Damage limitation: comparing the impact of polymers on bleached hair, when applied within or as post-bleach treatments

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In response to consumer demands for less harsh hair colouring treatments, specialist chemical companies and product formulators have sought to develop new technologies that mitigate or compensate for the chemical and structural alteration of the hair fibre caused by oxidation. Such technologies are expected to be effective at the time of bleaching/colouring or immediately after.

Hair bleaching is known to cause structural changes to the cortex via the oxidation of the disulphide bonds crosslinking the Keratin Associated Proteins (KAP) thus destabilising the Intermediate Filaments (IF) structure. The cuticle also undergoes oxidative damage resulting in reduced thickness, and increased hydrophilicity and roughness.

This study compares the effects of several polymers, with claimed affinity to hair proteins, on the tensile and thermal properties, as well as the combing force of bleached hair. The polymers represent different chemical structures and properties:

- Hydrolysed keratin (Aver. Mw=1800);
- Cystine/silicone copolymer (Aver.Mw = approx. 20000)
- Hydrolysed vegetable protein/silicone copolymer (Aver. Mw=1000)

Causation virgin brown hair swatches were tested. Three types of treatments were carried out: double bleached hair - no active; double bleached hair- with a polymer added to the bleach (each time); double bleached hair soaked in polymer solution immediately after each bleaching. All data has been reported below as % change in polymer-treated hair from control (doubled bleached hair).

Tensile stress: polymer-in-bleach results: The hydrolysed veg. protein/silicone polymer elicited a 21.50% and 16.45% increase in tensile strength (wet and dry results respectively), accompanied with 25.85% wet elongation increase. The cystine/silicone co-polymer also improved wet tensile strength by 18.63%, with a minimal effect on elongation.

Tensile stress: polymer after bleaching results (wet): The cystine-containing polymer increased tensile stress for wet and dry hair (35.91% and 8.57%), whilst hydrolysed veg. protein/silicone polymer improved wet tensile stress only: 21.13%.

DSC (wet): The Td of double bleached hair was 124.04°C, with reductions for in-bleach polymer treatments down to Td=120.04°C (cystine/silicone copolymer) and Td=119.05°C (vegetable protein/silicone copolymer).

To widen the study, the wet and dry work of combing was also measured. When used in the bleach, the vegetable protein/silicone copolymer reduced dry combing work by 32.36%. All other treatment variables caused an increase in the combing work (dry and wet). These results would be investigated further.

The data implies that some in-bleach polymer treatments are stable and suitable for moderating the impact of bleach on the cortex and cuticle structure. DSC suggests possible moderate impact of the actives on the KAPs structure due to intermolecular interactions. The impact of the chosen materials as after treatments was limited.

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