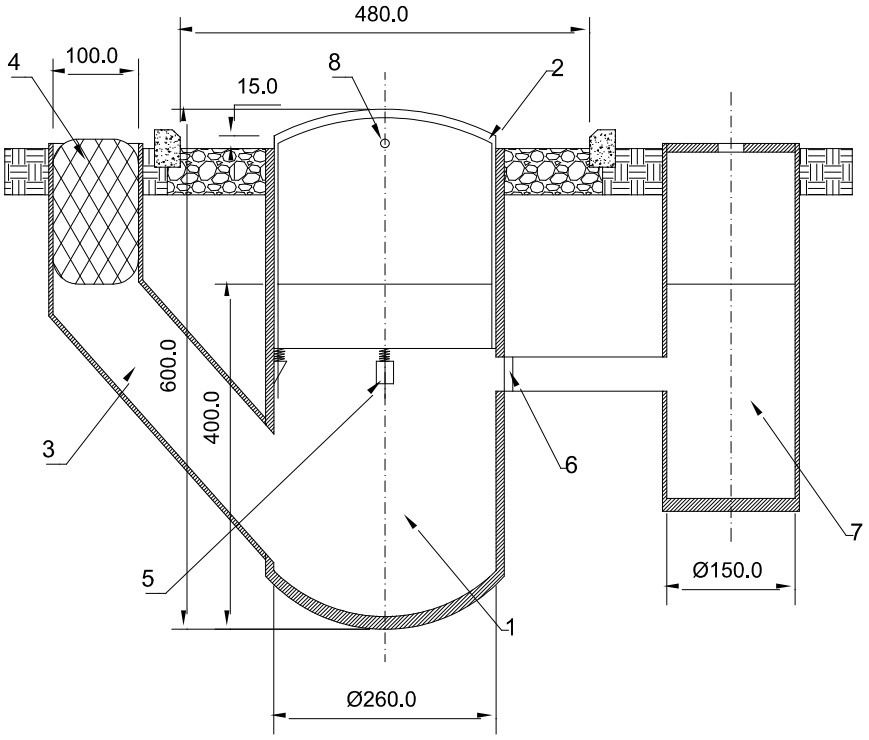

Fig. 1 Methane fermentation reactor with pneumatic mixing system

Technical Data:

Parameter		Value (please fill or tick) If value not available, please give estimate (and indicate with *).	**Comments** (e.g. which condition does the entered value correspond to?)
Current technology	Biogas production rate of technology at current TRL-level (Nm^3/h)	1 Nm^3/h	

Data basis for following data list	1.: market ready stage of technology (based on test runs of current techn.) **<u>Please only use 2. or 3. if 1. not at all possible.</u>** 2.: market ready stage of technology (based on estimate) 3.: current level (TRL) of technology	1 ☐ (preferably) 2 ☒ 3 ☐	
Technical efficiency	Methane content in biogas (%)	45-65	Depending on the substrate
Capacity	Flow rate and type per substrate (Mg/h)	0.008-0.016	
	Biogas production rate (range) (Nm^3/h)	≈ 1,1	Depending on the substrate
	Possible range for upscaling		Increasing the scale is possible by adding next reactors of the same construction
Data for assessment of economical added value, possible contribution to GHG-reduction and availability	Fermenter and biogas process technology (e.g. continuously stirred reactor, plug flow digester, box or garage type)	semi-plug flow digester	
	Electricity demand (kWh_{el}/Nm^3 biogas)	0,02	
	Heat demand (kWh_{th}/Nm^3 biogas)	1.30	
	Chemical/additives demand (kg/h or kg/Nm^3 biogas)	not necessary	
	Demand of other substances (kg/h or kg/Nm^3 biogas)	not necessary	
	Temperature in fermenter (°C)	30 - 40	
	Pressure of biogas at exit of fermenter (bar_{abs})		should be establish during test in full scale
	m^3 fermenter volume used	21	
	Full load hours (h/a)	8000	
	Hydraulic retention time (days)	≈60	

	Max. dry matter content (%)	15	
	Organic loading rate (kg VS/m³d)	2-3	
	Space requirement (m^2)	10	
	Staff requirement (excluding maintenance) (h/a)	730	
	Specific capital costs (excluding project development, planning, permission and additional building costs) (€/Nm³/h)	Please give exact specific cost if possible, if not please specify range. x < 5.000 €/Nm³/h ☐ 5.000 - 10.000 €/Nm³/h ☒ 10.000 € - 15.000 €/Nm³/h ☐ > 15.000 €/Nm³/h	
	Maintenance costs (including spare parts, staff) (€/a or €/operating hour)	3650	Costs have not been calculated yet. presented value it is approximation
	Production costs (€/Nm³ biogas)	0,2-0,3	Costs have not been calculated yet. presented value it is approximation
	Expected lifetime of unit (years)	10	
Flexibility	Types of substrate (solid and liquid)	Solid and liquid	
	Start-stop-flexibility	low	
	Part-load possibility	☒Yes, 50% of full capacity ☐ No	

	Is self-maintenance of technology possible?	☒Yes, 90% of total maintenance hours per year that can be done by operator himself ☐ No	
	Necessity for adaptions of other parts of the plant	no	
	Advantages/disadvantages of technology	Advantages: simple mixing system /disadvantages durability and tightness.	
	Special application area of technology		