

Comparison of damage to human hair fibers caused by monoethanolamine- and ammonia-based hair colorants.

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Abstract

The number of Level 3 hair color products that substitute 2-aminoethanol [monoethanolamine (MEA) for ammonia is increasing. There is some anecdotal evidence that higher levels of MEA can be more damaging to hair and more irritating than a corresponding equivalent level of the typical alkalizer, ammonia (in the form of ammonium hydroxide). Our interest was to understand in more quantitative terms the relative hair damage from the two alkalizers, particularly at the upper limits of MEA on-head use. Limiting investigations of oxidative hair damage to increases in cysteic acid content (from cystine oxidation) can underreport the extent of total damage. Hence, we complemented Fourier transform infrared spectroscopy (FTIR) cysteic acid level measurement with scanning electron microscopy (SEM) photomicrographs to visualize cuticle damage, and protein loss to understand not only the oxidative damage but also the damage caused by other damage pathways, e.g., reaction of the more nucleophilic (than ammonia) MEA with hair protein. In fact, all methods show an increase in damage from MEA-based formulations, up to 85% versus ammonia in the most extreme case. Hence, if the odor of ammonia is a concern, a better approach may be to minimize the volatility of ammonia in specific chassis rather than replacing it with high levels of a potentially more damaging alkalizer such as MEA.