BM-T RESPIROMETRY STUDY ABOUT THE ADAPTATION OF A POTENTIAL TOXIC INDUSTRIAL WASTEWATER TO AN SPECIFIC ACTIVATED SLUDGE

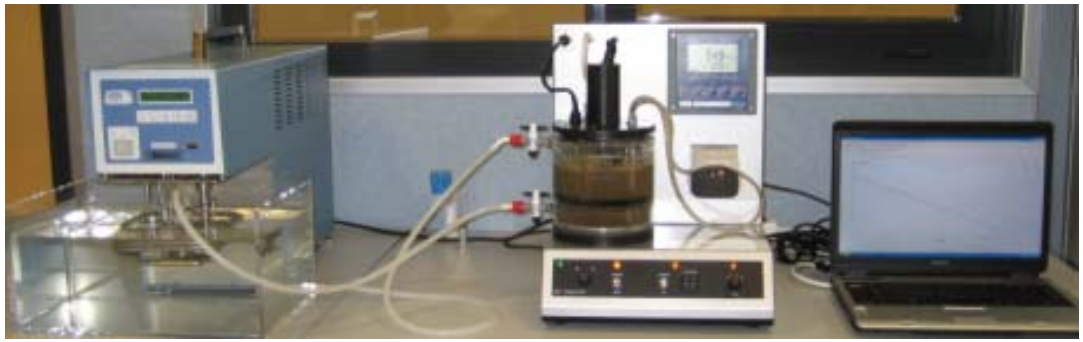
Enterprise: CELANESE CHEMICALS IBÉRICA, S.A. (Tarragona – Spain)
Premier materials for painting industry

Celanese enterprise, before the SURCIS study, in several laboratories had already tried several analysis of its industrial wastewater in order to find out if it could be certain degree of toxicity when wastewater will be treated with activated sludge and also to know its biodegradability degree. According to the bioassays and ecotoxicity results from laboratories, the wastewater has got a high degree of toxicity and it would be not possible the construction of a new biological treatment process to remove the COD of such wastewater (!?) SURCIS, by means of its BM-T respirometer demonstrated however that after some controlled period of adaptation to the activated sludge, the wastewater was not only at all toxic but also presented a high degree of biodegradability.

The objective of the study was, therefore, to obtain a clear confirmation on the toxic and biodegradable nature of a genuine sample from Celanese Iberian Chemicals with the purpose of contributing with fundamental data to the future activated sludge process design.

Respirometry system

This service was carried out by specialized SURCIS (Spain) personnel by means a BM-T respirometer system and some complementary reagents and instruments.



BM-T system

Glossary of terms

Aeration energy: Energy (kWh) utilized in the actual aeration system of the treatment plant.

AOR (Kg O_2/d): Actual oxygen requirement by ASP

ASP: Activated Sludge Process

CO (mg O_2/L): Consumed oxygen in substrate oxidation in the R dynamic test in BM-T respirometer.

Equivalent mixed-liquor: liquor made from RAS and wastewater influent to aeration tank in the same proportion to the actual ASP

Inhibition in activated sludge: Sludge bioactivity reduction due to some specific compounds in waste water or physical-chemical conditions.

MLVSS (mg/L): Mixed liquor volatile suspended solids concentration = biomass concentration

RAS: Recirculation activated sludge from 2nd settler to influent to ASP

Toxicity in activated sludge: Sludge bioactivity elimination due to the presence of some toxicant in wastewater.

Respirometry parameters in use

PARAMETERS TO FOR MIXED-LIQUOR ASSESSING

Parameter	Description	Application
OUR mg/(l.h)	Total oxygen uptake rate	Quantitative analysis of the total oxygen consumption rate from biomass.
SOUR mg/(gVSS.h)	Specific OUR related with MLVSS	Activated sludge bioactivity assessment.

PARAMETERS AND DERIVED CALCULATIONS FOR WASTEWATER

Rs mg/(l.h)	Dynamic respiration rate	Analysis of the activity provoked by the addition of substrate to the activated sludge.
bCOD (mg/l)	Biodegradable fraction of COD	Biodegradability / treatability, F/M, Nutrients ratio, …
Biodegradability	bCOD / COD ratio	Biodegradable character of one sample.

Samples

For this study of toxicity & biodegradability, Celanese has provided SURCIS a wastewater sample and activated sludge from a compatible ASP.

The sludge has been continuously aerated maintained from the first moment in order to conserve it alive, with enough oxygen for its respiration and with some organic preparation for its basic biological needs

According to Celanese this sludge has got a volatile suspended solids concentration of 4 mg MLVSS/L.

To the sample provided by Celanese we have periodically added a certain amount of nutrients on the base of BOD/N/P about 100/5/1

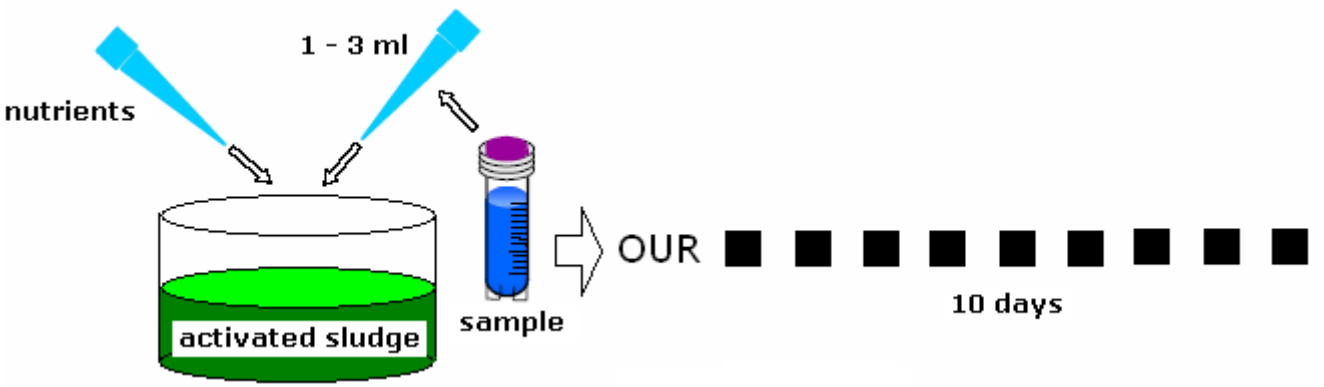
Total COD is 6,000 mg/L.

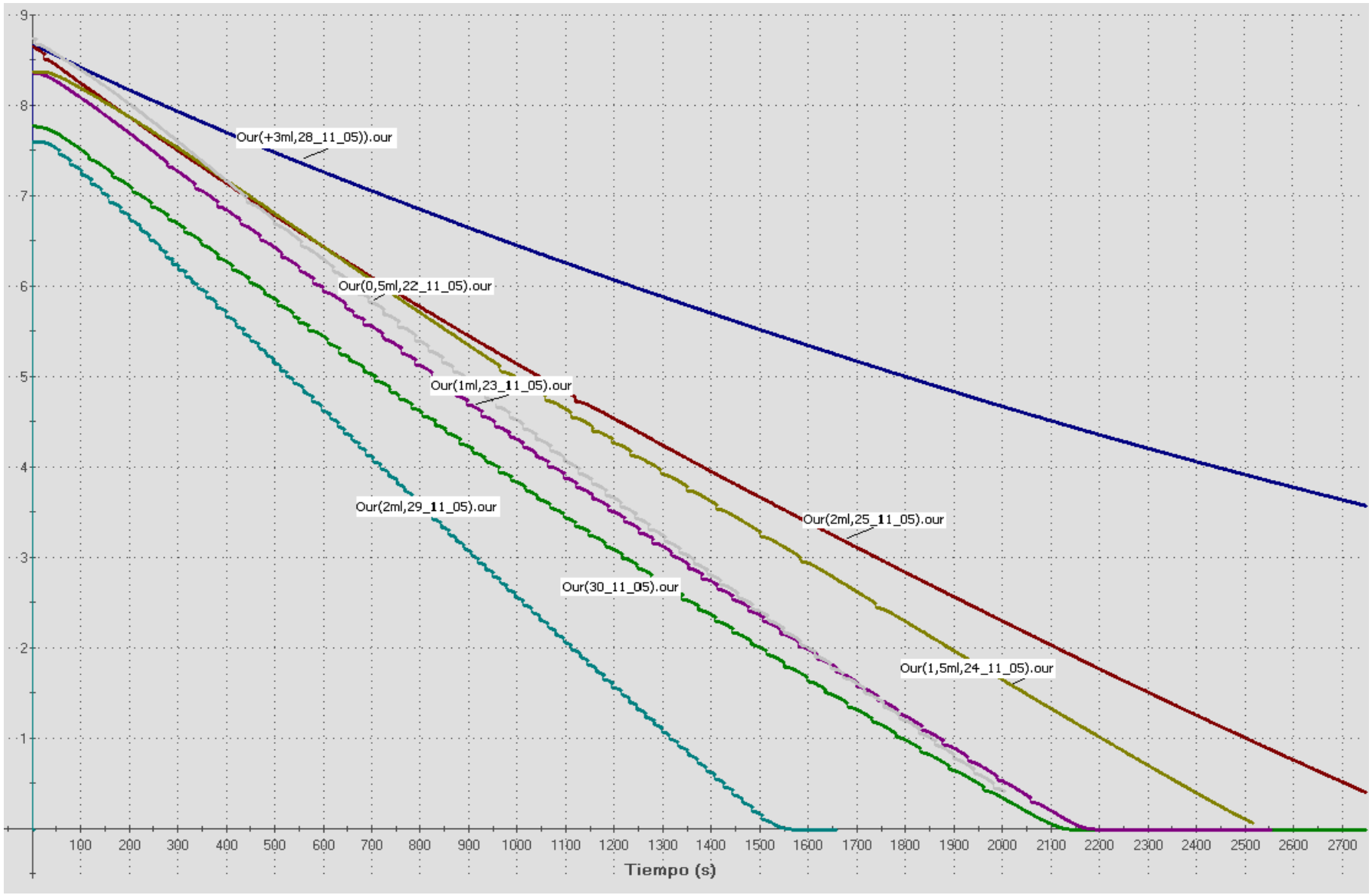
Adaptation of the activated sludge to the wastewater sample

In order that the activated sludge were adapting to the specific nature of Celanese sample was submitted, during an adaptation period, to a series of small doses of sample. Throughout this period the sludge activity was controlled by means of periodic tests of OUR & SOUR.

The adaptation period was of 10 days. During this period to the sludge it was added different small doses of Celanese sample and was analyzed its progressively biological activity through out the corresponding OUR & SOUR tests.

In each test the activity level in comparison with the previous days is analyzed in order to confirm that the sludge was under its wastewater adaptation period.



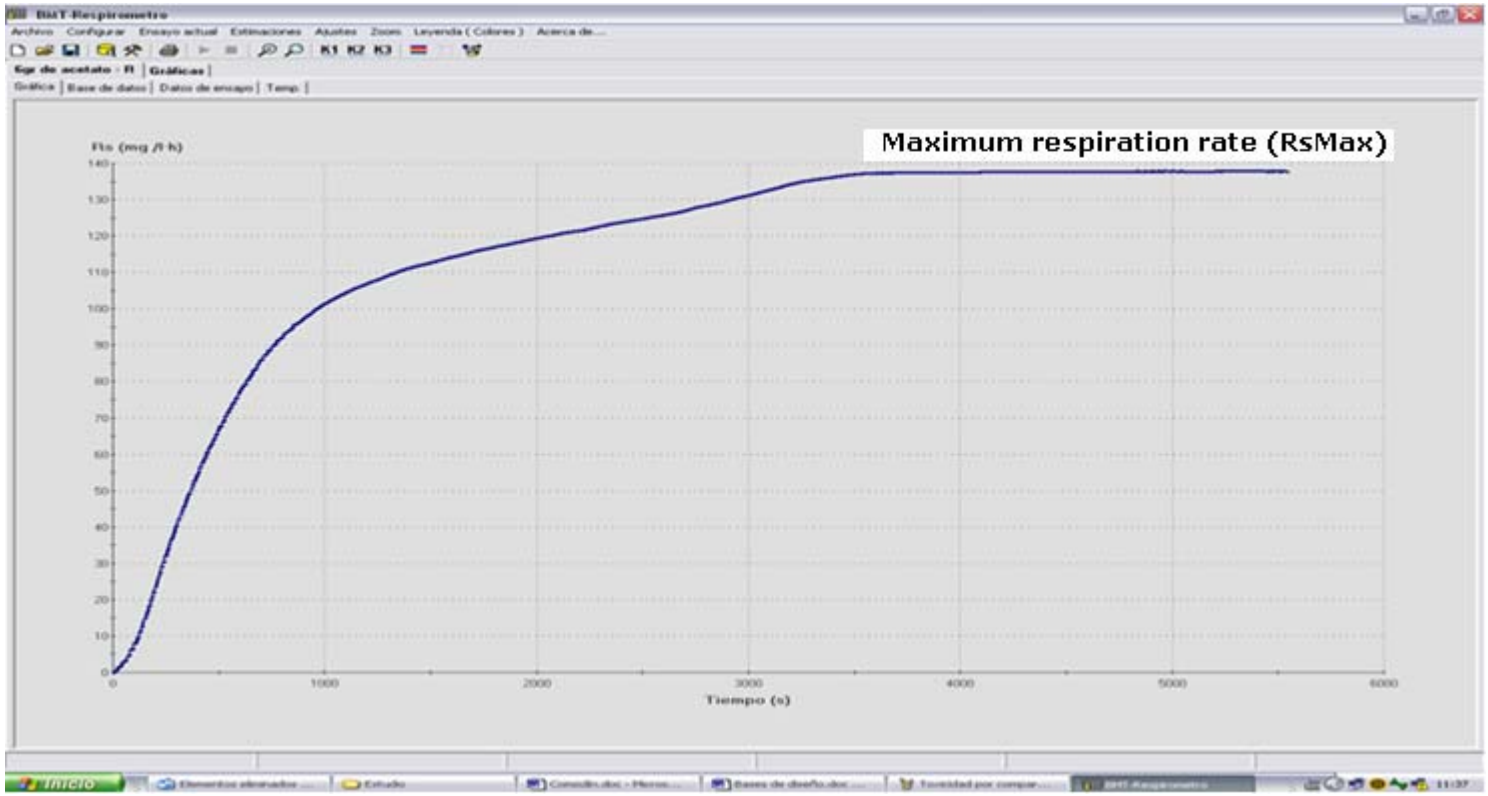


Set of OUR respirograms in BM-T respirometer corresponding to the activated sludge adaptation period

Checking the sludge activity for a standard sample

In order to confirm the activated sludge health for a normal substrate removal capacity, we submit it to one R respirometry test in order to find out its reaction in the presence of a sample of sodium acetate standard

For that we have carried out an R test in which we add an amount of acetate enough for reaching the maximum respiration rate.



With this test we have checked that the reaction was normal. For that reason, we are ready to go to a toxicity test based on the comparison method of the sample versus standard compound (acetate)

Toxicity test by comparison method versus a reference compound

This test it was carried out with the BM-T respirometer by making use of the dynamic R working mode.

As a reference we use sodium acetate compound. As sample we use a sodium acetate dilution in the Celanese sample to be analyzed.

We carry out one R test for the reference and another one for the sample to be analyzed. Once we had reached the maximum respiration rates in each of those tests we have stopped them. Then, in order to find out a possible toxicity, we have compared both respirograms on their respiration rates for a determined time and maximum respiration rates.

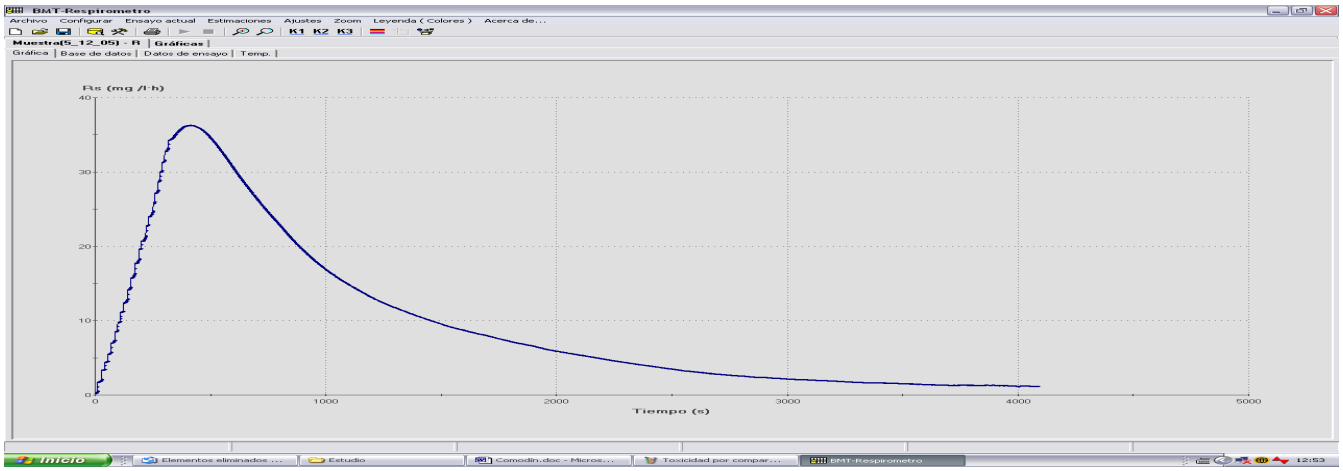
We can see that, within a determined time period in the respirogram, the maximum respiration rates were similar. For that reason we could affirm that there is not any toxicity or inhibition symptom in the activated sludge when the sample is added in equivalent proportion.

Result: There is not any toxicity referred to activated sludge bioactivity

In case of toxicity symptom, the respirogram graphic corresponding to the sample it would be significantly lower than the reference respirogram and its RsMax would be also inferior to it.

Confirmation of normal activity

For a definitive confirmation of normal activity in the sludge and demonstrate that it has been completely adapted to the wastewater, we have carried out a final dynamic R test to obtain a coherent bCOD result.



Ensayo			Estimaciones		
Nombre:	Muestra(5_12_05)		S:	0	mg/l
Operario:					
Temp.:	20				
Fecha:	05/12/2005				
Línea de base:	7,8888				
Sólidos:	4	g/l			
Vf:	1000	ml			
Vm	2	ml			
s:	2				

Resultados		
RsMax:	36,324	mg/l·h
RspMax:	9,081	mg/g·h
DQOb:	5519,302	mg/l
Duración:	01:08:08	

DQOb = bCOD

bCOD = 5,519 mg/l

The bCOD result is perfectly coherent with the total COD of 6,000 mg/L and then we confirm like that the perfect adaptation of the activated sludge.

Biodegradability

We calculate the biodegradability degree in base of the bCOD / total COD ratio.

Biodegradability (bCOD) = 5.519/6.000 = 0.91

Biodegradability (bCOD/COD) = 0,91

The biodegradability result represents a high degree of biodegradability. That means: by avoiding the potential toxicity by means the activated sludge adaptation, the wastewater treatability is high and, in principle, the activated sludge process could be design without problems.

Benefits obtained from the study

1. From the BM-T respirometric study, Celanese Chemicals has got the confirmation to go ahead with the Project for a new wastewater treatment plant design and construction.

2. With the new wastewater treatment plant, Celanese avoids the important economical charge that represented the need to send the industrial wastewater to the regional incinerator in order to eliminate the generated polluted water.

3. Celanese Chemicals Ibérica responds as well to the matrix Celanese USA requirements.

SURCIS, S.L.
Encarnación, 125
02480 Barcelona (España)
Tel. +34 932 194 595 / +34 652 803 255
E-mail: eserrano@surcis.com
Web: www.surcis.com