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Effect of Thermocycling on the Properties of Goat Skin Leather

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Keywords: collagen, thermocycling, property

Abstract. The pickled goat skins were crosslinked by chromium, aluminum, wattle extract and chestnut extract, respectively. The samples were thermal treated in a container held at different temperature for 5 h for different cycles. The xerothermic stability, water vapor permeability and dimensional stability of the samples were characterized before and after thermal treatment. The effect of thermocycling on the properties of tanned samples was discussed. It was found that the thermocycling at moderate temperature (50 ºC) exerted little influence on the xerothermic shrinkage temperature (T_{xs}) of the tanned collagen fibers. The treatment at higher upper limit temperature (100 ºC and 150 °C) decreases the T_{xs} and results in an impaired thermal stability. The water vapor transmission rate was decreased after the thermal treatment, likely due to the reduction of the amount of hydrophilic groups of collagen macromolecules as well as the decrease of the pore ratio of leather. Treatment at high temperature damaged the dimensional stability of the specimens.

Introduction

Collagen constitutes the most abundant proteins found in mammals. Collagen contains greater or lesser stretches of triple helix [1]. Leather is biomaterial made of collagen fibrous protein, which has been industrially modified and transformed in order to avoid its putrefaction. In principle, the tanning efficiency of a tanning agent is critically dependent on its ability to form interfibril cross-links with great strength and extensiveness. These cross-links are formed from the collective multiple site interactions between the tanning agents and the collagen protein. It is known that it is very important to evaluate the impact of environment factor on the structure and properties of collagen materials. Factors that influence the temperature of denaturation (shrinkage) include the content of amino acid of collagen and their hydroxylation and position in the chain, the content of water in the material, the pH, the nature of heating medium, the ionic environment, salt type and salt concentration, crosslinking and various types of ageing, etc.

As is well known, collagen is highly hydrophilic and the content of water in collagen strongly influences the shrinkage temperature (T_s). A hydrothermal stability is usually characterized by shrinkage of collagen sample when heated in water at a defined temperature. However, many of the industrial application of collagen-based materials involve dried collagen or dehydrothermally treated collagen. For instance, in shoe-making processes, the leather usually endures the dehydrothermal treatment at 120~130ºC. In some operation, the leather is treated at high temperature as 170ºC. In dehydrothermal state the structural properties of collagen and its supermolecular architecture are of great importance [2-4]. Dehydrothermal treatment has been used to examine the changes in the strength and solubility of collagen-based products for the biopharmaceutical industry, and also as a means of developing regimens for accelerated ageing [2]. However, the influence of heating in the dehydrated state has been studied to a little extent. Leather products are sometimes used in environment with periodically varying temperature. The alternating temperature exerts greater influence on the structure and properties of collagen other than the constant one. However, little research work has been done to understand the influence of thermocycling on the performance of leather product. In the present work, two metal complexes and two vegetable extracts were applied as tanning agents to endow the collagen with extra crosslinking. The samples were thermal treated at