# Studies on the Characterization of the Reject Stream Salt Residue and Possible Reuse in Leather Processing

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## Abstract

Salt laden evaporated residue is being heaped up in the leather industry. The evaporated residue contains high concentrations of organic and inorganic impurities along with sodium chloride. In this study an attempt has been made to characterize the residual salt and reuse the salt during pickling operation in leather processing. The leathers processed using evaporated residue salt showed properties on par with the conventionally pickled skins.

## 1. Introduction

Several initiatives have been taken up by the Indian tanneries to overcome the problems associated with pollution. Tanners have set up either individual treatment plants or they are connected to a Common Effluent Treatment Plant to treat the wastewater emanating from the tanneries. Membrane separation has been advocated for the treatment and recycling of wastewater. In order to comply with the requirement of zero wastewater discharge, reverse osmosis process has also been made mandatory in several tanneries in Tamil Nadu. However, in both the treatment methods, the reject stream poses a major consideration as the recovery of water by this process is limited only up to 70%, and the remainder 30% of feed stream is discharged as reject stream. The general strategy is to evaporate the reject stream in either solar evaporation pan or in multiple effect evaporators to reduce the volume, leaving behind an evaporated residue. The disposal of this evaporated residue onto secured landfill sites is banned due to the possibility of leaching of constituent ions and the treatability of leachate becomes more difficult because of its high salinity. Hence, the leather industry is left out with salt laden evaporated residue, which has attracted many researchers all around the world to work on the management of the evaporated residue. Till date not much work has been reported on the characterization and utilization of these residues. Hence, in this study an attempt has been made to characterize the residual salt and find a feasible reuse options for the same.

## 2. Materials and methods

Wet salted goat skins have been used for the pickling and tanning trials. All the chemicals used for leather processing were of commercial grade and chemicals used for analysis of salt were of analytical grade.

### 2.1. Characterization of salt obtained from evaporated residue.

The commercial salt and the salt obtained from the evaporated residue were characterized for calcium, magnesium, chlorides and sulphates as per standard procedure. The salts were also observed under the optical microscope.

### 2.2. Utilization of evaporated residue in Leather processing

The evaporated salt and the commercial salts were used during the pickling of goat skins. The left halves of the skins were pickled with the commercial salt and the right halves of the skins were pickled with evaporated salt residue. The pickled goat skins were then chrome tanned and converted in to a crust.

### 2.3. Physical Testing and Hand Evaluation of Leathers

The leathers were subjected to physical testing and hand evaluation in order to observe the effect of residual salt on the final characteristics of the leather. Samples for strength analysis were cut as per IUP method and were conditioned at 80±4$^{o}$F and 65±2% relative humidity (R.H.) over a period of 48 hrs. Physical properties such as tensile strength, % elongation at break, tear strength and distension at break were examined as per the standard procedures. Experimental and control crust leathers were assessed for softness, fullness, grain smoothness, grain tightness, fluffiness and general appearance by hand and visual examination. Experienced tanners rated the leathers on a scale of 0-10 points for each functional property, where higher points indicate better property.

## 3. Results and Discussion

### 3.1 Characterization of salt obtained from evaporated residue.

The salt from the evaporated residue dissolved completely without any residue to give a 10% solution. Also, salt from evaporated residue was characterized chemically and it is observed that the residue salt contained 4% Calcium, 0.4% Magnesium, 86.14% Chlorides and 4.95% sulphates and some quantity of organic nitrogen.

Figure 1 provides the optical microscopic picture of the evaporated salt residue. From the figure, it could be observed that the salt had a clear crystal structure and the size of the salts varied from 0.2±0.1 mm. Based on these results, the salt was used during picking goat skins.

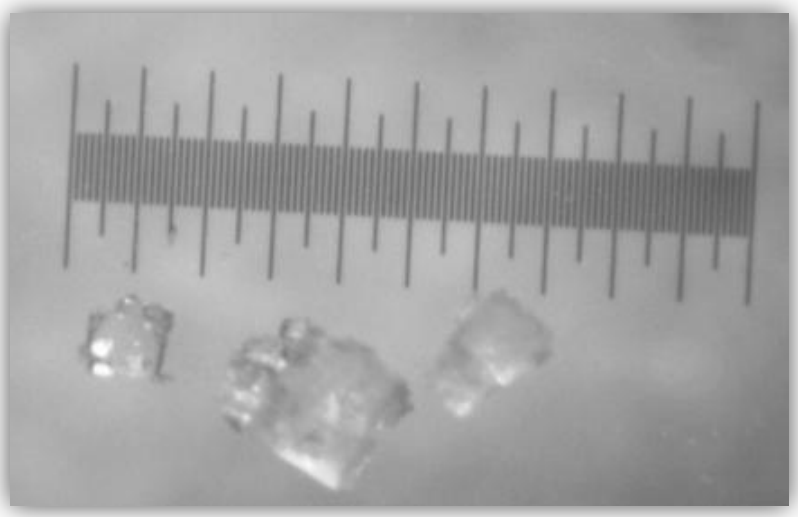

**Figure 1: Image of the residual salt under optical microscope (1 division = 0.01 mm)**

### 3.2. Utilization of evaporated residue in Leather processing

Five goat skins have been used for experiments. Left halves of the goat skins have been pickled conventionally using commercially available salt where as right halves have been pickled using salt of evaporated residue and marked as control and experimental leathers, respectively. The leathers after pickling have been converted in to crust leathers.

### 3.3. Physical Testing and Hand Evaluation of Leathers

The physical properties and the organoleptic properties of the crust leathers are presented in Table 2 and 3, respectively. From the Table, it could be observed that characteristics of both the leathers are comparable. This shows that the salt from evaporated residue, did not affect the strength properties of the leathers.

**Table 2**
**Physical Characteristics for Leathers**

| Physical properties | Leathers pickled using | |
|---|---|---|
| | Commercial salt | Evaporated salt residue |
| Tensile strength (Kg/cm$^2$) | 263±7 | 257±7 |
| Elongation at break (%) | 67+3 | 72+2 |
| Tear strength (N/mm) | 39±7 | 42±5 |
| Distention at break | 9±0.5 | 10±0.5 |

**Table 3**
**Organoleptic Properties of the Leather**

| Bulk properties | Leathers pickled using | |
|---|---|---|
| | Commercial salt | Evaporated salt residue |
| Fullness | 8 | 8 |
| Grain tightness | 8 | 8 |
| Softness | 7 | 7 |
| Roundness | 8 | 7 |
| Strength | 8 | 8 |

## 4. Conclusion

The Evaporated salt residue was characterized and was used for pickling of goat skins. The physical properties of leathers processed using the evaporated salt residue was on par with that of the conventionally processed leathers.

## 5. Acknowledgements

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