EPICHLOROHYDRIN TREATMENT OF FEATHERS

Varesneg Z. Pasternak, Cincinnati, Ohio, assignor to the United States of America as represented by the Secretary of the Army

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This invention relates to a method of treating land fowl feathers, especially chicken feathers, to increase their "filling power" and resiliency, and to impart permanent curliness and water repellency, thereby making such feathers an acceptable substitute for the standard down and feather mixture now in wide use for sleeping bags, comforters etc. A further object is to minimize, a single chemical which will make the feathers resistant to moths and which will result in a product that is more stable than most aldehyde-treated feathers. Another object is to make the feathers resistant to microbial attack. Other objects will be apparent from the following description of the method presently preferred by me.

In explanation of the expression "filling power," reference may be made to the report entitled "A Proposed Method for Measuring the Filling Power of Down and Feathers" by Henry A. Sinski, publication No. TD103037, The Office of Technical Services, Department of Commerce, and to the article by N. B. Edelman in Textile Research Journal, vol. 17, p. 199 (April 1947), entitled "Investigation of Methods for Determining the Filling Power of Feathers." See also the Sinski et al. Patent No. 2,706,910 dated April 26, 1955. Ordinarily, chicken feathers have a filling power of 1.8 to 2.1 cm., while the 40–60 down-feather mixture has a filling power of 5.3 to 5.9 cm.

The term "feathers" as used herein includes whole land fowl feathers of the desired size, crushed (commercial "curled") land fowl feathers, land fowl feather fibers, stripped land fowl feathers, and mixtures of these.

Provided the preferred procedure, the feathers, if not known to be entirely free from blood, are first soaked for about ten minutes at about 110°–125° F. in a solution of Coagusol® (a mixture of sodium hexametaphosphate and alcohol sulfate), a commercial blood solubilizer. After the soaking, the solution is drained from the feathers and the feathers are then laundered or dry cleaned. In laundering, preferably a detergent such as "Tergitol NPX" (alkyl phenyl ether of polyethylene glycol) is used (0.25% water solution at 110°–125° F.). Other non-ionic detergents have been found to be satisfactory. In general, the non-ionic type of detergents should be used to obviate any action on the protein of the feathers. Laundering continues for about twenty minutes, then the solution is removed from the feathers by centrifuging or wringing. While a number of well known dry cleaning solutions could be used to clean the feathers, laundering is preferred because it is less expensive. Both laundering and dry cleaning may take place in the same vessel or container that is used during the blood-solubilizing step. Of course if the feathers as initially received are perfectly clean, the soaking and washing or dry cleaning may be omitted.

If the feathers are from immature chickens, the damp feathers from the described laundering or dry cleaning operation are placed in a 1% water solution of trisodium phosphate Na₃PO₄.12H₂O at 110°–120° F. for about ten minutes. If feathers from mature chickens are being processed, the phosphate treatment period is increased to about thirty minutes. This mild alkaline treatment of the feathers is believed to alter the structure of the feathers by modification of the cystine linkages in the keratin. This step is important because it materially increases the curliness of the feathers and it curls naturally uncurlable mature feathers, thereby to increase the bulk value of the final feather product. Other suitably buffered alkaline solutions, for example, soda carbonate or bicarbonate solution used in lieu of the trisodium phosphate, but in all cases the time of the treatment must be less for immature chickens to avoid excessive degradation. Trisodium phosphate is preferred because of its quicker action due to a higher pH. It is believed that the higher concentration of cystine linkages in mature feathers enables them to resist the action of the alkaline solution for a longer period.

The data from a successful run at The Tanners' Council Laboratory, University of Cincinnati will now be given.

A 70 gram batch of poor quality chicken feathers was soaked in 1500 ml of the phosphate solution previously described. The well rinsed feathers were placed in 1500 ml of 2.5% aqueous solution of an epichlorohydrin (1-chloro-2,3-epoxypropane) which was obtained from the Matheson Company & Bell Division of The Matheson Company, Inc., E. Rutherford, N.J. The batch was kept for thirty minutes in this solution at pH 6.4 and 45° C. Then the pH was raised to 9.2 with dilute Na₂CO₃ solution. After twenty-five minutes the pH was 8.8. After forty-five minutes the pH was 8.4. At the end of sixty-five minutes the pH was 7.9 and after two hours it was down to 7.4. This lowering of the pH was probably due to the formation of HCl from the epichlorohydrin. The total time of treatment was 150 minutes. The solution was neutralized with dilute acetic acid; then the feathers were rinsed and dried in a tumble drier. The filling power of the treated feathers was 5.9 cm., which is high, considering the quality of the raw product. A better grade of feathers treated in the same manner would have a filling power of about 6.5 cm.

The treated feathers were resistant to papain-biulfite digestion, showing enhanced resistance to microbial attack, and had other desirable qualities as mentioned in the statement of objects.

Having described the invention, I claim:

1. A method of treating land fowl feathers to enhance their filling power, which comprises modifying the cystine linkage of the keratin of said land fowl feathers by immersing said feathers in an aqueous alkaline solution until their curliness is increased, rinsing said feathers after said immersion, then immersing said feathers in a dilute aqueous solution of epichlorohydrin at about 45° C. with the pH of said epichlorohydrin solution initially at about 6.4, then raising the pH of said epichlorohydrin solution to about 9.2 with a dilute alkaline solution, allowing the pH of said epichlorohydrin solution to drop to a pH of about 7.4, then raising the pH of said epichlorohydrin solution to about 9.2, with a dilute alkaline solution and allowing the pH of said epichlorohydrin solution to drop to about 7.4, neutralizing said epichlorohydrin solution, said
3 feathers being kept in the epichlorohydrin solution for a total of about 150 minutes until their filling power is substantially increased, removing the feathers from said epichlorohydrin solution, then rinsing and drying the feathers.

3. The method according to claim 1, wherein said aqueous alkaline solution is an approximately 1% solution of trisodium phosphate having a temperature of about 110°-120° F., said immersion having a duration of about 10-30 minutes.

4. The product produced by the method of claim 1.

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