

# **INTRODUCTION TO WASTEWATER TREATMENT**

A. Saatci

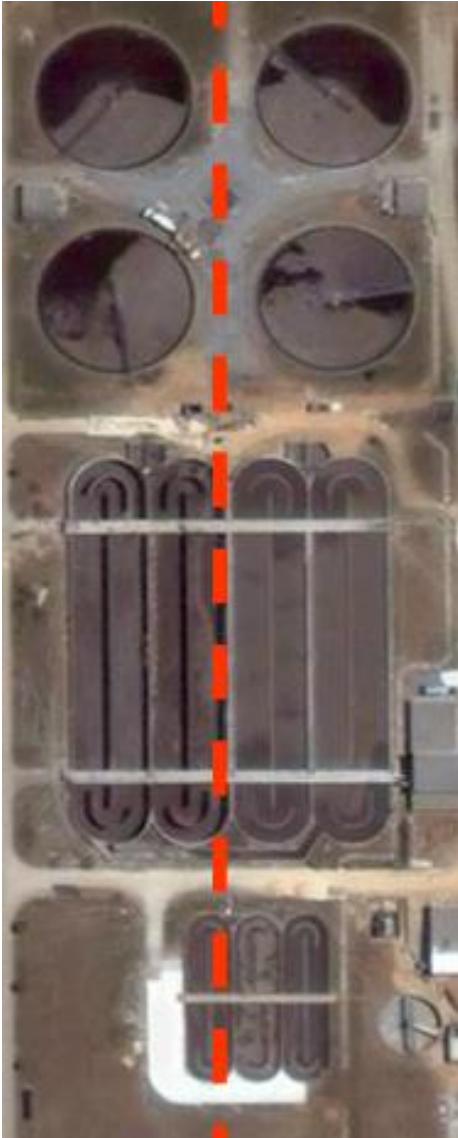
May 2007

# Main Pollutants

**C, N, P**

Carbon, Nitrogen, Phosphorous

# Paşaköy AAT



# ÖMERLİ HAVZASI ÇEVRE KORUMA PROJESİ

malı Barajı

Riva Deresi

Ömerli Barajı

Ömerli Atıksu  
Tüneli

Sarıgazi Atıksu  
Toplayıcıları

İMİRANİYE İLÇESİ

STP

PAŞAKÖY BİYOLOJİK  
TAŞFIYE TESİSİ

Batı Sultanbeyli  
Samandıra  
Atıksu  
Toplayıcıları

PAŞAKÖY

BİYOLOJİK ARITMA HAVZASI

Doğu  
Sultanbeyli  
Terfi Hattı  
Atıksu Toplayıcıları

WTP

Atıksu Kanal  
İnşaatları

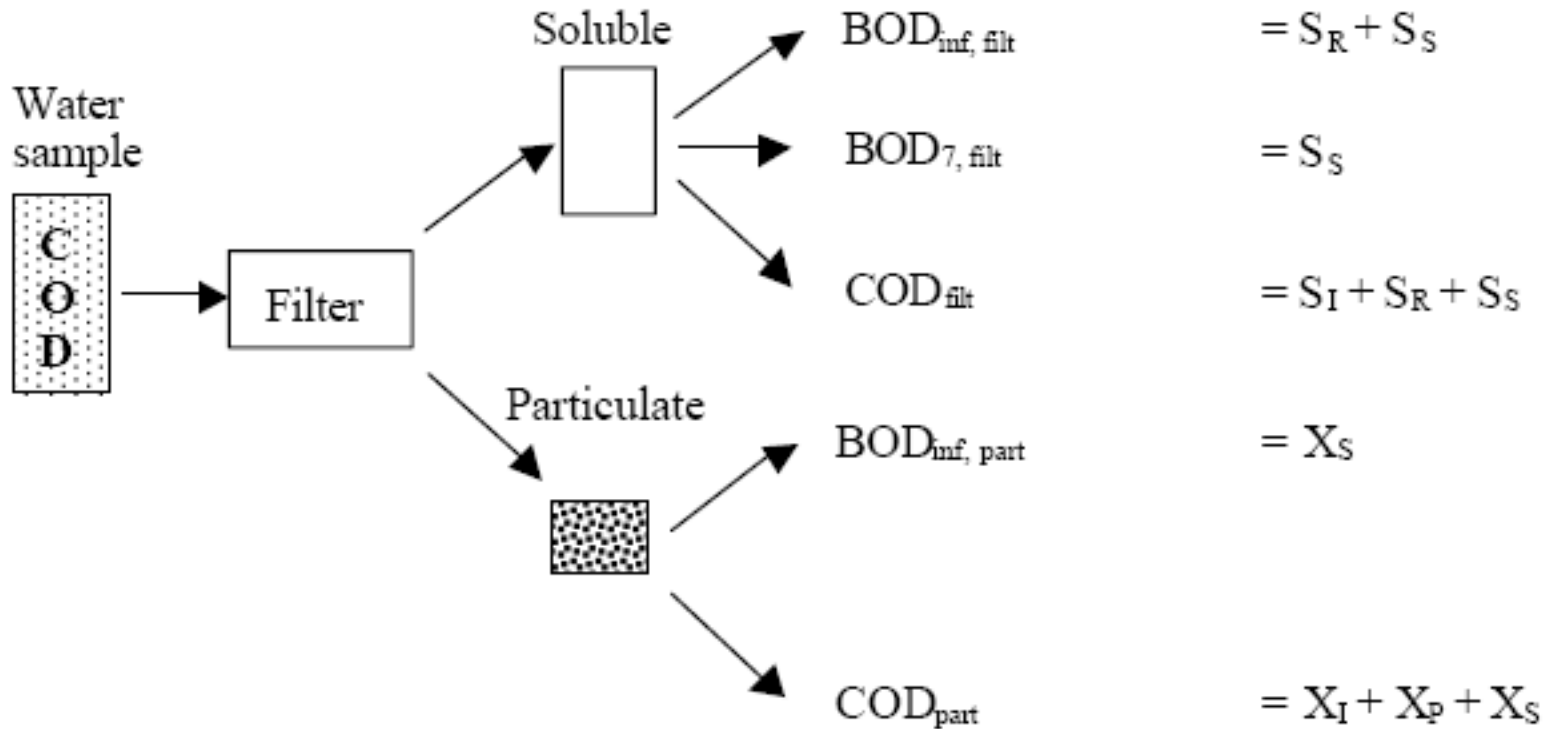
KARTAL İLÇESİ

PENDİK İLÇESİ



# COD Fractionation

SR=Slowly Biod Soluble BOD  
1 uBOD Whatman



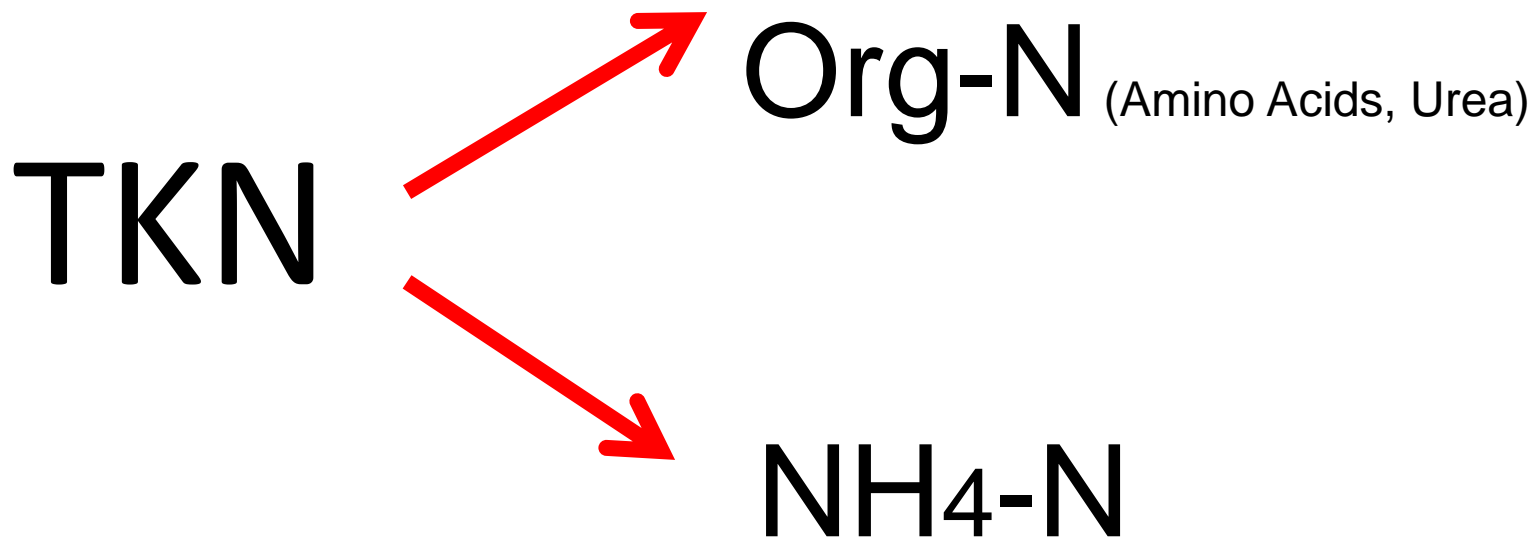
# Carbon Removal

C sources are proteins, lipids etc.



😊: Heterotrophic Bacteria

# Total Kjeldahl Nitrogen



# Nitrogen Removal:

$N_2$ : Nitrogen gas (79 % of air)

$NH_3$ : ammonia

$NH_4^+$  : ammonium ion

$NO_2^-$  : nitrite ion

$NO_3^-$  : nitrate ion

$(NH_2)_2CO$ : urea(in human urine)

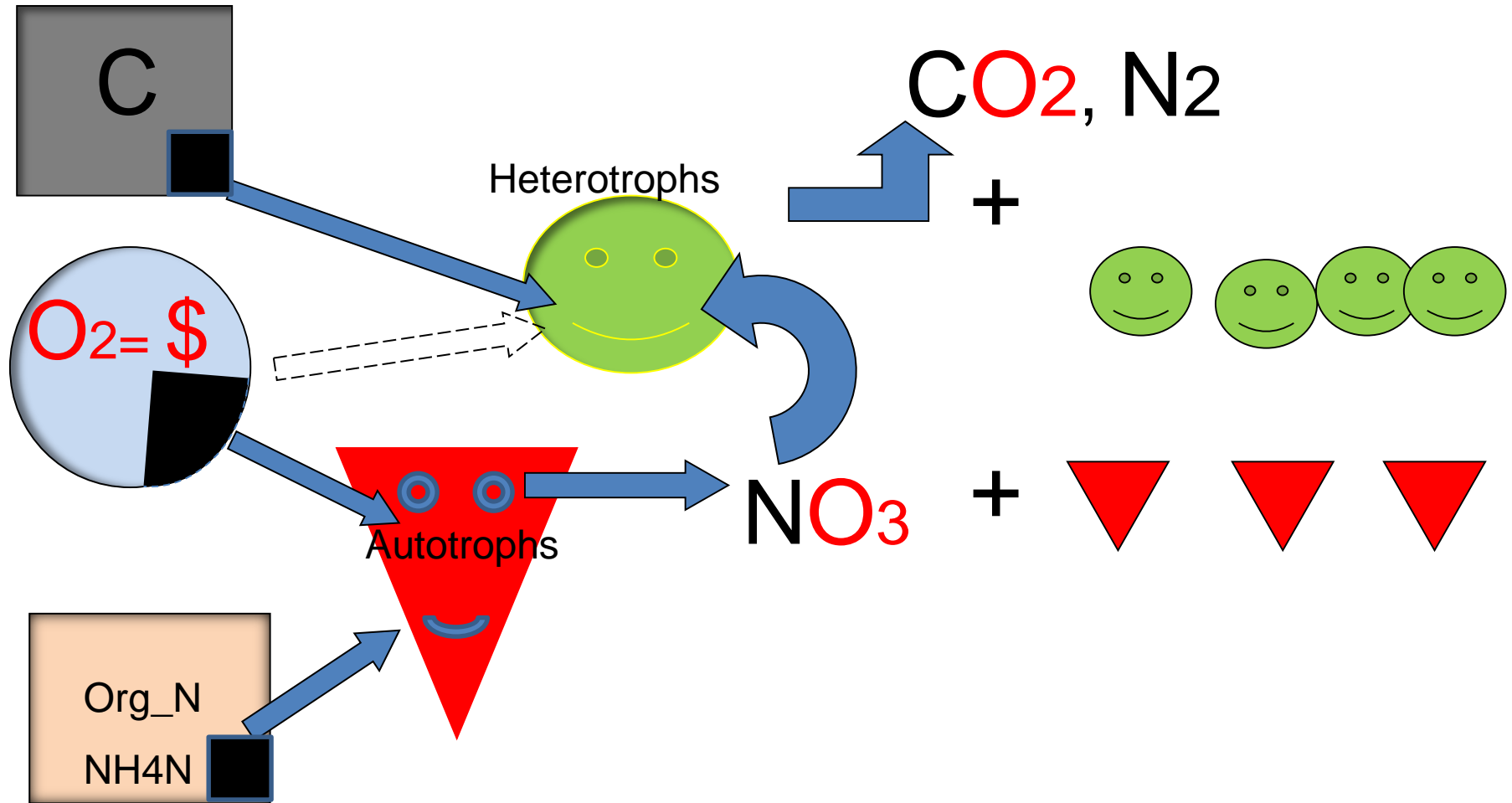
$(2NH_3 + CO_2)$

Org N: organic nitrogen

TKN: Total Kjeldahl Nitrogen(% 40 org N -- %60  $NH_4^+$  )



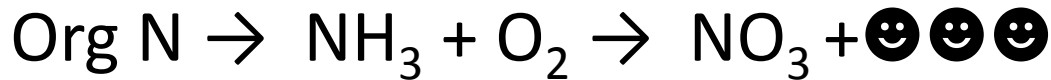
# C Oxidation, Nitrification & Denitrification



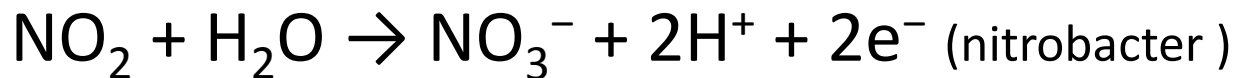
# Nitrogen removal

⋮

- NITRIFICATION

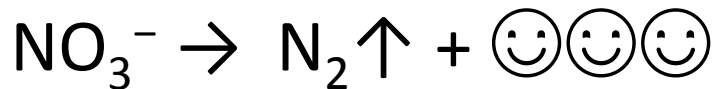


😊: Autotrophic bacteria



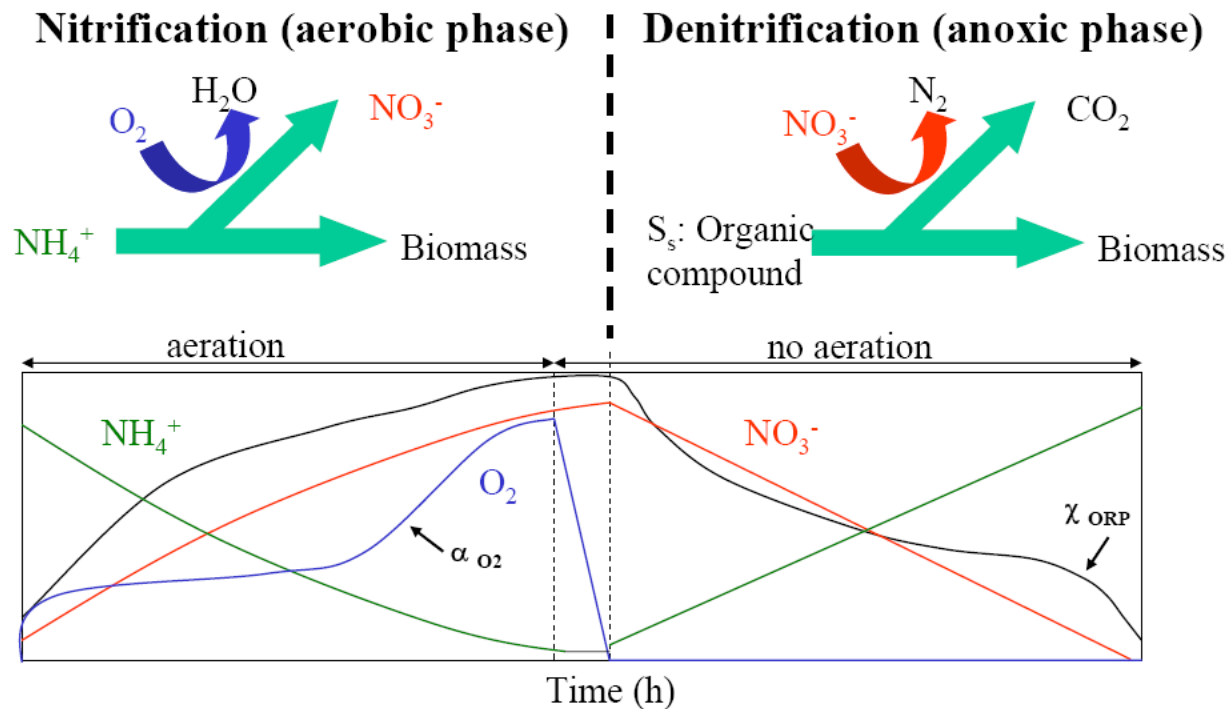
- DENITRIFICATION

😊(requires C for Denitrification)



# Nitrification & De-nitrification

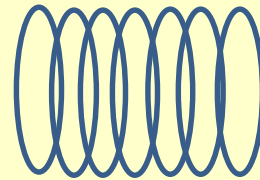
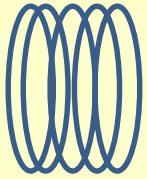
## Nitrogen removal process description



Usefull dynamic information : inflexion points

- $\text{O}_2 \Rightarrow$  Ammonia depletion
- $\text{ORP} \Rightarrow$  Nitrate depletion

# P- Removal:



- P is released in the anaerobic tank (bacteria under stress) but it accumulates more P in the aeration tanks



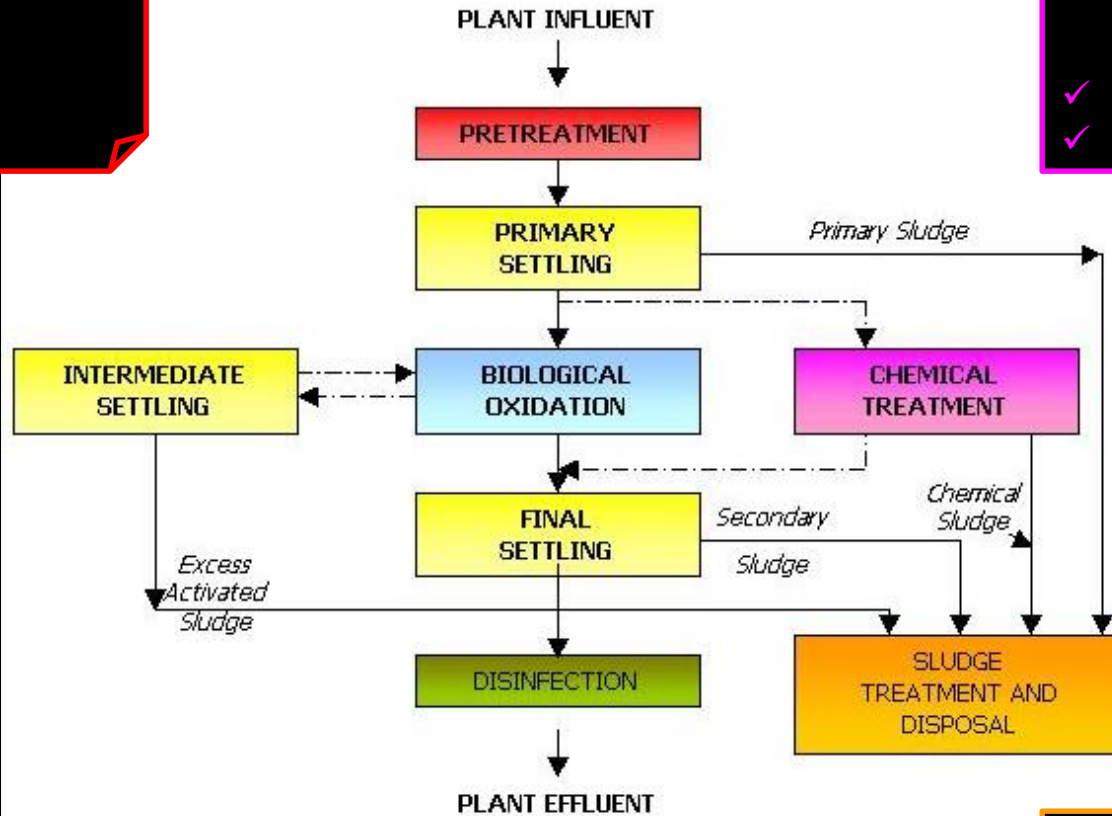
# Conventional Wastewater Treatment Process

**Pretreatment**

- ✓
- ✓
- ✓
- ✓

**Chemical Treatment**

- ✓
- ✓



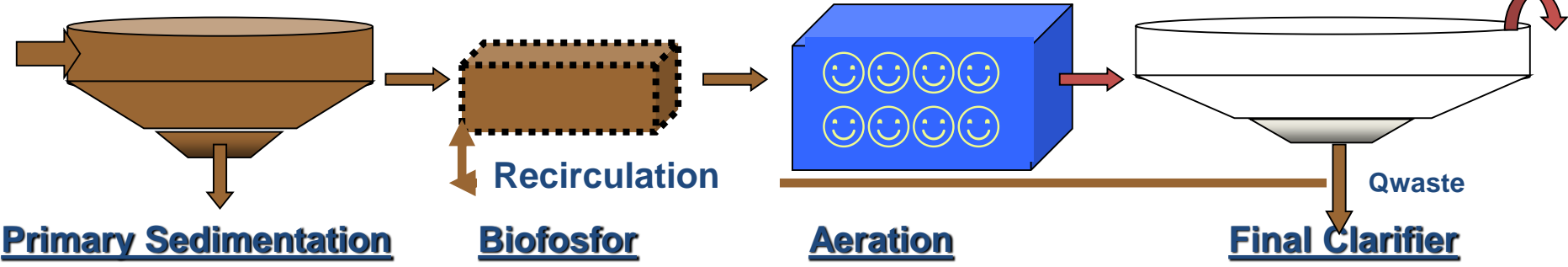
**Disinfection**

- ✓
- ✓
- ✓
- ✓

**Sludge Treatment and Disposal involves:**

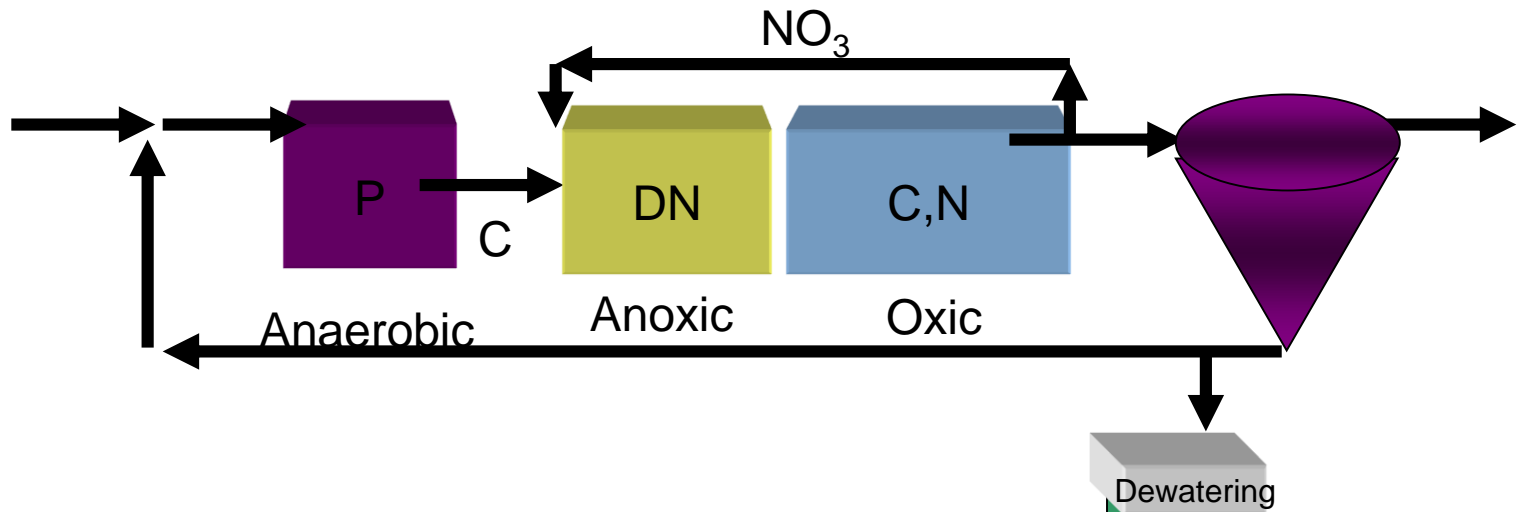
# WWTP:

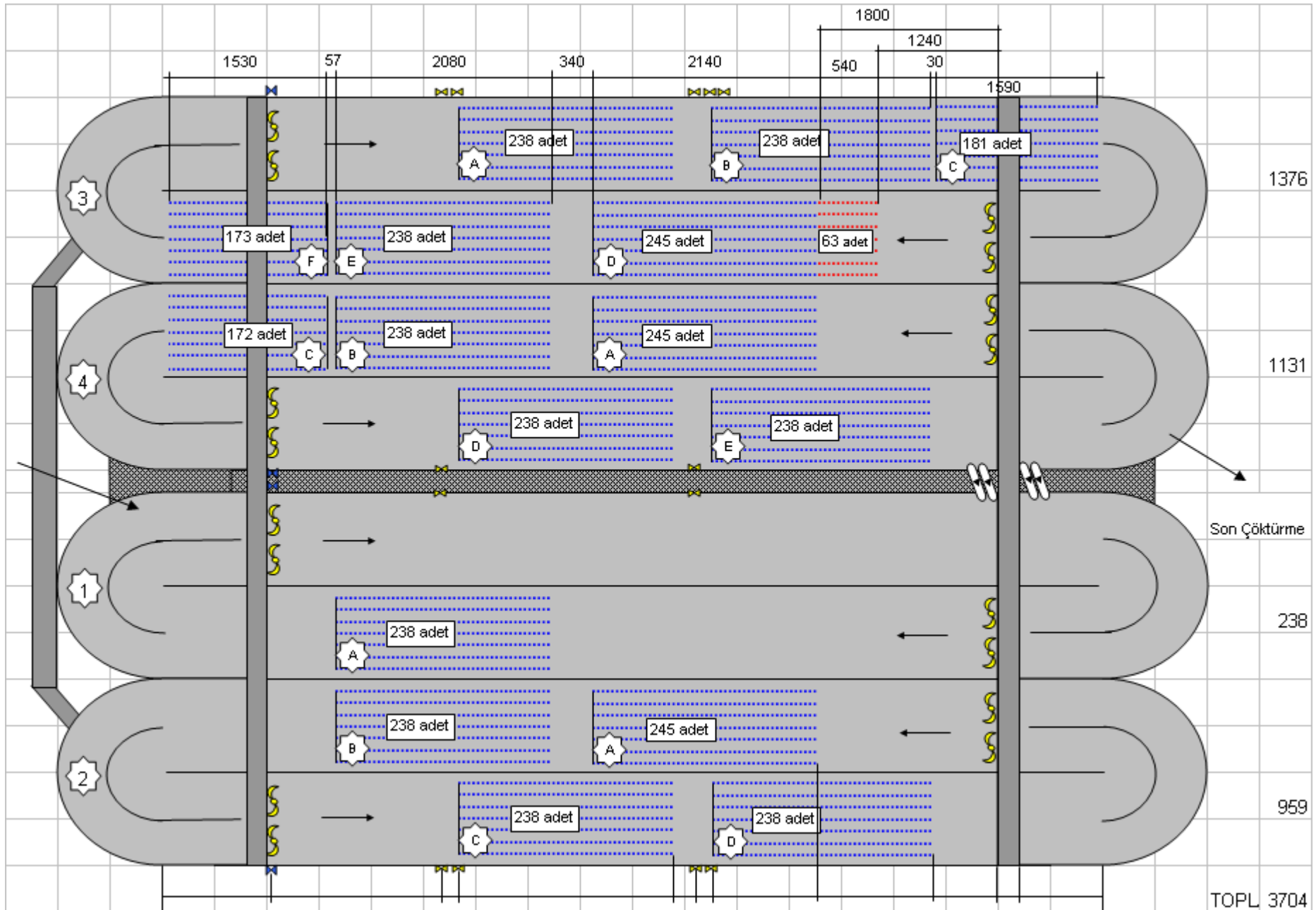
INPUT



# PRE-DN

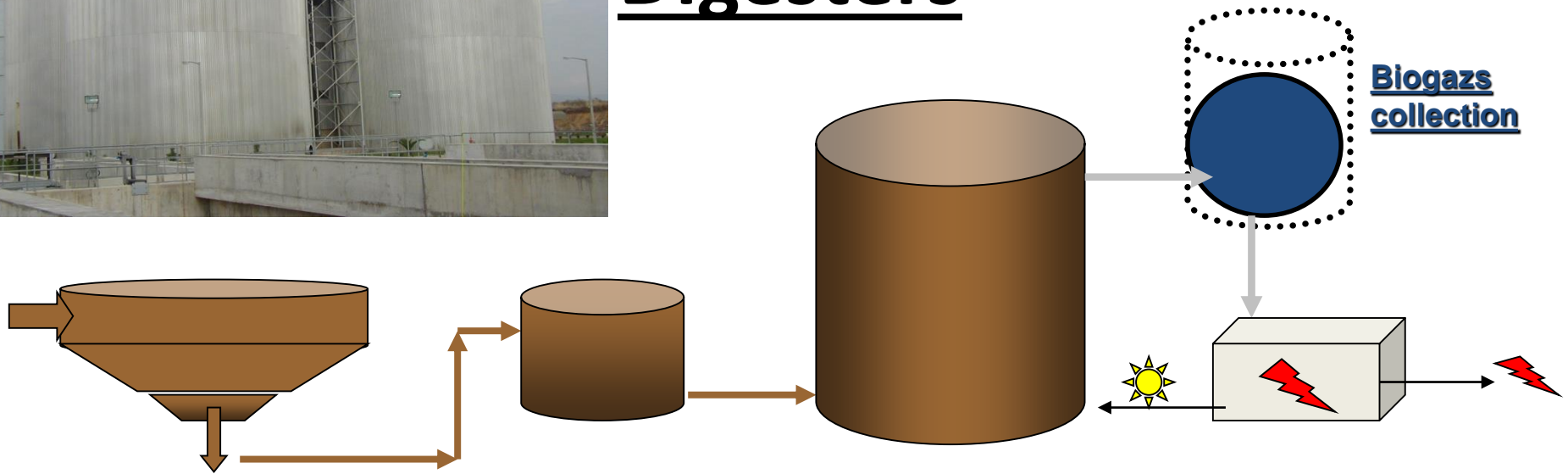
Paşaköy STP: A<sub>2</sub>O Process(3 stage Bardenpho)







# Digesters



Primary Sedimentation  
20.000 - 30.000 mg/l

Thickening  
%4 KM sludge

Anaerobic Di,gester  
(35-36 °C)  
15-20 d

Co-Generation

## Digester Reactions

1- Organics → Vinegar (acidic asit)i (formic asit)  
acid formers

2- — Metane (CH<sub>4</sub>), CO<sub>2</sub>  
metane formers



# Sludge Age & Sludge Production

## Çamur Yaşı ve Çamur Üretimi

Çamur Yaşı (gün) = SRT

$$SRT = \frac{\sum V_T X_T}{P_x}$$

Çamur Üretimi (Sludge Production)

$$P_x = Q_{des} Y_{obs} (S_0 - S)$$

Stable Sludge Production (Extended Aeration)

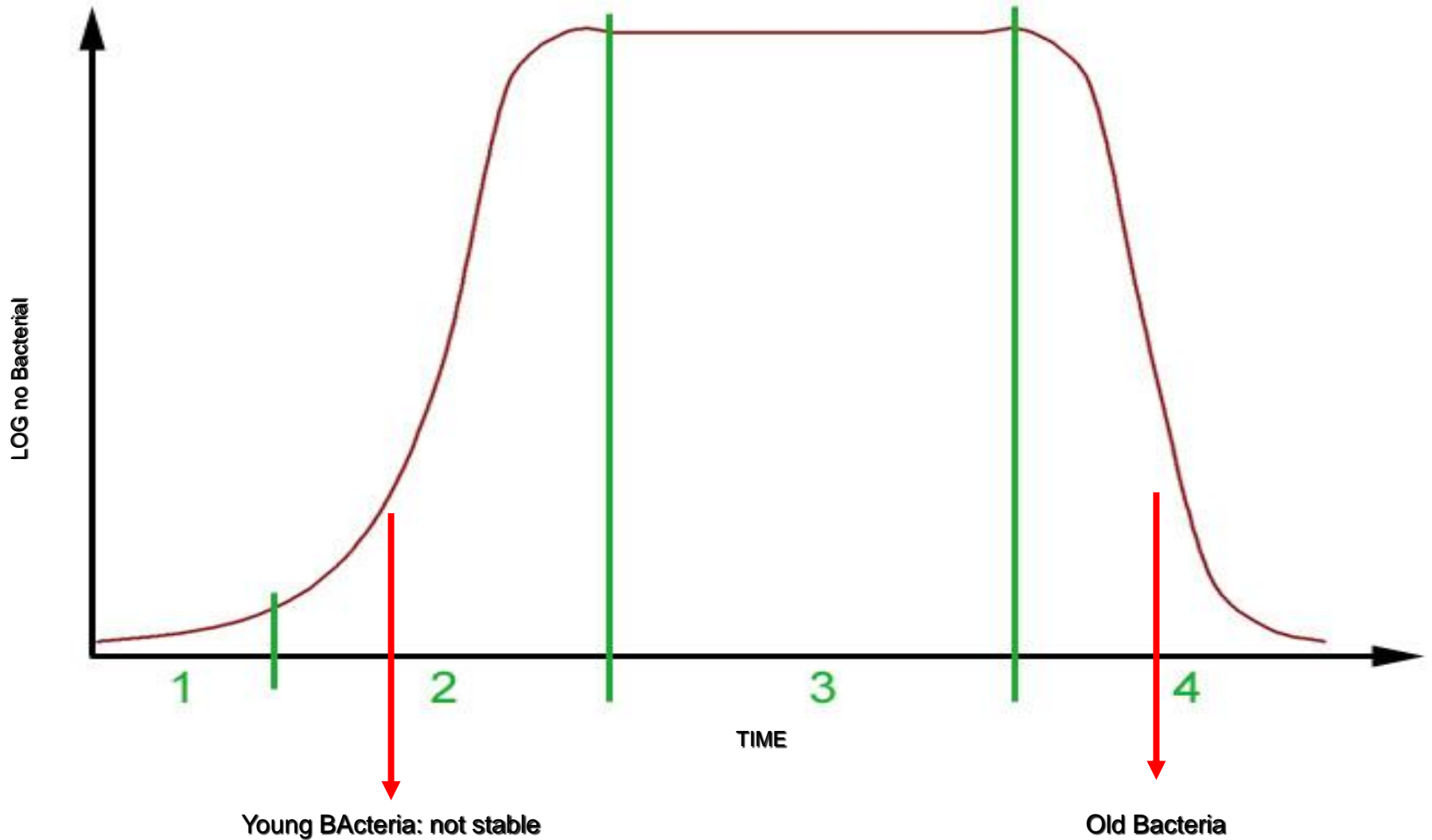
Stabil Çamur Üretimi (Uzun Havalandırma)

$$\theta_{CT} = (25) 1.072^{12-T}$$

Eq'n 5-5 of ATV-131

ATV : Abwassertechnische Vereinigung )

# SRT: Sludge Age



# $P_x = \text{Sludge Production}$

- $P_x = Y_{\text{obs H}} (Q \cdot S_0)$
- $Y_{\text{obs H}}$  :Growth Yield Coefficient ( $Y_{\text{obs H}} = 0.9$ )
- $Q$  : 75.000 m<sup>3</sup>/day
- $S_0$  : 300 g/m<sup>3</sup>
- $Q \cdot S_0 = \text{BOD Load} : 75.000 * 300 = 22,5 \text{ ton /d}$

<u>Date</u>	<u>Wasted Sludge ,Px</u>	<u>BOD<sub>5</sub> Load, (QSo)</u>
• .....	• .....	• .....
• .....	• .....	• .....
• .....	• .....	• .....
• .....	• .....	• .....
• .....	• .....	• .....

# Endogeneous Respiration

$$ER = SRT * F_T / (1 + 0.17 F_T * SRT)$$

ER : Endogeneous Respiration

# WAS Calculations( $Y_{obs H}$ )

## Metcalf-Eddy $Y_{obs}$ values

$$Y_{obs H} = 0.4 \text{ (much different in the field)}$$

## ATV 131 (Abwassertechnische Vereinigung) – $Y_{obs}$ Calculation

$$Y_{obs H} = 0.75 + 0.60 SS_0 / BOD_5 - 0.102 \text{ (ER)}$$

# WAS Calculation Example

## Artık Çamur Hesabı

$$Y_{\text{obs H}} = 0.75 + 0.60 \text{ SS}_o / \text{BOD}_o - 0.102 (\text{ER})$$

ER : endogeneous respiration =  $\text{SRT} * F_T / (1 + 0.17 F_T * \text{SRT})$

SRT : Sludge Age

$F_T$  : temperature correction factor =  $1.072^{T-15}$

$T = 15^\circ\text{C} \rightarrow F_T = 1$  , Take SRT = 25 days

$\text{ER} = 25 / (1 + 0.17 * 25) = 4.76 \gg \gg 4.76 * 0.102 = 0.48$

$Y_{\text{obs H}} = 0.75 + 0.60 (500 / 300) - 0.48 = 1.27$



# P.Köy STP Measured Yobs Values vs Yobs from ATV

