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Treatment of Starch Wastewater from Cardboard Packaging Industry

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Abstract: *The starch wastewater from corrugated cardboard and box manufacturing industry generated due to the process of machine washing. However, starch wastewater is high strength and not easily treated. Wastewater contains starch powder which is used as gluing agent used in pasting machine. The starch wastewater is milky white color. Both suspended and dissolved solids concentration present in starch wastewater are very high. This type of wastewater generally treated by conventional method such as sedimentation, coagulation and flocculation methods. This method gives limited purifying efficiency. In this work the treatment of starch wastewater by using solids and liquid separation with the help of gravitational settling and supernatant wastewater is treated by biologically sequential batch reactor process. Firstly analysis of quantity of wastewater, pH, TSS, TDS, BOD and COD in starch wastewater these are the operating parameters to optimize. The pH of starch wastewater is acidic in nature ranges from 4 to 6. After the simple gravitational settling suspended solids is settled at the bottom of the tank and supernatant wastewater slightly Colorless. Due to simple sedimentation TSS, BOD and COD reduces from 52630mg/l, 1740mg/l and 4440mg/l to 4934mg/l, 960mg/l and 2400mg/l respectively. Biologically treated industrial effluent BOD and COD reduced up to 80% to 90% and pH of wastewater lies 7-8. Good agreement between theoretical analysis and experimental result is maintain. The physicochemical parameters including color, odor, pH, TSS, TDS, COD and BOD is to be maintained up to permissible standards.*
Key Words*: BOD, COD, Starch, Treatment, wastewater, sludge*

I. Introduction

The different types of industry generate a variety of wastewater pollutants which are difficult and costly to treat. Wastewater strength and its characteristics are varying significantly from industry to industry. Large scale industrialization tends to increase wastewater generation and increase the pollution load on the environment. The treatment and the disposal of industrial waste now become a challenging problem for developing country.

The cardboard packaging industry manufacturing of corrugated cardboard related to packaging and printing sector are currently the fastest developing industry. Due to banned on used of plastics bags and plastic packaging therefore increasing demand for diverse goods and the necessity of delivering them to the recipients require higher productivity from the manufacturers of cardboard Cartons. The cardboard cartons must protect transported goods form mechanical damage and other external factors. A color cartons should encourage prospective buyers to purchase a cardboard product. The process of manufacturing corrugated cardboards the raw material is use rolls of brown paper are put into machine in such a way that sets of three to four paper passes through machine in which they are corrugated. The process by which corrugated cardboard are made, using a machine is called as corrugators. Corrugated cardboard producing by attaching liner sheets to both sides of a corrugated sheet using an adhesive to thus increase cushioning ability is mainly used in the manufacture of product packaging boxes. This adhesive made by starch corn powder and borax powder mixture used in proper proportion. Adhesive used as a gluing agent used in pasting machine. This adhesive layer tends to stick the moving part of the machine these affects the manufacturing process , due to this machine have to be wash time to time by using water thus the wastewater is generated. The wastewater from this production contain large amount of pigments derived from starch adhesive. Both Total suspended solids (TSS) and total dissolved solids (TDS) concentration present in the wastewater is very high. This solids present in the starch wastewater should be separated by simple gravitational settling and decanted wastewater treated by biological treatment process.

1.1. Industrial problem

This Cardboard packaging industry involves in the production of large amount manufacturing of corrugated cardboards also carried the process of cardboard cutting and printing. There are by products like starch wastewater and sludge releasing from industry. Most of the time wastewater is treated by various types of physical and chemical treatment process such as precipitation, filtration and coagulation. Inadequate treatment process and inappropriate proportion of chemicals let a lot of contaminants released to the environment such as BOD, COD and TSS. When the level of such contaminants is beyond the permissible limits it cannot be disposed directly into the natural environment. Hence this study is to search the proper treatment of effluent and reduced the contaminants from releasing waste.

1.2. Objective of the work

1.2.1. General objective

- To reduced the level of BOD, COD and TSS in starch wastewater from industry

1.2.2. Specific objectives

- To optimize proper method of treatment.
- To reuse of treated water in industry for all secondary purposes like washing of machines, gardening etc.

1.3. Significance of the study

Wastewater from the industry needs to be treated to reduce any possible impacts on the aquatic environment. Industry required proper treatment scheme for starch wastewater. After the treatment this water should be reused for machine washing and gardening purposed.

II. Materials And Methods

2.1. Materials

The apparatus and equipment used during the experiment was aspirator bottle, aquarium air pump for aeration, pipe for decanting treated water, pH meter, volumetric flask, beakers, and biological oxygen demand incubating apparatus.

Chemicals and reagents- potassium dichromate (K2Cr2O7), H_2SO_4, glucose powder, distilled water etc.

2.3. Sample collection

The starch wastewater samples collected include effluent from industrial outlet and effluent from the collection tank. One liter of each liquid sample is taken out. The collected sample was taken out to the laboratory for the analysis of physicochemical characteristics such pH, BOD, COD and TSS.

2.4. Sample Analysis

Biological oxygen demand (BOD_5) was detected from the difference between first day and after 5 days of incubation. Chemical oxygen demand (COD), Total dissolved solid (TDS), total suspended solid (TSS), and pH were determined on the same day of collection.

2.5. Method of Optimization

Experimental setup: Starch wastewater after simple gravitational settling enters into batch reactor. Volume of reactor is 1000ml and reactor contains 250-300ml biologically active sludge. Supernatant starch wastewater enters into the reactor which is 700-750ml. Continues aeration was provided by using air pumps. The active bacteria present in the reactor stabilized the wastewater. After 20-22hrs aeration was stopped and sludge was settled down at the bottom of the tank. Supernatant treated water was decanted. Then determine the physicochemical properties of treated water. Reactor includes fill, react, decant and idle.

Fig 1: Batch reactor

III. Results And Discussion

The study on starch wastewater from cardboard packaging industry analysis of industrial effluent high amount of solids present in it. The treatment of starch wastewater by using solids and liquid separation with the help of gravitational settling and supernatant wastewater decanted and treated by biologically process. Due to gravitational settling TSS, TDS, COD and BOD is reduce up to certain limits.

Table 1: Starch wastewater characteristics

Sr.	Parameters	Starch wastewater characteristics	After gravitational settling
1	pH	5 – 5.5	5.5
2.	TSS	52630 mg/l	4934 mg/l
3.	TDS	30890 mg/l	3838 mg/l
4.	BOD	1760 mg/l	960 mg/l
5.	COD	4400 mg/l	2400 mg/l

The analysis result of starch wastewater revealed that the high amount of TSS and TDS. Accordingly, TSS, TDS, BOD and COD are 52630 mg/l, 30890 mg/l, 1760mg/l, and 4400 mg/l respectively. The pH of wastewater is found that 5-5.5. After gravity settling the solids settled at the bottom of the tank and BOD and COD value reduced up to 45%. The supernatant wastewater goes to the further treatment process. Wastewater enters into the batch reactor. Batch reactor provides highest efficiency possible in a single step biological process.

In SBR is variation of the activated sludge process. Now a day's SBR is widely used biological wastewater treatment. After screening and sedimentation process supernatant wastewater pumped out and goes to batch reactor for treatment process. Aeration process is the heart of batch reactor process. The dissolved oxygen is maintained by blowing air into the tank through diffusers (in some cases with a mechanical aerator). Organic matter and dissolved oxygen are brought together in the aeration tank. The biological oxidation takes place due to aerobic microorganisms. A required concentration of microorganisms is maintained in the tank. After 20-22hr aeration treatment process is stop. Sludge is settled down at the bottom of the tank and supernatant treated water can be decanted in decant tank.

Table 2: Results before and after treatment

Sr.	Starch Wastewater samples	Before treatment COD mg/l	After treatment COD mg/l	Before treatment BOD mg/l	After treatment BOD mg/l
1	Sample I	2400	204	920	26
2	Sample II	2304	186	940	23
3	Sample III	2256	173	880	25
4	Sample IV	2352	194	940	24
5	Sample V	2448	198	960	29

3.1. Graphical representation

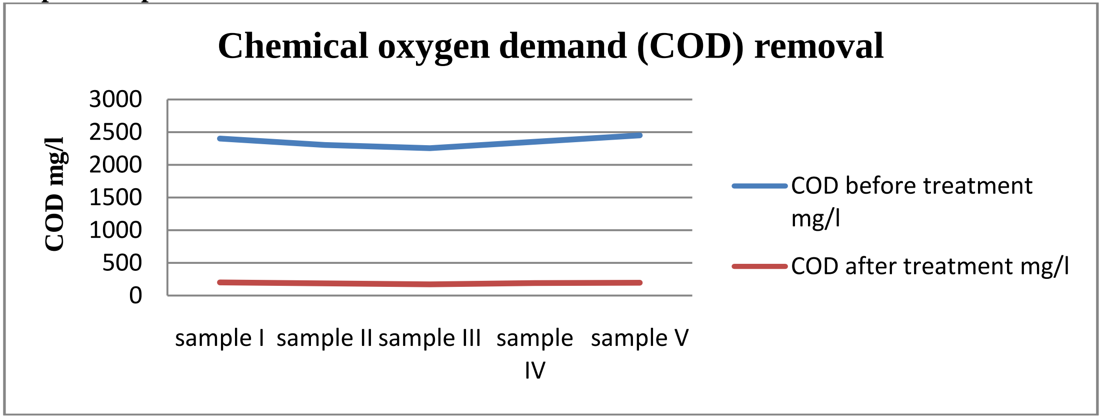

Fig 2: Chemical oxygen demand (COD) removal

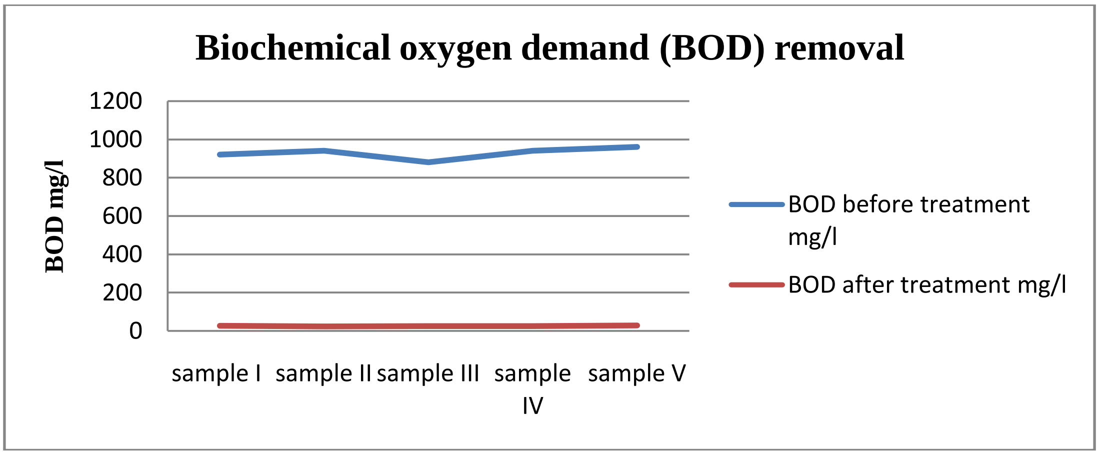

Fig 3: Biochemical oxygen demand (BOD) removal

IV. Conclusions

In this study the treatment starch wastewater after removal of suspended solids by simple gravitational settling. Due to simple gravity settling suspended solids settled at the bottom. Supernatant wastewater BOD and COD reduced up to 45%. This supernatant starch wastewater treated by batch reactor process. A required concentration of microorganisms is maintained in the tank. The active bacteria present in the reactor stabilized the wastewater. BOD and COD reduced up to 80-90%. pH of treated water is 7.5-8. There is no requirement of secondary clarifier.

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