Minimally disruptive skin softening formulations

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We have begun using a concept we refer to as minimally disruptive formulation (MDF) as an effective approach to product development.[1-3] This approach depends upon the ability of personal care formulators to provide products that have consumer perceptible differences that meet a market need. Since product aesthetics are a key attribute of personal care products, the ability to alter product aesthetics to provide a different consumer perception with minimal change to the formulation is a very cost effective way to develop new products.

The fact is a silicone polymer, properly chosen at a concentration of 5% or less, will provide to the formulation (1) a lowering of surface tension, (2) an alteration of feel, (3) an altering of cushion and playtime, (4) a change in gloss and (5) a perception to a customer the product is different from the formulation to which the additive has not been made. This makes silicone polymers quite valuable at low concentrations on formulation to make "new products".

I have often said: "If a personal care product is compared to a gourmet meal, silicone additives will be the spice, not the meat or potatoes." This means that small amounts of silicone polymer added to great formulas will bring out desired properties to a consumer, that will amaze and delight. This approach will allow the formulator to make SMALL but MAJOR modifications to formulators in a very efficient way by modifying well known formulations to provide new products with different aesthetics.

Additions of a properly chosen organo-functional silicones can be made to (1) the oil phase (alkyl silicones), (2) water phase (PEG/PPG dimethicone) or (2) the silicone phase (dimethicone), there are many possibilities. The reason for the addition needs to be evaluated. Adding a silicone to the oil phase can result in improved wetting and spreadability, which in turn alters cushion and play time. The surface tension reduction can be reduced from 32 dynes/cm to 25 dynes/cm. This dramatic change will alter cushion, playtime and ultimate aesthetics. Addition of a silicone

Abstract

Several key changes have occurred in the personal care industry over the last twenty. Firstly, there are fewer chemists working on the development of new formulations, due in part to consolidation and downsising of the industry. Secondly, the lead time for new products has contracted. Thirdly, the regulatory requirements have expanded considerably. These changes have forced the formulator to work in a more efficient way, minimising the steps needed to commercialise a product.

The formulator has in many cases adopt formulation platforms that contain most the ingredients needed for functionality, but can be varied for different consumer expectations. The salient property of formulations that signal a new product experience to customers is aesthetics. Fortunately, most of the formulation aesthetics come from additives that are present in low concentrations and are surface active. Most formulators are aware that water soluble surfactants can be added to aqueous formulations to change surface tension, spreading and feel. Many formulators are not aware that there is a plethora of oil soluble silicone polymers that perform the exact same function in oils. The ability to alter the feel of an oil phase adding less that 5% of the properly chosen silicone surfactant offers the ability to keep the platform and offer outstanding aesthetics of different types that the consumer will regard as unique and desirable. Since the platform ingredients are the same, the need to qualify new raw materials is low. We call this approach 'minimally disruptive formulation'. Silicone polymers are especially conducive to this type of development approach since they provide a perceivable consumer aesthetic advantage at low use levels.

Formulations							
Ingredients	1	2	3	4	5	6	7
Part A							
Water	68.00	68.00	68.00	68.00	68.00	68.00	68.00
Glycerine	3.50	3.50	3.50	3.50	3.50	3.50	3.50
Alcohol Denat	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Butylene Glycol	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Part B							
Mineral Oil	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Jojoba Oil	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Myristyl Alcohol	5.40	5.40	5.40	5.40	5.40	5.40	5.40
Petrolatum	2.00	2.00	2.00	2.00	2.00	0.00	2.00
Stearic Acid	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Glyceryl Stearate	4.50	4.50	4.50	4.50	4.50	4.50	4.50
Hydrogenated Coco-glyceride	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Dimethicone 100cp	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Polyglyceryl-2-Caprate	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Myristyl Myristate	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Lanolin Alcohol	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Ethyl Methicone	0	1.00	0	0	0	0	0
MQ Resin	0	0	1.00	0	0	0	0
Silicone gum	0	0	0	1.00	0	0	0
Dimethicone vinyl/dimethicone crosspolymer	0	0	0	0	1.00	0	0
Multidomain alkyl-silicone	0	0	0	0	0	2.00	0
PEG-8 dimethicone HLB 10.6	0	0	0	0	0	0	3.00
Phenoxyethanol	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Part C							
Tocopheryl Acetate	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Fragrance	0	0	0	0	0	0	0
Total	100	100	100	100	100	100	100

Procedure:

1. Into a cleaned and sanitised stainless container equipped with a propeller mixer, Combine the ingredients of Part A, mix well. Then heat up to 75 ~ 80°C.
2. In a separate clean and sanitized vessel, add all the ingredients of Part B, and heat up to 75 ~ 80°C, mix well until uniform.
3. Add Part B into Part A slowly and continue stirring.
4. Keep the temperature at 75 ~ 80°C for 5 minutes and cool down until 45°C, then add Part C one by one slowly and continue stirring and cool down to room temperature.
5. Homogenise the batch for 1 minutes at 2,000 rpm

that is soluble in the aqueous phase will reduce the surface tension of the water phase and alter aesthetics. Finally, addition of a silicone soluble material other than dimethicone can provide water resistance, barrier properties and alter the skin-feel providing a dry powdery feel. All in all, there are many possibilities.

Case study: skin softening cream

There is an increasing trend to use naturally derived esters to replace mineral oil in skin care products. The substitution can offer an ability to alter the skin-feel by addition of silicone polymers, providing altered aesthetics, around which a marketing programme can be structured.

Table 2: Analytical.

Specs	1	2	3	4	5	6	7
Viscosity (cps)*	18,500	18.40,	18,500	18,500	19,000	19,000	3,500**
pH	6.93	6.99	6.90	6.98	6.90	6.97	6.93
Appearance	White cream	White cream	White cream	White cream	White cream	White cream	White cream
Stability RT/45C	stable/ stable	stable/ stable	stable/ stable	stable/ stable	stable/ stable	stable/ stable	stable/ stable
Feel	Good	Good	Great	Great	Great	Great	Great
Compatibility	Good	Good	Good	Good	Good	Good	Good
Conclusion	Good	Good	Good	Good	Good	Good	Good

*Brookfield Synchro-Lectric Viscometer LVF Spindle #4, 12 rpm, at 25 °C
**Because part of Solid Glyceryl Stearate was replaced by liquid PEG8 dimethicone, therefore its viscosity was much lower than that of commercial duplicate.

Target formulation

With silicone additives, the differences of the finished products can be felt obviously by the skin. For example, the cream is more lubricious and very soft with the addition of the silicone gum (Formula 4). With the addition of the ethyl methicone (Formula 2) the cream is rendered with a silky feel and the skin looks bright when dry.

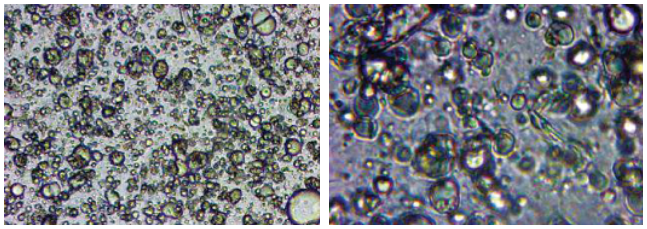
When a multi-domain silicone is used to replace petrolatum, the cream is rendered with a very soft silky glossy feel on the skin and can be played with more time and cushion.

Addition of a Q resin (Formula 3) results in a powdery feel and dry after-feel.

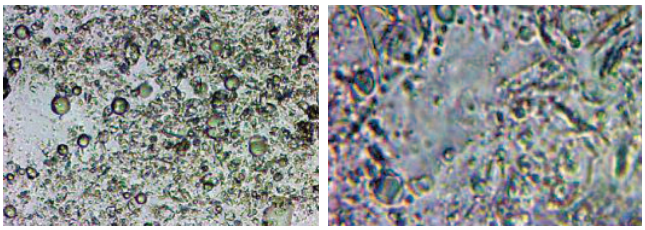
Very significantly, partially replacing solid emulsifiers with the correct PEG 8 dimethicone results in a formulation with a significantly more lubricious, softer and smoother feel.

The control formulation is interesting since it incorporates dimethicone 100 cst into the product. This results in an improvement of the normally sticky oils in

Formula 1: Control (left100x, right: 400x)



Formula 2: Ethyl methicone (left100x, right: 400x)



Formula 3: Q resin (left 100x, right: 400x)

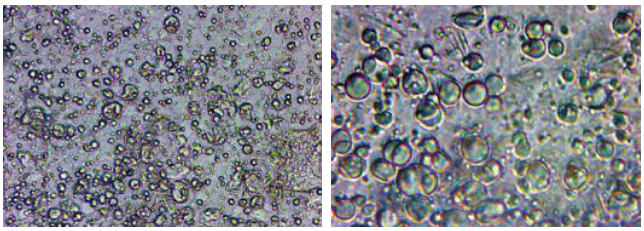


Table 3: Sensory evaluation.

Spensory Parameters*	1	2	3	4	5	6	7
Before Absorption: wetness	8.0	8.5	8.0	8.0	7.5	8.0	8.0
Spreadability	8.5	9.0	8.5	9.0	8.5	9.0	9.0
No tackiness	8.0	8.5	8.5	8.5	8.5	8.5	8.5
absorbency	7.5	8.5	8.5	8.5	8.5	8.5	8.5
After absorption: gloss	7.0	7.0	7.5	7.5	7.0	7.5	7.0
Film residue	7.5	7.5	7.5	7.5	7.5	7.5	7.5
No greasiness	8.5	9.0	9.0	9.0	9.0	9.0	9.0
Silkiness	8.0	8.5	8.5	8.5	8.5	8.5	8.5
No tackiness	8.0	8.5	8.2	8.5	8.5	8.5	8.5
Softness	8.0	8.5	8.5	8.5	8.5	8.5	9.0
Total	79.0	82.5	81.7	82.5	80.0	82.0	82.0

*1–10, 10 is the best

the formulation and increases spread. This approach results in a much better product than if the dimethicone were not present, and the selection of 100 cst results in a combination of increased spreadability and compatibility with the various oils present in the product. Replacing the 100 cst dimethicone (3%) with the multidomain silicone at 1% we believe would provide improved aesthetics over the silicone fluid.

Microscopy study

Method: Barska AY11374-Digital Microscope was used to take pictures of the standard and other products. The images were taken at 100X and 400X magnification at multiple spots on each microscopy glass slide. Pictures were processed by using Adobe Photoshop 7.0. Full scale of the image is 400 µm and 100 µm respectively.

PEG-8 dimethicone is a liquid O/W emulsifier which can be used to replace the solid emulsifier in the formulation to give the emulsion a more 'liquid feel'. Not only is the improved feel obtained by adding this emulsifier, one can see from the microscopic images of the emulsion that Formula 7 has the smallest emulsion particles and very narrow particle size distribution. Johann Wiechers, a prominent pioneer in the field of emulsion aesthetics, has pointed out the importance of the emulsifier selection in the aesthetics of the emulsion. PC

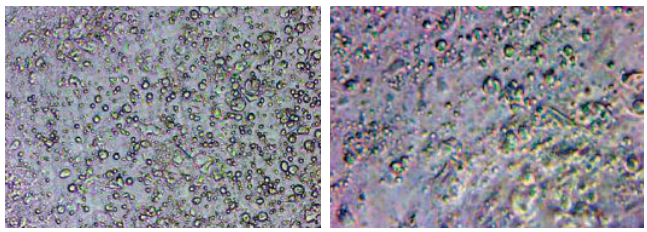
References

1 Clayton M. Christensen The Innovator's Dilemma Harvard Business School Press 1995 ISBN 0-87584-585-1

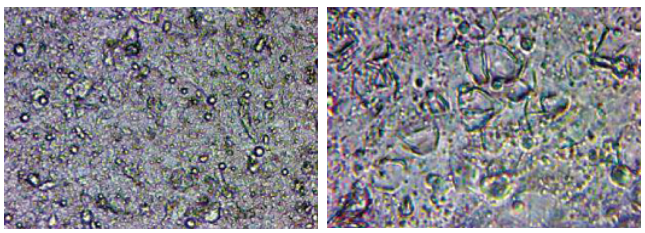
2 http://whatis.techtarget.com/definition/disruptive-technology

3 http://whatis.techtarget.com/definition/disruptive-technology

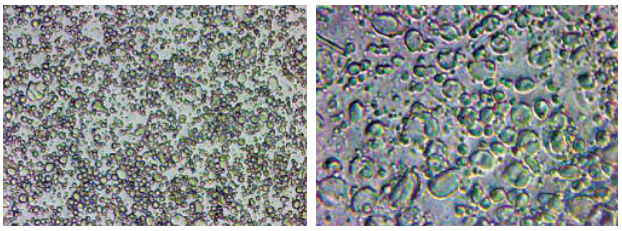
Formula 4: Dimethicone gum (left100x, right: 400x)



Formula 5: Dimethicone/vinyl dimethicone copolymer (left: 100x, right: 400x)



Formula 6: Multi domain alkyl silicone (left:100x, right400x)



Formula 7: PEG-8 dimethicone (left 100x, right: 400x)