Soak liquor treatment using *Artemia*

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Salt is commonly used for curing hides and skins because it is an inexpensive preservative, a good dehydrating agent and easily available especially in rural areas. The amount of salt applied in India for preservation of hides and skins is estimated in the range of 3,00,000 to 5,00,000 tons / year. In addition to the salt applied for preservation of raw hides and skins by external agencies about 50,000 tons of sodium chloride is used in the tanneries in pickling operation prior to tanning and discharged as waste in the effluent. It is estimated that about 1,10,000 tons salt is discharged along the waste soak liquor of about 5 million m^3 per year from Indian tanneries. 400 kgs of salt is used for curing I ton of raw hides and skins depending on the type of raw material. Out of this about 42.5% is the average quantity of salt washed during soaking operations. 20% of salt is dusted by manual desalting and the rest of the salt is otherwise removed. However, about of 9% salt is carried over by hides for further operation.

Various methods have been tried to reduce pollution in the soak. The amount of water used for soaking cannot be reduced. 'The dirt wash is heavily contaminated with blood, dirt, fat and salt etc., but more importantly with bacteria.

With regard to the dusted salt it is made into brine of 150 ppt. The brine is screened to remove hairs and non-dissolvable 'matters and chemically treated with poly aluminium chloride (300 ppm) and polyelectrolyte (10 ppm). It is allowed to settle for 5 hours. 80% of the suspended solids are settled and the clarified brine is used for pickling.

Typically salted raw stock yields 25% collagen (leather) 10% hide residues, 8% hair, 40% water and 17% effluent constituents e.g. hydrolyzed proteins, salt, fat etc., Soak liquor contains large amount of sodium chloride soluble globular proteins like albumin. globulin suspended matters dung and dirt etc., The effluent contains a large quantity of suspended matter which increases turbidity of the effluent. Dissolved organic matter such as dissolved collagen and degraded protein consume a large amount of dissolved oxygen during their microbial metabolism. Absence of dissolved oxygen in the effluent causes anaerobic putrefactive fermentation especially in presence of protein leading to foul odour. Of the total effluents it is estimated that the organic pollutants comprise about 40% waste soak liquor contributes 40% of TDS. The average TDS discharged from soaking operations is about 160 kgs per ton of raw hides / skins.

The soak liquor discharged outside has increased the salinity of ground water. Further "salt stains" are usually caused as a result of imperfect addition of salt rather than the presence of salt. It is observed that salt produced from eutrophic saline inlet channels of salt field is not fit for preservations of raw hides.

Since soak liquor contains wastes which are animal in origin such as from hides skin and plant in origin such as algeal blooms, algeal impurity in salt, both such biological impurities are filtered by Artemia. Brine shrimp Artemia often a life line the salt is the major faunal element of hypersaline ecosystems.

Artemia tolerates high salinity at high temperature as it is generally considered as a summer species. Hence, Artemia has been chosen for biological treatment of soak liquor.

The objectives of soaking the hides and skins are 1) Rehydration of the hide 2) Removing of curing salt 3) Dissolution of blood and dirt 4) Removal of unstructured proteins and proteoglycans 5) attack on the epidermal structures and 6) slackening of the subcutis.

The method of soak liquor treatment is designed with filter, grit chamber, soak liquor collection tank, condensers I and II Artemia bio-pond, effluent flow cemented channels secondary collection tank and crystalliser yard.

The methodology deals with removal of hairs by filter dirt dung and soil by grit chamber and effluent is collected in the collection tank below the ground level. It is then pumped into the condensers 1 and 11 for building brine concentration up to 100 ppt. The brine flows into the Artemia biopond from one end and the effluent is collected the other end of the pond, which is provided with appropriate filters to retain nauplii and cysts. The biologically treated soak liquor is allowed to flow in cemented floor channel and collected in the secondary collection

tank for further increasing the concentration of brine, which is then sprayed over the cemented crystalliser yard. The removal of suspended solids by Artemia increases the evaporation of soak liquor, which facilitated for salt crystallisation.

The novelty in the present study is the recovery of organic nutrients waste by Artemia as value added biomass energy. The nutrients in the form of dissolved and suspended forms are recovered from soak liquor. The use of brine shrimp as filter feeder, which can filter solids which are less than 50 micro in size as a secondary stage in the system. When under correct soak liquor effluent management the brine shrimp filters the organic waste particles and utilises the energy source for its growth and multiplication.

The excess biomass is harvested along with the cysts. Cyst production rate in the soak liquor is very much higher than under natural Indian saline ecosystem. Artemia biomass is used-as a live feed which is a recycled protein of animal origin to give requisite amino, acid spectrum and additionally will reduce the requirement for the input of protein from a "new" source. Being a continuous filter feeder, Artemia ingests all organic particles and thus act as vacuum cleaners converting any particulate matter into Artemia biomass, cysts or faecal pellets which do not interfere with the salt production. The brine shrimp excrete their waste in membrane bound faecal pellets which sinks to the bottom and forms a good organic substrate for halobacterium. Recovery of salt as by-product from the soak liquor is not a slow physical process because there is an active contribution from the biological components that exists with the soak liquor treatment process.

By using this ecofriendly method soak liquor is treated . The advantages in the methodology are the recovery of Artemia biomass, cysts and salt as the major by-product besides solar evaporation of effluent. The result of this investigation indicates that Artemia is able to convert the dissolved nutrients, which are animal origin predominantly present in the effluent into anostracan biomass.

When compared to the chemical composition of raw and treated soak liquor using by the present biological method of treatment, it indicates that TDS has reduced to 17%, COD to 30%, BOD to 42% and the length of Artemia has grown to 12 mm in size on an average and the fecundity is low being 22-45 when compared to the natural population. In earlier study a similar reduction was reported in BOD (34%), total solids (69%) using Artemia in treatment of distillery effluent.

The paper suggests a methodology for treatment of soak liquor in the tannery and the recovery of value added bio and by-products thus achieving zero pollution as far as soak liquor is concerned.