United States Patent Office

2,937,918

Patented May 24, 1960

2,937,918

ACRYLONITRILE TREATMENT OF FEATHERS

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

No Drawing. Filed Apr. 23, 1957, Ser. No. 654,618

3 Claims. (Cl. 8—94.10)

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 employ a single chemical which will make the feathers resistant to moths and microbiological 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. TD 103037, 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 range, crushed (commercial "curled") land fowl feathers, land fowl feather fibers, stripped land fowl feathers, and mixtures of these.

In 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 water solution of a commercial blood solubilizer, such as "Coagusol," a mixture of sodium hexametaphosphate and alcohol sulfate. 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 $Na_3PO_4.12H_2O$ at 43°–49° C. 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 stability 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 uncurly mature feathers, thereby to increase the bulk value of the final feather product. Other suitably buffered alkaline solutions, for example, sodium carbonate or borax, may be used in lieu of the phosphate solution mentioned above, but in all cases the time of the treatment must be less for immature feathers 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 successful laboratory runs at The Tanners' Council Research Laboratory, University of Cincinnati, will now be given.

ACRYLONITRILE TREATMENT

A batch of 45 grams of clean chicken feathers was soaked in trisodium phosphate (as previously explained) for thirty minutes at 48° C. and then the feathers were rinsed with water and dried. The dry feathers were placed in a 2% solution of acrylonitrile (vinyl cyanide or cyanoethylene) in dioxane (1,4-diethylene dioxide), that is, 25 ml. of acrylonitrile in 1000 ml. of dioxanes. The pH was 6. The feathers were kept in the bath for ninety minutes at 44°–49° C., then were removed, rinsed with water thoroughly, wrung, dried and cured at 86°–88° C. for ten minutes. After conditioning for 19 days, the filling power was measured as 6.0 cm.

HYDRAZINE-ACRYLONITRILE TREATMENT

According to this technique, the phosphate soaking is omitted, and a 45 gram batch of clean chicken feathers is immersed in a 0.1% solution of hydrazine at pH 8 and a temperature of 35° C. for fifteen minutes. The feathers are rinsed with water and then placed in a 2% acrylonitrile solution (78 ml. of acrylonitrile in 1000 ml. of water) and the pH is raised to at least 10 with dilute Na_2CO_3 solution. The feathers are kept at pH 10–11 and at a temperature of 38°–42° C. for about ninety minutes. Then the solution is neutralized with glacial acetic acid and the feathers are removed, rinsed well with water, wrung, dried, and cured for ten minutes at 89°–91.5° C. The filling power is 6.0 cm. In an actual test, the same feathers, which had not been disturbed for ten months or treated in any way, were found to have a filling power of 6.2 cm.

The following table gives additional data regarding the acrylonitrile treatment of chicken feathers at the University of Cincinnati.

Table.—Showing treatment of chicken feathers with acrylonitrile

Run No.	Lot No.	Pretreatment	Reaction, pH	Filling Power (cm.)
54	7	trisodium phosphate	7 (water)	5.2
55	7	do	6 (dioxane)	6.0
56	7	do	6 (water)	5.3
57	7	do	6 (dioxane)	5.7
58	7	do	10-4 (water)	5.6
59	7B	none	11-6 (water)	5.7
60	7B	trisodium phosphate and hydrazine.	10-6 (water)	6.1
61	7B	hydrazine	11-6 (water)	6.0

A drawback of the described procedures is that acrylonitrile is poisonous, therefore must be handled with care.

Having described my invention, I claim:

1. A method of treating land fowl feathers to enhance their filling power, comprising first soaking said land fowl feathers in a dilute mildly alkaline aqueous solution of hydrazine, then rinsing said feathers, then immersing said feathers in an aqueous solution of acrylonitrile, said solution having a pH of about 6–11 and a temperature above room temperature, keeping said feathers in said acrylonitrile solution until their filling power is increased, then removing the feathers from said solution, and rinsing and drying them.

2. A method of treating land fowl feathers to enhance their filling power, which comprises immersing the feathers in a dilute aqueous solution of hydrazine, said hydrazine solution having a pH of about 8 and a temperature of about 35° C., for about fifteen minutes; then removing the feathers and rinsing; then putting the rinsed feathers in an about 2% aqueous acrylonitrile solution, the pH of said solution being about 10–11, the temperature of said solution being about 38°–42° C., and the time of the treatment being about ninety minutes; then neutralizing the solution, removing the feathers, and rinsing and drying them.

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

References Cited in the file of this patent

UNITED STATES PATENTS

2,129,219	Koga	Sept. 6, 1938
2,389,292	Bjorksten	Nov. 20, 1945
2,406,958	McQueen	Sept. 3, 1946
2,583,574	Jones	Jan. 29, 1952
2,805,913	Frederick	Sept. 10, 1957
2,805,914	Frederick	Sept. 10, 1957

OTHER REFERENCES

Valentine: Jour. of the Textile Inst., April 1955, pp. T270–T283.