

## Introduction to WASP Eutro

- BOD-DO
- Algae & Nutrients

## BOD-DO

- Bottle Example
- T.Harapan Example

### Example 5.1

A bottle opened to reaeration and filled with polluted water has the following characteristics:

$$\ell_0 = 17.98 \text{ mg/L} \quad c_0 = 6.681 \text{ mg/L} \quad c_s = 8.418 \text{ mg/L}$$

$$\beta = 0.97 \text{ d}^{-1} \quad \alpha = 0.40 \text{ d}^{-1}$$

Find  $\ell(t)$  and  $c(t)$  after 86400 s.

$$\ell = 12.05 \text{ mg/L}$$

$$c = 4.085 \text{ mg/L}$$

### Example 5.1 – Analytical Solution

(a) After 86400 s

$$\ell = 17.98 \times \exp\left(\frac{-0.4 \times 8.64 \times 10^4}{86400}\right) = 12.05 \text{ mg/L}$$

$$D_1 = 1.737 \times \exp\left(\frac{-0.97 \times 8.64 \times 10^4}{86400}\right) = 0.658 \text{ mg/L}$$

$$D_2 = 17.98 \times \left(\frac{0.4}{0.57}\right) \times \left[ \exp\left(\frac{-0.4 \times 8.64 \times 10^4}{86400}\right) - \exp\left(\frac{-0.97 \times 8.64 \times 10^4}{86400}\right) \right]$$

$$= 3.67 \text{ mg/L}$$

$$\therefore D = D_1 + D_2 = 0.658 + 3.67 = 4.33 \text{ mg/L}$$

$$\text{and } c = 8.418 - 4.33 = 4.085 \text{ mg/L}$$

### Example 5.1 – WASP & E2DISP

| Table | DO mg/L (1) X     | DO mg/L (1) Y | uCBOD-1 mg/L (2) X | uCBOD-1 mg/L (2) Y |
|-------|-------------------|---------------|--------------------|--------------------|
| 1     | 1/1/2018 0:00:00  | 6.68          | 1/1/2018 0:00:00   | 17.98              |
| 2     | 1/1/2018 0:00:00  | 6.68          | 1/1/2018 0:00:00   | 17.98              |
| 3     | 1/1/2018 12:00:00 | 4.79          | 1/1/2018 12:00:00  | 14.72              |
| 4     | 1/2/2018 0:00:00  | 4.08          | 1/2/2018 0:00:00   | 12.05              |
| 5     | 1/2/2018 0:00:00  | 4.08          | 1/2/2018 0:00:00   | 12.05              |

| E2DISP Result |           |           |           | DO        |           |           |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|
| Time          | Segment 1 | Segment 2 | Segment 3 | Segment 1 | Segment 2 | Segment 3 |
| 0.000         | 0.0000    | 17.9800   | 0.0000    | 0.0000    | 6.6810    | 0.0000    |
| 0.125         | 2.0010    | 17.1031   | 0.0010    | 7.0000    | 6.0539    | 0.0020    |
| 0.250         | 2.0010    | 16.2690   | 0.0010    | 7.0000    | 5.5387    | 0.0020    |
| 0.375         | 2.0010    | 15.4755   | 0.0010    | 7.0000    | 5.1207    | 0.0020    |
| 0.500         | 2.0010    | 14.7208   | 0.0010    | 7.0000    | 4.7668    | 0.0020    |
| 0.625         | 2.0010    | 14.0028   | 0.0010    | 7.0000    | 4.4526    | 0.0020    |
| 0.750         | 2.0010    | 13.3199   | 0.0010    | 7.0000    | 4.1773    | 0.0020    |
| 0.875         | 2.0010    | 12.6703   | 0.0010    | 7.0000    | 3.9329    | 0.0020    |
| 1.000         | 2.0010    | 12.0524   | 0.0010    | 7.0000    | 3.7148    | 0.0020    |


### Example 5.1 – Longer Period



### Tasik Harapan Example

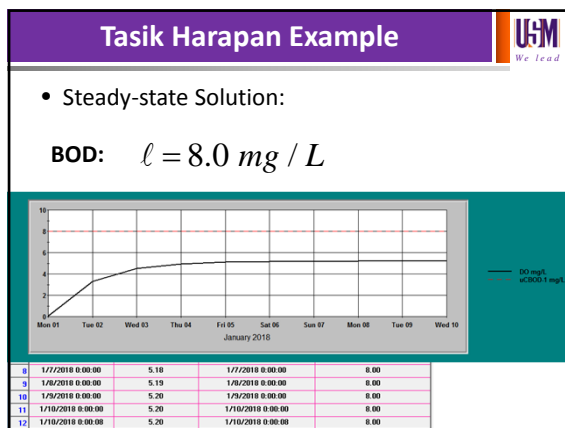
**BOD :**  $\frac{d\ell}{dt} = -\alpha\ell + \gamma$  (5.1)

**DO :**  $\frac{dc}{dt} = -\alpha\ell + \beta(c_s - c)$  (5.2)



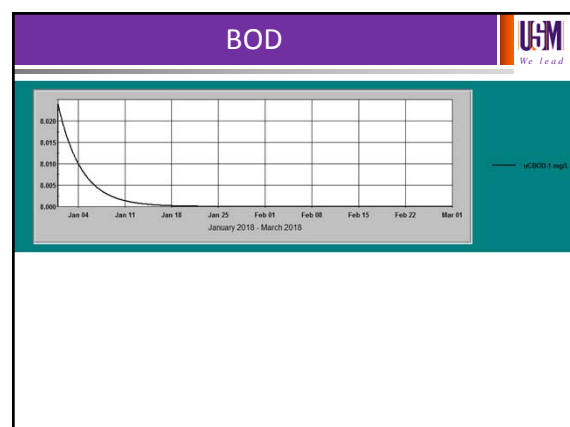
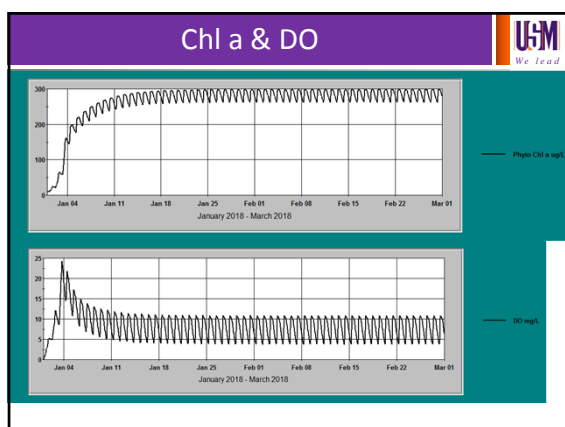
### Parameters values

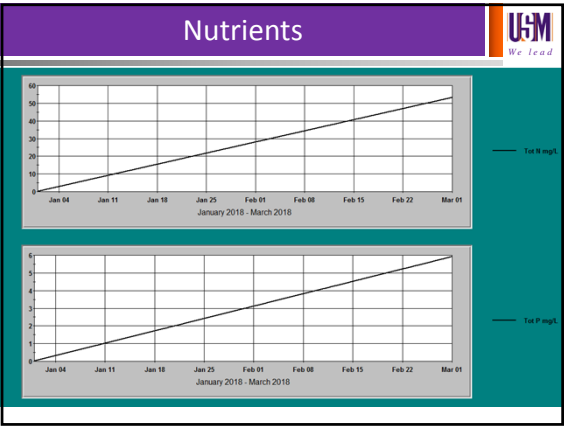
| Parameter           | Symbol   | Unit              | Value  |
|---------------------|----------|-------------------|--------|
| Reaeration rate     | $\beta$  | day <sup>-1</sup> | 1.00   |
| DO saturation level | $c_s$    | mg/l              | 7.50   |
| BOD decay rate      | $\alpha$ | day <sup>-1</sup> | 0.2875 |
| BOD loading         | $\gamma$ | mg/l/d            | 2.30   |



## Algae & Nutrient

Tasik Harapan Example





**Thank you**

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