THE PHYSICAL AND CHEMICAL CHARACTERISTICS OF THE WASTEWATERS FROM FOOD PROCESSING INDUSTRY

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Abstract

This study was conducted to evaluate the physical and chemical characteristics of the wastewaters from dairy and meat processing industry. Wastewater samples were collected before treatment at the plant and were analyzed in terms of the following parameters: chemical oxygen demand (COD, mg/l), biochemical oxygen demand (BOD, mg/l), suspended solids (mg/l), pH (pH units), chlorides (mg/l), nitrogen (mg/l) and phosphorus (mg/l). The results shows that the wastewaters from dairies contain high biological oxygen demand (BOD) and chemical oxygen demand (COD) compared to those in the meat industry. The values of the suspended solids and the chlorides concentrations were higher in the samples collected from the milk unit compared to the values registered in the samples from the meat factory. The wastewaters from meat processing industry contained high levels of nitrogen and phosphorus concentrations.

Key words: wastewater, food industry, quality indicators, pollution.

INTRODUCTION

Wastewater from different industries represent a significant pressure on the environment and treatment is normally required before discharge.The indicator assesses the proportion of wastewater that undergoes different levels of treatment (www.un.org./esa/sustdev/). Treatment plants remove varying amounts of contaminants from wastewater, depending on the level of treatment they provide. In many countries a large proportion of the wastewater is discharged to the environment with little or no treatment. Low water quality reduces the availability of water resources for specific uses, in particular domestic needs, and has adverse implications for public health (Olsson, 1999). As well as containing organic matter and nutrients, wastewater can also contain hazardous substances. The level of treatment of these hazardous substances before discharge and the sensitivity of the receiving waters will affect their impact on the aquatic ecosystem (www.fao.org.). An important environmental impact of the animal processing industry results from the discharge of wastewater. Most processes in slaughterhouses, tanneries and dairy plants require the use of water. This water and water used for general cleaning purposes will produce wastewater. The strength and composition of pollutants in the wastewater evidently depend on the nature of the processes involved.

The main objective of this research was to determine the physical and chemical characteristics of the wastewater generated in the dairy

industry and to compare these characteristics with those of the wastewater in the meat industry.

MATERIAL AND METHODS

The wastewater samples were collected, in 2013, from a milk and meat processing factory. The monitored food units are placed in Satu Mare County. The physical and chemical parameters of the wastewater from milk and meat processing factories were monitored before treatment at the plant. All samples were analysed for determination of the following parameters: chemical oxygen demand (COD, mg/l), biochemical oxygen demand (BOD, mg/l), suspended solids (mg/l), pH (pH units), chlorides (mg/l), nitrogen (mg/l) and phosphorus (mg/l). Analyses were done according to methods outlined in G.D.188/2002: biochemical oxygen demand was obtained by determining the dissolved oxygen content in water after harvest and after 5 days, and the difference was BOD_5; chemical oxygen demand was determined by potassium dichromate method; total suspensions were determined by their separation with filtration or centrifuging, depending on their size; pH of the wastewater - using a pH meter; chlorides were analyzed by titration with silver nitrate using chromate as indicator (Mohr method); total nitrogen was determined with Kjeldahl method; total phosphorus was determined using ammonium molybdate spectrometric method.

RESULTS AND DISCUSSION

In the figs. 1-7 are presented the mean values of the wastewater quality indicators monitored in the studied food units: COD, BOD, total suspended solids, pH, chlorides, total nitrogen and total phosphorus.

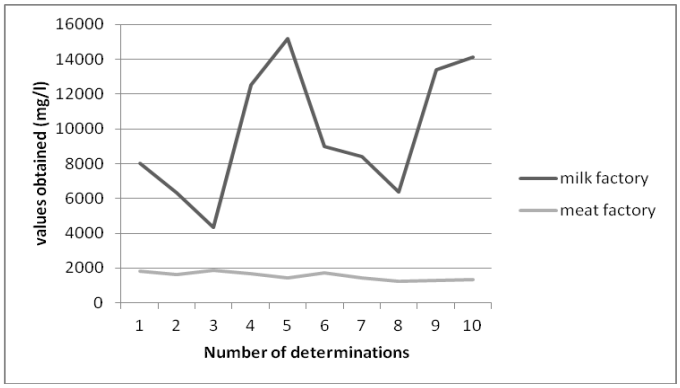

Fig. 1. Values of the chemical oxygen demand (mg/l)

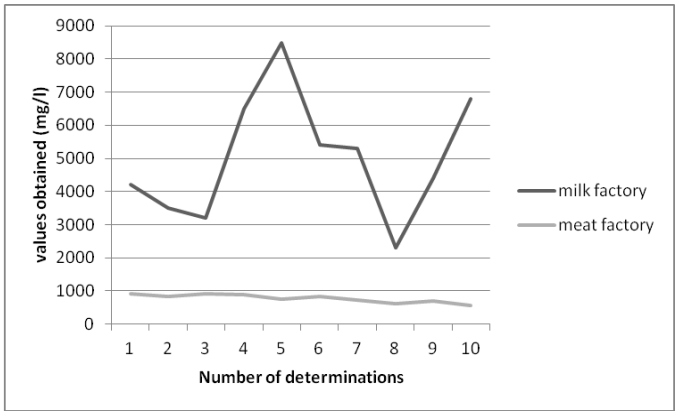

Fig. 2. Values of the biochemical oxygen demand (mg/l)

The chemical oxygen demand (COD) represents the oxygen consumption for chemical oxidation of organic material under strongly acid conditions. The COD test yields results within a period of a few hours and therefore provides direct information. In this test biodegradable as well as non-biodegradable compounds are oxidized (APHA, 1995). The COD therefore only provides an indirect indication of the potential oxygen depletion that may occur from the discharge of organic material in surface waters. Wastewater often contains organic materials that can be decomposed by microorganisms, using oxygen as this happens (Rein, 2003). If the wastewater contains too much organic material and is discharged into a stream it can cause a drop in the oxygen content of the stream as the microorganisms decompose the organic material.

The amount of oxygen consumed by the microorganisms in breaking down the waste is known as the BOD. So by monitoring the BOD of the wastewater, we can make sure that too much organic material is not discharged (www.pollutionsolutions-online.com).

The results presented in the figs. 1 and 2 reveal that the wastewaters from dairies contain high biological oxygen demand (BOD) and chemical oxygen demand (COD) compared to those in the meat industry.

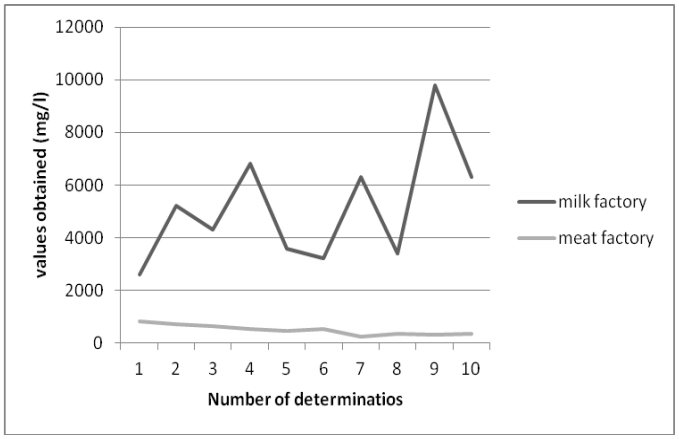

Fig. 3. Values of the suspended solids (mg/l)

Suspended solids are insoluble organic and inorganic particles present in wastewater. Discharge of suspended solids increases the turbidity of water and causes a long term demand for oxygen because of the slow hydrolysis rate of the organic fraction of the material. This organic material may consist of fat, proteins and carbohydrates. The natural biodegradation of proteins (from for instance meat and milk), will eventually lead to the discharge of ammonium. Ammonium oxidation into nitrite and nitrate by nitrifying bacteria, leads to an extra consumption of oxygen (www.fao.org).

The fig. 3 show that the values of the suspended solids are higher in the samples collected from the milk unit compared to the values registered in the samples from the meat factory.

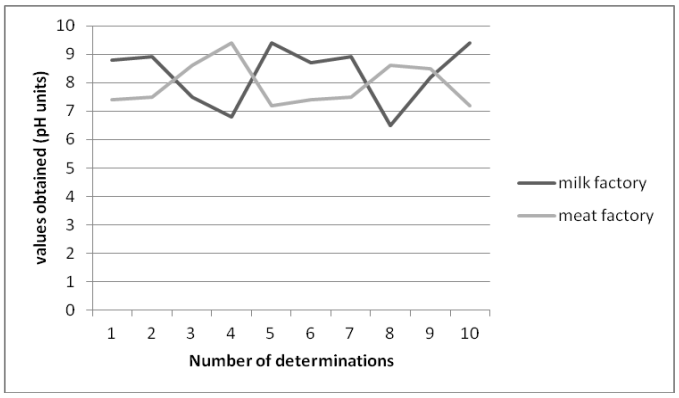

Fig. 4. Ph values

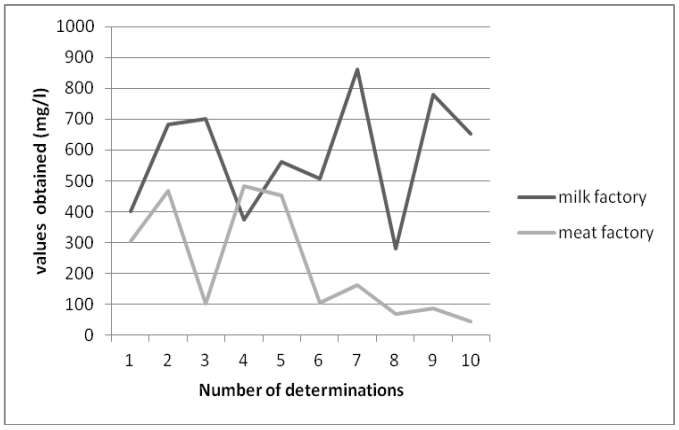

Fig. 5. Values of the chlorides concentrations (mg/l)

Wastewaters monitored in the milk factory presented values of the chlorides concentrations higher than that of the wastewater monitored in the meat factory (fig. 5). Also there were high levels of chloride concentrations as washing water resulting from the processing of butter and manufacturing the cheese are heavily loaded with inorganic salts .

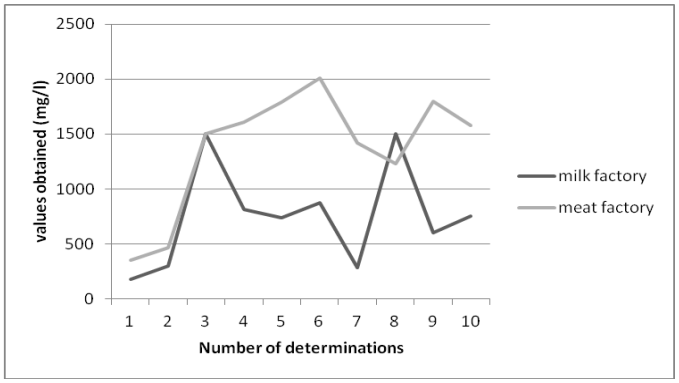

Fig. 6. Nitrogen concentrations

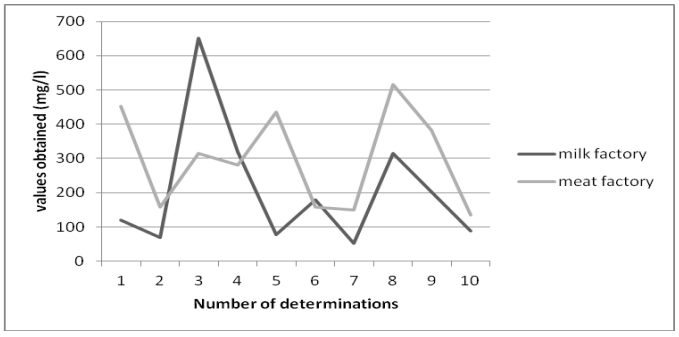

Fig. 7. Phosphorus concentrations

In wastewater nitrogen is usually present as fixed in organic material or as ammonium. Occasionally also nitrate may be present (this may be the case in dairy industries where HNO_3 is used for cleaning operations). Nitrogen and phosphorus are important because these two nutrients are responsible for the growth of aquatic plants.The presence of phosphorus (P) is determined photometrically. Nitrogen and phosphorus removal can be achieved through special wastewater purification systems, which are based on either biological or physic-chemical processes (Johns, 1995). The graphics presented in the figs. 6 and 7, evidence that the wastewaters from meat processing industry contains high levels of nitrogen and phosphorus concentrations.

CONCLUSIONS

The wastewaters from the dairy processing industry contain high concentrations of organic material such as proteins, carbohydrates, and lipids, high concentrations of suspended solids, chlorides, or high biological oxygen demand (BOD) and chemical oxygen demand (COD) comparative with the wastewater from meat industry wich contain high nitrogen and phosphorus concentrations. Industrial wastewater effluents are usually highly variable, with quantity and quality variations brought about by bath discharges, operation start-ups and shutdowns, working-hour distribution and so on. A long-term detailed survey is usually necessary before a conclusion on the pollution impact from an industry can be reached. Food-processing wastewater can be characterized as nontoxic, because it contains few hazardous and persistent compounds. With the exception of some toxic cleaning products, wastewater from food-processing industry is organic and can be treated by conventional biological technologies.

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