International Journal of Economics, Business and Management Research

Vol. 2, No. 03; 2018

ISSN: 2456-7760

COST-EFFECTIVENESS BETWEEN METHODS OF TREATMENT OF TANNERY WASTEWATER

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Abstract

Treatment and disposal of wastewater in tanneries is expensive and important. Most tanneries in Europe closed down due to high cost of treatment. Tanneries have to treat their wastewater up to the standard specifications. This requires building of an efficient waste treatment plant with high fixed capital in addition to aworking capital. Once the waste treatment factory starts operating, its operating cost continues without any income. When the total cost is allocated to the product, the price per unit increases and one can hardly get the minimum rates of return. This leads to neglection of the waste treatment plant through irregular maintenanceand financial support, and consequently the treated wastewater will not comply with the standard specifications.

On the other hand, application of clean technology through recycling will save chemicals, water and protect the environment; its application is simple, less expensive with less operating cost. In this study a cost-effectiveness comparison between biological treatment, precipitation method, evaporation method for chromium sulphate solution reduction in the discharge effluent and the recycling method will be investigated.

Keywords: Tannery- wastewater, methods of treatments, cost effectiveness.

1. Introduction

Conventional waste-water effluent treatment has imposed very high equipment cost, land and working capital without any return on the investment. This entails cost and tanneries operate in most cases below the break-even point. Due to the daily expenses on the effluent treatment and due to no return on the money spent, tanneries have completely neglected continuous maintenance and support and therefore discharge much polluted effluent with high B.O.D, C.O.D and TSS.

The local authorities have recently proposed an ideato gather all tanneries at one industrial area with one huge effluent treatment plant for all waste-water in tanneries, but this requires an indoor treatment and recycling. Indoor recycling will save chemicals, water and contributes in reduction of the pollution load to the proposed effluent treatment plant in the Industrial area.

Although all beam-house, tanning and retanning waster-waters from soaking through retannage require proper treatment, this study would focus attention and investigation on spent waste-water

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ISSN: 2456-7760

from chrome tannage, the same may be applied to other effluents. A comparison between the methods of treatment will be made quality and cost wise. The method of treatment that shows to be effective, cheap, save chemicals water will be outlined and recommended.

2.Experimental work and cost evaluation

The process of chrome tannage is carried out on pickled sheep skins and the chrome is added initially in the pickling liquor. The process of pickling is performed using the spent chrome for picking followed by chrome tannage in the same float.Highexhaustion reagent which a self-basifying chromium sulphate may be used to give chrome exhaustion of 90%.

2.1Process of tannage

450 kg of delimed sheep skins (about 150 pieces) were picked in a drum with the following reciepe based on delimed weight:

Float 200% at 30°c

8% salt (Nacl)

Run 30 mins

1%H2SO4 (1:10)
0.5% Formic acid (1:10)
Run 2 hrs,leave over-night
Add 4%basic chromium sulphatepowder of 26 % cr_2O_3in two lots with 1hr. interval
Run 4 hours, leave over-night, check penetration, full
PH =2.8
Basify with 0.2% sodium bicarbonate PH=5.5
Run 1 hour check Shrinkage temp. = 100 °c

2. Methodsof wastewater treatment

3.1Biologicaltreatmentmethod

Biological treatment of wastewater is evaluated as a good treatment method for industrial effluents. Treatment of wastes with bacteria involves the stabilization of waste by decomposing them into harmless inorganic solids either by aerobic or anaerobic process. In aerobic process the decomposition rate is more rapid than anaerobic process and it is not accompanied by unpleasant odours, where as in anaerobic process longer detention period is required and gives unpleasant odours.

The processes used most frequently for biological treatment of tannery wastewaterare activated sludge process (ASP) and the up flow anaerobic sludge blanket process .In general, ASP-based treatment is considered to be energy-intensive and expensive from an operation and maintenance point of view. On the other hand, anaerobic process claims to offer several advantages,

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ISSN: 2456-7760

especially under tropical climatic conditions. However a comprehensive comparison of the relative's merits of tannery treatment by these two processes with field data has not been performed. As such, it is imperative that experience and knowledge gained through the operation of full scale treatment plants treating tannery effluents employing both ASP and UASB processes is utilized.

3.2 The precipitation method

The spent chrome solution is precipitated by addition of 10% sodium hydroxide.The spent basic chromiumsulphate is reduced to chromium hydroxide.The solution is filtered;cake is dhydrated and transferred to drying pits in the open area. The clean alkaline solution is discharged to the drain,
but it may be used in liming if it is completely free from chromium hydroxide which has a slight taming effect that may make the hair removal quite difficult.

3.3 Evaporation method

This method is carried out in multiple-effect evaporation. The spent solution is fed to the first effect through the last effect.The water evaporated in each effect is acidic and it can be used for pickling. The exhaust basic chromium sulphate is concentrated to a thick solution that can be used in the subsequent batches, after its adjustment to the required recipe.

3.4. The Direct Recycling Method

This is a simple method in which the spent solution is filtered and collected in storage tank. The solution is analyzed for pH, cr_2o_3, salt and volume. The spent chrome is pumped to an overhead tank and fed to the chrome tanning drum after addition of make-up acid, salt and chrome for pickling and chrome tannage. The same is repented for subsequent batches.
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4. Results and discussion

4.1Results

A cost- effectiveness comparison is made between the four methods of treatment in tanneries as shown in the following tables:
Table4.1: **Comparison of cost evaluation**
Wastewater output = $20m^3$/day

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Method		Fixed cost ($)	Operating cost($)	Total investment($)	Remarks
1	Biological treatment	22.000	8.800	30.800	All treated wastewater went to the drain.
2	precipitation	9.500	3.700	12.700	All treated wastewater went to the drain;the precipitatewas dried causing a solid pollution.
3	Evaporation	23000	9.200	31.200	Distilled water and concentrated chrome were recycled including salt and acids.
4	Recycling	9000	3.600	12.600	Water, chrome, salt and acid were recycled.

Table 4.2: **Saving in chemicals and water**
Wastewater output= $20m^3$/day

Method		Total investment ($)	Saving ($)	Net investment ($)
1	Biological treatment	30.800	Nil	30.800
2	precipitation	12.700	Nil	12.700
3	Evaporation	31.200	1160	30.040
4	Recycling	12.600	1160	11.440

4.2 Discussion

The biological effluent treatment method is costly and in most cases not as effective as the standard specifications required. It has a high B.O.D, C.O.D and total suspended solids (TSS). The operating cost of this method leads to close-down most of tanneries and is not recommended.

Although theevaporation method is very effective and clean, it is expensive and comparatively complicated and therefore it is also not recommended.

The precipitation method used alkali and produces precipitate and alkaline solution with some residual chromium hydroxide. The method is able to discharge a clear alkaline solution which should be acidified to a neutral pH (7) prior to be discharged to the drain. The precipitate cake which has been dehydrated and dried is another polluted chrome, but in solid state. The chrome dried-cake has a very high calorific value and it is used by brick-makers, this application transferschromium iii tochromiumVI, a more dangerous, carcinogenic and toxic material, hence it is not recommended.The comparison between the four methods of treatment illustrates that the recycling method has the least cost followed by the precipitation method. The least cost of the recycling method is due to its simplicity and saving in chemicals and water, on the other hand the low cost of the precipitation method is due to its simplicity, less equipmentand low fixed and operating costs. Other methods of treatment have high fixed and operating costs with no saving in chemicals.

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5. Recommendation

From this study it is recommended that the recycling method is superior over other methods of treatments. The recycling method is simple, less expensive, save chemicals and protect the environment. The method can be adopted towards zero wastewater from the process of soaking through retannage.The researchers can confidently help tanneries to implement the recycling method.

The precipitation method is not recommended due to the fact that it left a solid-chemicals waste that needs to be further treated.

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