ANAEROBIC BIODEGRADABILITY, TOXICITY AND LONG-TERM CONTINUOUS TREATMENT OF COMMERCIAL PESTICIDES IN AN EGSB REACTOR

XIII Taller y Simposio Latinoamericano de Digestión Anaerobia

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INTRODUCTION

- Pesticides are widely used for control pests, including insects, rodents, fungi and unwanted plants (weeds). Agrochemical products contain active ingredient and a variety of solvents, synergists, surfactants, and other inert ingredients to improve the stability, delivery and effectiveness of the pesticidal ingredient. Industrial wastewater generated in the washing of commercial pesticide containers are characterized by a heterogeneous composition in terms of pesticides type and concentration (Zapata et al., 2010). Due to the toxic character of these effluents an efficient treatment is needed in order to removed them.
- The aim of this work is to assess the anaerobic treatment of synthetic wastewater bearing commercial pesticides (MCPA, imidacloprid and dimethoate) by an EGSB reactor to optimize the operation conditions.

METHODS

PESTICIDES

MCPA

Imidacloprid

Dimethoate

BIODEGRADABILITY

Compounds as sole carbon source

INHIBITION

Acetoclastic e hydrogenotrophic

CONTINUOS RUNS

Synthetic wastewater + Pesticides = 1.75 gCOD/L

COMPONENTS	CONCENTRATION (mg/L)
Peptone	17.4
Yeast extract	52.2
Milk powder	116.2
Sunflower oil	29.0
Sodium acetate	79.4
Starch	122.0
Urea	91.7

		Stage I 20% TOC	Stage II 30% TOC	Stage III 40% TOC
Commercial pesticide	Active ingredients	Conc. (mg/L)	Conc. (mg/L)	Conc. (mg/L)
Selective herbicide	MCPA	57.7	86.5	100.0
Couraze®	Imidacloprid	19.4	29.0	38.7
Danadim®	Dimethoate	24.8	37.3	49.7
	Cyclohexanone	26.7	40.4	53.5

RESULTS

BIODEGRADABILITY

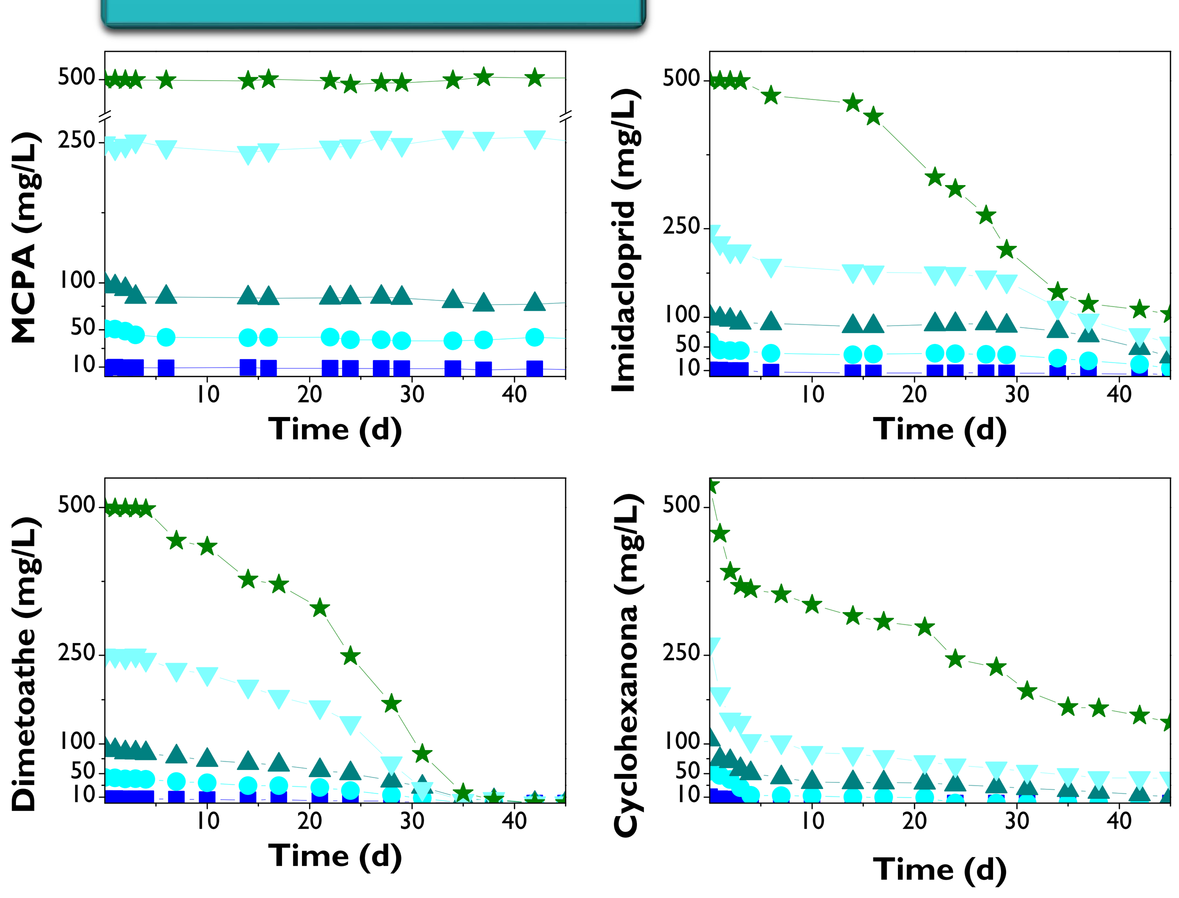

Figure 1. Time-course of MCPA, Imidacloprid, dimethoate and cyclohexanone during the biodegradability test at different initial concentration: 10 (squares), 50 (circles), 100 (triangles), 250 (inverted triangles) and 500 mg/L (stars).

INHIBITION

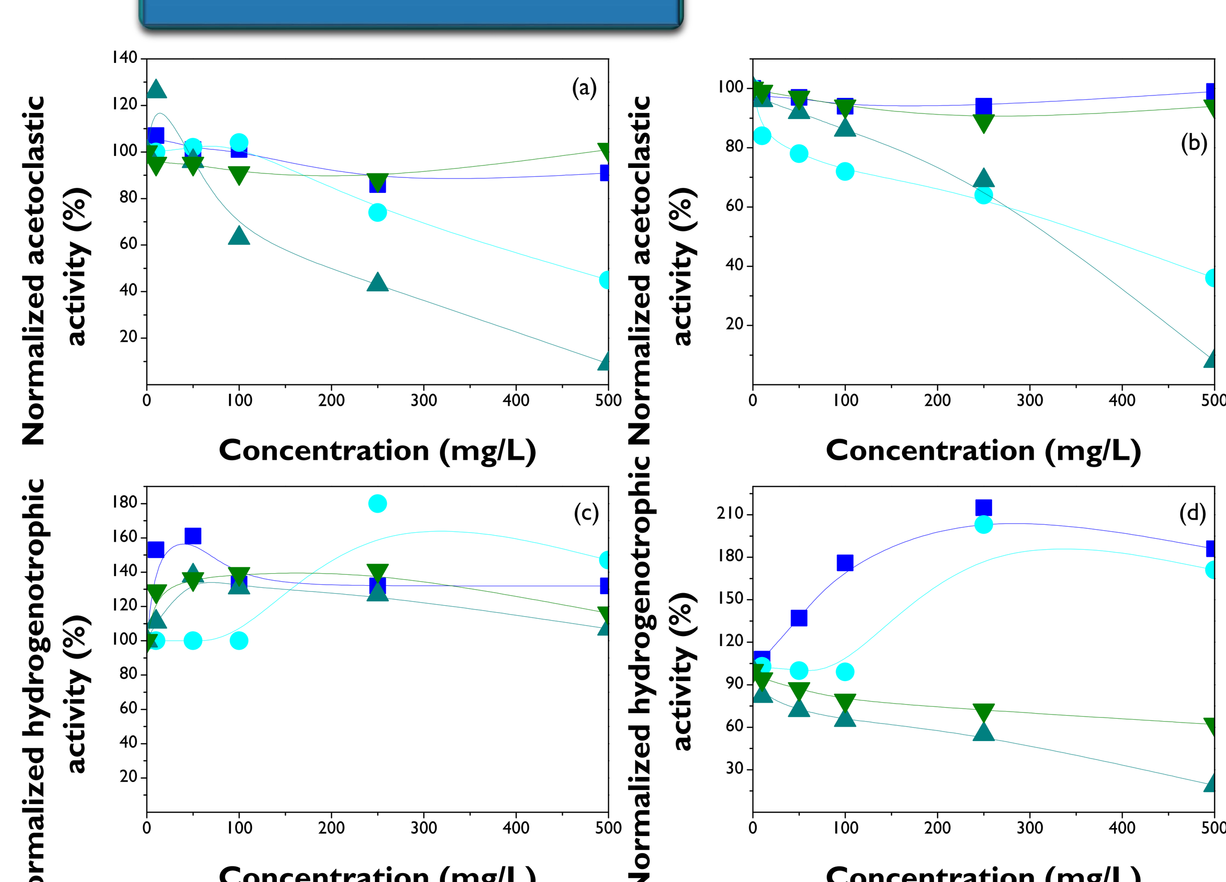

Figure 2. Normalized acetoclastic and hydrogenotrophic activity during the inhibition (a, c) and recovery test (b,d) using MCPA (squares), Imidacloprid (circles), dimethoate (triangles) and cyclohexanone (inverted triangles).

EGSB

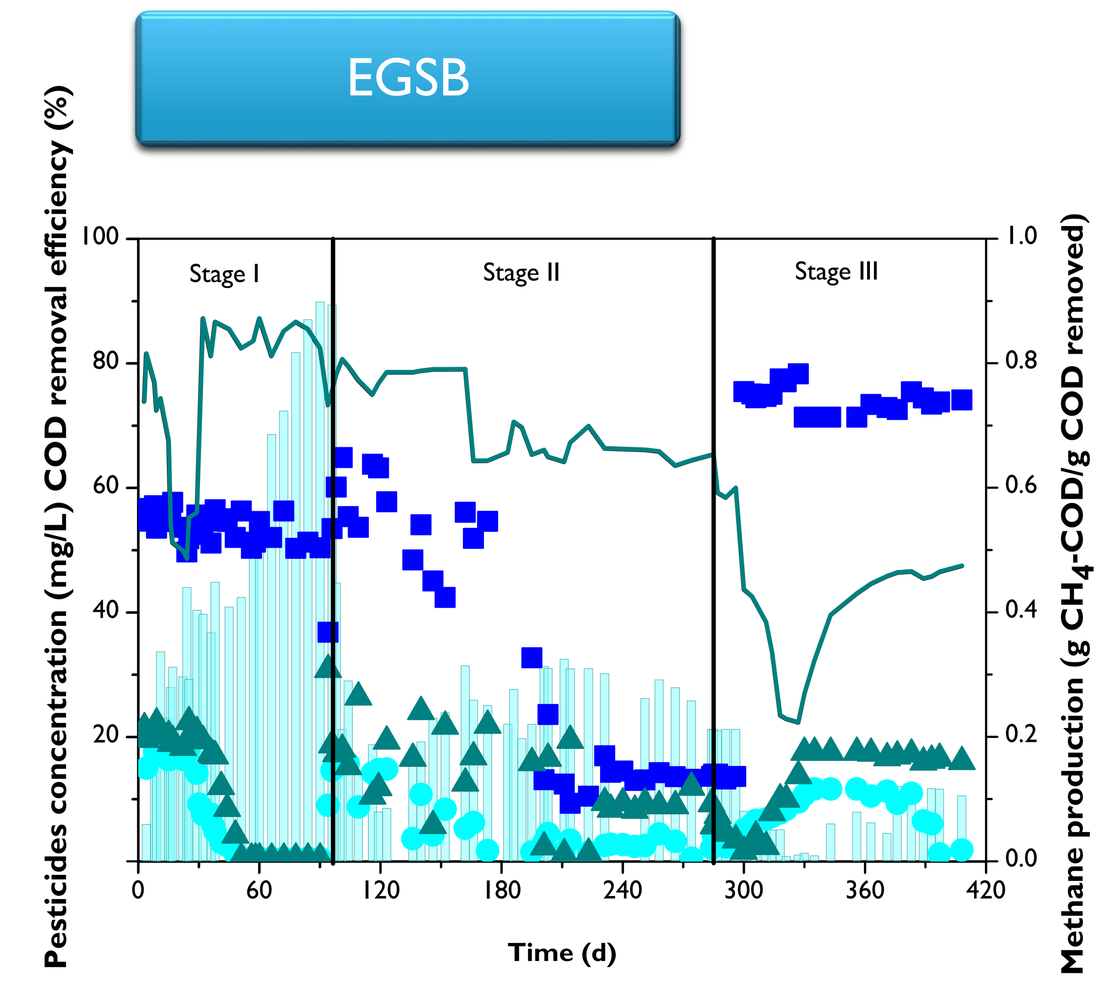

Figure 3. COD removal efficiency (continuous line), methane production (bars), and concentration of pesticides: MCPA (squares), imidacloprid (circles) and dimethoate (triangles) in the effluent during the EGSB reactor operation.

Methanobacterium genus, an hydrogenotrophic archaea, dominated the granular sludge

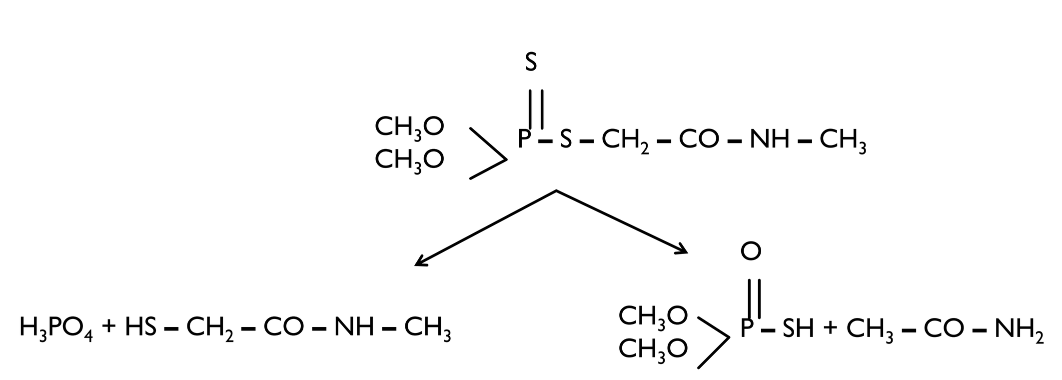

Figure 4. Metabolites obtained by the two proposed degradation pathways of dimethoate.

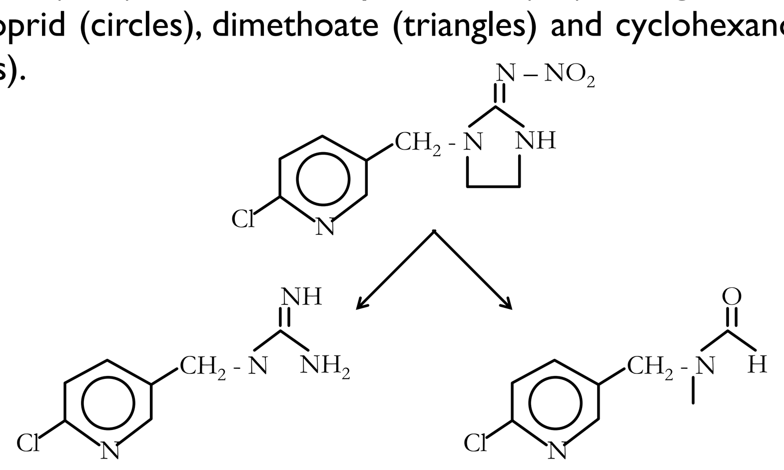

Figure 5. Metabolites obtained by the two proposed degradation pathways of imidacloprid.

CONCLUSIONS

- Dimethoate was successfully removed within the concentration range studied. Two mechanisms for its degradation have been proposed, one start with the attack of the alkoxy group and the second with the demethylation of the methylamine moiety. Imidacloprid degradation occurred by the reduction of the nitro group following a two-stage degradation model. However, MCPA was poorly biodegraded under anaerobic conditions. Insecticides provoked an irreversible inhibition over the acetoclastic archaeas, while only dimethoate was toxic for hydrogenotrophic biomass. DGGE analysis showed that *Methanobacterium* genus, a hydrogenotrophic archaea, prevailed in the granular biomass during the long-term experiment. The selected pesticides could be successfully biodegraded using and EGSB reactor which shows a high tolerance to pesticides and also cushioned the variations of their concentration.

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