Crundtvig-Project

Water and Life

Monday, 1st of July to Friday, 5th of July Schrobenhausen, Augburg, Wolnzach, Germany

EVOLUTION OF BIOLOGICAL WASTEWATER TREATMENT: From Activated Sludge (AS) to Moving Bed Membrane Bioreactor (MB-MBR)



Microbiology and Environmental Technologies (MITA)

University of Granada (UGR)





OUR RESEARCH GROUP

Working centres:

- ✓ Civil Engineering School
- ✓ Institute for Water Research
- ✓ Pharmaceutical Sciences Faculty

Departments:

✓ Civil Engineering

✓ Microbiology

✓ Structures and Hydraulic Engineering

Research lines:



- ✓ Urban wastewater treatment
- ✓ Industrial wastewater treatment
 - ✓ Wastewater reuse
 - ✓ Soil bioremediation
 - ✓ Soil pollutant removal





BIOLOGICAL WASTEWATER TREATMENT

- Natural consumption of the organic matter.
 Nutrients removal.
- ✓ Microorganisms removal.







CONVENTIONAL ACTIVATED SLUDGE





MEMBRANE BIOREACTOR

Influent





MOVING BED BIOREACTOR



Moving bed bioreactor (A) with biofilm or (B) with hybrid biomass: biofilm and suspended solids



MOVING BED BIOREACTOR

Carrier



- ✓ Protected area to cell growth.
- ✓ Microorganisms and organic matter transfer.
- ✓ Microorganisms and oxygen transfer.
- ✓ Carrier density slightly lower than the water one to provide the bed motion.











MOVING BED BIOREACTOR

A moving bed bioreactor must be in continuos motion to:

- Bed clogging.
- Contact between the organic matter and the microorganisms.

Pure Moving Bed
 Hybrid Moving Bed
 VIDEO 2



MOVING BED BIOREACTOR

✓ Aeration (aerobic bioreactor) or mechanical stirrer (anaerobic or anoxic bioreactor).



Moving Bed Bioreactor (A) aerobic conditions or (B) anoxic conditions



MOVING BED BIOREACTOR

Elements of the wastewater treatment plant

✓ Air diffuser.





MOVING BED BIOREACTOR

Elements of the wastewater treatment plant

✓ Sieve arrangement.





MOVING BED BIOREACTOR

Elements of the wastewater treatment plant







MOVING BED BIOREACTOR

Advantages

Simple alternative to uploaded conventional activated sludge plants.

VIDEO 3

✓ Advantages from the biofilm process.

✓ Increase the organic matter and nutrient removal rates.

✓ Efficiency depends on the filling ratio.

Reduce the suspended solids concentration in the bioreactor.

✓ The sludge retention time increases.

 \checkmark Biofilm is more resistant than the biological flocs regarding the variation of pH or organic loading.



MOVING BED BIOREACTOR

Some plants in the world

318 K	Vitivinícola del Ribeiro, España
17.00	Nufri, España
5.200	Bonduelle, Portugal
20.00	E.T.A.R. Pranchinha, Portugal
220.0	Bergamo, Italia
17.00	Bury St. Edmunds, Reino Unido
40.0	Caboolture, Australia
50.00	Gardermoen, Noruega
3.00	Solvay Paperboard, EEUU
36.00	Stora Enso Langerbrugge, Bélgica
20.00	UPM Schongau Mill, Alemania
4.20	Coca Cola Apizaco, México
22.00	Stora Enso Intercell, Polonia

g DQO/d 0 kg DQO/d Kg DQO/d 00 hab.equiv. 000 hab.equiv. 0 hab.equiv. 00 hab.equiv. 00 hab.equiv. 0 kg DBO/d 00 kg DQO/d 00 kg DQO/d 0 kg DBO,/d 00 kg DQO/d



MOVING BED BIOREACTOR





MOVING BED BIOREACTOR

Vitivinícola del Ribeiro, España	
Nufri, España	
Bonduelle, Portugal	
E.T.A.R. Pranchinha, Portugal	
Bergamo, Italia	
Bury St. Edmunds, Reino Unido	
Caboolture, Australia	
Gardermoen, Noruega	
Solvay Paperboard, EEUU	
Stora Enso Langerbrugge, Bélgica	
UPM Schongau Mill, Alemania	
Coca Cola Apizaco, México	
Stora Enso Intercell, Polonia	

318 Kg DQO/d 17.000 kg DQO/d 5.200 Kg DQO/d 20.000 hab.equiv. 220.000 hab.equiv. 17.000 hab.equiv. 40.000 hab.equiv. 50.000 hab.equiv. 3.000 kg DBO/d 36.000 kg DQO/d 20.000 kg DQO/d 4.200 kg DBO,/d 22.000 kg DQO/d



MOVING BED BIOREACTOR





MOVING BED BIOREACTOR

CMPC Santa Fe, Chile	127.000 kg DQO/d
Greenfield, Francia	19.000 kg DQO/d
SCA Puigpelar, España	1.700 kg DQO/d
Broomfield, Colorado, EEUU	73.500 hab.equiv.
Alier, España	15.000 kg DBO ₇ /d
Klippan WWTP, Suecia	7.000 hab.equiv.
Tafall - Olite, España	34.000 hab.equiv.
Klabin Kimberly, Brasil	5.500 kg DQO/d
Irving Pulp & Puper, Canadá	10.000 kg DQO/d
AstraZeneca, Suecia	1.500 kg TOC/d



OUR RESEARCH RESULTS

✓ Comparative study of carrier type

Martín-Pascual, Jaime; Lopez-Lopez, Cristina; González-López, Jesús; Hontoria-García, Ernesto; Poyatos-Capilla, José Manuel (2011). Comparative Kinetic Study of Carrier Type in a Moving Bed System Applied to Organic Matter Removal in Urban Wastewater Treatment. Water, air & soil pollution 223 (1) 1699-1712

Lopez-Lopez, Cristina; Martín-Pascual, Jaime; González-Martínez, Alejandro; Calderón-Alvarado, Kadiya Del Carmen; Hontoria-García, Ernesto; Poyatos-Capilla, José Manuel (2012). Influence of filling ratio and carrier type on organic matter removal in a moving bed biofilm reactor with pretreatment of electrocoagulation in wastewater treatment. Journal of Environmental Science and Health, Part A 47 1-9

Calderón-Alvarado, Kadiya Del Carmen; Martín-Pascual, Jaime; Poyatos-Capilla, José Manuel; Rodelas-González, María Belén; González-Martínez, Alejandro; González-López, Jesús (2012), **Comparative analysis of the bacterial diversity in a lab-scale moving bed biofilm reactor (MBBR) applied to treat urban wastewater under different operational conditions.** Bioresource technology 121 (1) 119-126



OUR RESEARCH RESULTS

✓Kinetic behaviour of the hybrid biomass

Leyva-Diaz, Juan Carlos; Calderón, Kadiya; Rodríguez, Francisco Alejandro; González-López, Jesús; Hontoria-García, Ernesto; Poyatos-Capilla, José Manuel (2013). Comparative kinetic study between moving bed biofilm reactor-membrane bioreactor and membrane bioreactor systems and their influence on organic matter and nutrients removal.Biochem. Eng. J.

Martín-Pascual, Jaime; Reboleiro-Rivas, Patricia; González-López, Jesús; Hontoria-García, Ernesto; Poyatos-Capilla, José Manuel (2013). Influence ot hydraulic retention time on heterotrophic biomass in a wastewater moving bed membrane bioreactor treatment plant. Int. J. Environ. Sci. Technol. DOI 10.1007/s13762-013-0329-6



OUR RESEARCH RESULTS

✓ Behaviour of a membrane bioreactor

Martín-Pascual, Jaime; Rodríguez-Íñiguez, Francisco Alejandro; Reboleiro-Rivas, Patricia; González-López, Jesús; Hontoria-García, Ernesto; Poyatos-Capilla, José Manuel (2012). Influence ot the temperature in the permeate flux of the membrane in a membrane bioreactor with moving bed biofilm reactor, Procedia Engineering 44 (2012) 275-277

□Rodríguez-Íñiguez, Francisco Alejandro; Martín-Pascual, Jaime; GARCÍA-MESA, JUAN JOSÉ; González-López, Jesús; Hontoria-García, Ernesto; Poyatos-Capilla, José Manuel(2012). Influence of pure oxygen or air to suply the aerobic conditions in membrane bioreactor in the recovery of permeability of the membrane. Procedia Engineering 44 (2012) 1970-1973

García-Mesa, Juan José; Martín-Pascual, Jaime; Muñío-Martínez, María Del Mar; Delgado-Ramos, Fernando; Hontoria-García, Ernesto; Poyatos-Capilla, José Manuel (2012). Wastewater particle size distribution variation in a real membrane bioreactor plant, Procedia Engineering 44 (2012) 942-945

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Thank you for your attention

Membrane Dioreactor (MD-MDN)



Gru

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Microbiology and Environmental Technologies (MITA)

University of Granada (UGR)

