Contract nr. PO 161479 (Vito nr. 961192)

MELISSA

Study of the Rhdodospirillum rubrum growth on superantant from compartment I

L. Diels, S. Van Roy, W. Ghyoot

Technical Notes 36

2000/MIT/R/123

Milieutechnologie

June 2000

Management summary

The objective of this work was to filter the liquid from compartment I from the MELISSA cycle over a membrane and to treat the permeate for the removal of volatile organic acids. In the first compartment plant debris and faeces were degraded and liquifyed by an anaerobic thermophylic consortium of bacteria. The organics were degraded into volatile fatty acids. The aim of the second compartment was to remove these fatty acids.
Several membranes (poly acrylonitrile, polysulfone and poly acrylopyrolidone) were tested and the flux reduction was evaluated. It turend out that in the case of the poly acrylonitrile and polysulfone membranes the flux was quite fastly removed. Therefore the water was further fitrated overnight over the poly acrylopyrolidone membrane.
The in this way filtrated liquid from compartment I could be treated by either *Rhodobacter* either *Rhodospirillum. Rhodospirillum* showed to be the best one and *Thiocapsa* (formerly added) was of no use. With Rhodobacter all the volatile fatty acids were removed and biodegraded. Only acetic acid was not completely removed (see also report 2000/MIT/R?). In the former experiments also always some residual concentration of acetic acid was observed although more than 95% could always be removed in a relatively short period of time (hydrualic residence time < 5 days).

Introduction

Liquid from compartment I (obtained from EPAS) was filtrated over several membranes and than treated by *Rhodobacter* or *Rhodospirillum* bacteria for the removal and the biodegradation of the volatile organic acids. During the filtration the reduction of flux in function of time was measured and during the biodegradtion process the kineteics of the biodegraddation process were observed.

Membrane filtrations

The filtrations of the compartment I liquid were done with tubular membranes with an internal diameter of 5 mm and a surface of 0.0082 m². The filtration speed was 4.1 m/s, the recirculation flow rate 290 L/h and the transmembrane pressure 37 – 200 kPa. The following membranes were used:

- WFA4125: PAN (Poly acrylonitrile) membrane with a MWCO of 100,000 Dalton;
- WFB4125: PS (Polysulfone) membrane with a MWCO of 50,000 Dalton;
- WFF4385: PVDF (Polyvinyldifluoridone) membrane with a pore diameter of 30 nm.

The filtration was done in a special measuring system were the flux could be measured on-line.

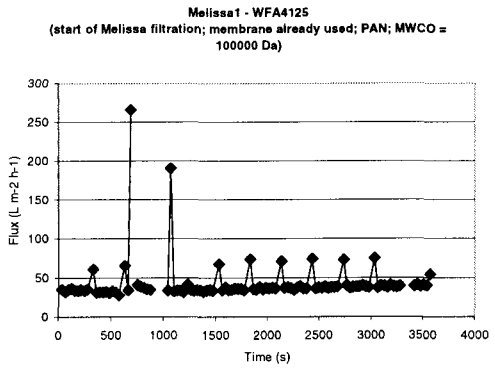

Figure 1. Flux versus time curve of the filtration of comparyment I liquid over a PAN-membrane.

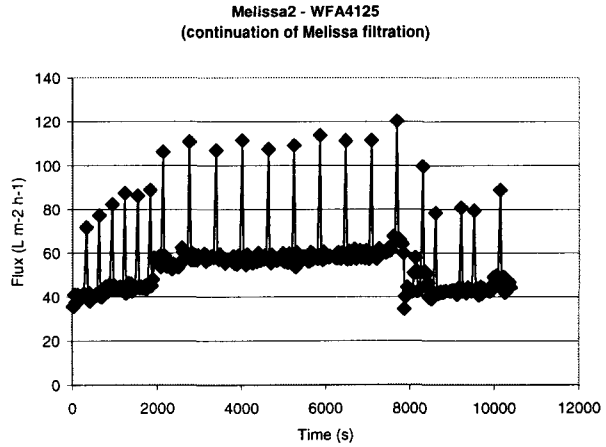

Figure 2. Flux versus time curve of the filtration of comparyment I liquid over a PAN-membrane (continuation of figure 1).

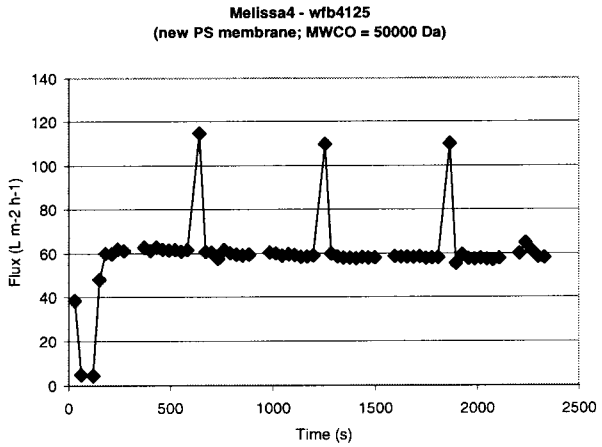

Figure 3. Flux versus time curve of the filtration of comparyment I liquid over a PS-membrane.

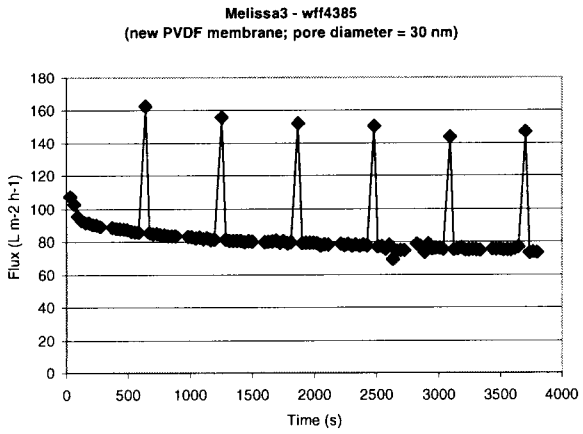

Figure 4. Flux versus time curve of the filtration of comparyment I liquid over a PVDF-membrane.

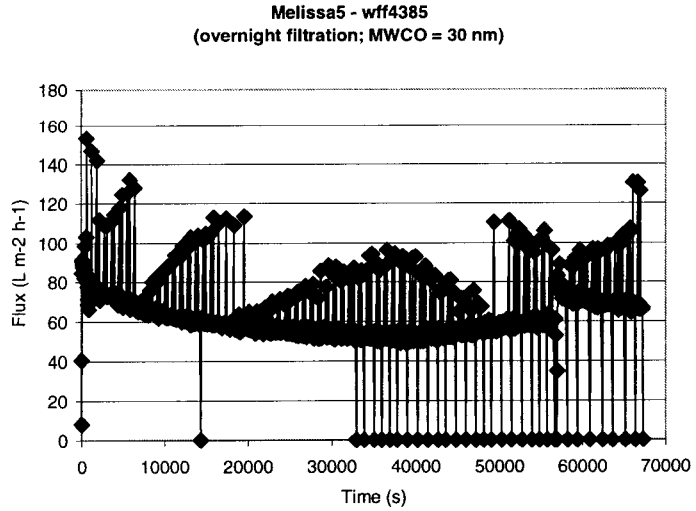

Figure 5. Flux versus time curve of the filtration of comparyment I liquid over a PVDF-membrane (overnight filtration).

Degradation of the volatile fatty acids in compartment II

The mermeate liquid, obtained after overnight filtration of the compartment I liquid on a PVDF-membrane was treated in a continuous sytem by Rhodobacter or Rhodospirillum bacteria and in a control system without bacteria. The sytem was ran by pumping 10 ml permeate per hour into an erlenmeyer inoculated with one of the two bacteria and illuminated wit a 100 Watt lamp. After the reaching of an equilibrium state, samples were taken every day and the concentration of the volatile fatty acids was measured. The results are presented in tables 1 till 8.

Table 1. Acetic acid concentrations

Time (days)	**Input (mg/l)**	***Rhodobacter* (mg/l)**	***Rhodosprillum* (mg/l)**	**Control (mg/l)**
T0	15	334	163	107
T1	18	310	23	116
T2	10	27	13	116
T6		10	13	167

Table 2. Propionic acid concentrations

Time (days)	**Input (mg/l)**	***Rhodobacter* (mg/l)**	***Rhodosprillum* (mg/l)**	**Control (mg/l)**
T0	2	28	5	2
T1	1	5	1	3
T2	0	1	1	3
T6		0	1	16

Table 3. Isobutyric acid concentrations

Time (days)	**Input (mg/l)**	***Rhodobacter* (mg/l)**	***Rhodosprillum* (mg/l)**	**Control (mg/l)**
T0	11	121	84	33
T1	2	149	75	48
T2	0	107	32	46
T6		62	1	72

Table 4. Butyric acid concentrations

Time (days)	**Input (mg/l)**	***Rhodobacter* (mg/l)**	***Rhodosprillum* (mg/l)**	**Control (mg/l)**
T0	5	65	47	19
T1	2	89	9	29
T2	0	61	0	28
T6		21	1	44

Table 5. Isovaleric acid concentrations

Time (days)	Input (mg/l)	*Rhodobacter* (mg/l)	*Rhodosprillum* (mg/l)	Control (mg/l)
T0	20	230	169	66
T1	2	305	179	96
T2	0	240	167	91
T6		166	44	145

Table 6. Valeric acid concentrations

Time (days)	Input (mg/l)	*Rhodobacter* (mg/l)	*Rhodosprillum* (mg/l)	Control (mg/l)
T0	2	11	8	4
T1	1	16	4	6
T2	0	13	0	6
T6		7	0	9

Table 7. Isocapronic acid concentrations

Time (days)	Input (mg/l)	*Rhodobacter* (mg/l)	*Rhodosprillum* (mg/l)	Control (mg/l)
T0	0	17	1	0
T1	0	8	1	0
T2	0	5	1	0
T6		4	2	0

Table 8. Capronic acid concentrations

Time (days)	Input (mg/l)	*Rhodobacter* (mg/l)	*Rhodosprillum* (mg/l)	Control (mg/l)
T0	2	3	5	0
T1	1	6	2	2
T2	0	4	0	2
T6		2	0	3

Rhodobacter and *Rhodospirillum* degraded acetic acid up to 10 mg/l. This is in the same order of magnitude as formerly observed in the reactors based on membrane diffusion. Propionic acid was removed by both bacteria. Isobutyric acid was degraded by *Rhodospirillum* and only slowly by *Rhodobacter*. The same is through bor butyric acid isovaleric acid and valeric acid. Isocapronic acid and capronic acid were nearly degraded in the same way and with the same kinetics.
So, it can be concluded that the liquid from compartment I can be filtrated and afterwards treated by either *Rhodobacter* either *Rhodospirillum*. *Rhodospirillum* showed to be the best one and *Thiocapsa* (formerly added) was of no use.

Conclusions

Several membranes (poly acrylonitrile, polysulfone and poly acrylopyrolidone) were tested and the flux reduction was evaluated. It turend out that in the case of the poly acrylonitrile and polysulfone membranes the flux was quite fastly removed. Therefore the water was further fitrated overnight over the poly acrylopyrolidone membrane. The in this way filtrated liquid from compartment I could be treated by either *Rhodobacter* either *Rhodospirillum*. *Rhodospirillum* showed to be the best one and *Thiocapsa* (formerly added) was of no use. With Rhodobacter all the volatile fatty acids were removed and biodegraded. Only acetic acid was not completely removed (see also report 2000/MIT/R?; Technical Notes 31.2, 31.3, 31.4). In the former experiments also always some residual concentration of acetic acid was observed although more than 95% could always be removed in a relatively short period of time (hydrualic residence time < 5 days).