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# Raw hide desalting process optimisation.

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Abstract: The presented paper deals with desalting of raw hides, meaning soaking operations viewed from the position of tanner. The process of raw hide desalting is associated with dissolving kinetics of a solid salt adhering to the surface and inside hairy spaces of hide on the one hand, and on transport of sodium chloride ions from the inner volume of hide mass. There are thus two desalting process mechanisms--kinetic, related to dissolving solid surface salt, and diffusion, related to transport mechanisms, i.e. to internal diffusion.

Key words: Optimisation, ecology, economic system, waste treatment, environmental engineering.

## 1. INTRODUCTION

Raw hide, being an expensive starting material for manufacturing natural leathers, arrives in tanneries in a preserved state. In most cases, sodium chloride is used as preservation medium. In a whole number of operations through which raw hide is transformed into leather, raw hide desalting is a very important operation in view of final quality. The procedure incorrectly executed may cause considerable damage to edge parts of raw hide, effecting considerable economic losses in final area yield of leather substance (e.g. Kirk-Othmer, 1992). Another important factor playing a great role is environmental protection. The tanning industry consumes considerable amounts of power, chemicals and technological water, thus producing a great quantity of waste liquids. From this viewpoint, a specific optimum of processing procedures should also be sought.

This contribution mainly deals with the kinetic mechanism taking place in the first stage of desalting process, i.e. through dissolving of solid salt (Dean, 1992) and the optimization of the process from the operational point of view.

## 2. DESCRIPTION OF KINETIC MECHANISM

Desalting is performed in rotating cylindrical reactor--tanning drum in which salted hides and water are loaded (Hankey, R.A, et al., 2003; Venkatachalam, et al., 1982). Drum rotation is produced by means of electric motor.

Main general operating costs N are given by sum of costs of power [N.sub.E] for rotation by electric motor and of consumed technological water [N.sub.W] (desalting solution).

N = [N.sub.E] + [N.sub.W] = P [K.sub.E] [tau] + V [K.sub.v] (1)

The complete list of symbols is described at the end of the article. Time o in equation (1) naturally depends on the volume of technological water. In order to derive this dependency, it is assumed that rate of surface salt dissolution is proportionate to difference between concentration of saturated solution and immediate concentration of salt in technological water. The relation can be expressed by a differential equation:

da/d[tau] = k([a.sub.n] - a) (2)

The desalting degree x is defined as

x = [am.sub.v]/[a.sub.p][m.sub.s] = a[[rho].sub.a]V/[.sub.p][[rho].sub.s][V.sub.s] [approximately equal to] a/[a.sub.p] x [N.sub.a] (3)

where [N.sub.a] = V/[V.sub.s] (soaking number).

The function a([tau]) in (2) can be derive from (3) by:

a = [sup.xa]p/[N.sub.a] (4)

After some substitution and derivation a similar equation is obtained in the form:

dx/d[tau] = k (K - x), where K = [a.sub.n][N.sub.a]/[a.sub.p] (5)

Integration of (5) gives

[tau] = 1/kln(1 - x/K) (6)

and after the substitution for [tau] from equation (6) into (1) the final relation for operating costs is given by:

N = [K.sub.v]V-1/k ln (1 - x/K) (7)

This function is the proper cost function for an optimizing process which results in optimal industrial operating conditions.

3. EXPERIMENTAL RESULTS

The rate constant k can be easily determined from equation (2) which integration gives:

ln([a.sub.n]/[a.sub.n] - a) = k[tau] (8)

Plotting natural logarithm [a.sub.n] [([a.sub.n]-a).sup.-1] as a function of time, it is obtained a straight line whose gradient gives the value of rate constant k of dissolving salt. During dissolving of salt, dissociation into [Na.sup.+] cations and [Cl.sup.-] anions takes place, making possible the conduction of current. Seven samples of various concentrations of salt (NaCl) were prepared and their conductivities measured. The dissolving rate constant was found by measuring changes in conductivity and, thereby, also changes in concentration of salt in solution dependently on time. To stirred distilled water of 120ml volume tempered at 20[degrees]C was suddenly added approximately 4.4g salt. Conductivity measurements were read at 5s intervals.

3. SIMULATION CALCULATIONS

In practical desalting of raw hides three cases may occur. The first is very similar to dissolving pure salt. This situation seldom appears because salt is considerably polluted with low-molecular ingredients such as soluble amino acids, fats, dirty particles and the like (Eaton, et al., 1995). It is shown in Fig. 5 for dissolving rate constant equalling 160 [h.sup.-1]. The second case involves weakly polluted salt particles with a dissolving rate constant of 16 [h.sup.-1] (Fig. 6), and finally the third case involves strongly polluted salt particles, where the dissolving rate constant has a value of 1,6 [h.sup.-1] (Fig. 7). The majority of real situations in desalting of raw hides occur between cases 2 and 3 (dirty soakings). Common starting parameters applied in all cases were as follows:

Economic parameters:

[K.sub.E] = 0,12 EUR kW[h.sup.-1]

[K.sub.v] = 1,3 EUR [m.sup.-3]

Technological parameters:

x = 0,999

$[V_s]$ = 10 $[m^3]$

$[a_n]/[a_p]$ = 1

P = 20 kW

The final procedure of the desalting operation process consists of following steps. The flow chart of this procedure is depicted in Fig. 1:

[FIGURE 1 OMITTED]

[FIGURE 2 OMITTED]

[FIGURE 3 OMITTED]

[FIGURE 4 OMITTED]

## 4. CONCLUSIONS

The developed results demonstrate that the specific optimum volume of technological water (desalting solution) and the total costs for desalting process can be found. Further authors recommendations suggest to continue in this way and to establish optimal process for diffusion desalting. It may optimize operating costs as well as avoid economic losses for incorrectly performed procedure and reduce quantity of waste liquids.

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## 5. REFERENCES

Dean, A. J. (1992). Lange's Handbook of Chemistry. 14th edition. McGraw-Hill, INC, New York.

Eaton, A.D., L.S. Clesceri and A.E. Greenberg (1995). Standard methods of the examination of water and wastewater. In: 19th Edn. APHA, Washington D.C.

Hankey, R.A. et al. (2001). The Use and Subsequent Treatment of Surfactants for Leather Processing. The Journal of the American Leather Chemists Association, Vol. 96, No. 6., pp. 368-375.

Kirk-Othmer. (1992). Encyclopaedia of Chemical Technology. 4th edition. Vol. 6. pp. 269. Willwy, New York.

Venkatachalam, P., S. Sadulla and B. Duraiswamy (1982). Further experiments in salt-less curing. Leather science, . Vol. 29, pp. 217-221.

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