Eco-friendly Deliming in Leather Manufacture Industry

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Abstract:-

Deliming means to remove the lime by reacting with acids or acid salts.The alkali lime and other alkalis may be removed by inorganic or organic acids or acid salts also.The reaction between alkali and strong inorgainc acids, heat is generated which may be melt the protein inside skins.So, organic acids are preferable but organic acids are costly and take more time to remove the alkali from the skins.Here the organic acids are used which are obtained by the fermentation of wheat bran which is the by-products of rice or flouring industry.; less costly than the direct organic acids.

Introdution:- Leather Industry is the most polluted Industry in India, it produces a lot of solid waste , as well as creates water and air pollution also. So, it is a great challengable job to reduce the pollution. There are different process for the production of leather .Deliming is one of them just after the liming process .Without deliming of Limed skins can not be produced the leather ,so generally lime should be removed by reacting skins with acids or acid-salt also, it produces salt and water which causes water pollution and they some soluble effect on hide proteins. If you remove these alkalies (Lime and sodium hydrooxide) by using organic acids or organic acid salt (Eco-friend Processes)not only reduces the pollution load but also increasing tannins materials uptake (specially chrome) by the masking effect. Beam house Operation , especially liming -deliming processes contributes 60-70% total pollution load in the leather processing (Pandy et.al.2016)

What is Liming

The soaked hides & skins are treated with alkalies for obtaining the following effects for satisfactory tannage. The Lime is the cheapest alkali and easily available , that is why here lime is used for alkali treatment of skins.

1. Remove Keratinous matters.
2. Remove interfibrillary soluble proteins
3. Swell up and spit up the protein fibres
4. Remove the grease matters. Etc.

Deliming;

After liming the excessive lime should be remove from the skins, otherwise skins can not coverted into good quality leather.

$Ca(OH)_2 + H_2SO_4 = CaSO_4. + 2H_2O.$

$Ca(OH)_2 + 2NH_4cl = Cacl_2 + 2NH_3 + 2H_2o.$

$Ca(OH)_2 + (NH_4)_2SO_4. = CaSO_4 + 2NH_3 + H_2O$

There are two types of alkali present in the limed skins

(a)free alkali (b) combined alkali . The free alkali can be removed by repeated washing with plain water but the combined alkalies can done like this ways,it should required chemical treatment like above.

In common pactice ammonium salphate or ammonium chlorie or boric acid are used to remove the combined alkalies

$2H_3BO_3 + 3Ca(OH)_2 = Ca_3(BO_3)_2 + 6H_2O.$

Boric acid Calcium borate.

This Calcium borate is converated into Boric acid by reacting with Sulphuric acid.It is also reused.

$Ca_3(BO_3)_2 + 3H_2SO_4 = 3CaSO_4 + 2H_3BO_3.$

Organic Acid or Organic Acid Salt Used in Deliming Purpose : The Organic acids like lactic,acetic,formic etc. Can be used for deliming purpose in more than two instalments . These organic acids can be derived through the fermentation of starch and other carbohydrates associated with bran of wheat. Known as drenching .(Dutta, S.S).During this fermentation not only produced the different organic acid but also generated some gases like carbon dioxide , hydrogen, oxygen,nitrogen etc. These gases are produced by the respiration and other metabolic changes of fermentative bacteria present in solution.

Fermentation:-The wheat bran is soaked in warm water at about 45^0 C to 50^0 C for better result.for 2-3 days. Then the whole mass is cooled at room temperature at 35^0 C for better bacterial action and small quantity of old liquor is added which contained the fermentative bacteria for the production of organic acids. The whole mass is alloed for better fermentation for 2-4 days . After this the fermented solution is settled down . The top solution is seperated and diluted to such an extent that there may be 4 partsof bran per 1000 parts of water.The limed skins are delimed in this solution for several hours ,the thicker skins are required more than 3-4 times ,simultaneously the gases generated during the perspiration of bacteria ,split up the fibres also.

Chemistry of Bacteriology of Fermentation.

The fermentation takes two phases (i) Enzymetical (ii) Bacteriological

Enzymetical:

During soaking of wheat bran ,the enzyme ‘’Cerealin” present in the bran reacts with starch and converts it into the glucose and dextrine.

$(C_6H_{10}O_5)_n + nH_2O. = nC_6H_{12}O_6.$

Starch Glucose and Dextrine.

Bacteriological:

The fermentative bacteria alpha & beeta furfuris supplied from the old fermentative solution react with glucose and converted it into different organic acids

i) $C_6H_{12}O_6$ ---------- $2CH_3\text{-}CH(OH)COOH$

Lactic Acid.

ii) $2CH_3CH(OH)COOH$ ---------- $CH_3\text{-}CH_2\text{-}CH_2\text{-}COOH + H_2 + CO_2$

Butyric acid

iii) $C_6H_{12}O_6$ ---------- $3CH_2\text{-}COOH.$

Acetic acid

.Table-1.

Acids	Gms.per litre of liquor	%of acid to total acid
Lactic Acid	0.79 gms.	73.5%
Acetic Acid	0.24 gms.	22.5%
Formic Acid	0.30 gms.	2.8%
Butyric Acid	0.01 gms.	1.2%
Total	1.07 gms.	100.0%.

The percentage of different acids present in the liquor are given above

The approximate percentage of Gases evolved induring the fermentation given below .

A cost -effective valuble process for lactic acid production has to be developed for which several attemps have been initiated. (John et.al. 2007).

Gases	Percentages
Carnon dioxide	25.2%
Hydrogen	46.5%
Nitrogen	26.2%
Oxygen	2.10%
Total	100.0%

S.S.Dutta in An Introduction to the Principle of Leather Manufacture

Control of Butyric acid fermentation:

The temperature of liquor should be controlled below 95 ^{0}C or 35 ^{0}C, otherwise an abnormal fermentation sets in.

Table 2: Effects of fermentation on the antinutritional factors (tannins and phytic acid)

Wheat bran	Tannin (mg catechin/ 100 gm material)	Phytic acid (mg/100 g)
Non-fermented		
Coarse	0.03^{d}	626.12^{c}
Medium	0.06^{b}	740.36^{b}
Fine	0.07^{a}	795.20^{a}
Fermented		
Coarse	0.01^{e}	572.79^{d}
Medium	0.05^{c}	367.13^{e}
Fine	0.06^{b}	301.63^{f}

*Any mean values in the same column having different superscript letters differ significantly ($P \leq 0.05$).

Carbon Dioxide Deliming:

The carbon dioxide gas is sparingly soluble in water , produced weak acid that can neutralise the alkalinity of limed pelts.

$CO_2 + H_2O = HCO_3^{--} + H^+$

Technically , the application of carbon dioxide is simple ,the gas is stored under pressure in the vessel with small heater and is led by pipe through the axle of the drum.

Conclusion:- The Eco friend is developed by using different by-products of agro-industry but it is required more time consumption for fermentation of organic acids ond enzymes also.The working place also will be drity ,more space is required (Covington and William ,2017).

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