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► **To cite this version:**

Guilherme Araujo Pimentel, Alain Vande Wouwer, Jérôme Harmand, Alain Rapaport. Corrigendum to “Design, analysis and validation of a simple dynamic model of a submerged membrane bioreactor”. *Water Research*, 2016, 89, pp.384-385. 10.1016/j.watres.2015.10.044 . hal-02638986

**HAL Id: hal-02638986**

**<https://hal.inrae.fr/hal-02638986>**

Submitted on 28 May 2020

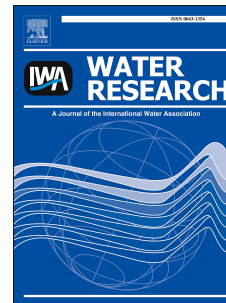
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# Accepted Manuscript

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PII: S0043-1354(15)00380-2

DOI: [10.1016/j.watres.2015.10.044](https://doi.org/10.1016/j.watres.2015.10.044)

Reference: WR 11605

To appear in: *Water Research*

Please cite this article as: Pimentel, G.A., Wouwer, A.V., Harmand, J., Rapaport, A., Corrigendum to “Design, analysis and validation of a simple dynamic model of a submerged membrane bioreactor”, *Water Research* (2015), doi: 10.1016/j.watres.2015.10.044.

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Comment citer ce document :

Araujo Pimentel, G. (Auteur de correspondance), Vande Wouwer, A., Harmand, J., Rapaport, A. (Auteur de correspondance) (2016). Corrigendum to “Design, analysis and validation of a simple dynamic model of a submerged membrane bioreactor”. *Water Research*, 89, 384–385. DOI : [10.1016/j.watres.2015.10.044](https://doi.org/10.1016/j.watres.2015.10.044)

## Corrigendum to “Design, analysis and validation of a simple dynamic model of a submerged membrane bioreactor”

Guilherme A. Pimentel<sup>a,b,d</sup>, Alain Vande Wouwer<sup>a</sup>, Jérôme Harmand<sup>b,c</sup>, Alain Rapaport<sup>b,d</sup>

<sup>a</sup>University of Mons - Automatic Control Laboratory - Biosys, Boulevard Dolez 31, 7000 Mons, Belgium

<sup>b</sup>Equipe Projet INRA-INRIA MODEMIC, Route des Lucioles 06902 Sophia-Antipolis, France

<sup>c</sup>INRA, UR050, Laboratoire de Biotechnologie de l'Environnement, Av. des Etangs, F-11100 Narbonne, France

<sup>d</sup>UMR INRA-SupAgro MISTEA, 2 Place Viala 34060 Montpellier, France

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### Abstract

In this paper, the readers can find the corrections of the published article. The authors apologize for any inconvenience caused.

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### SECTION 4.2 - Three-time-scale singular perturbation

The small parameters are assumed to be  $\epsilon_1 = |\gamma|$  and  $\epsilon_2 = \frac{1}{V}$ .

**Hypothesis 1.**  $\gamma$  is small.

**Hypothesis 2.** The volume  $V$  is large, with  $V < \frac{1}{|\gamma|}$ .

The application of the procedure introduced in the previous subsection yields:

*Email addresses:* guilherme.araujopimentel@umonts.ac.be (Guilherme A. Pimentel),

alain.vandewouwer@umonts.ac.be (Alain Vande Wouwer),

jerome.harmand@supagro.inra.fr

(Jérôme Harmand), rapaport@supagro.inra.fr (Alain Rapaport)

First: The stretched time-scale  $\tau_1 = \epsilon_1 t \rightarrow \frac{1}{dt} = \frac{\epsilon_1}{d\tau_1}$

$$\frac{dx_{sl}}{d\tau_1} = \text{sign}(\gamma)x_{sl} \quad (\text{Slow})$$

$$\epsilon_1 \frac{dy_1}{d\tau_1} = g_1(y_1, y_2) = -\frac{1}{Y}\mu(y_1)y_2 + \frac{Q_{in}}{V}(S_{in} - y_1) \quad (\text{Fast})$$

$$\begin{aligned} \epsilon_1 \frac{dy_2}{d\tau_1} = g_2(x_{sl}, y_1, y_2, z) = \\ \mu(y_1)y_2 + \frac{Q_{in}}{V}X_{in} - \frac{Q_{in}}{V}y_2 + x_{sl}\frac{J_{air}}{V}\frac{z^2}{K_{air}+z} \quad (\text{Fast}) \end{aligned}$$

$$\epsilon_1 \frac{dz}{d\tau_1} = h(x_{sl}, y_2, z) = Q_{cake}y_2 - x_{sl}J_{air}\frac{z^2}{K_{air}+z} \quad (\text{Fast})$$

Considering  $Q_w = Q_{in} - Q_{cake}$  and letting  $\bar{S}_{in} = S_{in} + \frac{X_{in}}{Y} > S_{in}$  the following slow-fast approximation can be developed:

$$0 = g_1(y_1, y_2) \rightarrow \mu(y_1) = \frac{Q_w S_{in} - y_1}{V \bar{S}_{in} - y_1} \quad (11)$$

$$0 = g_2(x_{sl}, y_1, y_2, z) \rightarrow y_2 = \frac{Q_{in}(\bar{S}_{in} - Yy_1)}{Q_w} \quad (12)$$

$$0 = h(x_{sl}, y_2, z) \rightarrow \frac{x_{sl}J_{air}z^2}{V(K_{air}+z)} = Q_{out}y_2 \quad (13)$$

Second: The stretched time-scale  $\tau_2 = \epsilon_2 \tau_1 = \epsilon_2 \epsilon_1 t \rightarrow \frac{1}{d\tau} = \frac{\epsilon_2}{d\tau_2}$  and  $x_{sl}$  is constant.

$$\epsilon_1 \frac{dy_1}{d\tau_2} = -\frac{1}{Y\epsilon_2}\mu(y_1)y_2 + Q_{in}(S_{in} - y_1) \quad (\text{Fast})$$

$$\epsilon_1 \frac{dy_2}{d\tau_2} = \left(\frac{\mu(y_1)}{\epsilon_2} - Q_w\right)y_2 + Q_{in}X_{in} - Q_{cake}y_2 + x_{sl}J_{air}\frac{z^2}{K_{air}+z} \quad (\text{Fast})$$

$$\epsilon_2 \epsilon_1 \frac{dz}{d\tau_2} = h(x_{sl}, y_2, z) = Q_{cake}y_2 - x_{sl}J_{air}\frac{z^2}{K_{air}+z} \quad (\text{Ultrafast})$$

$$0 = h(x_{sl}, y_2, z) \rightarrow z = \frac{\frac{Q_{cake}Q_{in}Y\bar{S}_{in}}{Q_w} + \sqrt{Q_{cake}^2\left(\frac{Q_{in}Y\bar{S}_{in}}{Q_w}\right)^2 + 4\frac{Q_{cake}Y\bar{S}_{in}K_{air}J_{air}x_{sl}Q_{in}}{Q_w}}}{2x_{sl}J_{air}} \quad (14)$$

TABLE 2

Table 2: Parameters with their confidence interval.

	Ultrafast [0.02 Days]	Fast [6 Days]	Slow [20 Days]	All Parameters
$\beta_0$	$(4.819 \pm 0.573) \times 10^4$	fixed value	fixed value	$(5.531 \pm 0.643) \times 10^4$
$K_{air}$	$(4.773 \pm 0.575) \times 10^1$	fixed value	fixed value	$(4.596 \pm 0.134) \times 10^1$
$Y$	fixed value	$(8.996 \pm 0.022) \times 10^{-1}$	fixed value	$(8.985 \pm 0.016) \times 10^{-1}$
$\mu_{S,max}$	fixed value	$(2.004 \pm 0.722)$	fixed value	$(2.265 \pm 0.343)$
$\gamma$	fixed value	fixed value	$(0.001 \pm 0.882)$	$(0.001 \pm 0.535)$
$\min(f_{cost}(\theta))$	53.55	0.8592	6.42	22.79