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DESCRIPTION OF PROPOSAL FOR THIS PROCESS WASTEWATER TREATMENT OF SMALL LEATHER PROCESSING FACTORY

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ABSTRACT: *Solving the problem of purification of industrial wastewater in order to protect the environment and to meet legal standards on the quality of water discharged into streams, low-accumulative small businesses represent a substantial investment outlay. Therefore, in most cases approaching half-incomplete solutions that enable them to avoid or minimize legal liabilities and the problem of inadequate disposal of waste water remains unresolved. Here we propose one of the technological solutions for wastewater with small modifications can be applied in many industrial wastewaters such as water the leather industry, small slaughterhouses and meat processing, milk processing and dairy products.*
KEYWORDS: *wastewater, technological design*

INTRODUCTION

Solving the problem of purification of industrial wastewater in order to protect the environment and to meet legal standards on the quality of water discharged into streams, low-accumulative small businesses represent a substantial investment outlay. Therefore, in most cases approaching half-incomplete solutions that enable them to avoid or minimize legal liabilities and the problem of inadequate disposal of waste water remains unresolved. Table 1 provides an overview of wastewater which produces in small factories and similar facilities in the majority of small factories in Bosnia and Herzegovina. [1,3] Clearly expressed in different productions daily volume of wastewater indicate not only the expected variability in concentrations of components which waters are loaded, but also to the frequent interruptions or vacancy of production capacities.

Table 1. Volume of basin for the equalization of water quality are derived on the basis of data on production of wastewater [1,3]

The daily production of wastewater								
Day	24.11.01	25.11.01	26.11.01	28.11.01	30.11.01	01.12.01	02.12.01	03.12.01
Flow Q(m^3/d)	14	48	7	17	5	9	22	46
Outlet (m^3/d)	20	20	20	20	20	20	20	20
Remains in the tank (m^3/d)	42	42	29	26	11	0	2	28
Day	06.12.01	07.12.01	08.12.01	09.12.01	10.12.01	11.12.01	12.12.01	13.12.01
Flow Q(m^3/d)	9	22	56	11	8	14	26	7
Outlet (m^3/d)	20	20	20	20	20	20	20	20
Remains in the tank (m^3/d)	17	19	55	46	34	28	34	21

Table 2: Analysis of treated wastewater

Analysis of the leather industry wastewater flow of 9.33 m^3					
Parameter	Unit	Result	MDK	After phase 1	Reduction (%)
Temperature of water	^0C	4	30		
pH value		11	6-9	8	
Total alkalinity	mg/l $CaCO_3$	2690			
Electrical conductivity	µS/cm	12880			
Evaporation residue	mg/l	7499			
Ignition loss	mg/l	2706			
Total suspended matter	mg/l	420	35	42	90%
Chemical consumption of O_2 HPK	mg O_2/l	3264	125	1632,00	50%
Biological consumption of O_2 BPK_5	mg O_2/l	1099	25	549,50	50%
NH_4-ion	mg/l	316,44	10	252,80	20%
Nitrites (NO_2-N)	mg/l	0,37	0,5		
Nitrates (NO_3-N)	mg/l	4,48	10		
Total nitrogen N	mg/l	320,00	10	256,00	20%
Total phosphorus P	mg/l	0,26	1,0	0,16	40%
Total oils and fats	mg/l	0,1090	200	0,01	95%
Chlorides	mg/l	3438,6	20	-	-

In the Table 2 are shown the results of analysis of the same wastewater for daily production of 9.86 m^3/d and the expected quality parameters after mechanical treatment of the same, determined and based on the DWA-norms and data from equipment manufacturers on the degree of mechanical wastewater treatment with a selected processes.

To achieve the required quality of MDK purified water, it is necessary to implement the following processes and install the appropriate equipment [2,5]:

- extract the raw materials and residues of production by installing screens and flotation plants
- elimination of precipitating matters, coagulation / flocculation
- decomposition of organic compounds and nitrogen (NH_4), in the SBR-reactor
- chloride separation by filtration (membrane technology)
- dehydration and disposal of sludge generated during the process

On the base of presented data, we will provide a proposal of water purification in two phases:

Phase 1:

- extract the raw materials and residues of production by installing screens and flotation plants
- elimination of precipitating matters, coagulation / flocculation
- dehydration of generated sludge by bags

Phase 2:

- decomposition of organic substances (KPK) and nitrogen (NH_4), in the SBR-reactor
- chloride separation by filtration (membrane technology)
- dehydration of generated sludge in the process of biological treatment

At first, it's necessary to realize a technological solution from the first phase and on the basis of the collected data reexamine a water quality whether the envisaged technological solution for the phase 2 correctly selected. If necessary, the technology will be accommodating. Until then, for design and dimensioning of plants in phase 2 we will use data from phase 1.

In phase one will be made a mechanical, chemical and physical separation of impurities from water. On the basis of literary data [2,5] at this phase will be extract about 50% organic and inorganic and insoluble matters Table 1.

DESCRIPTION OF PROPOSAL FOR TECHNICAL SOLUTION - Phase I

The first degree of purification involves fine rotational sieve (Figure 1) with size of openings 2 mm to remove solid particles from wastewater. Sieve retains all particles larger than 2 mm, which are collected in the lower part of the rotating sieve [5]. After removing the residue from the sieve, the wastewater enters into basin for equalization of water quality.

The production of wastewater (table 1) for the 16 days as measurements performed was 311 m^3. Considering the seven-day work time, the output of wastewater from the equalization basin for further processing is 19.45 m^3/d.

$$Q = \frac{311}{16} = 19.45\ m^3/d$$

For further calculation of the plant it's necessary to take a flow of 20 m^3/d and for burden of water given in Table 2. As can be seen from Table 1, it is necessary to plan a basin with minimum volume of 56m^3 for reception and equalizing the quality of incoming water into plant (Figure 1). The relevant assumption for sizing of the basin is the worst operating case of the devices [2,4,5].

It is designed a round basin for equalizing with diameter of 4m and height of 4.5 meters which gives a volume of 56.52 m^3, and it is quite enough to accept all the water from the production process and lead to the factory site.

$$V = \pi \frac{4^2}{4} \times 4.5 = 56.52\ m^3$$

The basin is equipped with aeration system in which is ensured complete mixing and providing aerobic conditions in the basin. With mixing are prevented a deposition of silt and improves the oxidation in the water of the presence components and improving the removal of KPK. To achieve these conditions it is necessary to install it mechanical mixers and aeration system. Aeration of water also improves flocculation properties of solid particles. In this basin are performing, if necessary, correction of pH conditioned in the following series of process or just to neutralize the water.

Dosage acid, coagulants and flocculants regardless of plant size, in the long run, it is best to automate by installing automated system for dosing which consists a tank of chemicals, dosing pumps and electrical panels with automatic control. These containers and related equipment are installed in a solid object, or in a container for storing the equipment mounted in the immediate vicinity of the basin.

DESCRIPTION OF PROPOSAL FOR TECHNICAL SOLUTION - Flotation

Flotation is one of the methods for removal of precipitating substances and other substances from wastewater. It is based on the principle which is opposite to sedimentation, inflowing fine air bubbles into the wastewater and lift the suspended particles to the surface where it can be removed mechanically. It's usually placed after the rough treatment and equalization of water quality. The *effect of flotation can be enhanced by adding agents for precipitation and flocculation before the wastewater reaches the flotation tank. Salts of metals such as iron (III) sulfate, iron (III) chloride, aluminum sulfate, aluminum chloride and a number of polymers used for precipitation and flocculation. The quantity and type of the flocculation can be determined on-site during the running in flotation processes. Using flotation devices can be achieved a reduction of KPK, BPK, nitrogen and phosphorus 30-40% [5].*

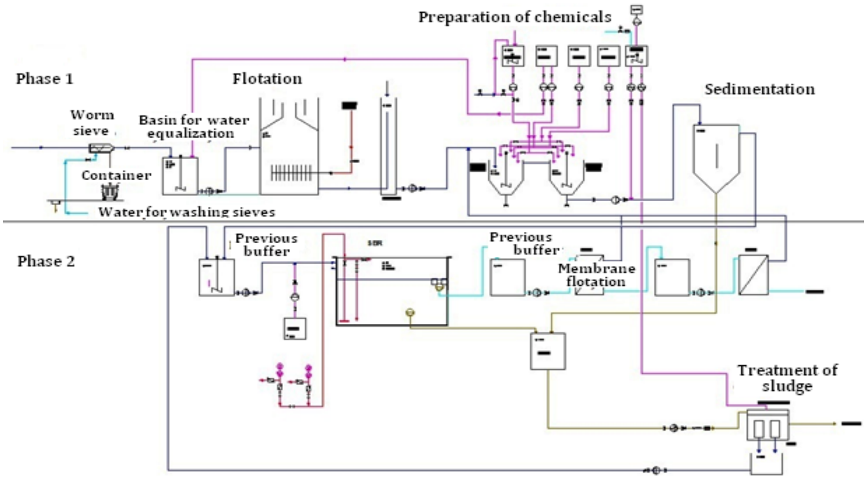

Figure 1. The technological scheme of treatment of wastewater from a separate phase of 1 and 2

BIOLOGICAL TREATMENT

Based on data from table 2 the ratios of nutrients are derived as a measure of biodegradability of wastewater constituents.

$$\frac{CSB}{BSB_5} = 2.92 > 2, \text{ biologically difficult degradable water}$$

$$\text{Content of dry matter in relation to } BSB_5\text{: } \frac{TS_0}{BSB_5} = 0.375$$

$$\text{Content of nitrogen in relation to } BSB_5\text{: } \frac{TKN}{BSB_5} = 0.236 < 0.25$$

$$\text{Content of phosphorous in relation to } BSB_5\text{: } \frac{P}{BSB_5} = 2.42 \times 10^{-4}$$

To achieve parameters for discharge into natural recipients, it is necessary to biologically treated a wastewater. With pretreatment has been achieved the essential elements that allow the operation of a biological level, apropos:

- *from wastewater are removed coarse material*
- *wastewater is neutralized and uniform in composition*
- *chemical pretreatment are reduced the loads which is directly reduced volume and installed power of the biological treatment degree.*

The selected technology for purification is the SBR technology. Due to the unfavorable relationship KPK/BPK$_5$ values and high content of nitrogen, it's determined the cycle time of 24 hours with intermittent aeration (3-6 cycles by denitrification during phase reactions). Furthermore, there is a need for phosphorus dose (insufficient quantities of waste water) and what can be done manually by adding at the beginning of the cycle. Source of additional phosphorus mustn't contain nitrogen.

In addition, there were unfavorable ratio of carbon and nitrogen and due to denitrification processes must be dosed easily degradable external source of carbon. Therefore, it's provided the dosage of glycerol during sub-cycles of denitrification. The basic description of the process:

- ***Phase - Infiltration of contaminated water, mixing and aeration -** During this phase of the process, it's coming up to the oxidation of organic compounds. Oxygen concentration is between 0.5 and 2 mg / l and can be performed and processes of nitrification (aeration) and denitrification (mixing, filling) and removal of phosphorus compounds (filling).*
- ***Phase - Aeration -** After completing the process of entering polluted water, continues the process of aeration required for the oxidation of compounds of carbon and nitrogen. In this process it is necessary to monitor the concentration of dissolved oxygen and respiration of activated sludge.*
- ***Phase - Precipitation -** The concentration of sludge at maximum water level is 4.5 g / l. Stopping the aeration comes first due to the slow deposition of residual flow, rapid deposition and then at the end of the slow deposition of high concentrations of silt at the bottom of the pool. The concentration of sludge in the settling zone of approximately 5 g / l.*

- ***Phase – Discharge of treated water and excess sludge -*** *For discharge of clarified water can be used movable groove or pump that automatically activates and stops and with their work manage the level probe. When is reached the minimum level, the groove is automatically returns to its original position. In the biological treatment process is necessary to provide sufficient time and oxygen that bacteria degrade the pollution contained in wastewaters. Characteristically, the leather wastewater, it's necessary to add two chemicals to a biological process to be even possible - phosphorus and carbon for denitrification. For a relatively small amounts, and the fact that once-daily dosing is possible, the source of phosphorus it can be added to the wastewater manually. Carbon source (glycerol) is required to dose using automatic dosing system related to the operation of SBR process. The carbon has to be dosed at the beginning of denitrification cycle, and each day takes place 4-6 cycles during the cleaning process.*

It is not realistic to expect that worker which is determined for the operation and maintenance of devices, make a six times daily dosage with an exact amount of glycerol (or other carbon source). The basin for aeration with volume of 90 m^3 should be performed as a reinforced concrete buried object in the vicinity of equalization-reaction basin. In this way, it isn't necessary additionally pumping from one basin to another, but the gravity over the electric valve can transfer water. Measuring, regulating and control equipment with tank and pump of glycerol is located in the same object as the equipment of chemical pretreatment.

DISPOSAL OF SLUDGE

It is necessary to process and dispose of sludge from:

- *chemical pretreatment,*
- *biological treatment.*

The estimated quantities of sludge are:

- *1,0 m^3/d of sludge of chemical pretreatment (5% dry matter, 50 kg/d),*
- *0,5 m^3/d of excess of biological sludge (1% dry matter, 5 kg/d).*

The total volume of excess sludge was estimated as 1.5 m^3/d (3.7% dry matter, 55 kg/d). Annual amount of sludge, calculated with 250 working days would be 375 m3, or 13 875 kg dry matter.

The choice of technique for the use and disposal of sludge depends on several factors. This includes for example, spreading sludge on land, disposal that are conducted at landfills, the use of materials for insulation, burning, incineration, wet oxidation, pyrolysis, gasification, vitrification.

Capital and operating costs related to sludge treatment can be high and therefore the scale when selecting a disposal technologies. The amount of sludge which separates in small plants like this, it's best suitable to make a dehydration of sludge by bags or that further treatment of sludge take over some greater plant.

CONCLUSIONS

Although a relatively small daily quantity of wastewater, the device for purification must contain all the elements necessary for proper processing of wastewaters in the leather industry.

The proposed solution and calculation of the volume of essential elements into the device is in accordance with appropriate standards in this area.

Our proposal is that in the process of building the device, not only this but also and other devices approaching by phase, apropos:

I. phase of mechanical treatment with associated equipment
II. phase biological part of the device with associated equipment

Thereby, it would be after the first phase of the analysis of water enabled: accurate sizing of plant and proper selection of further treatment of wastewater.

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