

Supplementary material

**ENHANCING pH CONTROL IN A BIOREACTOR THROUGH EXPERIMENTAL
SYSTEM IDENTIFICATION AND DYNAMIC ANALYSIS**

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SUPPLEMENTARY FILE

Supplementary Tables

Table S-1. Comparison of two different reaction curves obtained from different operation modes and calculation of model parameters from three different types of methods.

Calculation Methods of FOPDT Model Parameters	Without microorganism			With microorganism		
	K_p	θ	τ	K_p	θ	τ
Transient Analyze	0.351	468	2886	8.318	520	6300
Smith	0.351	1077	2172	8.318	4590	3330
Linear Regression	0.351	905	2813	8.318	3072	3280

Table S-2. ARMAX model parameters calculated as a result of the effects given to the input variable

Second order ARMAX model parameters	INPUTS		
	Square wave	Random	Ternary
a ₁	-0.7157	-1.1837	-0.9720
a ₂	-0.2841	0.1860	-0.0276
b ₀	0.0172	0.0440	0.0131
b ₁	-0.0068	-0.0011	0.0008
Integrated square error (ISE)	293.2066	47.2691	126.6264

Supplementary Figures

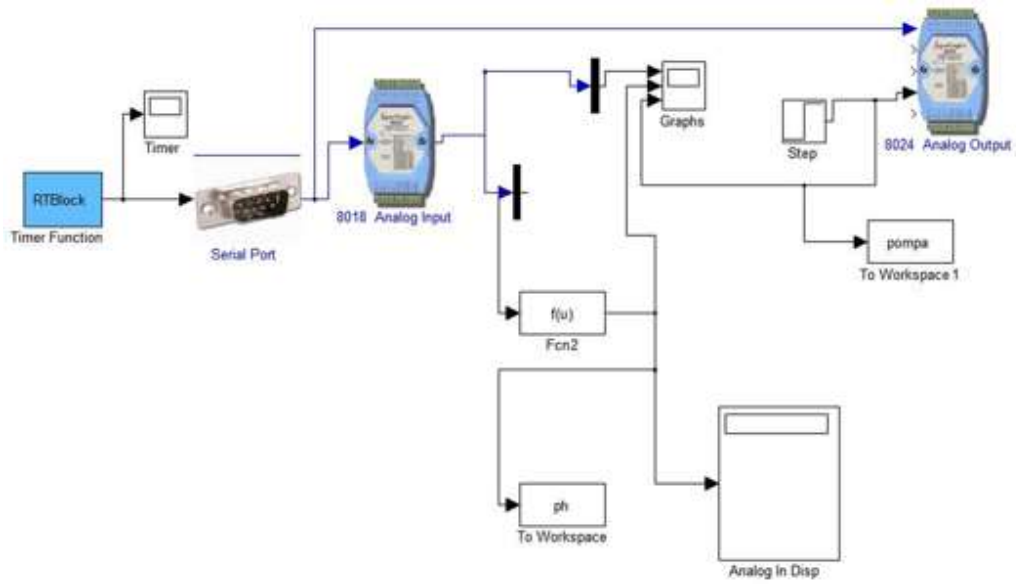


Figure S-1. Simulink Block diagram performed in dynamic analysis

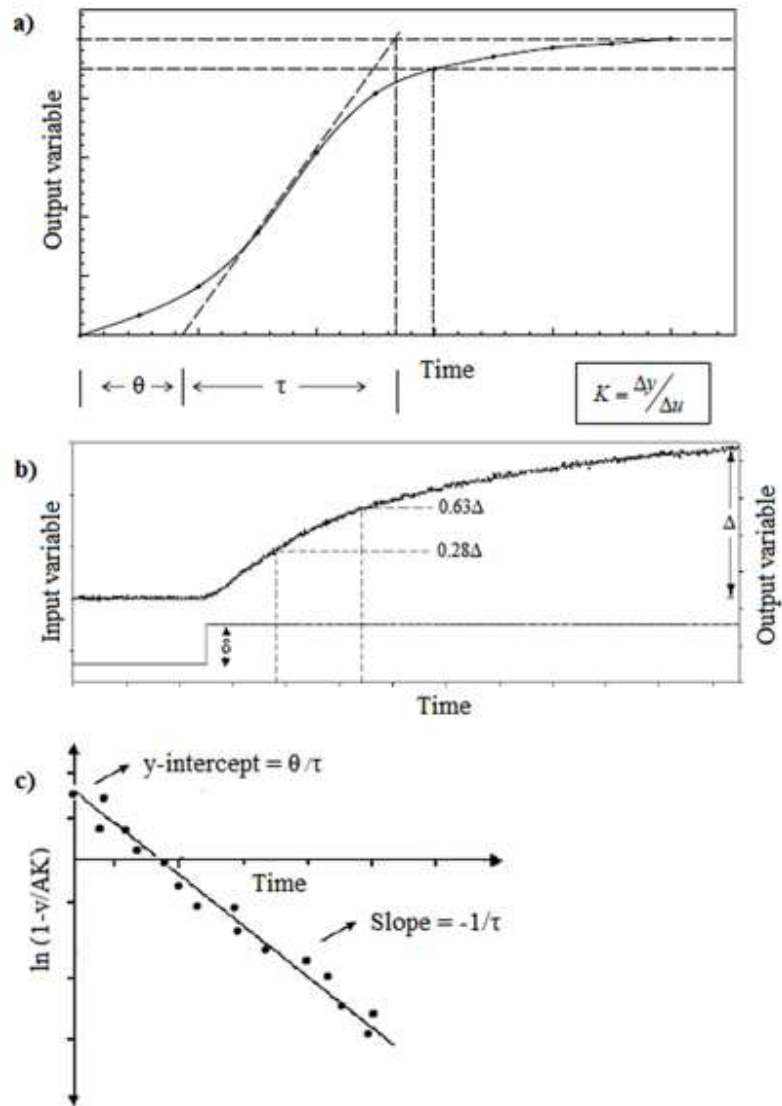


Figure S-2.

a) Transient analysis method (Process reaction curve method) for obtaining model parameters of FOPDT

b) Model parameter calculated method proposed by Smith 1972

c) Linear regression parameter calculation method

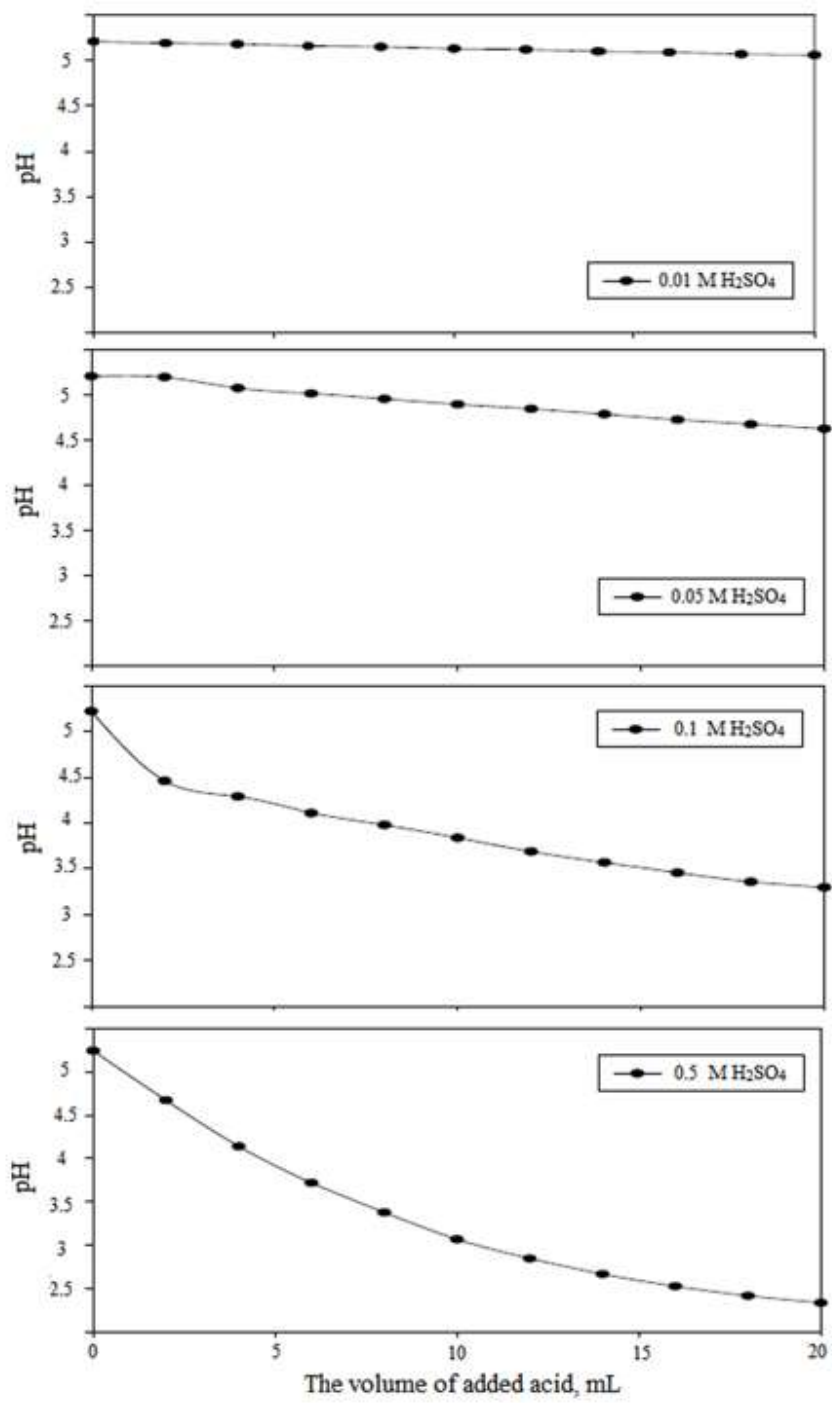


Figure S-3. pH change according to the added volume of H₂SO₄