Evaluating Shampoo Foam

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There is probably no personal care category that is more competitive than shampoos. With this in mind, formulators of shampoos are asked by marketing to develop products to both appeal to consumers and perform (whatever "perform" means).

Performance

Speaking about performance, I scanned the shampoo products available on www.drugstore.com and quickly was able to come with a list of claims (see sidebar). I stopped looking at the claims after reviewing the labels of approximately 25 shampoos of the more than 300 they sell!

We have come to expect these outrageous claims, as have consumers. A consumer may indeed purchase the shampoo based on one or more of these claims, but the four attributes that come into play only during use, and that are rarely mentioned (and are most valued by consumers), are: cleansing, fragrance, viscosity and foaming.

Cleansing: Cleansing is taken for granted by consumers. In fact, while marketing people may be concerned that the shampoo being developed by R&D cleans adequately, in reality all shampoos contain several times the amount of surfactant needed to clean even the most soiled hair! It would be almost impossible to make a shampoo using today's anionic surfactants that didn't clean the hair.

Fragrance: Fragrance is one of the most important reasons a person buys a shampoo. Have you ever seen a shampoo that was fragrance-free? I think not!

Viscosity: To a purchaser, a shampoo that is thick implies it must be "rich" (whatever that means) and will certainly perform. It is silly, but who am I to argue with consumers?

Foaming: The consumer, standing in the shower with eyes closed and wet hair, applies the shampoo, rubs, feels the foam/lather and quickly makes a judgment as to the performance of the shampoo. If it does not provide a copious, lubricious, dense foam quickly (that also smells pleasant) the consumer will have a rather negative impression of the shampoo that will be difficult to overcome even if it does a great job in providing hair conditioning. Let's spend a few minutes talking about foam evaluation.

Shampoo Label Claims Found in a Quick Search of Drugstore.Com

- Volumizer
- Thickens
- 100% vegan
- DEA free
- Sulfate free
- Mild
- Purifies
- Balances
- Conditions
- pH balanced
- Maximizes bounce
- 50% organic ingredients
- Shiny hair
- Detangles
- Healthy hair
- Softer hair
- Hydrating
- Ultra-hydrating
- Clarifies and absolves impurities
- Rejuvenates
- Adds vibrancy
- Provides weightless moisturizing

Foam Evaluation

Without question the best method to evaluate the foaming ability of the shampoo is consumer testing, most often done in a salon setup. However, it is costly and very time consuming. Just imagine, you have just finished preparing a shampoo formulation using a new conditioning polymer and you have to wait several days (at best) before you will know if it negatively affects the foam attributes. This is an intolerable situation.

Foam evaluation has been going on for many years. Following is a brief description of the most popular methods employed by chemists. In each of these methods the temperature of the water and water hardness may be varied. Additionally, a synthetic sebum may be added to simulate the presence of "soil," i.e., dirty hair.

Ross Miles: This method is the oldest standardized method, dating back to 1941. A dilute solution is dropped from a fixed height into a pool of the same dilute solution and the foam volume is measured. This test produces an airy foam that in no way approximates foam produced in actual use by the consumer. These days it is only used by suppliers of surfactants. It doesn't give an accurate reading on foam volume, foam density or foam longevity. In my opinion, it shouldn't be used by anyone.

Cylinder shake: Also developed in 1941 (Stiepel), the cylinder shake method is, by far, the most widely used foam evaluation test method.

"If it [the shampoo] does not provide a copious, lubricious, dense foam quickly (that also smells pleasant) the consumer will have a rather negative impression of it that will be difficult to overcome even if it does a great job in providing hair conditioning."

A fixed amount of dilute shampoo is poured into a graduated cylinder. A stopper is placed onto the cylinder and it is inverted for a fixed number of times. The foam volume is then measured.

While is very easy and quick to run, the data generated, just like the foam, is very inconsistent. It is very operator dependent. Even the same operator has difficulty in reproducing data. A standard shampoo should always be used to try to insure reproducibility.

Many people have tried to reduce operator dependence of this test. One such modification (Beh-James) uses 300 ml of a dilute shampoo solution in a 1000 ml graduated cylinder. The cylinder is subjected to rotation on a vertical plane perpendicular to the axis of a motor (attached to the cylinder). It is rotated for 2 minutes at 36 rpm. The foam height reading is taken 30 seconds after rotation has finished.

Perforated disk: This foam evaluation method was developed in 1958 (Barnett & Powers). A sample of 200 grams of shampoo solution is placed into a glass cylinder (6.3 cm in diameter and 30 cm in length). A perforated disk (6 cm in diameter) is moved up and down in the tube (26.5 cm) at a speed of 30 strokes per minute. The foam height is measured after 30 strokes. This method is fairly good in its consistency, but the foam it produces is loose and airy.

Moldovanyi-Hungerbubler: A 500 ml shampoo solution is prepared and poured into a flask. The flask has an input tube to permit nitrogen gas to flow into the solution (from the bottom) at a rate of 17 liters/minute. The time needed to produce 2 liters of foam is measured. The liquid is drained off and the flask is weighed. We now have a measure of the foam density. If we wait a fixed period of time and then drain off additional liquid, we have an indication of foam stability.

This method is a bit cumbersome and like the other methods discussed, produces a loose, airy foam.

Hart-deGeorge blender method: This foam evaluation method was the first to incorporate a blender to generate the foam. The foam produced is thick and creamy and very similar to the foam seen is actual use tests.

A 200 ml shampoo solution is agitated in a blender (1 liter vessel size) for one minute. The foam is then poured into a funnel placed on a sieve with a mesh of 0.5 mm. The funnel measures 182 mm (top) to 23 mm (bottom). A gauging wire is placed 80 mm from the bottom of the funnel. The time for the level of foam to reach the wire (seconds) is recorded; the higher the number, the better the foam. This is an excellent method for assessing foam.

Blender Foam Volume/Drainage: For this method (1981-Henkel Corp.), a 10% solution of shampoo is prepared. Four grams of this solution are added to 146 grams of water (50 ppm hardness) at 29°C. The solution is agitated for 10 seconds at a medium speed in a blender. The foam is poured into a 1000 ml graduated cylinder and the volume is measured. After 3.5 minutes the position of the foam water interface is recorded (drainage). The evaluator may add 0.5 grams of synthetic sebum (or castor oil) to determine its effect. Additionally, the time of agitation may be decreased to 5 seconds to determine flash foam. This method is, in this author's opinion, the best technique (aside from salon testing) currently available.

Blender-Foam Density/Stability/Lubricity: In this method (1967-Unilever) a 10% solution of the shampoo is prepared. Four grams of this solution are added to 146 grams of water (50 ppm hardness) at 29°C. The solution is agitated for 10 seconds at a medium speed in a blender. The foam is poured into a 100 ml graduated cylinder to overflowing. A rubber stopper is gently dropped into the foam. This stopper has been shaved so that it is slightly smaller in diameter than the inside diameter of the graduated cylinder. The time for the rubber stopper to pass between two points (80 ml-40 ml) is measured. A longer time indicates a denser and more stable foam. The rate at which the stopper falls is dependent on the upward pressure. This upward pressure is inversely proportional to the size of the bubbles. Thus, a more dense foam will cause the rubber stopper to fall more slowly. This is a very good test method that closely approximates consumer perception of foam "quality."

Summary: While none of these tests is without drawbacks, by using the last two (Blender Foam Volume/Drainage and Blender-Foam Density/Stability/Lubricity), the formulator can quickly get a very good reading on how consumers will judge the foaming of the tested shampoo.

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