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Research Article

ESTIMATION OF HEAVY METALS AND SALTS FROM THE SLUDGE SAMPLES THAT CONTAIN TANNERY EFFLUENTS AND THEIR CONSEQUENCES IN AND AROUND WATER BODIES

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ABSTRACT
Tannery industry effluents and their toxicity is one of the major environmental issues recent years. The aim of the study is to find the impact of tannery waste discharge into a pond namely 'Sai cheruvu' in Warangal district of Andhra Pradesh (now in Telangana state) in India. A detailed study of the process flow sheet of the tannery industry was done and also bottom sediment of pond was tested in order to trace the sources and types of the pollution. Standard methods of analyses were adapted to estimate pH, contents of salts and different heavy metals such as chromium (Cr), cadmium (Cd), copper (Cu), zinc (Zn), lead (Pb) and nickel (Ni). As expected we found that an abnormal content of chromium concentration was noticed and it is not in a permissible limit. Also we discussed the types of toxic effects on water bodies and consequences specifically problems with regard to ecological balance including cytotoxic effects of chromium and other metals including salts on flora and fauna in and around Saicheruvu. Suggestions were made to the authorities to take immediate action in order to eliminate the impact of tannery effluents on an existing pond and surrounding environment.

Keywords: *Tanning, Saicheruvu, Alkaline, Chromium, Hazardous*

INTRODUCTION
Tannery industry was in existence for several decades, but the problem of potential environmental pollution from these tanneries was taken up seriously recently. The industry discharges different types of hazardous wastes into the environment primarily in the form of liquid effluents containing different heavy metals like chromium, nickel, copper, zinc, lead and cadmium and salts such as sulphates, chlorides etc (Belay 2010). Heavy metals are generally classified into two based on the usage. First one is essential and another one is non essential. In another way some heavy metals at low doses are essential micronutrients for flora and fauna but above certain concentrations heavy metals turn into toxins and they may cause metabolic disorders and growth inhibition in most of the species and specifically it may become health hazard to man and animals (Reeves and Baker, 2000; Ozdener *et al.,* 2011).

As we all know that the untreated wastewater from any industry when allowed to stagnate, as is being done in most cases now, gives rise to odor nuisance and causing water bodies pollution once if it discharges. Specifically the site of tanners involved in leather tanning and the unit is surrounded by a number of small scale tanneries. As mentioned above major components of the tannery effluents are the toxic trace metals and other salts and most of these wastes are discharged in to ponds or lakes and end up with sediments and that constitute one of the major sources of pollution. In contrast, estimation of these sludge sediments helps in understanding of industrial pollution and how it impacts that area specifically affecting the ecological functioning of in and around pond due to heavy metal and other salts mobilization.

Due to high price and insufficient effectiveness of the present day techniques to nullify the pollution, urges the need to make alternate arrangements and this may lead to the search for more economical and simple procedures for the removal of heavy metals and salts from water bodies (Giannetti *et al.,* 2004; Mahvi 2008). Instead of all these problems, it is better to filter the wastes before being discharged in to ponds, agricultural fields etc. In addition concerned authorities have to take severe mitigation methods to

solve these problems. Similarly heavy metals were distributed in sludge sediments of the 'Saicheruvu' due to direct discharge of tannery effluents and intensity of chemical usage.

Therefore the present study made an attempt to know the physical and chemical properties of tannery effluents on water bodies from different sludge collections of Saicheruvu. Specifically estimation of different types of heavy metals and salts will give some clues for reduction of pollution in tannery pollutant rich areas. The present investigation is also useful to concerned authorities to prevent water pollution by taking precautionary measures.

MATERIALS AND METHODS

Collection of sample

The majority of effluents discharged into aquatic system eventually end up in sediments that may act as a sink as well as a source of pollution. In contrast sediments were ecologically important components of the aquatic habitat which play a significant role in maintaining the tropic status of any water body.

The sludge sample was collected from the 'Saicheruvu' pond in Warangal district of Andhra Pradesh, India where wastes are disposed from near by tanning industries. The sludge sample was taken with the help of a spade and was collected and transferred in to polythene bag. Portions of this sludge sample were used for different analyses. The samples were collected four times within a span of three months (between May-August 2010). Collection of samples and were processed as per standard protocols for the determination of different parameters.

Sample analyses

Collected soil sample was taken in a Chinese dish and kept in hot air oven at 105 ^{O}C with the help of mortar and pestle and allowed for sieving. It was stored in polythene bags. The sludge sample analysis was carried out to determine pH using standard meter.

Estimation of salts such as sulphates, chlorides and heavy metals was carried out in regular methods. All the above parameters were determined according to the procedure described by American Public Health Association (APHA). Chlorides were measured titrimetrically. The estimation of chromium was done on spectrophotometer (DR4000) by colourometric method and estimation of different heavy metals was done on an atomic absorption spectrophotometer (GBC, Avanta, Australia). Visual observations are done with effluents flow and excel programming techniques using personal computer for different parameters.

RESULTS AND DISCUSSION

FLOW CHART

Soaking
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Liming
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Fleshing & Dehairing
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Deliming
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Bating
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Pickling
↓
Tanning
↓
Neutralizing
↓
Fat liquoring
↓
Dyeing
↓
Finishing

Figure 1: Process of Manufacturing- Full Chrome Sheep Nappa

We started our experiments by collecting sludge sediment samples four times within a span of three months. Before that a detailed survey of tannery process and waste materials flow was thoroughly monitored and we observed most of the steps release hazardous wastes (Figure 1). In the present study an attempt has been made to estimate the different heavy metals and salts of the sludge sediments. In addition we did pH estimation to know the pond water conditions. These parameters will give information to know the pond ecosystem conditions for growth and development of different biota. Different parameters results obtained were documented below.

Acceptable limits for the discharge of waste waters to both surface waters and sewers vary ranging between from pH 5.5 to 10.0. But here in our experiments there is no significant variation of pH values and all the four collections from sludge were ranging between 8.27-8.72 (Figure 2). The pH values are not parallel within normal sludge/soil types. These alkaline values are sensitive to many small animal species, fresh water fishes and plant life and are susceptible to loss except some of microbial organisms such as bacteria (Srinivasan *et al.,* 2009). When biological processes are included as part of the treatment, the pH is lowered to more neutral conditions by surface carbon dioxide which is favourable to most of the flora as well fauna.

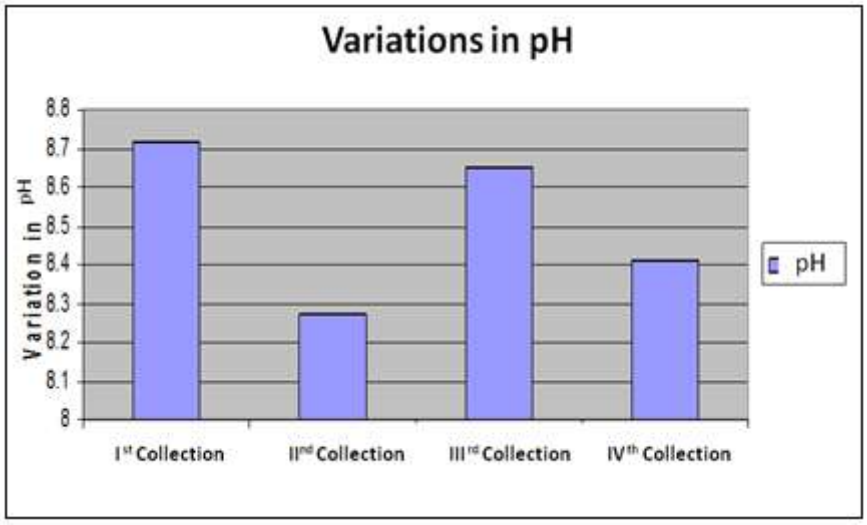

Figure 2: Estimation of pH from the sludge

Industrial wastes are a major source of pollution that originates from chemical industries, mining industries, tannery industries etc. These wastes include a variety of chemicals like heavy metals (Moffat, 1995). Tannery effluents contain some of the different metals which tend to remain insoluble and more inert. Four samples from the sludge were analyzed during the period of study and all heavy metals except chromium were found to be within the permissible limits. In the present investigation, we noticed extremely high levels of chromium concentrations from 5229 to 9886 mg/kg in all the four sludge collections (Figure 3). Similar results were observed with the case of Cr in Ganga river through tannery effluents near Kanpur by Beg and Ali (2008). As we all know that chromium is very toxic to human health, animals, plants and surrounding environment (Amin *et al.,* 2013). Generally release of industrial effluent and sewage sludge on agricultural land has become a common practice in the world as a result of which, these toxic metals can be transferred and concentrated into plant, indirectly and directly to animal tissues from the source which effects the growth and development but they will remediate easily (Galiulin *et al.,* 2001). Moreover rhizo filtration of heavy metals from the tannery sludge by some of the plants also can be alternative to remediation (Khilji and Bareen, 2008). Removal or reduction of chromium practices such as hydroxide sulphide precipitation technique, ion exchange recovery (IERECHROM) has been suggested to the authorities. Also the chromium remediation ability of *Bacillus subtilis*, *Pseudomonas*

aeruginosa and *Saccharomyces cerevisiae* is needed to be practiced to remove excess of chromium (Baldi *et al.*, 1990; Sundar *et al.*, 2010).

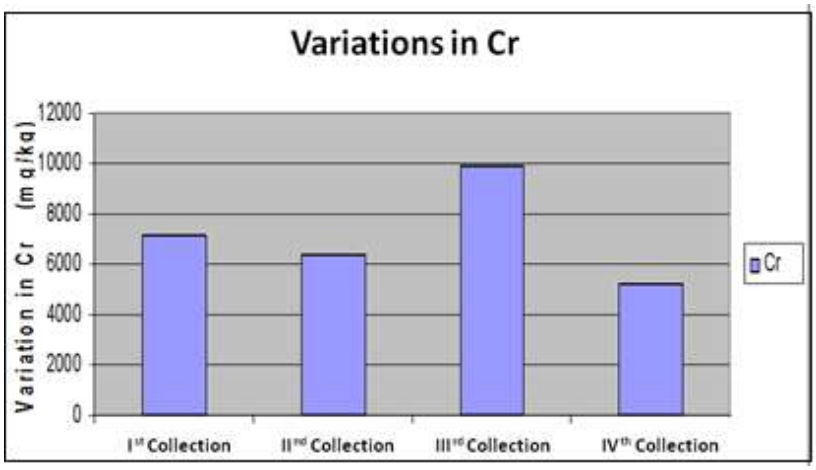

Figure 3: Estimation of Cr from the sludge

In continuous analysis of chemical properties of effluents from four collections, we found the nickel concentration is ranging between 12.1-21.3 mg/kg (Figure 4). Similarly copper ranges between 9.16-21mg/kg. With the case of lead, the range is in between 23-32 mg/kg and this is one of the dangerous heavy metal to human health. Abnormally among all other heavy metals (excluding Cr) zinc is more ranging between 58-86 mg/kg. Cadmium proved very low range availability (below 3.3 mg/kg). This study concludes that different heavy metals showed an irregular pattern in concentrations. The reason for this irregularity may be due to removal of water from ponds for agriculture and domestic purpose, evaporation of the water from pond and new rain water deposition.

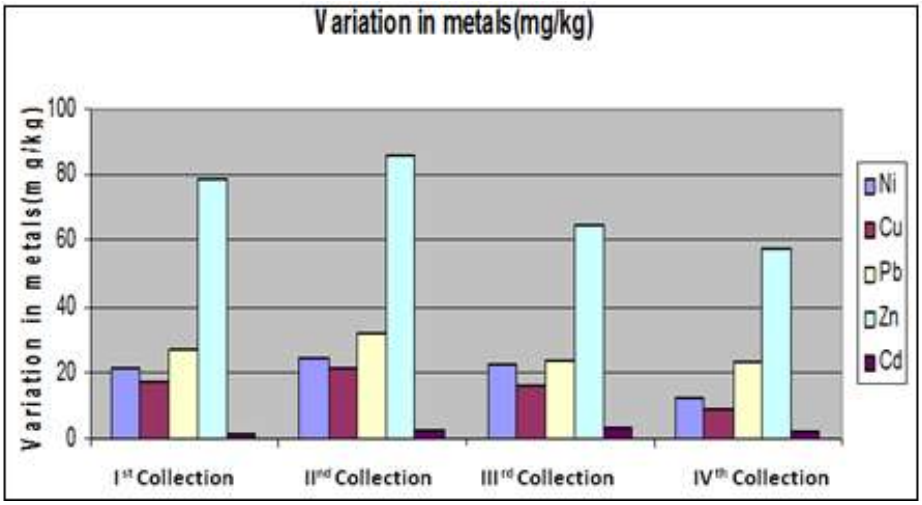

Figure 4: Estimation of different heavy metals from the sludge

Chlorides are more (maximum up to 28706 mg/kg) compared to the sulphates (maximum up to 10460 mg/kg) among four collections (Figure 5). Even though above said heavy metals and salts are not in dangerous levels, but it should be counted (because above normal levels from any pond) for growth and development of any living organism because this pond water is using both agriculture and domestic purpose. Moreover we all know that any specific metal once if it crosses its critical levels for each organism it acts differently both negative and positive ways (Reeves and Baker, 2000).

Hence it is necessary to implement strict sanitation protocols near the tannery units, reduction in the use of water in tannery units and design the new models for effluents transport. Also authorities need to adopt stringent measures to ensure that the discharged effluent is treated properly and these methods are definitely useful for safety of water bodies. This study may be useful to develop new eco-friendly technologies in near future.

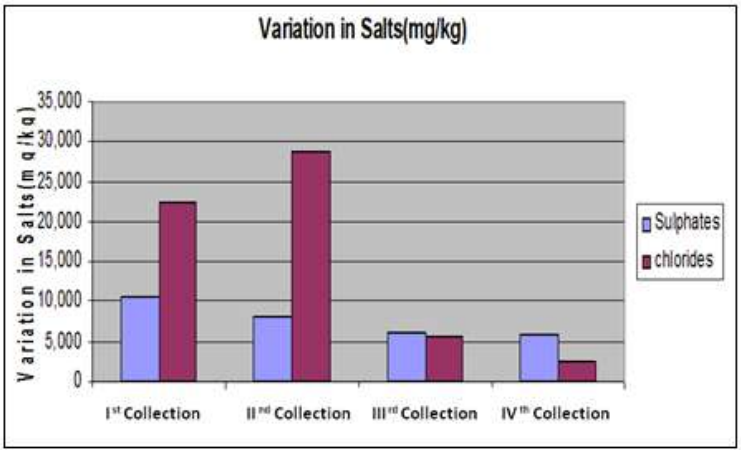

Figure 5: Estimation of sulphates and chlorides from the sludge

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