

**colorpHlex™
Chatsworth, CA**

Anti-breakage Benefits of Hair Care Formulations

Objective

To evaluate the anti-breakage properties in the dry state for tresses treated with various test products.

Products

The following products were provided by the requester for use in the anti-breakage study:

- Color additive - Test product #1 (Lot# BL-013015A)
- Finishing Conditioner -Test product #2 (BL-012915B)

Experimental

Hair

The hair tresses weighed approximately 3 g and measured 8" in length and 1" in width. Prior to testing, the tresses were bleached for Cells 2, 3, & 4.

Treatment

All product treatments were in accordance with information provided by the requestor. Groups of tresses were treated with one of the regimens outlined below. All the swatches were treated as per standard product application

- o Cell 1 (Virgin Hair)
 - Washed with 0.3 ml SLES/tress (massaged and rinsed for 30 seconds)
- o Cell 2 (9% Bleached Hair)
 - After bleaching, tresses were standardized by washing with 0.3 ml SLES/tress (massaged and rinsed for 30 seconds)
- o Cell 3 (9% Bleached Hair + Color additive)
 - Color additive (3.75 ml/ounce of bleach) was added to the bleach mixture
 - Tresses then standardized with 0.3 ml SLES/tress (massaged and rinsed for 30 seconds)
- o Cell 4 (9% Bleached Hair + Color additive + Finishing Conditioner)
 - Color additive (3.75 ml/ounce of bleach) added to the bleach mixture
 - Tresses then standardized with 0.3 ml SLES/tress (massaged and rinsed for 30 seconds)
 - Tresses treated with finishing conditioner (15% -0.45ml/tress) (leave on for 10 minutes and rinsed for 30 seconds)

Anti-Breakage by Repeated Grooming

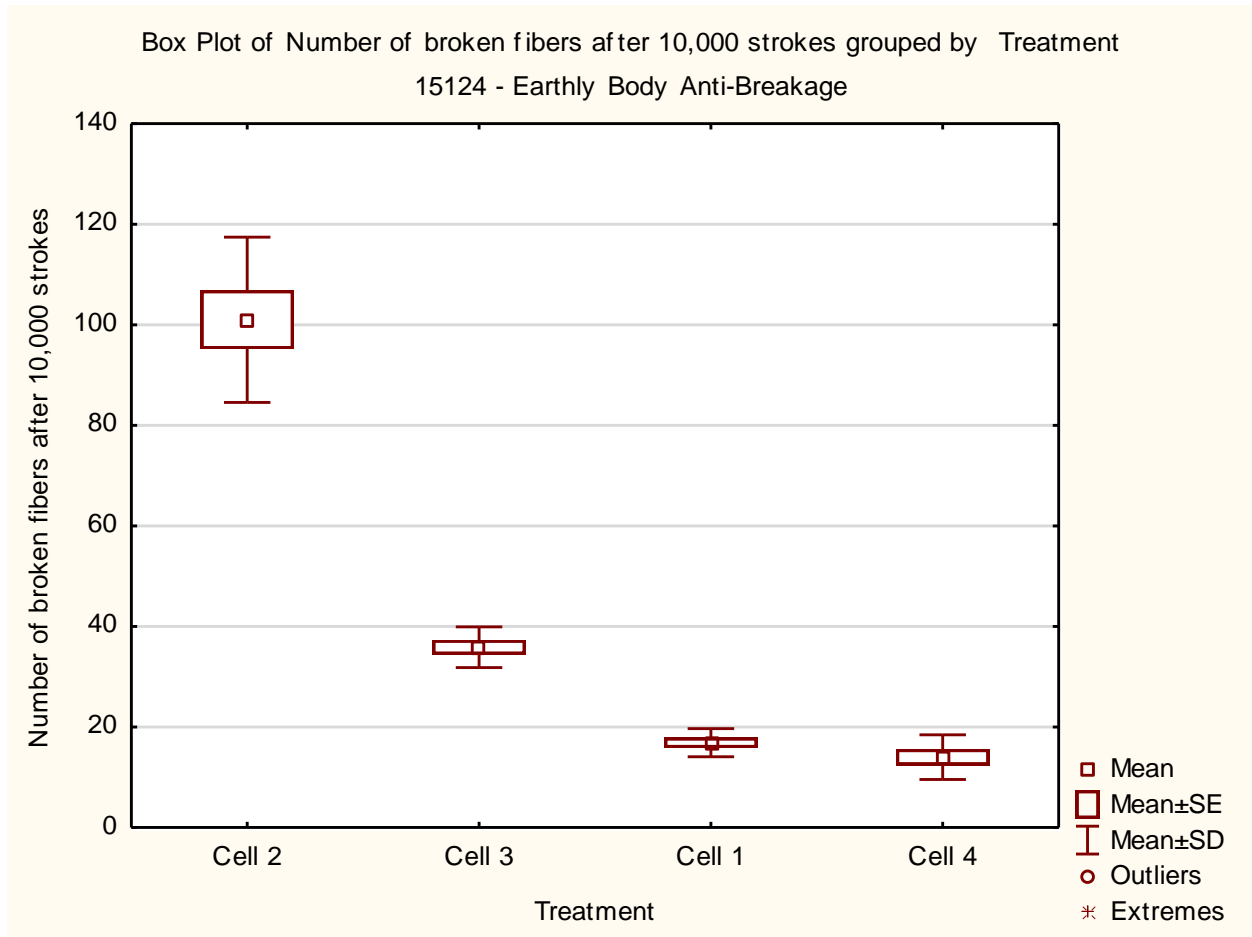
A useful method to determine whether a treatment will protect hair against breakage is provided by repeated grooming experiments; in this test, the number of broken fibers is recorded as a function of repeated combing/brushing strokes. Any treatment that reduces snags, entanglements and abrasion can help in substantially lowering the number of broken fibers.

A custom-built automated grooming device was used consisting of a hollow rotating drum-like assembly, where four outer crossbars contain holders for mounting combs or brushes. These outer arms are detachable to allow for different holders to be mounted and experiments to be performed using a variety of combs or brushes. One complete drum revolution combs (or brush) a tress four times. This entire set-up is duplicated three times in the horizontal direction allowing four tresses to be combed simultaneously. Collection plates are located under each tress to save broken fiber fragments, while spacer plates on the rotating drum prevent cross contamination. All experiments were again performed after overnight equilibration of the hair at 60% RH.

Tresses were repeatedly brushed 10,000 times with broken fibers being evaluated every 1000 strokes. Eight replicate hair tresses were used for each sample to ensure statistical relevance. This methodology has also been documented in the scientific literature (*Evans & Park, A Statistical Analysis of Hair Breakage. II. Repeated Grooming Experiments, J.Cosmet.Sci., 61, 439-455, 2010*).

Repeated Grooming Results

Box and whisker plot was generated using Statistica™, while JMP™ analytical software was used to calculate the statistics (student's t-test at 95% confidence level). Raw data is given in the Appendix at the end of this report. Result from repeated grooming testing after 10,000 strokes is shown below.



Results for Anti-Breakage

Number	Treatment	Mean	Std Dev	Std Err Mean			
Cell 2 (9% Bleached hair)	8	101.00	16.43	5.81	A		
Cell 3 (9% bleached hair + Color Additive)	8	35.88	4.05	1.43		B	
Cell 1 (Virgin Hair)	8	16.88	2.80	0.99			C
Cell 4 (9% bleached hair + Color Additive + Finishing conditioner)	8	14.00	4.44	1.57			C

Levels not connected by same letter are significantly different.

% Reduction in breakage is calculated as below,

$$\% \text{ Reduction in Breakage} = \left(1 - \frac{\text{Mean\# Broken Fibers of Treatment}}{\text{Mean\# Broken Fibers of Control}} \right) \times 100$$

Results show that Cell 2 (9% bleached hair) presents the highest level of breakage as compared to the other cells. Cell 3 (9% bleached hair + Color Additive) shows a reduction in breakage statistically different from Cell 2 (9% bleached hair). Notably, Cell 4 (9% bleached hair + Color Additive + Finishing conditioner) shows the highest reduction in breakage ranking statistically equivalent to Cell 1 (Virgin hair).

Raw Data

Brush Strokes	Cell 1 (Virgin Hair)							
	Tresses							
	1	2	3	4	5	6	7	8
1000	8	8	8	9	6	5	2	3
2000	3	3	2	2	2	2	3	3
3000	2	2	2	2	2	2	2	2
4000	1	1	1	1	2	2	1	1
5000	0	0	0	1	2	1	1	1
6000	2	0	0	0	1	2	1	1
7000	2	3	2	2	2	2	2	2
8000	1	1	2	1	0	0	0	0
9000	0	0	1	0	1	0	0	0
10000	0	1	1	0	0	1	0	0
Total	19	19	19	18	18	17	12	13

Brush Strokes	Cell 2 (9% Bleached Hair)							
	Tresses							
	1	2	3	4	5	6	7	8
1000	20	25	20	18	20	25	30	35
2000	8	19	10	10	10	15	16	10
3000	6	10	10	10	7	8	8	10
4000	8	9	10	10	6	9	10	15
5000	8	7	10	10	8	11	10	12
6000	5	9	10	9	9	5	9	10
7000	5	5	9	9	8	7	9	8
8000	6	7	9	9	4	6	9	9
9000	6	6	9	8	4	6	8	8
10000	5	8	8	8	4	6	8	8
Total	77	105	105	101	80	98	117	125

Brush Strokes	Cell 3 (9% Bleached Hair + Color Additive)							
	Tresses							
	1	2	3	4	5	6	7	8
1000	10	9	12	13	10	9	11	6
2000	5	5	4	6	5	4	3	7
3000	3	3	5	6	3	3	3	4
4000	4	5	2	2	5	3	3	3
5000	2	3	3	3	4	3	2	3
6000	1	2	2	3	3	4	2	2
7000	1	1	2	2	3	2	3	4
8000	2	1	1	1	2	4	2	2
9000	0	3	3	5	3	2	3	3
10000	2	1	1	2	2	2	2	2
Total	30	33	35	43	40	36	34	36

Brush Strokes	Cell 4 (9% Bleached Hair +Color Additive + Finishing Conditioner)							
	Tresses							
	1	2	3	4	5	6	7	8
1000	4	4	5	6	5	4	5	4
2000	2	2	1	1	3	2	4	4
3000	1	1	1	1	2	2	1	1
4000	1	0	1	1	2	3	0	0
5000	1	2	1	1	2	3	1	1
6000	0	1	0	0	1	0	2	2
7000	1	1	0	0	2	1	0	0
8000	0	1	1	2	2	1	1	1
9000	0	0	0	0	2	1	0	0
10000	0	0	0	0	2	1	0	0
Total	10	12	10	12	23	18	14	13