Newly Developed Silicone Amino Elastomers:  
The Key to Unlock the Mystery of Achieving Natural Looking Hair

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Introduction:  
When consumers are asked to define ‘natural’, as it relates to their hair’s appearance, they describe a balance 
between a tousled look and a well-conditioned look. Consumers want hair that has more flex, bounce and memory 
hold, without the loss of a conditioned, soft feel. Hair care manufacturers are currently using combinations of 
organic polyquaternium compounds and fixative resin polymers; however, existing styling polymers have a classic 
tradeoff. If they have good styling properties, there is an associated poor sensory feel and vice versa.

The development of a silicone amino elastomer emulsion has led to a product that combines the good styling 
properties of a resin and the superior sensory feel and conditioning properties of a silicone. These materials can be 
easily formulated into aqueous-based leave-in styling products and rinse-off conditioning products. The amino 
elastomer emulsion can function as a styling aid itself or it can be used with a styling resin to provide synergistic 
effects.

Background:  
The amino elastomers emulsions were prepared by combining surfactants, water, an aminosiloxane, and a 
crosslinker. The addition of functional groups, such as glycidyltrimethylammonium chloride (GTMAC), was also 
incorporated onto the aminosiloxane. Figure 1 shows the amino elastomer structure. Microemulsions were prepared 
for ease of use in water-based formulations and for the ability to formulate clear products.

![Figure 1: Silicone Amino Elastomer Structure](image_url)

Evaluations of the amino elastomer emulsions were performed for wet and dry combing performance, curl 
retention properties and sensory characteristics in different hair care formulations. The different types of 
formulations that were evaluated include a shampoo, rinse-off conditioner, leave-on conditioner, and aqueous 
styling aids (mousses, gels, pomades and hair sprays). Performance comparisons were also made with organic 
styling resins, a silicone resin and commercial styling aids on the market.

The conditioning properties of these emulsions were evaluated using standard Instron combing and sensory 
methods. Styling characteristics were evaluated using curl retention and sensory testing. The tresses were placed 
in a constant temperature and humidity chamber (25°C, 70 or 95% Relative Humidity) for a total of 5 hours for curl 
retention testing.
**Results:**

The amino elastomer emulsions demonstrated good curl retention properties when tested in dilute form (leave-on application). The tresses were also observed to have a nice bounce-back after they were extended to full length. Figure 2 shows tresses treated with the amino elastomer emulsion and a silsesquioxane resin, which also demonstrates good curl retention properties, and water. The tresses treated with the amino elastomer emulsion appear to have a tighter curl compared to the silsesquioxane resin and the tresses have a much nicer sensory feel. There was no residue left on the tresses and they were easy to comb, whereas the silicone resin left a tacky feel and it was hard to comb through the tress.

![Figure 2: Hair Tresses](image)

The results in Figure 3 show the performance of the amino elastomer emulsion compared to several commercial raw materials used for styling properties. The amino elastomer emulsion outperformed or had similar performance to the other styling products, except for one of the acrylates copolymer resins. Sensory testing also showed that the amino elastomer emulsion was significantly better than several organic styling resins tested. Figure 4 demonstrates the superior smoothness compared to polyvinylpyrrolidone (PVP). The data also show that the amino elastomer emulsion significantly improves the smoothness of PVP when they are combined in a single formulation.

![Figure 3: Curl Retention Results for Amino Elastomer Emulsions vs. Organic Styling Polymers at 70% RH](image)
Addition of the quat functionality to the amino elastomer resulted in a significant reduction in both wet and dry combing forces in a rinse-off conditioner formulation. The tresses had a soft, smooth feel in both the wet and dry state. There was also a decrease in combing forces when the quat functional materials were tested in a shampoo formulation. As shown in Figure 5, the amino elastomer emulsion has similar combing performance to a commercial amino siloxane cationic emulsion, known for its good combing performance. Addition of the quat functionality did not negatively impact curl retention or flexible styling properties. The results were similar to previous evaluations without quat functionality. This particular structure provides the conditioning benefits through the use of the amino fluid with additional quat functionality as well as the styling properties by having the cross-linked structure.

The amino elastomer can easily be formulated into various styling aid formulations. Curl retention benefits have been demonstrated in mousse, gel, pomade and hair spray formulations at 70 and 95% relative humidity. Performance is similar to commercial styling products within the same category, as demonstrated by the results for the mousse formulation in Figure 6. The improvement in dry combing and sensory feel is an added benefit of the amino elastomer emulsion in these types of styling products. After the hair has been dried or styled, the amino elastomer emulsion provides a nice, natural feel and appearance.
As shown in Figure 7, additional curl retention evaluations demonstrated that the amino elastomer emulsion itself, in dilute form, performed as well or better than several commercial gels, mousses and curl refining products on the market. The tresses had a very soft, well-conditioned feel, bounce-back and curl, while the commercial gels and mousses left a tacky, crisp feel and did not feel as soft. The commercial leave-on spray had a soft, conditioned feel, but did not provide very much curl retention or bounce. These results also show the effect of the amino elastomer concentration on the curl retention performance. Similar performance to the commercial products was observed, even though there was a decrease in curl retention at lower levels.

**Conclusion:**

The results of this study have confirmed that these newly developed amino elastomer emulsions have unlocked the mystery in providing improved performance for flexible styling benefits, which include flexible hold, mild styling and memory, together with the benefits of superior sensory feel and conditioning properties. The microemulsion form provides a stable and clear delivery system for the amino elastomer polymer. The amino elastomer can be used as the sole styling aid in the formulation or it can be combined with other styling polymers to provide synergistic effects, depending on the targeted benefits. Now consumers can have the natural look they have been trying to achieve.