

BM Respirometry

BM respirometry is a state of the art technology in where the traditional and most advanced respirometry techniques are gathered in one exclusive design developed by SURCIS Company.

BM Respirometry makes use of a single reaction vessel that in certain mode replicates the actions that occur at a treatment plant under the conditions we set for the test.

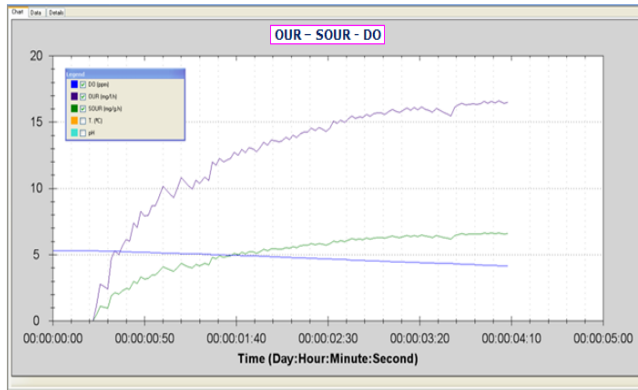
The BM system, under a powerful software, gives way to set of measurements and calculations for decisive parameters approached to manage, design and research the biological process of wastewater treatment.

At present SURCIS is manufacturing three new generation BM respirometers:

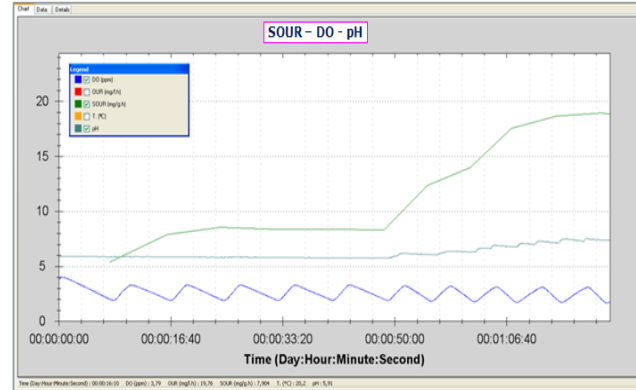


Three different operation modes in one analyzer

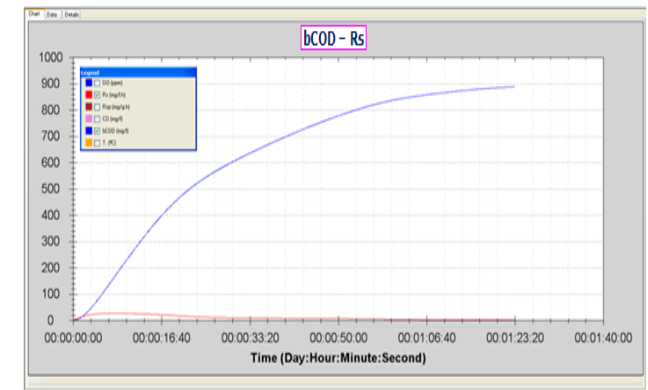
While most of the respirometers in the market offers only one operation mode, the BM respirometers have got three different operation modes: OUR mode, cyclic OUR mode and dynamic R mode. Each of them can go for specific applications and most of the times they used to be combined in a wide fan of studies.



OUR Mode



Cyclic OUR Mode



Dynamic R Mode

MEASUREMENTS

OUR (mg O₂/l.h) Oxygen Uptake Rate.
SOUR (mg O₂/g.h) Specific Oxygen Uptake Rate.
DO (mg O₂/l) Dissolved Oxygen
pH - in BM-Advance -

MEASUREMENTS

OUR (mg O₂/l.h) Oxygen Uptake Rate.
SOUR (mg O₂/g.h) Specific Oxygen Uptake Rate.
DO (mg O₂/l) Dissolved Oxygen
pH - only in BM-Advance -

MEASUREMENTS

Rs (mg O₂/l.h) Respiration Rate.
Rsp (mg O₂/g.h) Specific Respiration Rate.
CO (mg O₂/L) Consumed oxygen.
bCOD (mg O₂/L) Biodegradable COD.
rbCOD (mg O₂/L) Readily bCOD fraction.
pH - only in BM-Advance -
U (mg COD/l.h) COD utilization rate.
q (mg COD/mgVSS.d) Specific U.

Capacity to set the test conditions and modify them throughout the test

The current respirometers in the market are setting the test and cannot modify anything until the test is finished.

The BM respirometers have got the capacity to be open systems where we can set the tests conditions and modify them throughout the test performance.

In the configuration screen we set the Temperature, pH ([only in BM-Advance model](#)), Dissolved Oxygen range (in Cyclic OUT mode), air flow %, and others.

Those conditions can be modified during the test performance and thus study the biological activity evolution in response to the changes in one or more than one condition. That means: **with the only one reactor vessel of the BM respirometer, we can carry out studies about the influence of the different conditions and inhibition possibilities within the same test performance.**

This faculty permits highly effective results and time saving.

Direct oxygen measurements - Hamilton maintenance-free oxygen sensor

To determine the oxygen uptake rate and oxygen consumption, the BM-respirometers are not using indirect measurements such as, pressure, gas volume, CO₂, ... (such as many respirometers in the market are doing) In the BM series **all measurements are directly coming from the a free-maintenance and very much reliable oxygen sensor.**

Oxygen sensor description

The OXYSENS is an electrochemical oxygen sensor which is designed for applications in water, e.g. waste water treatment, swimming pools or fish farms.

It is easy to maintain, because the membrane and the electrolyte don't need to be replaced.

The response time of the OXYSENS is fast, it is almost independent of flow and insensitive to soiling.

The OXYSENS sensors have been developed as 100% maintenance-free.

As a solution, HAMILTON developed the OPTIFLOW membrane. This membrane is very mechanically stable and is manufactured as a laminate around a steel mesh. OPTIFLOW membranes are stable under harsh ambient conditions as well as high pressures. This ingenious design allows fast response times to be combined with unusually low flow dependence

Specifications

OXYSENS

O₂: 40 ppb to saturation

0 - 60 °C, max. 4 bar

TC: 22 kOhm NTC

Maintenance-free

- First maintenance-free DO sensor on the market; no changing of membrane or electrolyte required
- Developed for use in water, waste water, swimming pools, in fish farms and composting facilities
- Insensitive to soiling
- Almost flow-independent
- OXYSENS has a built-in 22 kOhm NTC for temperature compensation
- Very short polarization and response times
- 5 m fixed cable, VP head only on request.
- 12 mm stainless steel shaft, 120 mm shaft length and PG 13.5 thread



High resolution Hamilton pH sensor

EASYFERM Plus

pH: 0 - 14

0 - 135°C

Max. 6 bar at 135°C

Pressurized PHERMLYTE

Reference electrolyte

Temperature: Pt 100 in VP version

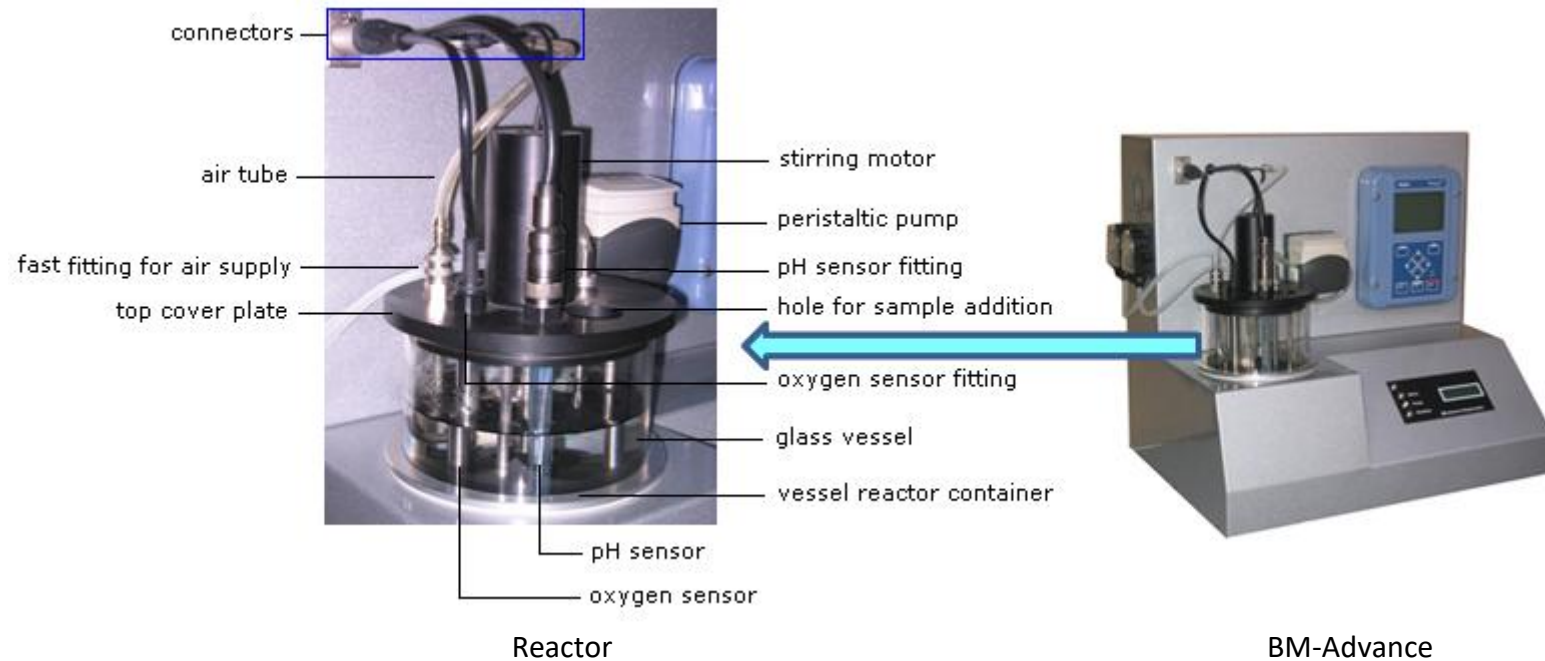
- Almost drift-free measurement
- PHERMLYTE Reference electrolyte factory prepressurized for a clog-free diaphragm and minimized diaphragm potentials
- High performance HP COATRAMIC Diaphragm
- EVEREF-F Reference cartridge for silver-free electrolytes
- Poison resistant "PHI" pH glass



One reactor assembly + powerful software = huge potential possibilities

What for many respirometers it is necessary the use of several reactor vessels, the BM series only need one reactor vessel.

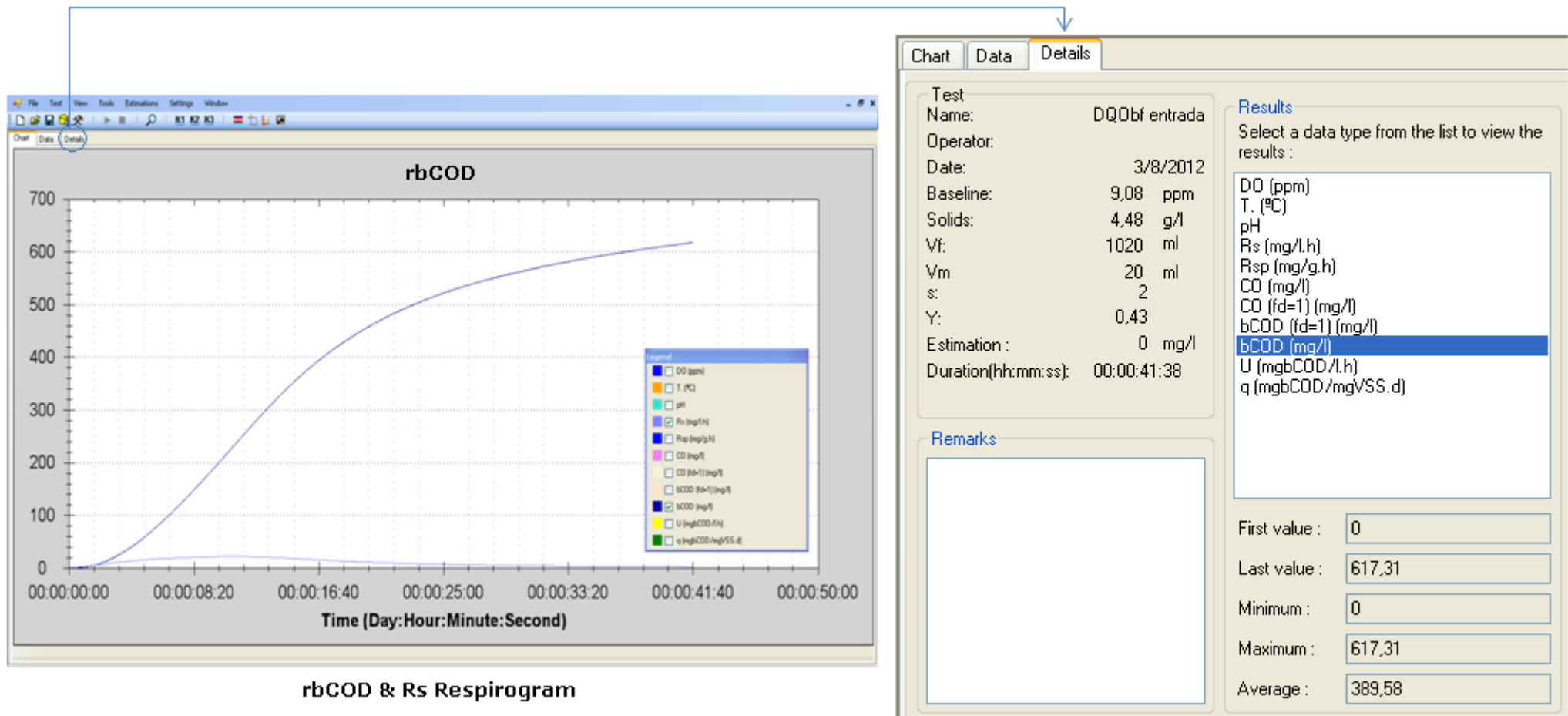
BM-Advance and BM-EVO measuring system is equipped with only one bio-reactor, which is dotted with one mini air compressor and ceramic diffuser and a state of the art design to avoid any atmospheric interference and air bubbles.



This special design, allows the use of small sample volumes; and this quality, together with the powerful software, allows to carry out short and precise duration test within a wide fan of analysis possibilities

Automatic calculation of the biodegradable COD and soluble readily biodegradable COD

BM respirometers are the only ones in the market that can automatically determine the total biodegradable COD (bCOD) and soluble readily biodegradable COD (rbCOD) by making use of small amount of wastewater sample (depending of the COD concentration, normally from 5 to 100 ml) within very short time (normally for a minimum of 30 minutes to a maximum of 2 hours) – from the difference between COD and bCOD we determine the non-biodegradable COD -



Automatic calculation of the substrate (COD) utilization rate

Simultaneously to bCOD and rbCOD it is also automatically calculated the substrate utilization rate, under U (COD utilization rate) and q (specific COD utilization rate) parameters: U (mg COD/l.h); q (mg COD/mg VSS. d)

Chart		Data		Details	
Test					
Name:	DQObf entrada				
Operator:					
Date:	3/8/2012				
Baseline:	9,08	ppm			
Solids:	4,48	g/l			
Vf:	1020	ml			
Vm	20	ml			
s:	2				
Y:	0,43				
Estimation :	0	mg/l			
Duration(hh:mm:ss):	00:00:41:38				
Results					
Select a data type from the list to view the results :					
DO (ppm)					
T. (°C)					
pH					
Rs (mg/l.h)					
Rsp (mg/g.h)					
CO (mg/l)					
CO (fd=1) (mg/l)					
bCOD (fd=1) (mg/l)					
bCOD (mg/l)					
U (mgbCOD/l.h)					
q (mgbCOD/mgVSS.d)					
Remarks					
First value :		0			
Last value :		17,45			
Minimum :		0			
Maximum :		27,81			
Average :		20,83			

Chart		Data		Details	
Test					
Name:	DQObf entrada				
Operator:					
Date:	3/8/2012				
Baseline:	9,08	ppm			
Solids:	4,48	g/l			
Vf:	1020	ml			
Vm	20	ml			
s:	2				
Y:	0,43				
Estimation :	0	mg/l			
Duration(hh:mm:ss):	00:00:41:38				
Results					
Select a data type from the list to view the results :					
DO (ppm)					
T. (°C)					
pH					
Rs (mg/l.h)					
Rsp (mg/g.h)					
CO (mg/l)					
CO (fd=1) (mg/l)					
bCOD (fd=1) (mg/l)					
bCOD (mg/l)					
U (mgbCOD/l.h)					
q (mgbCOD/mgVSS.d)					
Remarks					
First value :		0			
Last value :		0,09			
Minimum :		0			
Maximum :		0,15			
Average :		0,11			

Some important applications that can be carried out from U and q:

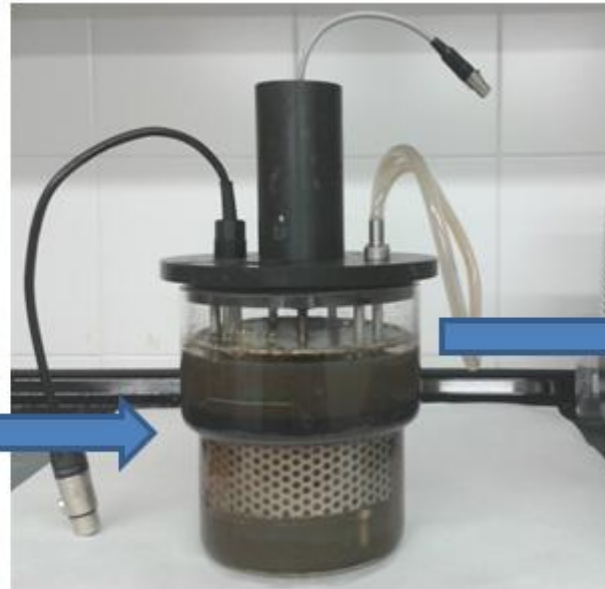
1. To measure the COD biological removal rate (current, maximum and average value)
2. To calculate the necessary hydraulic time to remove the COD in the biological treatment process.
3. Aeration tank volumen calculation.
4. To provide a calculation basis to the rest of heterotrophic kinetic and operational parameters for a specific process.
5. To assess the coherence of the actual F/M in the aerobic biological treatment..
6. As parameters for possible early symptoms of inhibition / toxicity.
7. Forming part of the calculation basis of the necessary hydraulic residence time for nitrification in the aerobic biological treatment process.

Special reactor assembly for moving beds bio-films (MBBR)

BM respirometers are the only ones in the market that can offer the possibility of making use of one special bio-reactor assembly (designed by Surcis) for respirometric test with moving beds bio-film (MBBR type) or granular biomass.



Biomass-carriers loading in the reactor-cage



Biomass-carriers + m. liquor loaded in the reactor vessel



Reactor installed in the system and ready for the test performance

The MBBR is increasingly used more in the biological treatment process for plants that, because of loading rates increase, have become small. As a matter of fact, many times there is the most effective solution to avoid having to expand the biological reactor volume.

Compact analyzer, with very low maintenance and very low probabilities to have problems

Thanks to its exclusive design and absence of sensitive components, **the maintenance of any BM respirometer is actually very low**. Furthermore, the possibilities for important problems are also very small – and this fact has been demonstrated throughout the numerous respirometers that are currently working fine -



Respirometry Unit-work in Plataforma Solar de Almería (PSA) for Advanced Oxidation Tracking applications.
CIEMAT: Spanish national research center for environmental sciences

Last, minimum, maximum and moving average results throughout any moment of the test

All the results are updated in the pre-programmed time interval for last, minimum, maximum and moving average.

Chart		Data		Details	
Test					
Name:	ciclico prueba				
Operator:					
Date:	12/21/2011				
Baseline:	5,28	ppm			
Solids:	2,5	g/l			
Vf:	1000	ml			
Vm	1	ml			
s:	3				
Y:	0,67				
Estimation :	0	mg/l			
Duration(hh:mm:ss):	00:02:46:38				
Results					
Select a data type from the list to view the results :					
DO (ppm)					
OUR (mg/l.h)					
SOUR (mg/g.h)					
T. (°C)					
pH					
Remarks					
First value :		5,91			
Last value :		6,92			
Minimum :		5,73			
Maximum :		7,49			
Average :		6,49			

Chart		Data		Details	
Test					
Name:	ciclico prueba				
Operator:					
Date:	12/21/2011				
Baseline:	5,28	ppm			
Solids:	2,5	g/l			
Vf:	1000	ml			
Vm	1	ml			
s:	3				
Y:	0,67				
Estimation :	0	mg/l			
Duration(hh:mm:ss):	00:02:46:38				
Results					
Select a data type from the list to view the results :					
DO (ppm)					
OUR (mg/l.h)					
SOUR (mg/g.h)					
T. (°C)					
pH					
Remarks					
First value :		0			
Last value :		0			
Minimum :		5,37			
Maximum :		18,94			
Average :		14,26			

Different modes of results presentation at any time we want to see them

At any time, each of the on-going results can be showed on different presentation modes: table, summary or graphic (respirogram)

Time (Day:Hour:Minute:Sec)	DO (ppm)	T. (°C)	pH	Rs (mg/L/h)	Rsp (mg/g.h)	CO (mg/l)	CO (fd=1) (mg/l)	bCOD (fd=1) (mg/l)	bCOD (mg/l)	U (mgbCOD/L/h)	q (mgbCOD/mgVSS.d)
00:00:24:38	8,685	17,024	7,399	6,87	1,533	295,1113	5,78872	10,15565	517,73912	24,736	0,133
00:00:24:40	8,686	17	7,4	6,852	1,529	295,30537	5,79253	10,16233	518,0796	24,719	0,132
00:00:24:42	8,688	17	7,4	6,817	1,522	295,49844	5,79632	10,16898	518,41832	24,702	0,132
00:00:24:44	8,69	17	7,4	6,783	1,514	295,69055	5,80008	10,17558	518,75535	24,685	0,132
00:00:24:46	8,69	17	7,4	6,783	1,514	295,88266	5,80385	10,18219	519,09239	24,667	0,132

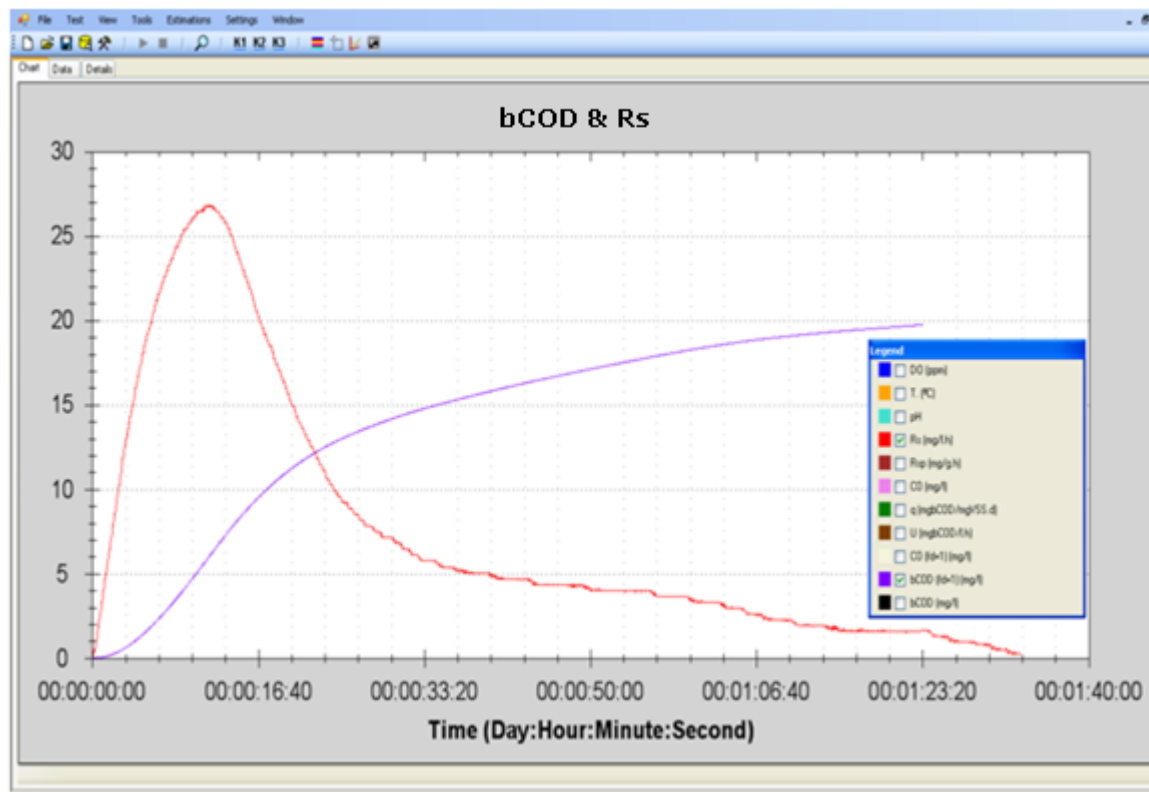
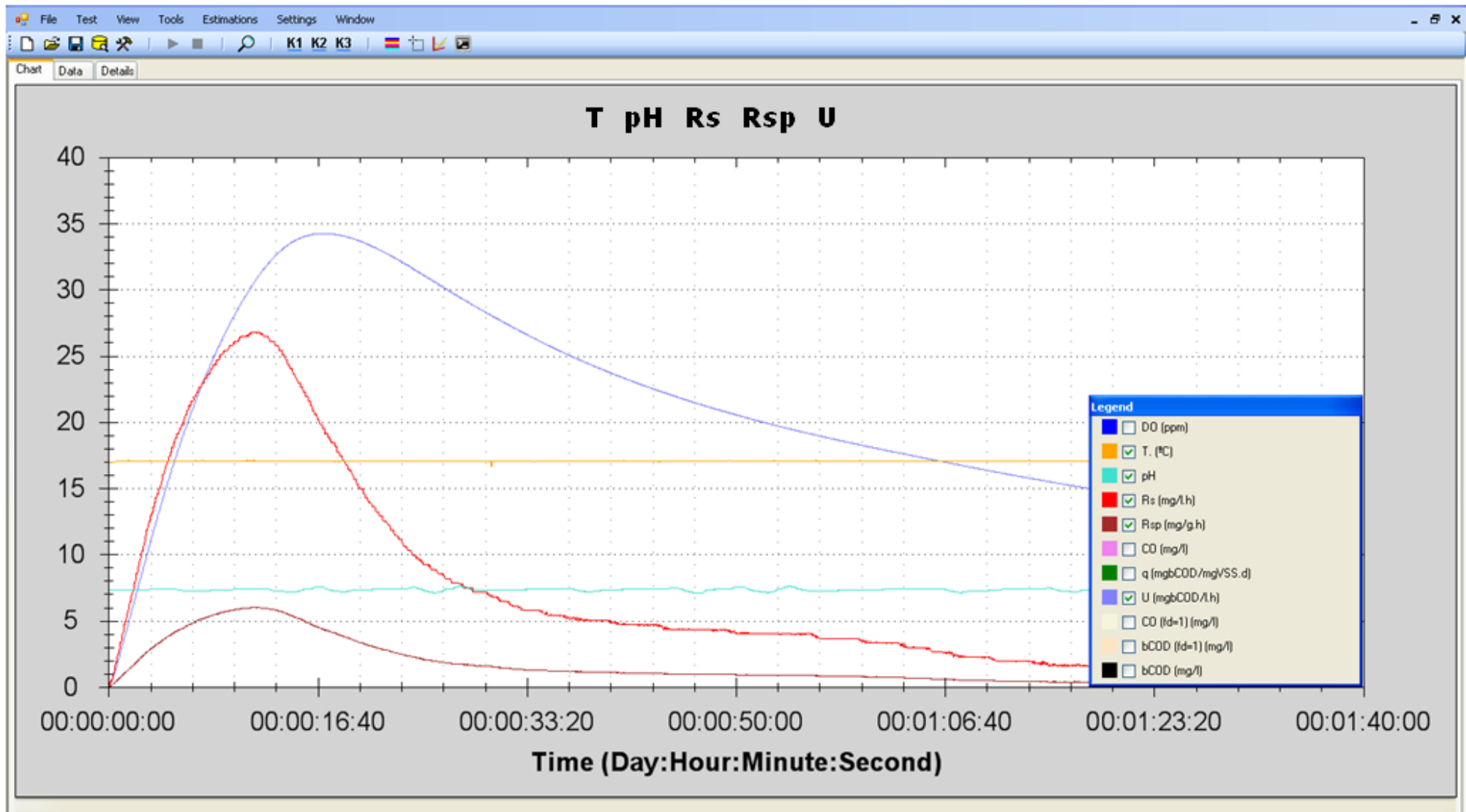


Chart	Data	Details
Test		
Name:	DQOb entrada	
Operator:		
Date:	3/8/2012	
Baseline:	9,16	ppm
Solids:	4,48	g/l
Vf:	1000	ml
Vm:	20	ml
s:	2	
Y:	0,43	
Estimation:	0	mg/l
Duration(hh:mm:ss):	00:01:33:18	
Results		
Select a data type from the list to view the results:		
<div>DO (ppm) T. (°C) pH Rs (mg/L/h) Rsp (mg/g.h) CO (mg/l) q (mgbCOD/mgVSS.d) U (mgbCOD/L/h) CO (fd=1) (mg/l) bCOD (fd=1) (mg/l) bCOD (mg/l)</div>		
Remarks		
<div></div>		
First value:	0	
Last value:	1006,37	
Minimum:	0	
Maximum:	1006,37	
Average:	713,25	

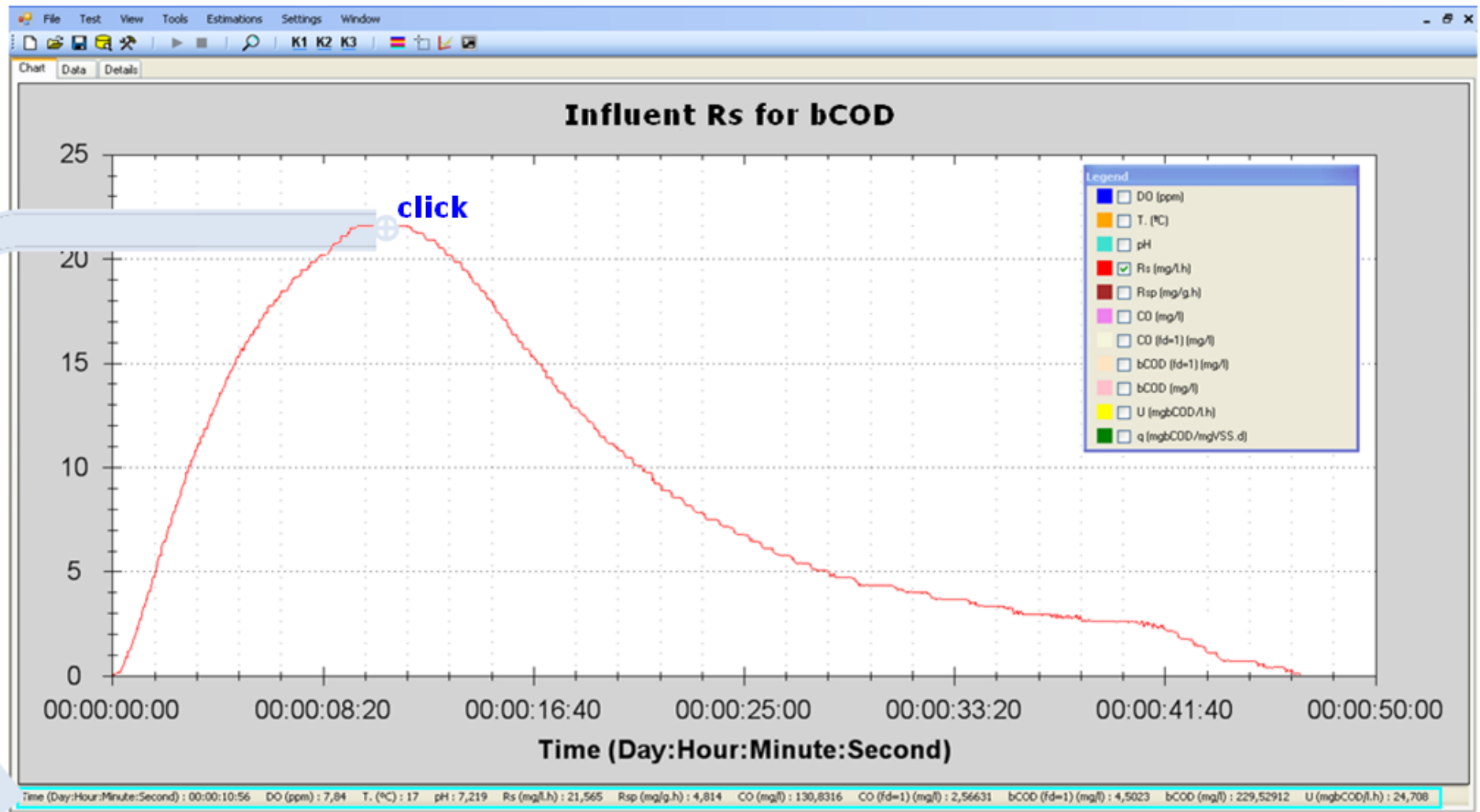
Results selection and simultaneous presentation

During the test and once it is finalized, we can select any parameter to analyze within any of the presentation modes. This includes seeing the selected parameters results by means their corresponding respirometers.



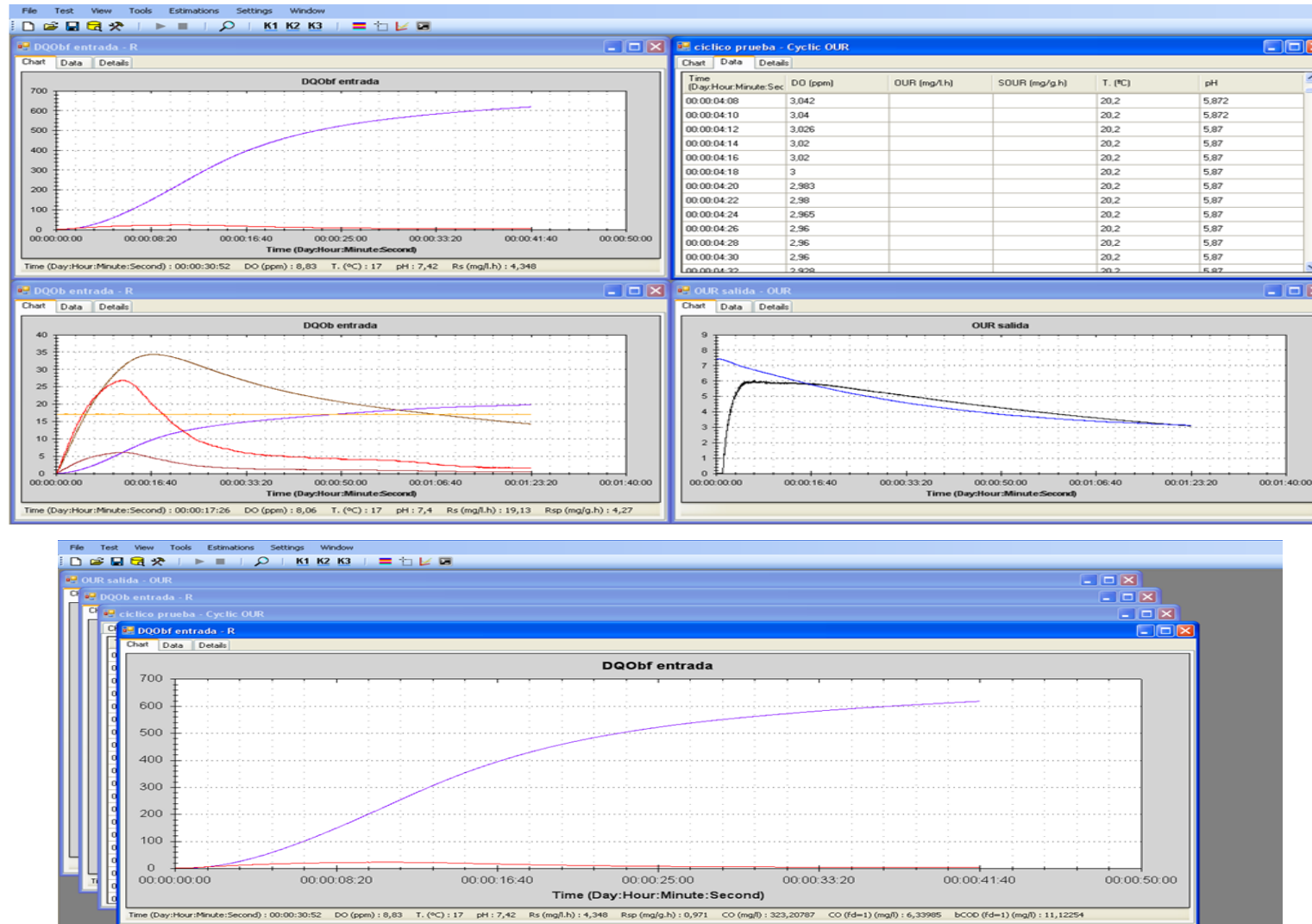
All the results in one click

By making use of the PC mouse, just in one click on any point of the respirogram, we obtain the package of results from this point.



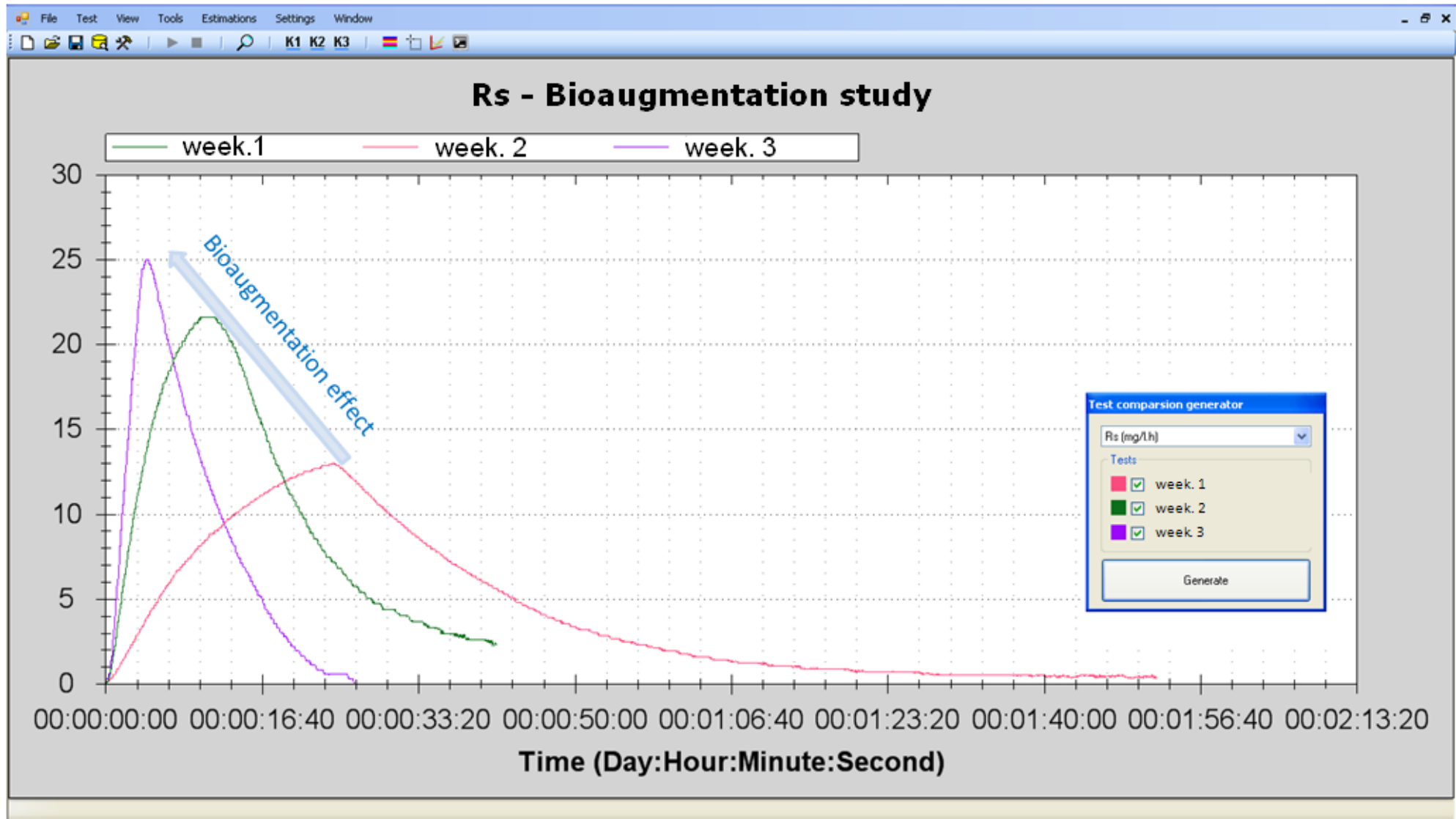
Simultaneous presentation of several open tests

The BM software offers the possibility of the simultaneous visualization of several already done test son different presentation modes: floating, vertical align, horizontal align. Likewise, in each of them it is possible to select the presentation mode (table, summary, respirogram)



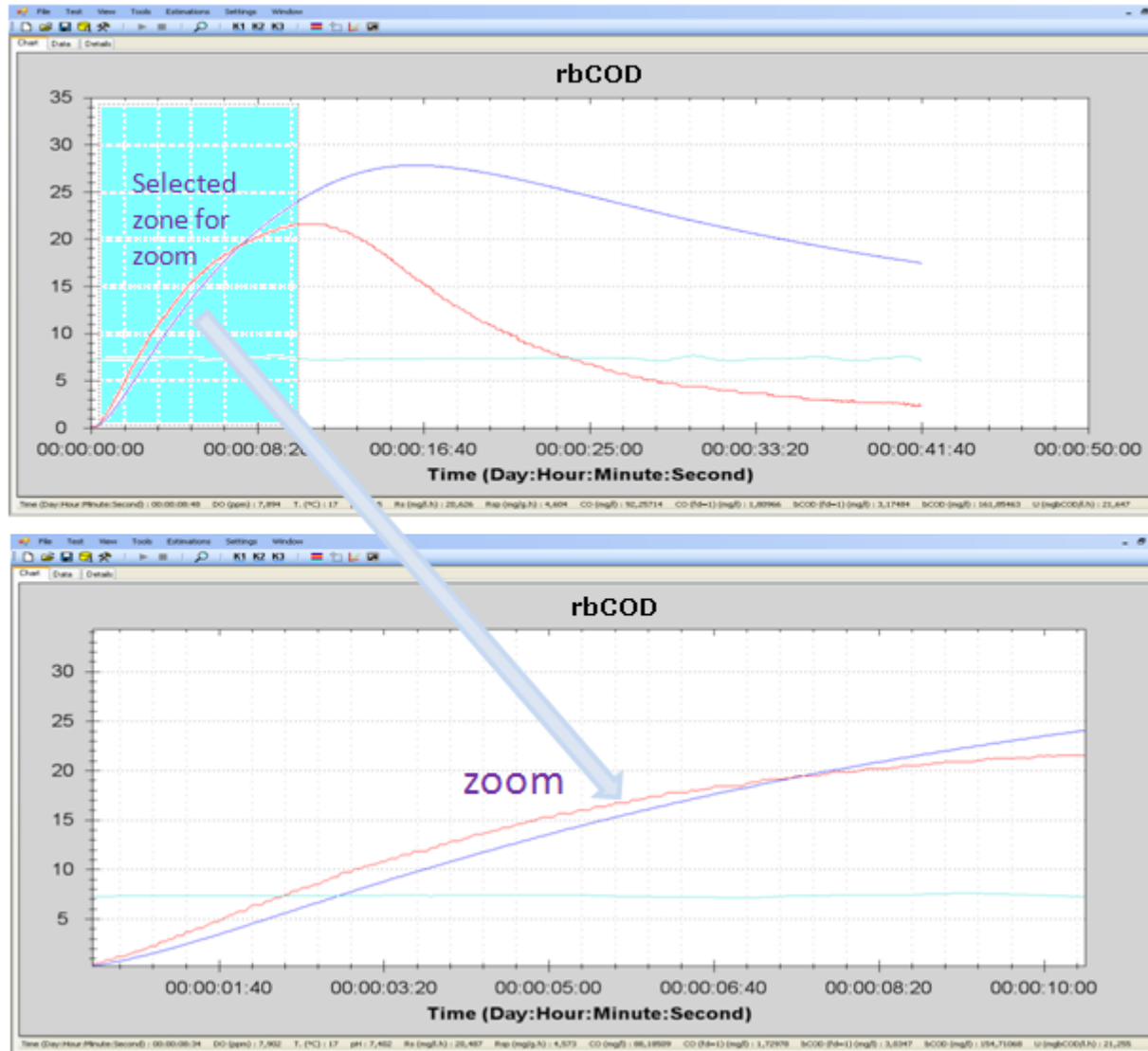
Overlaid respirograms

This is a very useful option where you can overlay several respirograms of the selected parameter from different open tests.



Zoom

By means the Zoom option, we can select and expand any zone of the respirogram of any selected zone from different overlaid respirograms. Furthermore, from each expanded zone, we can also obtain the test results on any point of them.



Main applications that can be done with BM respirometers

Fast pulse of the actual process performance

In only a few minutes it can get a fast diagnostic pulse on how the activated sludge process is performing.

Biological treatability

Analyze the ability of the biomass to degrade wastes under specific conditions.

COD fractioning

COD fractions determination (included the slowly and non biodegradable COD)

Advanced oxidation processes tracking

The combination of COD fractioning, substrate utilization rate and specific inhibition/toxicity permits the perfect tracking of any advanced oxidation system and assess the evolution of the substrate biodegradation character throughout the treatment.

Nitrification

Within very short time it is measured the nitrification rate under different DO, temperature and pH conditions, nitrification capacity, minimum sludge age.

Denitrification

Determination of the soluble biodegradable COD necessary for denitrification, and denitrification capacity.

Toxicity

Inhibition & toxicity for any specific activated sludge.

Operative parameters

Loading rate (F/M), Sludge age (MCRT, SRT)

Biokinetic parameters

For modeling and simulation software support

Energy optimization

Can analyze the minimum DO level at which the process can operate without any performance detriment.

SBR optimization

The respirometer can determine appropriate parameters and conditions for optimal operation.

MBBR optimization

By making use of the special reactor assay. It is possible to calculate the appropriate number of biomass carriers and conditions.

Influence of different conditions

By modifying the test conditions we can analyze their influence in the process activity and study the optimal, minimum level and loading capacity.

Nutrients

By means the bCOD efficiency and yield coefficient it is possible to analyze the optimal nutrients ratio.

Conclusion

The BM respirometry technology offers a world of possibilities to get all kind of resources to be adapted to different types of biological treatment process for wastewater and their conditions.

SURCIS, S.L.

Phone: +34 932 194 595 / +34 652 803 255

E-mail: surcis@surcis.com / eserrano@surcis.com

Internet: www.surcis.com