Early biomass health and process assessment in a biological wastewater treatment

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BM Respirometry

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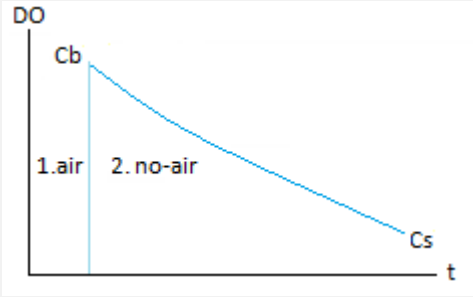
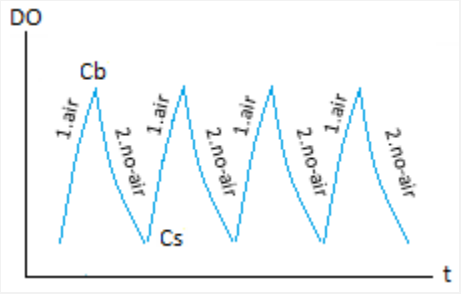
Three different operation modes

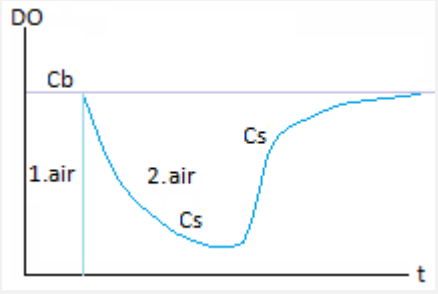
BM respirometers have three different operation modes: OUR mode, Cyclic OUR mode, and R mode. Each mode develops different respirograms for automatic parameters including D.O., Temperature, and pH (in BM-Advance) from where specific applications can be made.

In a single batch reactor, the measuring system can work as LSS and LFS batch respirometry. The system is optimized by a one-sense membrane device, that together with a dividing plate, is able to isolate the measuring chamber and avoid bubbles against the DO sensor.

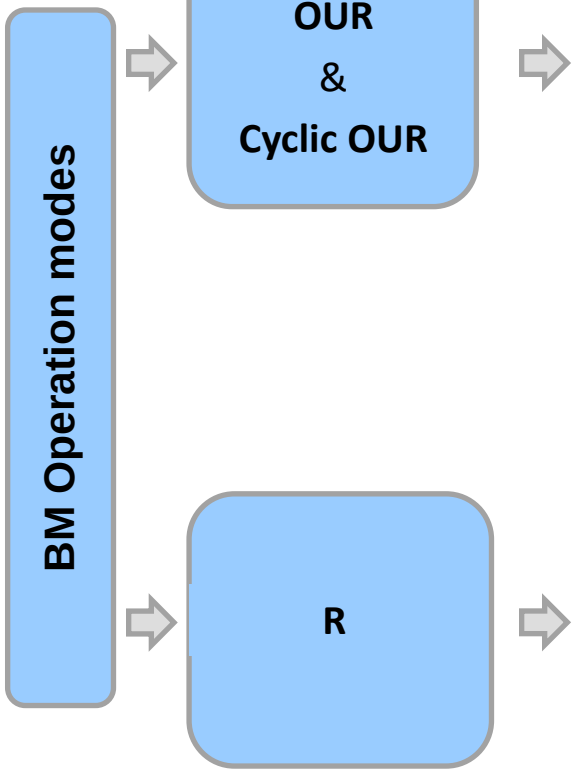
OUR	Cyclic OUR	R
This mode is making use of the LSS respirometry type. The OUR mode consists of a single test to measure the OUR and/or SOUR parameters (by manually setting the MLVSS concentration). It also has the option the get a partial SOUR for any period within the respirogram.	The cyclic OUR mode consists of a progressive sequence of OUR measurements, generated from the DO trajectory when it fluctuates between the DO. Low and DO. High set-points that were set at the start of the test.	The R mode corresponds to a modified LFS respirometry type test. The measuring system can be considered as a completely mixed batch reactor. In this mode, we get the important advantage to work with a small volume of samples in order to minimize the test time for an important package of several simultaneous parameters measurement.







Main automatic parameters in BM respirometer for the different operations modes



OUR: **Oxygen Uptake Rate** (mg O_2/l.h)

It measures the oxygen uptake rate for only one measurement or serial o measurements.

SOUR: **Specific OUR** (mg O_2/g VSS.h)

Specific OUR related to MLVSS. SOUR = OUR / MLVSS

Rs: **Dynamic Respiration Rate** (mg O_2/l.h)

It measures the oxygen uptake rate from the mixture of the activated sludge and certain amount of wastewater sample or compound within a continuous chain of measurements.

Rsp: **Dynamic specific respiration Rate** (mg O_2/g VSS.h)

Specific Rs referred to MLVSS. Rsp = Rs / MLVSS

bCOD: **Biodegradable COD** (mg O_2/l)

Biodegradable or soluble readily biodegradable COD fraction, based on Rs measurements integration from a mixture of activated sludge and biodegradable sample.

U: **COD removal rate** (mg COD/l,h)

Speed at which the COD is being removed.

q: **Specific COD removal rate** (mg COD/ mg VSS.d)

Specific U referred to MLVSS concentration.

Taking the pulse of the process

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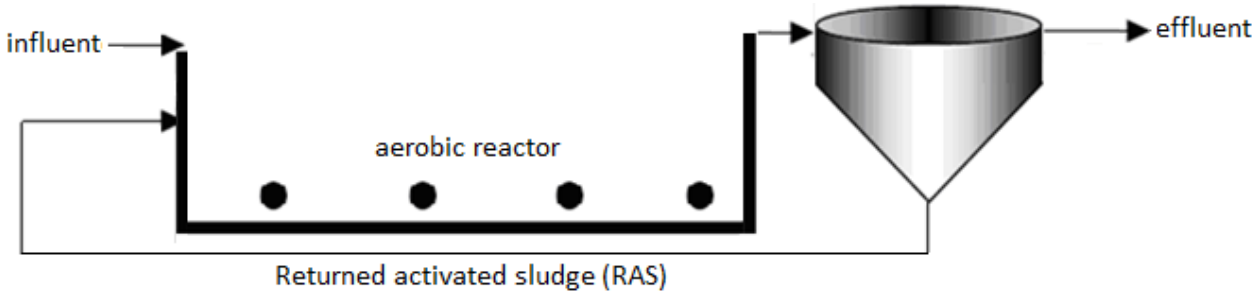
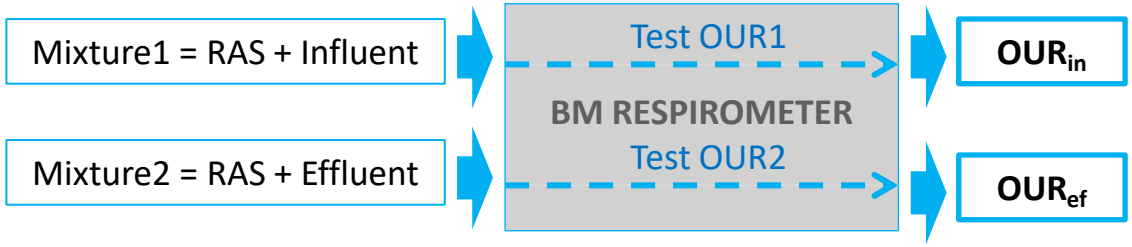
Taking the pulse to the activated sludge process

The pulse of the process can be taken by performing **two** OUR tests (OUR_{in}, OUR_{ef}) from mixtures made with influent + returned sluge and effluent + returned sludge (Mixture1, Mixture2) with same volumes ratio as their corresponding flows.





Loading Factor: **$LF = OUR_{in} / OUR_{ef}$**

LF	Assessment
LF < 1	Inhibition / Toxicity - already present in reactor -
1 < LF < 2	Low efficiency or low BOD loading
2 < LF < 5	Good process performance
LF < 5	Overloading

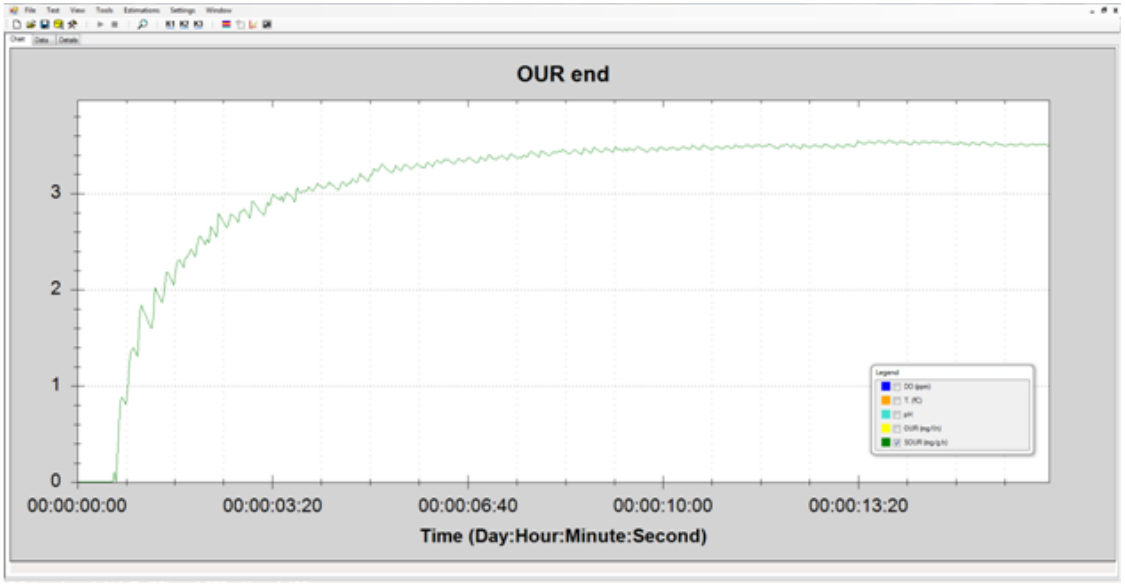
Taking the pulse of the biomass health

The pulse of actual biomass can be taken by performing the endogenous OUR test (OUR_{end}) from outlet sludge, aerated during > 24 hours (*), to get it into endogenous phase (without any substrate)

(*) For low loading processes , the endogenous phase is usually reached just after aerating the effluent sludge for 2 ~ 4 hours.

Table guide for OUR_{end} (20 ºC)

MLVSS (mg/l)	OUR_{end} (mg/l.h)
1000	2 – 3.5
1500	3 - 5
2000	4 - 7
2500	5 – 8.5
3000	6 - 10
3500	7 - 12
4000	8 – 13.5
4500	9 – 15.5



OUR end respirogram

<u>Reasons for which the OUR end value could be below its normal range</u>

1. Low active biomass concentration
2. Toxicity
3. Nutrients deficiency
4. Process conditions (Temperature, pH, Operative parameters) out of the normal operation range

Biomass production assessment

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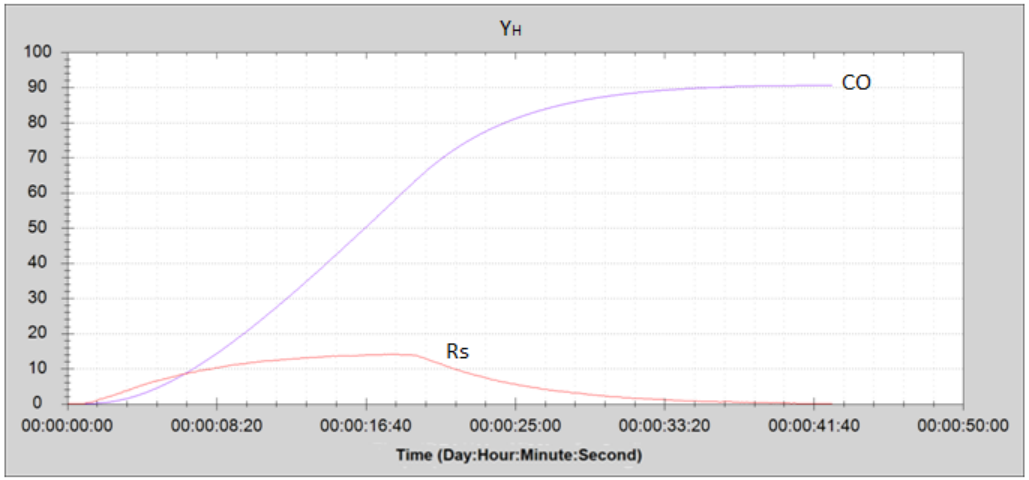
Heterotrophic yield coefficient

Yield coefficent is determined by means a single R test, by making use a sodium acetate solution sample of known COD (COD_{ac}). In that test, the BM software will automatically give out the cosumed oxygen result (CO), and then the yield coefficient is calculated from CO and COD_{ac}.



Rs Respirogram for Y_H

$$\mathbf{Y_{H.02}}\ (O_2/COD) = 1 - CO / COD_{ac} \rightarrow \textbf{Normal range 0,55 – 0,75 mg } \mathbf{O_2}\textbf{/mg COD}$$

$Y_{H.O2}$: Yield coefficient refrered to O_2 consumption (O_2/COD)

COD_{ac}: COD of the sodium acetate sample = 270 - 320 mg/L)

Reasons for which the Y_H value could be below the low limit (< 0,55) of the normal range

1. High percentage of slowly biodegradable COD in the influent wastewater
2. Nutrients defiency
4. Process conditions (Temperature, pH, Operative parameters) out of the normal operation range

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