

# Determination of oxygen mass transfer coefficient $IKLa$ ) in batch reactor

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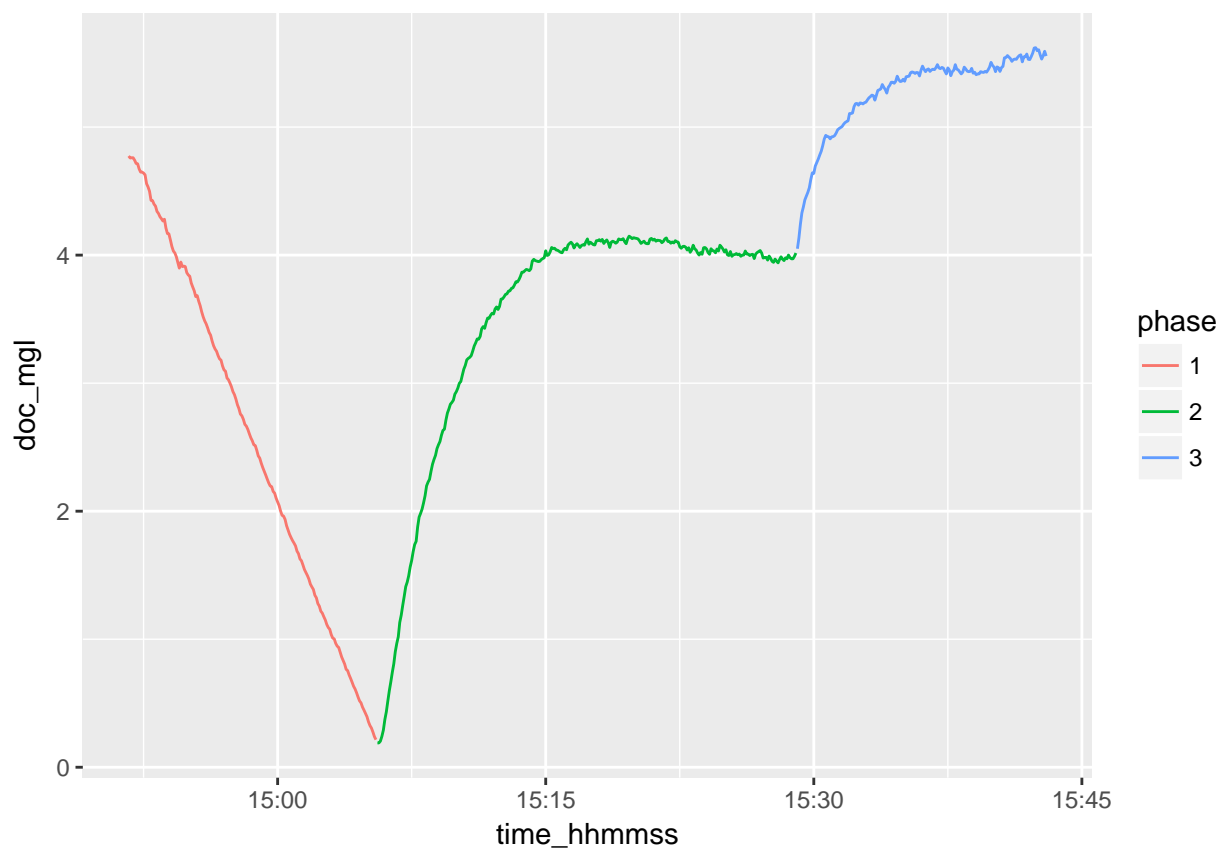
## Abstract

## Objectives

## Background

Assignment is based on experiment for measuring D.O.

## Warning: package 'readxl' was built under R version 3.3.3



## Procedure

Dissolved Oxygen concentration at equilibrium will be calculated using the Henry's Law. For that purpose: first, determine the barometric pressure at 2600 [m], given  $P_0$ ,  $T$ ,  $R$ ,  $g$ ,  $M$  using the barometric formula:

(1)  $P = P_0 * e^{\frac{-Mgz}{RT}}$  where:

$M = 1,785 * 10^{20}$  [mol];  $P0 = 101325$  [Pa];  $T = 298,15$  [K];  $R = 3,314$  [J\*K/mol];  $g = 9,80$  [m/s<sup>2</sup>]

$P = 101325 * \exp(-\frac{28,96*10^{-3}*9,8*2600}{8,314*298,15}) = 75214$  [Pa]

Second, determine dissolve oxygen concentration:

$$SO_{eq} = \frac{P}{K_H}$$

where  $P = 75214$  [Pa]

$$K_H = 78,020 * 10^3 \text{ [Pa*L/mol]}^1$$

Partial pressure for oxygen is  $P_{O_2} = 0,21 * P = 15795$  [Pa]

$$SO_{eq} = \frac{15795*32*100}{78,020*10^3} = 6.4 \text{ [mg/L]}$$

As substrate is depleted, Biomass undergoes endogenous respiration process in phase 1. As stated in problem definition, OUR is constant and it is calculated by mean of the following expression:

$$OUR = -\frac{DO_{end-of-phase1} - DO_{t0}}{t_{end-of-phase1} - t_0} \text{ [mg/L-h]}$$

## [1] "OUR\_OHO = 19.77 [mg/L-h] "

Alternatively,  $OUR$  can be obtained from linear regression of dissolved oxygen vs time

##

## Call:

## `lm(formula = doc_mgl ~ time_hh, data = p1_dataset)`

##

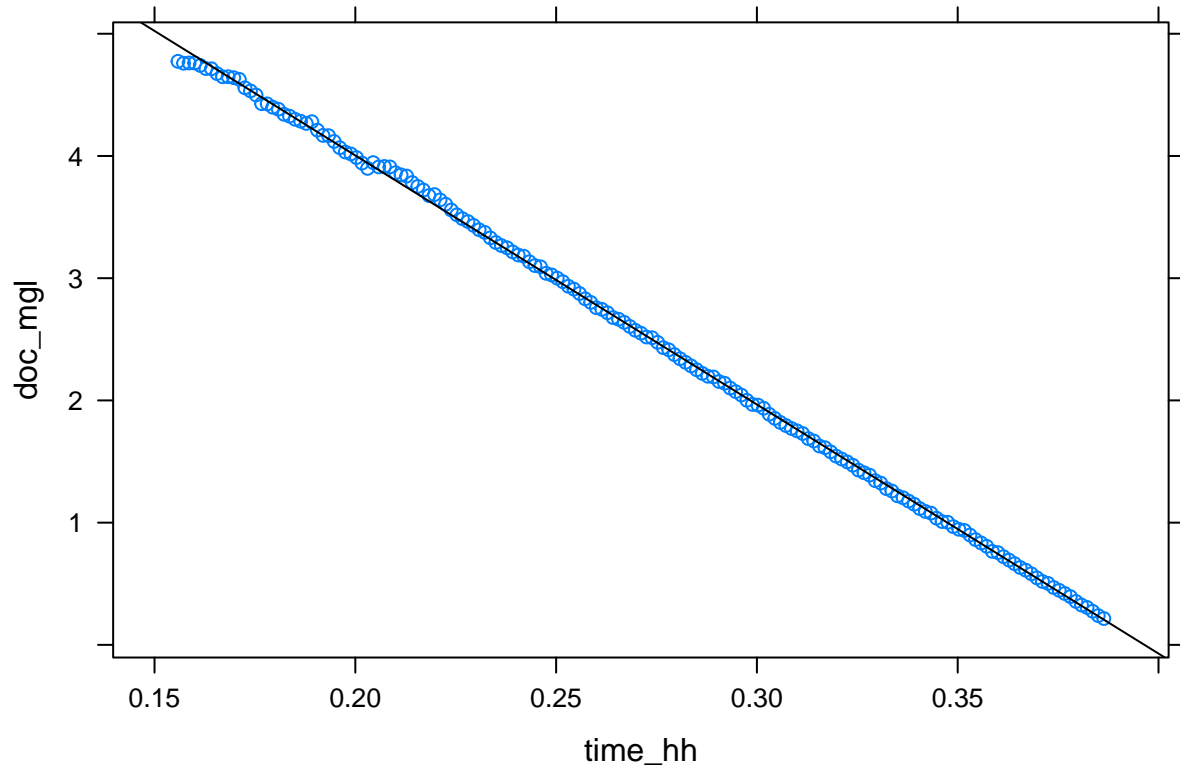
## Coefficients:

## (Intercept)      time\_hh

##            8.079       -20.376

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<sup>1</sup>Sanders, R (2015), "Compilation of Henry's Law constants for water as a solvent". Atmos. Chem. Phys 15: 4399-4981



```
## [1] "OUR_OH0 = -20.3764470549435 [mg/L-h] "
```

$K_{La}$  can be obtained directly without need to use AQUASIM, by plotting  $\ln(\frac{SO_{eq}-SO}{SO_{eq}-SO_0})$  vs time plus linear regression to obtain the linear slope coefficient as  $K_{La}$  with the assumption reactor is modelled as CSTR.

```
## [1] 0.3902778
```

```
##
```

```
## Call:
```

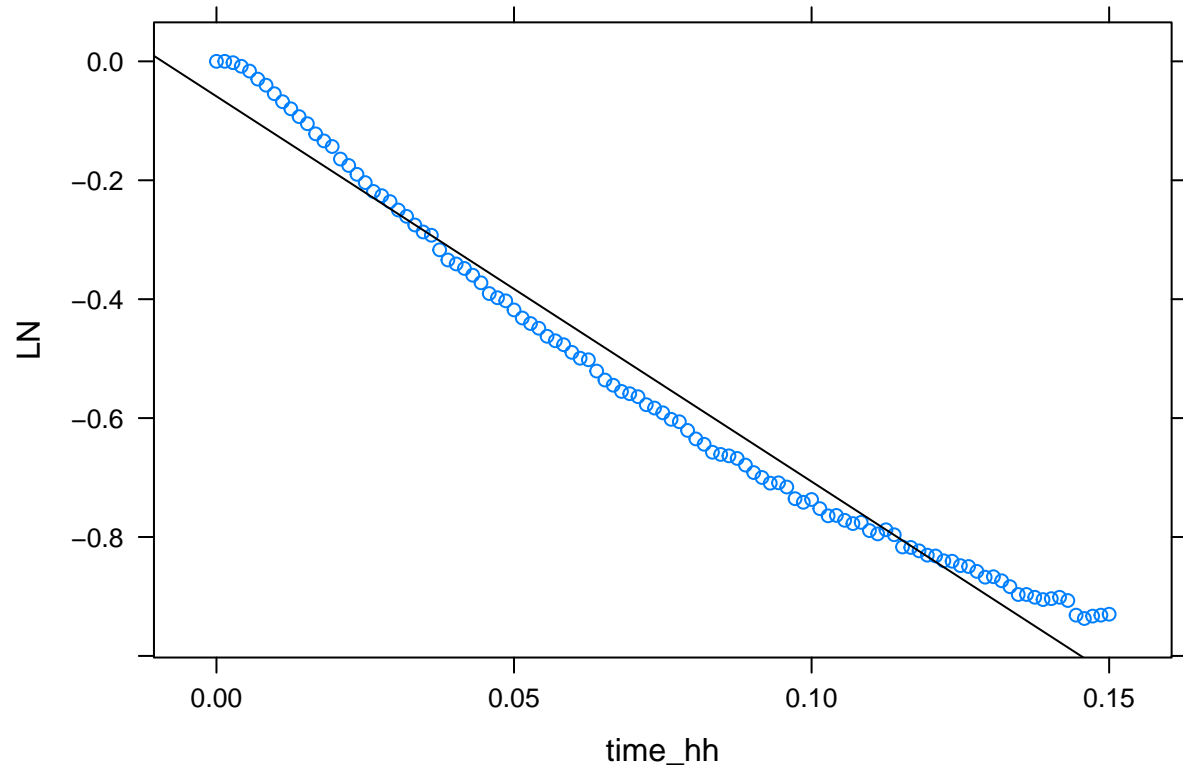
```
## lm(formula = LN ~ time_hh, data = p2_dataset_lm)
```

```
##
```

```
## Coefficients:
```

```
## (Intercept)      time_hh
```

```
##    -0.05884    -6.47921
```



```
## [1] "KLa = -6.479 [1/h] "
```

### Simulation with AQUASIM

State variable is dissolved oxygen concentration (SO) in [mg/L], read from a .CSV file.

Process variable is time in [h].

Process is defined as reaction in CSTR

Reaction rate is defined as  $KLa \cdot (SO_{sat} - SO)$ , where KLa and SOsat are set to be -6.935 [1/h] and 6.4 [mg/L], respectively.

Time interval simulation is set to be 0.10 [h] from 0 to 0.3902778

### Discussion

### Conclusions