Recycling of Latex Wastewater by Chemical Treatment

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ABSTRACT

Glove factories, wastewater contains a large amount of latex which is not biodegradable. Latex wastewater can be treated through: aeration, chlorination, sulfonation, biological treatment, filtration, coagulation, ozon oxidation and using activated carbon. In this paper a new method for treating latex wastewater has been reported.

Sulfuric acid has been used for separation of latex from wastewater. This method is compared with limits. The other advantages of this method are recovery of latex for other uses, decreasing coagulation and biological method. BOD and COD of the effluent are lower than DOE limits. The other more advantages of this method are recovery of latex for other uses, decreasing energy consumption and recovery of water.

Keywords: Latex, Wastewater, Recovery, Chemical treatment

INTRODUCTION

The latex (natural rubber diluted with water) from the Hevea brasiliensis tree is a colloidal dispersion consisting of nonrubber substances and rubber particles in an aqueous serum phase (Odian,1970). In order to improve latex properties, the molecules must be crosslinked by sulfur vulcanization. Ammonia is added for preventing premature coagulation before latex is brought to the factory. Other latex additives are zinc oxide as activator, talc as filler, and pigments as coloring agent (Bloomfield, 1961).

Glove manufacturing process consists of: washing with acid and water, dipping into the coagulant (calcium nitrate), dipping into the latex, spraying cotton flocks, chlorinating, and packaging.

Effluences of glove production generates large quantities of wastewater containing large amount of chemical substances which are not biodegradable. Today, some methods are used for treating this phenomenon: aeration, chlorination, sulfonation, biological methods, coagulation, ozonation, and treatment with activated carbon (Schatze, 1945). The results of aeration achieved by spraying rubber wastes showed that increasing aeration pressure above 10 psi improved the efficiency (Black, 1946). Chlorination has been used to reduce the phenolic constituents of rubber wastes, and sulfonation can yield an almost odorless waste but can not reduce BOD (Biological Oxygen Demand) significantly (Sechrist and Chamberlian, 1951). Other treatment systems, such as oxidation ditch, rotating biological contactor and activated sludge process, can be used for treating rubber wastes, however high implementation and operational costs decrease their economic viability, particularly in the developing countries (Mills, 1957; Rostenbach, 1952). It was reported that sewage containing latex was purified by coagulation with $CaCl_2$, $MgSO_4$, $Al_2(SO_4)_3$, $FeCl_3$ and $Fe_2(SO_4)_3$ but coagulation method is of little value because of less removal taste and odor (Morzycki et al., 1966; Ruchhoft et al., 1948).

In this paper, a new method for treating latex wastewater has been reported. In the following part, efficiency of this method will be compared with some conventional methods.

MATERIALS AND METHODS

The first method which was used for treating wastewater is the addition of lime and alum for coagulation and sedimentation of latex particles. The diagram of the treating process is shown in Fig.1.

The other method is the addition of sulfuric acid for coagulation of latex and its collecting on the surface of water in API pond. The diagram of the treating process is shown in Fig.2. In our method, the effluences of production unit enters to equalization pond, and sulfuric acid is injected to the mixing tank. By adding acid, latex particles are coagulated and come to the surface of water. Coagulated latex is collected and pretreated water exits the API and is pumped to the rapid mixing tank. About 98 percent of latex particles are removed from wastewater in API unit. For adjusting pH, lime is added to chemical treatment unit (coagulation and flocculation) to coagulate the rest of the latex particles. Then, wastewater flows to slow mixing pond for coagulating of small latex particles. After coagulation, particles are settled in settling basin. In this basin remained latex and lime particles are removed. Effluent wastewater from settling basin flows to sand bed filters for removing remained particles from settling basin. Clean wastewater from sand bed is pumped into storage tank. From here, water is pumped to use for tank washing and this cycle is repeated.

RESULTS AND DISCUSSION

The characteristics of the raw waste and the waste treated with method 1 are shown in Tables 1 and 2 respectively. By adding lime and alum, dispersed latex particles coagulate and settle. pH of the treated waste is more than 10. Acid is added for adjusting pH to 7. In the second method which is used in full scale, acid is added to the waste. As a result of increasing H^+ ion, latex particles are bonded to each other by cross-linking. Latex density decreases because of swelling and comes to the surface of water. The latex which is removed from water surface can be used as a by-product in some production plant. The characteristics of treated waste by method 2 in various parts of treatment plant and comparison of chemicals used in two methods are shown in Table 3 and 4 respectively. As shown in Tables 2 and 3 BOD and COD (Chemical Oxygen Demand) removal percent of treated waste are 94.8 and 96.9 for method 1, and 99.7 and99.4 for method 2 respectively. As shown in Table 4, the amount of chemical used in method 2 is less than method 1. The cost of chemicals used in method 2 is less than method 1 (2.43 US\$/m^3 in method 1 and 2.21 US\$/m^3 in method 2).

CONCLUSION

Acid adding method which has been used for the first time in wastewater treatment system can be used for similar wastes. In comparison with lime and alum adding method which is used in the same plants, acid adding method uses less chemicals, energy and lime sludge. COD removal with the second method is 2.5 percent more than the first method. The other advantages of this method are recovery of more than 98 percent of latex for using in other plants and recycling of water.

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Fig.1 Flow diagram of latex wastewater treatment by addition of lime and alum (a conventional method)

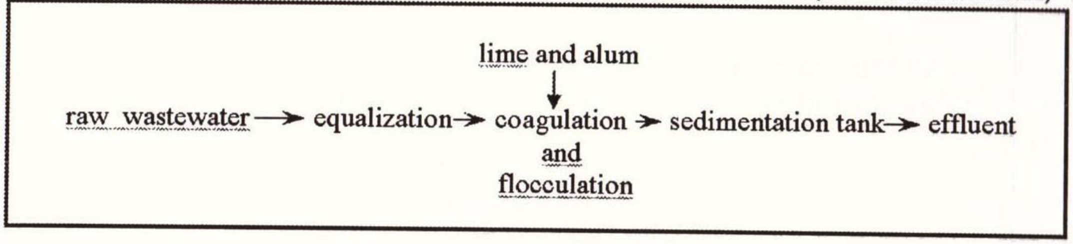

Fig.2 Flow diagram of latex wastewater treatment by addition of sulfuric acid (The proposed method)

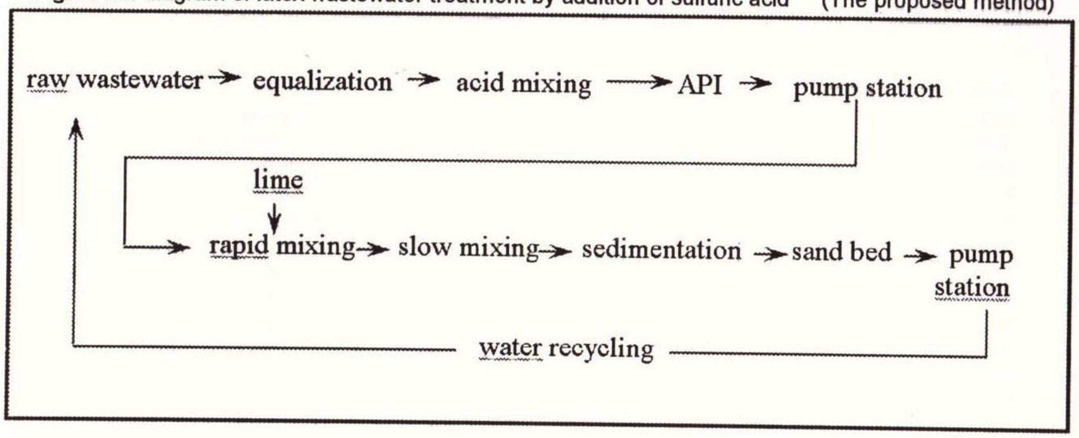

Table 1 The characteristics of the raw waste of the glove factory

pH	S.S (mg/l)	BOD_5 (mg/l)	COD (mg/l)
8.5	1270	2900	16000

Table 2 The characteristics of the wastewater treated with method 1

pH	S.S (mg/l)	BOD_5 (mg/l)	COD (mg/l)
8	50	150	500

Table 3 The characteristics of the wastewater treated with method 2 in various parts of the treatment plant

	pH	**BOD_5 (mg/l)**	**COD (mg/l)**
raw waste	**8.5**	**2900**	**16000**
Effluent from API	**2.5**	**70**	**439**
Effluent from sand bed	**7**	**10**	**100**

Table 4 Comparison of the amount of the chemicals used in two methods

	lime (mg/l)	alum (mg/l)	acid (ml)/ Lit
Method 1	2000	350	2.5
Method 2	1500	-	5