EMISSIONS IN ENVIRONMENT AND WASTEWATER TREATMENT IN SOME SUGAR FACTORIES IN SERBIA

Zita Šereš[1], Nikola Maravić[1], Szabolcs Kertesz[2], Ljubica Dokić[1], Dragana Šoronja Simović[1], Biljana Pajin[1], Žana Šaranović[1], Aleksandar Jokić[1]

[1]Faculty of Technology, University of Novi Sad, 21000 Novi Sad, Bul. Cara Lazara 1, Serbia
[2]Faculty of Engineering, University of Szeged, H-6725 Szeged, Moszkva krt. 5-7, Hungary
e-mail: zitas@tf.uns.ac.rs

Abstract

In a beet-sugar plant numerous sources of wastewaters exist. The cleanest water is from the evaporators (150% calculated on the sugar-beet), which contains ammonium and ammonium carbonate. The waste water used for cooling afterwords is used for beet washing (830% calculated on the sugar-beet). The third kind of waste water is used for washing beets soked with dirt. This water contains some residues, suspended solids, organic compounds. The fourth group is fecal waste water, which is treated in a system designed for recycling the waste. This system is composed of two decanters. Calcium-carbonate, aluminium sulphate could be used as precipitating agents. Sugar factories that manipulate with 500 tonnes of sugar-beet need lagoons with an area of about 30-40ha. Since 2006 the sugar factory near Novi Sad has not been letting the effluent into the chanal Bezdan-Vrbas. The waste water which is let into the lagoons has about 3000mg/l BOD_5, and 4-5 months later the level of BOD_5 decresed for about 70%.

Introduction

The sugar industry is one of the largest polluters. In a beet-sugar plant numerous sources of emission exist, especially in water and air. Beside that there are huge amount of emission of sludge too. Although sugar factories are only working one hundred days a year, in that period several million m^3 of highly contaminated wastewater (COD 5000-20000 mg/l) is generated [1,2].

If there would not be a regular practice in sugar industry that water recirculates, the water consumption would be very large. Thanks to the recirculation circuits, the water consumtion is reduced to a far smaller value. For example, for total water consumption of 15 m^3/t of processed beet, the consumption of fresh water is only 0.25 - 0.4 m^3/t, and in modern factories even smaller, about 0.1 m^3/t indicating that this technique achieved huge savings in the consumption of water and the amount of generated waste water, which is accompanied by adequate savings in the costs of providing fresh water and wastewater treatment costs [4,5,6]. Due to the nature of the raw materials used and the final products, the waste water derived from sugar plant is biodegradable. Auxiliary washing materials and disinfecting materials may be a problem if they are not degradable enough. The concentration and quantity of organic matter present in the wastewater depends on the ratio of the produced quantity of sugar to the amount of the generated wastewater [3,4,5].

The average COD / BOD ratio is about 1.5, indicating a high degree of biodegradability of the present substances. In addition to organic substances, technological wastewater is also loaded with suspended substances, and significantly increases during the sugar beet campaign. The ammonia content is about 12 mg/L and is not problematic for processing. Phosphorus from the wastewater originate from the used cleaning and disinfection agents. The concentrations vary, but generally the range is 0.25-6 mg/L. As with nitrogen, the phosphorus content depends on the amount of water and the type of detergent and disinfectant. The content of

heavy metals in wastewater is very low [4]. Waste water must not contain halogens derived from the use of chlorine or chlorine-releasing compounds, with the exception of chlorine dioxide in a warm water cycle [5,6]
Secondary products as a result of organic matter reduction appear in sugar wastewater. These products are gases of aerobic and anaerobic origin (methane, ethane, carbon dioxide, carbon monoxide, sulfur dioxide and others) dissolved in wastewater. In addition, pesticide and artificial fertilizers of agrochemicals occur in the wastewater of sugar. As regards microbiological contamination, it is expected not only in sanitary waters, but also as a result of favorable conditions (warm water, plenty of organic matter) for the development of microorganisms [4].
The wastewater in the sugar industy plant is usually purified in a process, which is divided in three parts. The first part is the water recycling circle from the sugar beet discharge, flooding and cleaning, which are connected throught a decanter. The second part is transporting two types of sludge to the depositional fields (lagoons). The third part is the addititonal decanter where the decontaminated water settles.

Experimental
The basic characteristics of the wastewater of the sugar industry are determined in accordance with the methods prescribed by international standards for wastewater. The process of determining the COD is based on the principle of oxidation of organic substances in a sample with potassium bicromate in a sulfuric acid medium with silver sulfate as a catalyst. After completion of the oxidation process, the amount of spent bicromate is determined titrimetrically according to the HRN ISO 6060: 2003 method. The pH value is determined by the method of domestic standards SRPS H.Z1.111:1987. The water temperature is measured according SRPS H.Z1.106:1970. NH^{4+} ion is measured using spectrophotometer by method SRPS ISO 7150-1:1992. The total nitrogen content is measured by method SRPS EN 12260:2008, using oxidation method, and the phosphorus is measured by SRPS EN ISO 6878:2008 [7,8,9,10,11].

Results and discussion
At the inhabitant's insistance on obiding the Law of about water cleannes, high taxes and fines for using fresh water and letting the efluent out into running water, forces sugar factories to construct a system of cooling and recirculating barometric water as well as creating an additional 23ha of new lagoone. Sugar factories that manipulate with 400-500 tonnes of sugar-beet need lagoons with an area of about 30-40 ha. Since 2006 this sugar factory has not been letting the effluent into the channal Bezdan-Vrbas [12].
In the Table 1. the average values of some physical characteristics of the wastewater in the lagoons during the campaign of the sugar plant are shown. Every month during the campaign in the sugar factory a samples of wastewater from each lagoons were examined.

Table 1. The physical characteristics of the wastewater in the lagoons during the campaign of the sugar plant

Sampling time	Air temperature (^oC)	Water temperature (^oC)	pH value
October	17	16	6.5
November	10	9	7.4
December	-2	3	6.2

Beside the physiacal characteristics, the main chemical characteristics of the sugar factory wastewater were examined too and the average result are shown in the table 2. In the table 2. could be seen that the wastewater which is let into the lagoons has about 3000mg/l COD at the

end of the sugar campaign but after 4-5 months later the level of COD decresed for about 70%.
Interesting is that at the end of the sugar campaign, the level of P_2O_5 increasis almost twice [12].

Table 2. The chemical characteristics of the wastewater in the lagoons during the campaign of the sugar plant

Sampling time	Organic compounds $KMnO_4$ (mg/l)	NH^{4+} (mg/l)	N (mg/l)	COD (mg O_2/l)	BOD_5 (mg O_2/l)	P_2O_5 (mg/l)
October	1120	0	6	980	640	1.5
November	1820	10	7	1643	962	1.5
December	3110	0	30	2750	1860	2.5

Conclusion

Due to the recirculation circuits in the frame of the sugar technology, the water consumtion is reduced to a far smaller value. For example, for total water consumption of 15 m^3/t of processed beet, the consumption of fresh water is only 0.25 - 0.4 m^3/t. Sugar factories that manipulate with 400-500 tonnes of sugar-beet need lagoons with an area of about 30-40 ha and in that case they do not need to let the wastewater effluent into the channal Bezdan-Vrbas. The main conclusion is that the wastewater which is let into the lagoons at the end of campaign, in December, has about 3000mg/l COD, but after 4-5 months later the level of COD decresed for about 70%.

Acknowledgements

Presented study was financially supported through bilateral project between the countries of Hungary and Serbia (HU project no. TÉT-16-1-2016-0138 financed under the NKFIH-1557-1/2017; SRB project number 451-03-02294/2015-09/4).

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