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Interactions between materials and the part they play in the functional kinematics are complex.

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ABSTRACT: This research examines how the interplay of ingredients in shampoo affects the product's final performance. The shampoo's flow characteristic and functional metrics including foam height and foam retention have not changed due to the use of the viscosity booster. Due to the low material contact between the SLES and the viscosity booster, the formulation's primary active compounds and their functionalities may be more effectively delivered. The document provides specifics.

SLES, Viscosity booster, shampoo,

I. INTRODUCTION

Shampoo is a common personal care product that serves dual purposes of both cleaning and preserving the 'health' of the hair and scalp. Primary and secondary surfactants with anionic or cationic charges are essential components of every shampoo's formulation design. The formulation additionally includes 'immiscible' and/or somewhat heavy and/or slowly dissolving elements for post-wash conditioning and/or leveling of the hair. 1, 2, When there is a significant demand for it, the shampoo system is also utilized to distribute the anti-dandruff ingredients, hair growth boosters, and hair colorants. The "body" of shampoo, also known as the "backbone architecture" of the formulation, has a significant impact on the distribution of the active ingredients.4, 5, 6

Understanding the kinematics of the individual chemicals in the shampoo requires knowledge of the fundamental material interaction between the various chemical elements. Only with this kind of information is it possible to manipulate and manufacture the shampoo's final effect. Other than the miscibility ratio of each ingredient in the given formulation, physical flow and viscosity would be the most relevant material interaction. 7, 8

In the present study we have analyzed the material kinematics of different chemical constituents of a shampoo individually and collectively in the formulation and accordingly a formulation blueprint was worked out and the details are presented in the paper.

II. MATERIALS AND METHODS

Formulation components' flow rates are measured. We analyzed a proprietary composition made up mostly of SLES, GHTC gum, and additional co-actives, the exact concentrations of which are classified as trade secrets.

SLES, and SLES with 0.3%Guar, material flow times The final product, which included HydroxypropylTrimoniumChloride(GHTC), was tested using a burette. In summary, the flow time difference between materials was estimated, and statistical significance was determined using the studentt test, by timing how long it took to dispense 1 ml of the substance from the burette out of a total amount of 50 ml.

Height and retention of foam are measured. Foam height and foam retention time were tested using SLES, SLES with 0.3% GHTC, and the final formulation.7, 8

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III. RESULTS

How long it takes for 0.3% GHTC in water and SLES to flow

Statistical tests showed no statistically significant difference between the flow times of SLES with 0.3% GHTC and 0.3% GHTC in water.

Results of a paired t-test SLES with 0.3% Gum and Gum with 0.3% SLES

Statistical significance and the p-value:

P = 0.5990 when using a two-tailed test.

This change is not statistically significant using the standard methods.

Proportion of certainty:

Group One's mean is - 0.0360 below Group Two's mean.

95% confidence interval of this difference: From -0.1854 to 0.1134

Intermediate values used in calculations:

t = 0.5450

df = 9

Standard error of difference = 0.066

Group	Group One	Group Two
Mean	0.2040	0.2400
SD	0.1011	0.2953
SEM	0.0320	0.0934
N	10	10

Flow time of 50% SLES & Shampoo

As expected the difference in the flow time of 50% SLES and shampoo was statistically significant andstatistical details are given below

Paired t test results 50% SLES & Shampoo P value and statistical significance:

The two-tailed P value equals 0.0011

By conventional criteria; this difference is considered to be very statistically significant.

Confidence interval:

The mean of Group One minus Group Two equals -3.6180

95% confidence interval of this difference: From -5.3489 to -1.8871

Intermediate values used in calculations:

t = 4.7284

df = 9

Standard error of difference = 0.765

Group	Group One	Group Two
Mean	0.0550	3.6730
SD	0.0165	2.4355
SEM	0.0052	0.7702
N	10	10

Flow time of 0.3% GHTC Gum in SLES andshampoo

As expected the difference in the flow time of 0.3%Gum in SLES and shampoo was statisticallysignificant and statistical details are given below Paired t test results 0.3% Gum in SLES andshampoo

P value and statistical significance:

The two-tailed P value equals 0.0011

By conventional criteria, this difference isconsidered to be very statistically significant.

Standard error of difference = 0.7

Confidence interval:

The mean of Group One minus Group Two equals -3.4690

95% confidence interval of this difference: From -5.1392 to -1.7988

Intermediate values used in calculations:

t = 4.6984

df = 9

Group	Group One	Group Two
Mean	0.2040	3.6730
SD	0.1011	2.4355
SEM	0.0320	0.7702
N	10	10

Flow time of 0.3% GHTC Gum in water and shampoo

As expected the difference in the flow time of 0.3%GHTC in water and shampoo was statistically significant and statistical details are given below

Paired t test results 0.3% gum and shampooP value and statistical significance:

The two-tailed P value equals 0.0007

By conventional criteria, this difference isconsidered to be extremely statistically significant.

95% confidence interval of this difference: From -4.9880 to -1.8780

Confidence interval:

The mean of Group One minus Group Two equals -3.4330

Intermediate values used in calculations:

t = 4.9942
df = 9
Standard error of difference = 0.68

Group	Group One	Group Two
Mean	0.2400	3.6730
SD	0.2953	2.4355
SEM	0.0934	0.7702
N	10	10

Determination of foam height and foam retention

100ml of 1% shampoo was when shaken for 5 minutes,produced foam of 350ml height. 50% SLES with 0.3% GHTC produced foam of 470 and460ml respectively for 100ml. Table - 1

The 350ml of the foam reduced by 30% in 30minutes in the case of shampoo and which further reduced to 50 and 80% respectively over 60 & 90 minutes.

The foam retention time in the case of SLES and SLES with 0.3% GHTC remain almost the same over 30, 60 and 90 minutes. Table- 1

Test details	Foam height (ml)	Foam retention time in minutes		
		30	60	90
Shampoo	100/350	30%R/350	50%R/350	80%R 350
50% SLES	100/470	60%R/470	90%R/470	100%R/470
50% SLES with 0.3% GHTC	100/460	59%R/460	88%R/460	98%R/460

IV. DISCUSSION

The current investigation revealed that 0.3% GHTC gum had the least material contact with SLES, providing further evidence that viscosity boosters, although increasing the shampoo's viscosity, should not change the base's surfactant property.

Statistical analysis shows no discernible difference in critical parameters as flow rate, foam height, or foam retention time between SLES and SLES with 0.3% GHTC. The final shampoo formulation, however, had properties that were different from those of the individual ingredients employed in the formulation, particularly with respect to flow time, foam height, and foam retention. Because the final formulation is developed to provide greater conditioning and active delivery for particular therapeutic effects, the aforementioned adjustments are required.

The natural properties of both the basic components and the substance used to improve viscosity must be maintained.

Due to the brief contact duration of toiletry formulations, flow time is crucial throughout the manufacturing process. Functional advantages envisaged via such formulation are only attainable when the formulation can reach a reasonable contact time with the scalp and hair.

The agent employed to improve the viscosity should not increase the contact duration, but rather the actives themselves. This indicates that the binding property of the actives over hair and scalp should only be affected negatively by the viscosity.

In this formulation, the botanical actives have been

employed for their anti-dandruff, hair-growth, and hair-conditioning properties. Since botanicals are complex, hefty particles, the viscosity of the shampoo plays a crucial role in ensuring that the ingredients are distributed evenly throughout the formula. The botanicals should shine through without the viscosity overshadowing them.

For the sake of this discussion, we will only be focusing on the primary surfactant, which is the main component of the formulation.

The percentage of amphoteric or anionic/cationic components in the final formula should be low.

We may attribute the shampoo's statistically significant changes in foam retention and foam height to the shampoo's botanicals, conditioning ingredients, and secondary surfactant.

Although it is essential to establish the phase of incorporation, temperature, pH, stirring force, volume of foam generated during production, etc., as well as the relative proportions and times of each ingredient, doing so can be challenging due to the complexity of material interactions.

In addition, the entropy of a system tends to rise over time, since the interaction between materials tends to grow in accordance with the rules of thermodynamics. Since the nature of the materials' interactions and the complexity they provide might change over time, it's important to zero in on the main ingredient(s) that provide the formulation's signature qualities and flavor profile.

The significance of material kinematics and formulation science has never before been established by a research.

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