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ASSESSMENT OF ACTIVATED SLUDGE FROM MUNICIPAL ENTERPRISE FOR WASTE TREATMENT OF SOFIA CITY DURING MODEL ADAPTATION PROCESS WITH LANDFILL LEACHATE

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ABSTRACT: *Landfill leachate is generated from the waste degradation in landfill sites and rainwater infiltrates. Its treatment includes more often biological methods combined with physical and chemical methods. The availability of polycyclic aromatic carbohydrates, phenols, polychlorinated phenols, pesticides, heavy metals, and refractory organics in landfill leachate remains a critical technological problem during biological treatment. The effect of these toxic pollutants on activated sludge (AS) processes is related to deformations of AS structure and to inhibition of biodegradation activity.* ***The aim of the study is to assess the activated sludge from Wastewater Treatment Plant to Municipal Enterprise for Waste Treatment of Sofia City during model adaptation process with landfill leachate.*** *Data showed that the most favorable conditions for adaptation of the AS to leachate are in the first 6 days, at the highest dilution of leachate. The availability of pin-point flocs showed a deformation of AS structure during the whole adaptation process. The results showed that AS would have a greater ability to adapt when the adaptation algorithm includes more intermediate steps with an addition of more diluted amounts of leachate.*

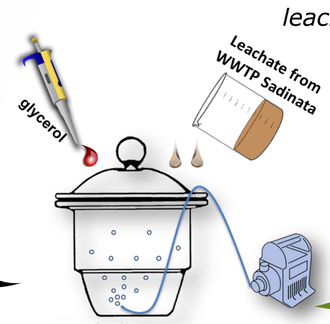
MATERIALS AND METHODS:

The duration of adaptation process was 21 days (Fig. 1). It was accomplished in aerobic reactors and it started with 50 times diluted leachate with addition of 0.79 g/l glycerol as co-substrate. On the 7th day was added 25 times diluted leachate with 0.79 g/l glycerol and on the 14th day was added undiluted leachate with 0.79 g/l glycerol. The influent was changed on the 2nd, 4th, 9th, 11th, 16th and 18th day without addition of glycerol. The used activated sludge and leachate semples were provided from Wastewater Treatment Plant "Sadinata" to Municipal Enterprise for Waste Treatment of Sofia City.

WWTP "Sadinata"

Activated sludge and leachate

How to adapt activated sludge in real conditions?



Model aerobic reactor for adaptation of activated sludge to refractory organics in leachate

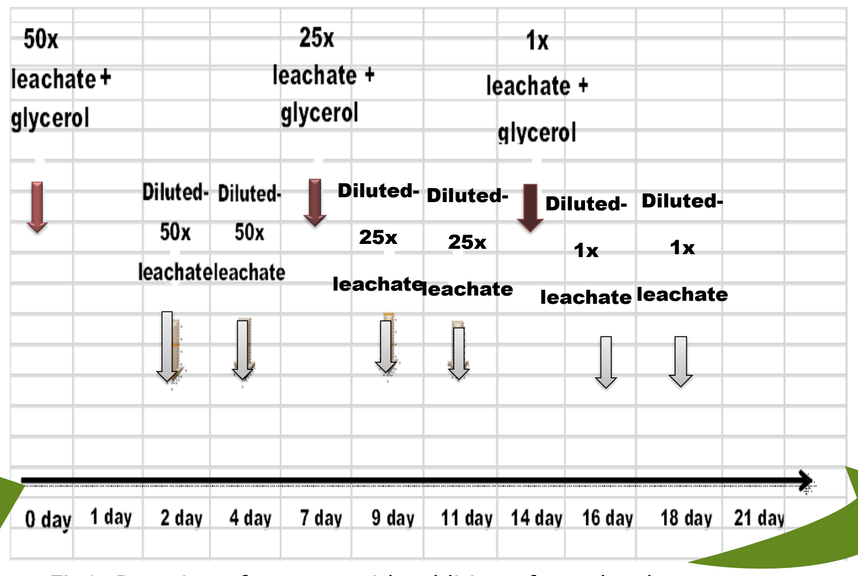


Fig1. Duration of process with addition of new leachate

Table 1. Investigated parameters and methods for analysis

Parameter	Method	Description of method
SVI (Sludge volume index), ml/g	Tsachev, 2009	The volume in ml, which occupies 1 g of sludge after 30 minutes of precipitation.
Dry substance, g/l	BDS 17.1.4.27-80	method for drying the sample at 105 ° C and weight analysis
genus *Pseudomonas* and genus *Acinetobacter*, CFU/g	Topalova, 2009	Used classical cultivation method for determining the number of *Pseudomonas sp.* on Glutamate Starch Pseudomonas Agar and *Acinetobacter sp.* on Sellers Differential Agar.
Chemical oxygen demand (COD), mgO_2/l	ISO 6060:1989	Determination of the chemical oxygen demand with sample heating in presence of H_2SO_4.
Biological oxygen demand (BOD_5), mgO_2/l	ISO 5815-1:2019	Determination of biochemical oxygen demand after n days (BODn) - Part 1: Dilution and seeding method with allylthiourea addition.

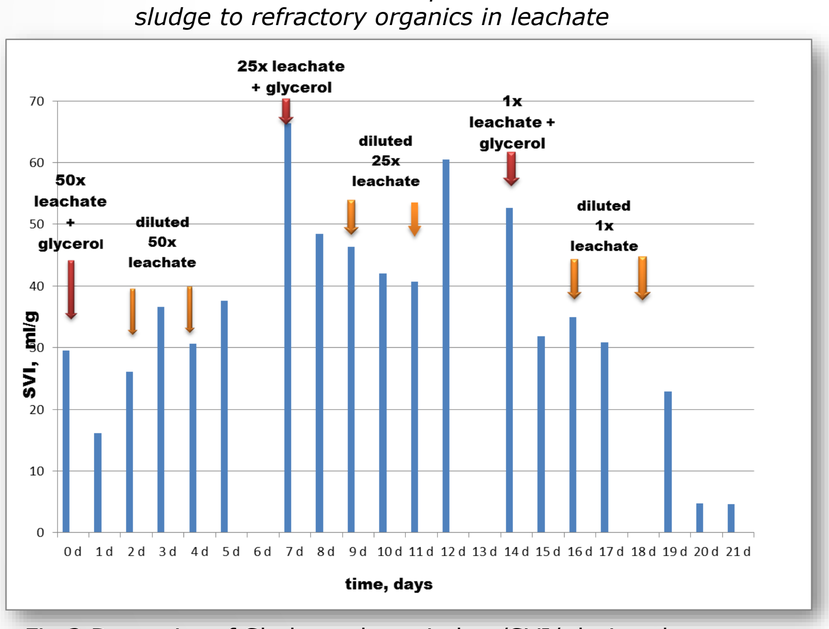


Fig.2 Dynamics of Sludge volume index /SVI/ during the process

In the first days activated sludge begins to improve values of SVI (from 29,50 ml/g on 1st day to 67 ml/g on 7th day) that means improvement of activated sludge structure and higher biodegradation activity. When the concentrations of the pollutants was raised (from 25 to 1 times diluted leachate) the sludge volume index was established a gradual decrease (from 67 ml/g at first period to 4,6 ml/g at the end of the experiment). That is an indicator for deformation of activated sludge structure and decrease of biodegradation activity. The reason for this result comes from concentrated pollutants of leachate and ability of refractory organics.

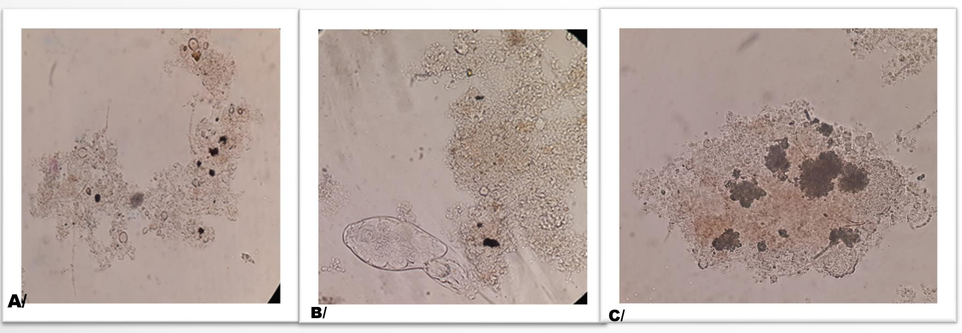


Fig.5 Pictures of activated sludge on **A/ 7th day**; **B/ 14th day**; **C/ 21st day** of experiment

The microscopic pictures show the appearance of filamentous microorganisms at the 7th day which is an indicator for restoration of activated sludge structure. With the concentration of the leachate in the second and third stage, pollutants are accumulate in the sludge flocs and the flocs remain pin-point with the absence of filamentous microorganisms. The pin-point flocs showed deformation of AS. This is an indicator for "starving" activated sludge which is related to a decrease of biodegradable organics measured as BOD_5 from 1200 mgO_2/l to 10 mgO_2/l.

RESULTS AND DISSCUSION:

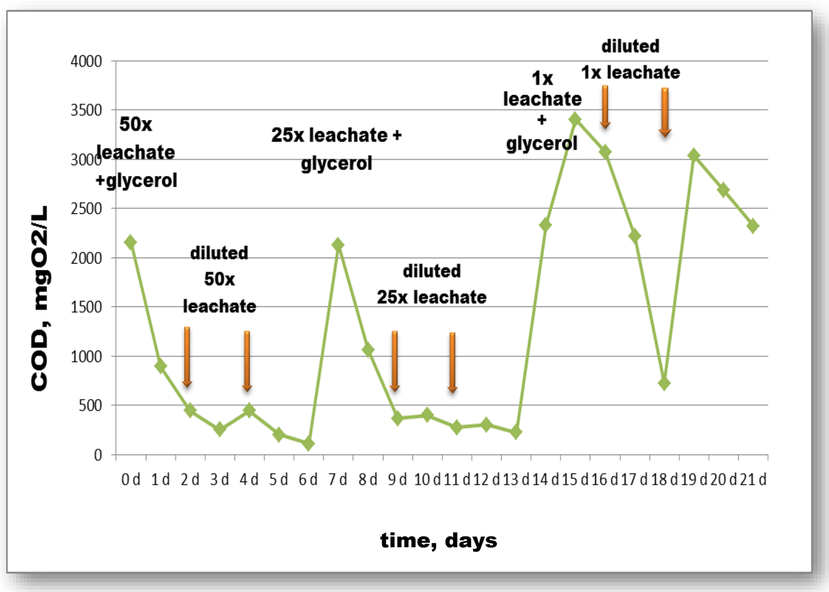


Fig.3 Dynamics of chemical oxygen demand /COD/

The values of COD at the start of experiment are high (2154,49 mgO_2/l) but at the end of the first stage organic matter concentration decreases to 108,91 mgO_2/l. In the end of the first week of experiment, with provide of 50 times diluted leachate and glycerol, activated sludge begins to adapt of toxic pollutants. During the other two periods AS reacts with inhibition. In the last days of the experiment there was a sharp increase in COD values, which shows that AS is difficultly adapt to the undiluted leachate. The dynamics of COD indirectly shows an inhibition of biodegradation activity of activated sludge at the end of the simulated process.

CONCLUSION:

The obtained results during adaptation process showed that the activated sludge begins to adapt to lower concentrations of pollutants in the leachate and utilizes easily biodegradable compounds, until the critical concentration is reached. That led to inhibition of metabolic processes and reduction of the amount of key groups of microorganisms. The results showed that AS would have a greater ability to adapt when the adaptation algorithm includes more intermediate steps with an addition of more diluted amounts of leachate.

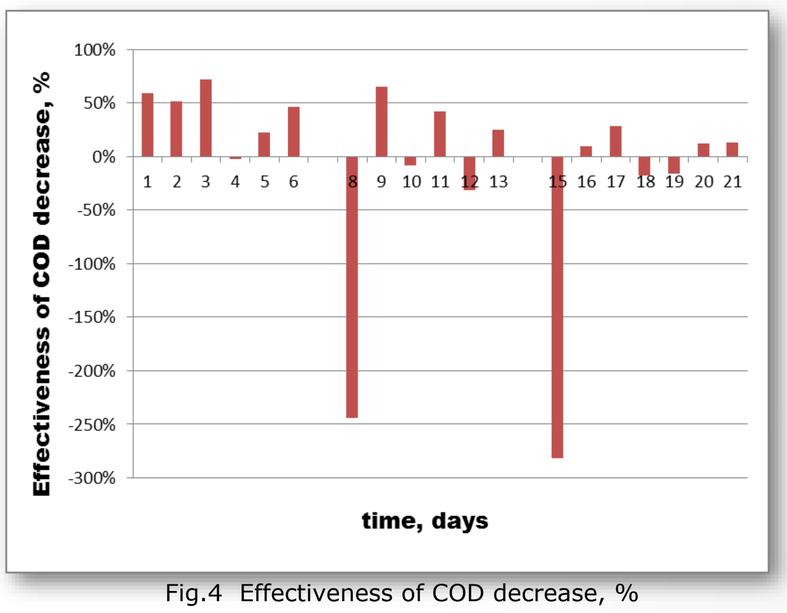


Fig.4 Effectiveness of COD decrease, %

Effectiveness of organics biodegradation measured as COD was highest in the first stage (41%) and was lowest in the third stage of the experiment (-36%).

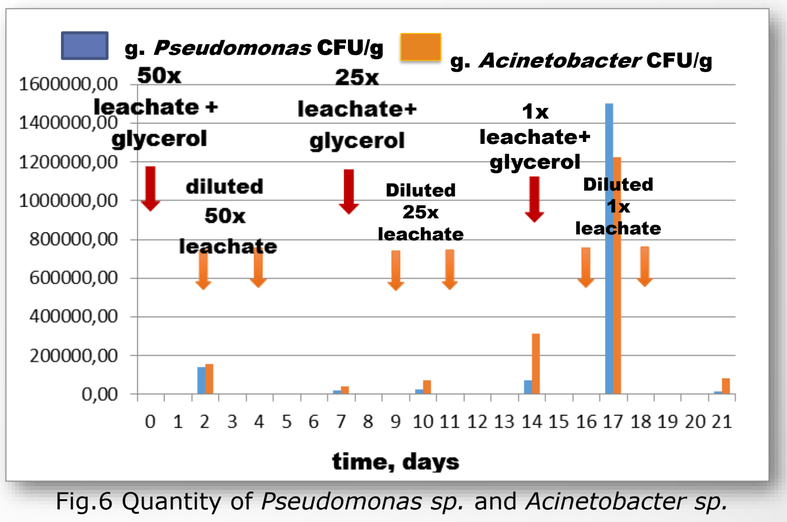


Fig.6 Quantity of *Pseudomonas sp.* and *Acinetobacter sp.*

Bacteria of genus *Pseudomonas* and *Acinetobacter* follow the same trend in the simulated process. These microorganisms are related with xenobiotics biodegradation. At the first period of the experiment, bacteria of genus *Pseudomonas* and *Acinetobacter* were present in relatively low quantities. Then at the second period we ascertained gradual increase in quantities of both genera. When in the last stage microorganisms of genus *Pseudomonas* and *Acinetobacter* react by reducing their amounts because they reach to the critical concentration of refractory organics in leachate. Its due to an increase of concentration of xenobiotics at leachate.

European Union
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