



Steady state characteristics of acclimated hydrogenotrophic methanogens on inorganic substrate in continuous chemostat reactors

著者	Ako Olga. Y., Kitamura Y., Intabon K., Satake T.
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2 **Notation**

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D	Dilution rate, 1/d
K_s	Half velocity coefficient, g /L
S	Residual substrate concentration at steady state, g /L
S_0	Substrate concentration in medium, g /L
t	Time in day, d
μ	Specific growth rate, 1/d
μ_{max}	Maximal specific growth rate, 1/d
X	Biomass concentration, g/ L
X_0	Initial input biomass concentration, g/ L
$Y_{X/S}$	Growth yield, g-cells/ mmol H ₂ /CO ₂

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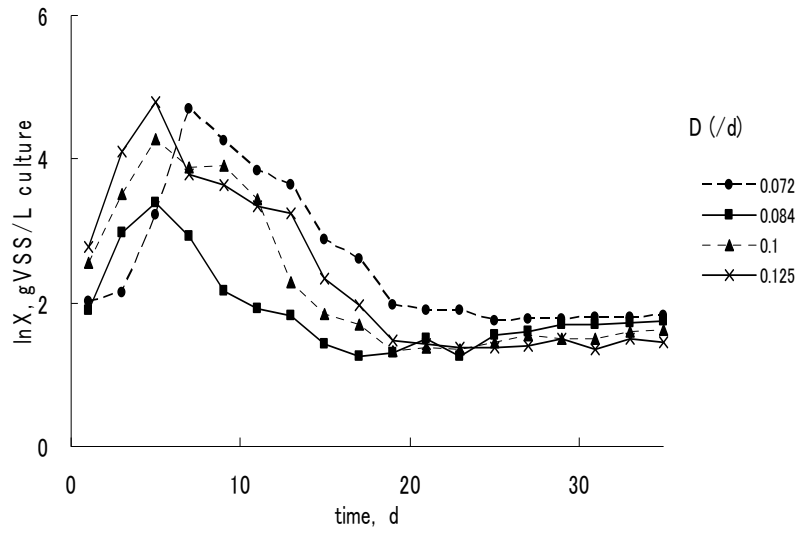


Fig.1. Time course of Bacteria growth during the experiment at different dilution rate

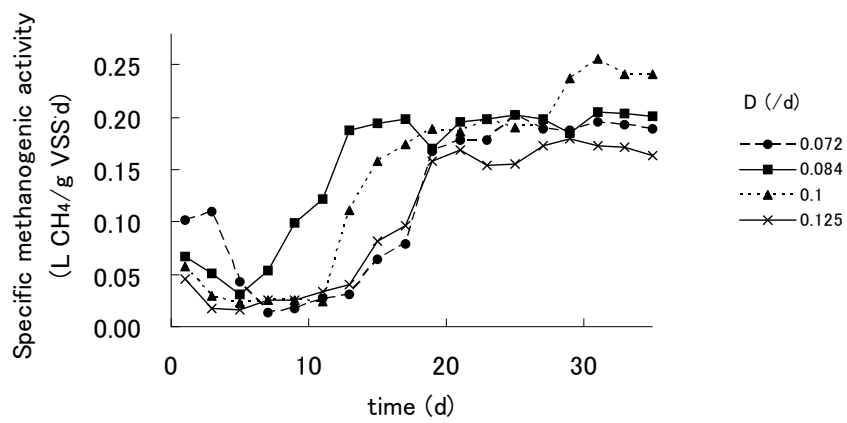


Fig.2. Time course of the Specific Methanogenic Activity (SMA) during the experiment time (days) at different dilution rate; the SMA was obtained from the relation between the bacteria growth rate and the methane production rate at mesophilic temperature ($37 \pm 2^\circ\text{C}$).

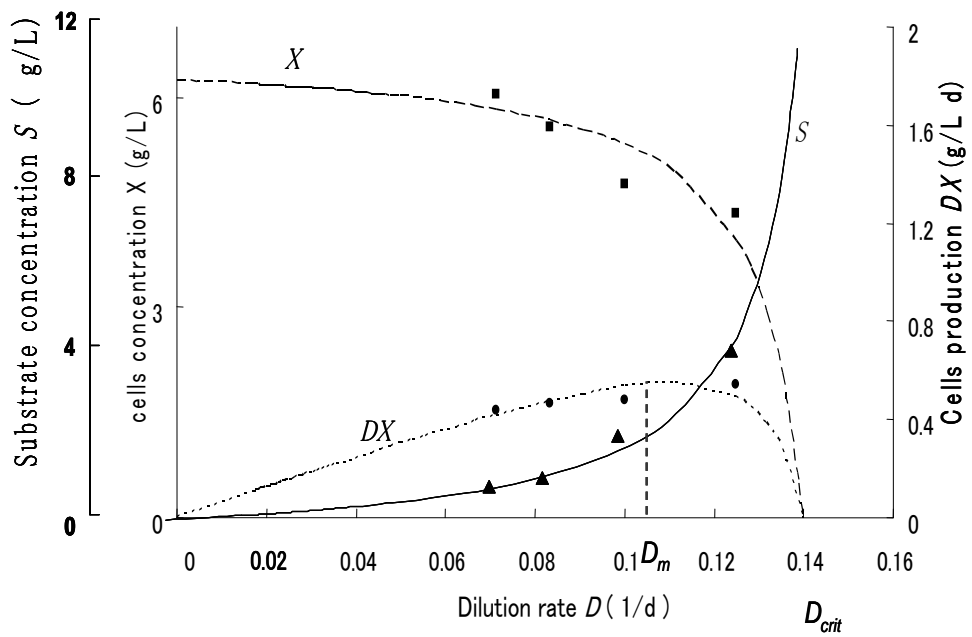


Fig.3. Dependence of cells concentration X , cells production rate DX and supply substrate concentration on continuous culture dilution rate D as simulated from Monod chemostat model. ■ cells concentration X ; ▲ H_2/CO_2 concentration S ; • cells production rate DX ; (—) model prediction. D_{crit} (0.14 /d).

Table 1

Characteristics of acclimated methanogens under H₂/CO₂ as sole substrate after 7 months acclimation representing the average of the duplicate reactors

Parameters	Values average	Standard deviation
COD (g/ L) ^a	9.4	0.387
TS (g/L) ^b	120.7	4.0
VSS (g/L) ^c	116.6	0.55
Total N (g/L)	2.2	0.243
pH	7.7	0.2
Acetic acid (mg/L)	0.0	0.0
Methane production (%)	56.6	1.7

^a COD, chemical oxygen demand.

^b TS, total solids.

^c VSS, volatiles suspended solids.

Values are averages of five determinations; the obtained data differences were less than 3 %.

Table 2

Experimental consumption rate of H₂ and CO₂ calculated when assumed that the gases are perfect (means \pm variance coefficients of data from triplicate sampling trials)

Reactor		Input substrate S ₀ (g/L)	Output substrate average S (g/L) after 24 hrs	Variance coefficients (%)	Consumption rate (%)
I	H ₂	1.71	0.13	2.3	92.0
	CO ₂	9.43	0.71	1.8	92.0
II	H ₂	1.71	0.15	5.5	91.2
	CO ₂	9.43	0.83	6.1	91.0
III	H ₂	1.71	0.29	3.7	83.0
	CO ₂	9.43	1.69	4.1	82.0
IV	H ₂	1.71	0.52	3.2	70.0
	CO ₂	9.43	3.14	4.4	67.0

Table 3
Proposed operational condition using hydrogenotrophic methanogens

<i>Parameters</i>	<i>Proposed values</i>
Dilution (<i>D</i>), 1/d	0.10
Hydrogenotrophic methanogens concentration (<i>X</i>), g VSS/ L culture	5 ± 0.12
pH	Controlled at 6.40-7.67
H ₂ /CO ₂ gas supply, L/d	12.00
Temperature, °C	37 ± 2
mixing	1min interval at 0.08 MPa
Methane production, L/d	1.21