ANALYZING OF BIODISC WORK EFFICIENCY PARAMETERS IN CONFECTIONERY INDUSTRY SECTION

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ABSTRACT

It is a known fact that the confectionery industry wastewater consists of a large amount of suspended and dissolved substances, which, by their main chemical consistence, are mostly fats and carbohydrates. Since this is a biodegradable organic substance, purification process in addition to traditional mechanical and physical-chemical includes biological treatment of wastewater from which high efficiency is expected. However, if the process is not managed properly, there can be a lack of desired effect, i.e. appropriate purification. This paper analyzes the efficiency of biodisc in Jaffa factory engaged in the production of preserved pastry goods and cakes, chocolates and chocolate products. The total amount of wastewater discharge is about 4000 m3 / h. Biological treatment is performed through two biodiscs arranged in series, with the capacity of 650 ES. We analyzed the wastewater at the entrance and exit of the bio disc at different temperature regimes and at different hydraulic load of water. The measured parameters were HPK, BPK, suspended substances, total nitrogen and phosphorus, through which the efficiency of the plant was calculated. It was noted that in combined sewer systems, atmospheric water can pose a lot of hydraulic load for biodisc intended for processing of technological and sanitary wastewater. By installing the separators for fats and oils in the process of primary purification, contaminants that may interfere with the activity of micro-organisms and reduce the efficiency of the process, would be removed from these substances.

Keywords: wastewater, confectionery industry, biodiscs, the efficiency of the plant

1. Introduction

Industrial facilities discharge water that is often aggressive, loaded with sludge and toxic substances. In its structure, the water may have organic or inorganic compounds or both. Such waste waters contain substances of different origin and composition: biodegradable organic compounds, non-biodegradable organic compounds, nutrients, dissolved inorganic substances, heavy metals and pathogenic microorganisms. The substances that disintegrate in water influence oxygen consumption thereby reducing its quantity and bring into question the survival of organisms (Dalmacija B,1999). The largest polluters with inorganic substances are chemical and metal industries. Through these objects the following elements are coming into the water: toxic and aggressive elements and compounds such as cyanides, heavy metal ions, mineral acids, phenols base and others. Food industry, on the other hand, burdens the water with a large amount of organic matter that causes the consumption of oxygen in the water necessary to sustain of water biocenosis and the quality of the water environment in general. Pollution of water with toxic substances and pathogenic organisms also has indirect effects on humans because the polluted water cannot be used for drinking and personal hygiene, in the food industry, for irrigation or in agriculture.

2. Wastewater treatment with biodisc technology in Serbian factory Jaffa

The total production of waste water in Serbia is approximately 3.5 million m^3 a day. Out of this, 70% are industrial waste waters where the total organic load is accounted for 50% (National Bureau of Statistics 2013). Treatment plants are not of sufficient capacity and efficiency. For this

reason, the goal of this paper was, in the case of the factory Jaffa, to analyze the efficiency of biological purification with biodisc technology in the confectionery industry.

The activity of JAFFA doo Crvenka is the production of crisp bread, biscuits, preserved pastry goods and cakes, as well as chocolate and chocolate products. During the making process, the water is, as one of the raw materials, used directly in technological processes and operations, as well as in secondary operations in the process of energy exchange where it is used as process water. In maintenance proceedings of process equipment and associated installation, the water is used as the basic medium or in solution with disinfectants. The Table 1 shows the daily and hourly consumption of different types of waste water in Jaffa.

Table 1: Overview of average and maximum quantities of wastewater (Jaffa in 2013)

Type of wastewater	The amount of wastewaters (m^3/day)		The amount of waste waters (m^3/h)	
	The mean value	The maximum value	The mean value	The maximum value
Sanitary wastewater	21	40	0.875	1.677
Technological wastewater	10	20	0.416	0.833
Process wastewater	10	30	0.416	1.250
Chemical wastewaters	2	5	0.083	0.208
Total	43	95	1.790	3.968

The aim of the biological treatment is the removal of dissolved substances from the water, such as organic matter and ammonia, and sometimes nitrogen and phosphorus.

As it is known biological removal of organic pollution from the water is based on two processes:

- physical and biological processes of small particles enlargement whose dimension and specific weight is not enough for their separation from the water by sedimentation, as well as the turbulence of sufficient strength to compact particles,
- real biological process, such as metabolism of bacteria

The very process of the operation is based on the light turning of discs around the horizontal axis where almost half of the surface thereof is submerged in waste water flowing through the biodisc pool (Bojić. M 2013). Biodegradable organic pollutants are absorbed by organism covering the submerged part of the discs and activated sludge in the tank with discs. In Jaffa, they use two regular biodisc devices with a single capacity of 650 ES. The structure of the biodisc device is composed of steel plates welded. Axis of the rotor is made of the axle steel. Discs of biodisc device are made of polyethan networks separated from each other by the spacing rings. The rotor is made up of sections, and it allows easy and quick installation. The rotor drive is provided by the three-phase electric motor of low power, mounted on a double worm gear reducer, which is connected to axis with the chain transmission. The cover of the disc is made of reinforced polyester, which is adapted to the usual mechanical stresses.

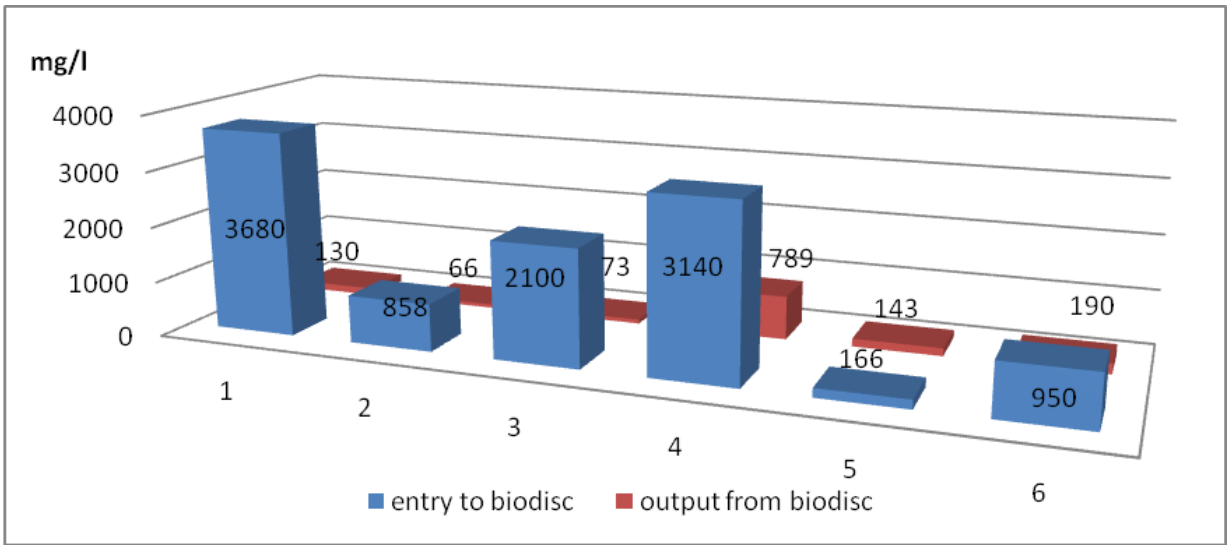
3. Obtained measuring results of the operation efficiency of "Jaffa" biodiscs

The sampling of summary wastewater, as well as wastewater before and after wastewater treatment for laboratory tests were carried out in accordance with the Regulations on the method and the minimum number of testing of wastewater quality (Official Gazette no. 47/83). Wastewater "Jaffa" was sampled at the entrance in biodisc 1, the exit from bio disc 1, the entrance in biodisc 2 and in place of inflow into the natural recipient. When sampling wastewater, the water from the Great Backa Canal was also sampled.

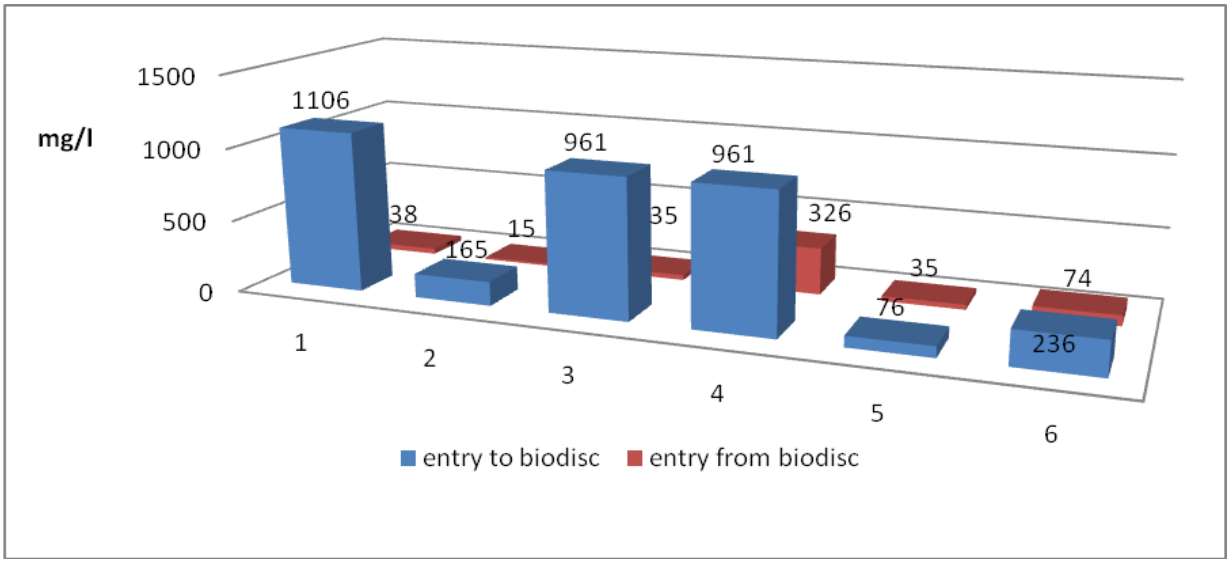
In the analyzed samples we measured chemical oxygen demand in water (HPK), biological oxygen demand in water (BPK5), suspended substances and total nitrogen, total phosphorus,

suspended substances and fat according to Soxlet. Some of the results are shown in the following graphs.

Graphs no. 1 and 2 show the values of chemical oxygen demand and biological oxygen demand before and after biodisc 1 in different samples of wastewater. The sampling was made in April, June and October of the year 2011 and April, September and December of the year 2013. The first three samples are related to the year 2011, and the last three to the year 2013.



Graph 1: HPK in samples of wastewater in the factory Jaffa during 2011 and 2013



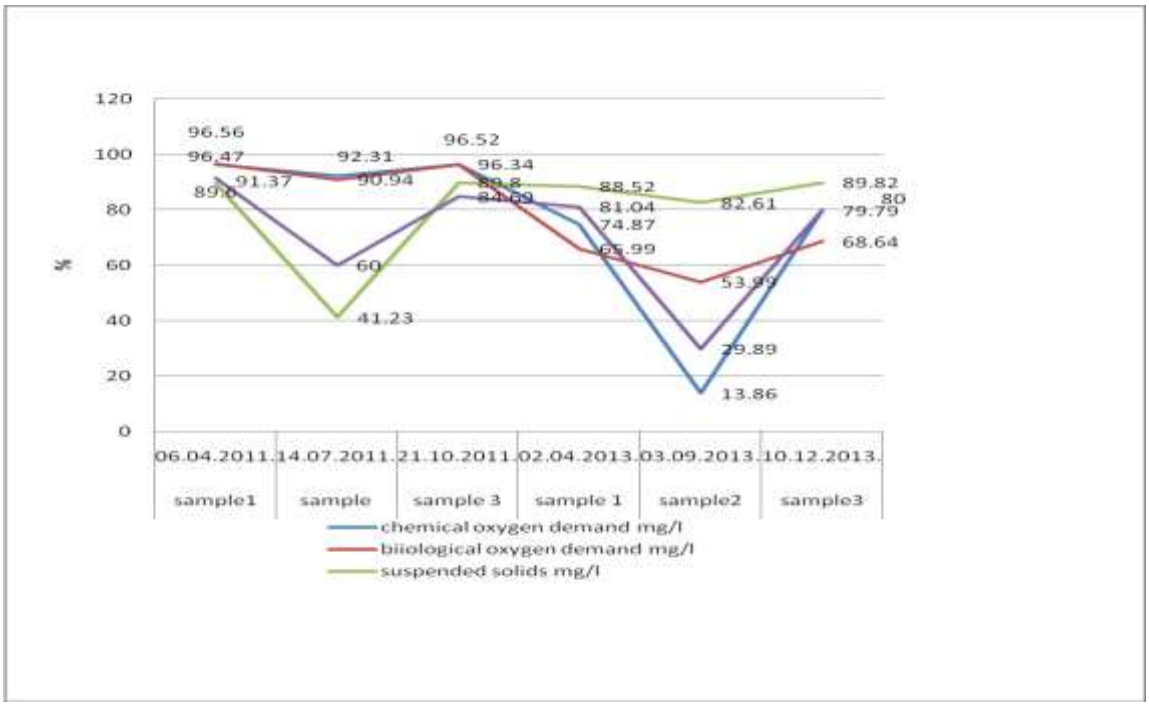
Graph 2: BPK in samples of wastewater in the factory Jaffa during 2011 and 2013

Based on the results of measurements of typical parameters of waste water quality control, the efficiency of biodisc is calculated, based on the following formula

$Ef = 1 - (U_I/U_U) \times 100$ (%) where:

UI - the parameter value at the exit of bio disc
UU - the value of the parameter at the entrance to biodisc

Figure 3 shows the individual purification efficiency achieved at the time of sampling wastewater on the first biodisc during the year 2011 and the year 2013.



Graph 3: Biodiscs operation efficiency in factory JAFFA during 2011 and 2013

From the previous graphics the following is evident: Maximum chemical oxygen demand in the influent was recorded in April of the year 2011 and it was 3680 mg/l. The highest HPK removal efficiency was achieved also in April 2011 and it was amounted to 96.47%.

Biodegradable organic pollution reached the maximum value also in April of the year 2011 when the BPK value was 1106 mg/l. At the same time the highest BPK reduction efficiency of 96.56% was achieved.

Low values of percentage reduction parameters in water samples that were taken in September 2013 can be ignored because the input parameter values were below the emission limit values, or are too low to achieve a satisfactory degree of purification. Extremely low organic, i.e. total load can be explained by the low production capacities after the annual overhaul.

As an example of the research from the year 2014 we will present in tables the efficiency of the biodisc operation measured in October of the year 2014 based on various parameters of wastewater quality control.

Table 2: Efefficiency of biodisc operation April 10. 2014

	concentration		% efficiency
	Before the device	After the device	
Chemical oxygen demand mg / l	1178	139	88,2
Biological oxygen demand mg/l	717	79	89
Suspended solids mg/l	626	52	91,7
Total N mg/l	36,5	6,7	81,6
Total P mg/l	2,9	0,836	71,2
Fat according to Soxletu mg/l	42	7	83,3

4. Conclusions

The poorer results of biodiscs operation which are reported in efficiency percentage in terms of reduction of parameters in samples that were observed in December 2013 can be explained by

increased hydraulic load of wastewater that are also burdened with atmospheric waters that are, with a single network of wastewater unnecessarily directed on biodiscs.

In order to achieve higher degree of efficiency of the biodisc device, the following is required: Provide physical separation of existing summary pipeline for atmospheric, process, technology and sanitary water from a block of buildings of the facility 1, directing flows depending on the type of pollutants, in order to reduce unnecessary hydraulic load of biodiscs.

In future studies, it is necessary to examine samples of wastewater from the laundry service, which is collected in retention vessels (lying cylindrical tanks) and to determine the effects of retaining them for 48 h and examine efficiency in terms of biodegradation of detergents in the vessels.

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