ABSTRACT OF THE DISCLOSURE

Straitening of live human curly hair is accomplished by moistening with dilute aqueous acidic glycol solution followed by hot combing or pressing to dryness.

This invention relates to the treatment of hair and more particularly to the straightening of normally curly hair. Although effective in the softening and straightening of hair having even minor curling tendencies, the invention finds particular utility in the treatment of supercurly human hair.

Excessive curliness or kinkiness of human hair causes extreme difficulty in caring for the hair and scalp as well as in styling. Many attempts have been made to find means for overcoming this condition, and many treatments have been described for more or less permanently removing part or all of the curl of supercurly hair. Thus the hair may be forcefully straightened and heavily coated with stiff waxy pomades; or it may be softened, using more or less corrosive or caustic chemicals which must be neutralized after mechanical straightening of the hair shaft; or the temporarily straightened hair may be chemically treated to impart water-resistance. None of these or other treatments has been found fully effective.

Either the effect is lost on again shampooing the hair, or the hair itself is unduly weakened or its luster diminished or destroyed, or the scalp is excessively irritated; or for various other reasons the prior art methods and materials have not proven fully satisfactory.

The present invention provides an improved treatment and treating agent for hair with which superior results are achieved both in imparting softness and manageability to the hair and in maintaining these and other desired properties. The hair is strengthened rather than weakened, while its resistance to water is increased. The full natural luster is retained. No protective emollients or creams are required, yet the scalp is unharmed.

In its simplest form, the invention requires merely the application to the clean hair of a dilute acidic aqueous solution of ethylene glycol or of 1,3-propylene glycol, followed by hot combing. The hair is promptly softened by application of the solution, so that it can be combed straight and held in that condition. The solution, although acidic, is sufficiently dilute to cause substantially no irritation of the scalp and presents no difficulty or inconvenience to the operator. Continued combing with a hot comb until substantial dryness is achieved then completes the process and results in straight or gently wavy hair.

Unlike many treatments, the effect is relatively permanent, so that the hair may subsequently be shampooed a number of times without again reverting to the supercurly condition.

Straightening or relaxation of supercurly hair is accomplished at high concentrations of glycol but at the expense of observable loss of luster as well as a tendency of the hair to have a heavy, sticky or "wet" feel. A preferred range for this component is about five to about ten percent of the total weight of solution, although concentrations as low as about three percent and as high as about twenty percent are also useful. The solution contains sufficient acid catalyst to bring the acidity within the range of approximately pH one to three. Formic acid is found to impart additional preliminary softness to the hair, and although completely volatilizable, remains effective throughout the hot combing process; and this material is therefore preferred. Hydrochloric acid, p-toluenesulfonic acid, acetic acid and monochloroacetic acid have also been found effective. Excellent results in the straightening of supercurly hair have been obtained with a solution of five parts by weight of formic acid and eight parts by weight of ethylene glycol in 87 parts of water, the solution having a pH value of about 1.1/2.

It will ordinarily be found helpful to add a small proportion of a wetting agent to assist in obtaining rapid penetration and treatment of the hair. About one part of a material such as "Ultrawet 60L Soft" liquid organic wetting agent in 2000 parts of the solution is illustrative. "Ultrawet 60L" is a biodegradable triethanolamine linear (C₆H₅CH₂) alkylate sulfonate liquid wetting agent. Although not required, various other components such as emollients, scents or perfumes, coloring or tinting agents etc., may be added if desired. In all cases the additives are subject to the requirement that they be inert toward the glycol and acid components, and non-irritating to the user. "Ultrawet 60L" is described in U.S. 3,190,836 of June 22, 1965.

The glycols are known to be effective softeners for many natural and synthetic fibers and might be expected to soften the hair; but since they are completely water-soluble the effect would logically be thought to be temporary only and to be lost on subsequent washing. Surprisingly, under acidic conditions and particularly when subjected to the elevated temperatures induced by hot combing, supercurly hair treated in this way is found to be softened and straightened and to remain in this condition through a number of subsequent washings.

In probable explanation of this important effect it is suggested that the hair is first softened and relaxed by the acidic aqueous glycol solution and is then easily drawn out and straightened by the combing action. As the treatment proceeds, esterification occurs between active groups of the hair keratin and the primary hydroxyl groups of the glycol under the influence of the acid catalyst at the elevated temperature, resulting in cross-linking between adjacent peptide chains. The straightened hair thus acquires a permanent "set" which is not relaxed nor destroyed upon subsequent washing. Consistent with such theory, it is found that the more reactive primary hydroxyl groups of the short chain glycols, i.e. ethyleneglycol and 1,3-propylene glycol, are required; the solution must be strongly acidic, i.e. at a pH of between 1 and 3, preferably about 1½; and the treatment must include hot combing or pressing, at comb temperatures of at least about 200° C., desirably at 210° C., and preferably continuing until substantially no free glycol remains on the hair.

The following specific examples will further illustrate the practice of the invention, which however is not to be limited thereto.

**EXAMPLE 1**

<table>
<thead>
<tr>
<th>Component</th>
<th>Grams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>91.7</td>
</tr>
<tr>
<td>Ethylene glycol</td>
<td>8.0</td>
</tr>
<tr>
<td>p-Toluenesulfonic acid</td>
<td>0.5</td>
</tr>
<tr>
<td>Wetting agent (&quot;Triton X-100&quot;)</td>
<td>3</td>
</tr>
</tbody>
</table>

The pH of the solution is 1.7, i.e. about 1½.

**EXAMPLE 2**

<table>
<thead>
<tr>
<th>Component</th>
<th>Grams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>86.2</td>
</tr>
<tr>
<td>Ethylene glycol</td>
<td>8.0</td>
</tr>
<tr>
<td>Formic acid (87%)</td>
<td>5.9</td>
</tr>
<tr>
<td>Wetting agent of Ex. 1</td>
<td>3</td>
</tr>
</tbody>
</table>

The pH of the solution is 1.8.
These solutions are applied to the freshly shampooed thoroughly rinsed, and fully or partially dried hair by padding, and the hair is then combed, a few strands at a time, with a hot comb maintained at 210° C. until the hair feels substantially dry. "Triton X-100" wetting agent is identified as a biodegradable water-soluble isoctyl phenoxypolyethoxy ethanol which contains 10 moles of ethylene oxide.

What is claimed is as follows:
1. Method of treating clean live human hair comprising thoroughly wetting the clean hair with an acidic aqueous solution of volatile glycol selected from the class consisting of ethylene glycol and 1,3-propylene glycol, and then hot combing the hair at a comb temperature of about 200° C.—210° C.
2. A solution for use in the treatment of hair, consisting essentially of from about three to about 20 percent of a glycol selected from the class consisting of ethylene glycol and 1,3-propylene glycol in an acidic aqueous solution at a pH within the range of about 1 to 3.
3. A solution as defined in claim 2 and including an acid selected from the class consisting of formic, acetic, monochloroacetic, hydrochloric and p-toluenesulfonic.
4. A solution as defined in claim 2 and containing about five to about ten percent of said glycol and sufficient formic acid to establish a pH of about 1½.
5. A solution as defined in claim 2 and including a significant small amount, within the range of about one-half to about one and one-half parts per thousand parts of said solution, of an organic wetting agent.

References Cited
UNITED STATES PATENTS
2,389,755 11/1945 Baker 424—71
2,643,375 6/1953 Gant 132—7
8—127.51; 424—71

ALBERT T. MEYERS, Primary Examiner
V. C. CLARKE, Assistant Examiner
U.S. Cl. X.R.