Multi-Sensory Technologies for Today's Effervescent Bath and Shower Products

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Abstract

Effervescent shower tablets, floating/foaming fizz and blooming bath oils arouse bathers' olfactory, visual, tactile and auditory senses to new levels. Formulators and developers have novel options for creating new product concepts.

The basics of effervescent bath tablet technology were previously published in this magazine.[1] This article examines recent advances in this basic technology that move the possibilities for sensory stimulation to new levels.

The more senses a product stimulates, the greater the chances for consumer delight. This paradigm leads product developers to incorporate as many sensory cues into their creations as they can. One of the beauties of effervescent technology is that it is ideally suited to produce bath products that can excite multiple senses. The fizzing sound of the effervescent reaction, the burst of fragrance delivered directly under the bather's nose, the dispersion of color throughout the bath water, and the tactile sensations of emollients both in the water and on the skin after the bath help create high levels of consumer satisfaction. Products that use well-known effervescent technology do all of these things quite well.

Multi-Sensory Stimulation

Anyone who has spent even a little time working on product formulation and development has learned that the more senses a product is able to stimulate, the more interesting it is to the consumer. And when a product is more interesting to the consumer, it will generate more sales and more loyalty.

One of the beauties of effervescent products is that they are able to stimulate up to four senses — smell, sight, touch and sound — at one time. Taste can certainly also be stimulated, but that sense is usually beyond the scope of our industry.

Olfactory Stimuli

The sense of smell is the most important of the senses in the cosmetics and personal-care industry. All product developers and marketers have learned that fragrance selection can make or break a product. A well-designed perfume can provide the sensory cue needed to drive a product with marginal technical performance to marketplace success. Conversely, even a product with vastly superior technical performance cannot succeed in the real world if its fragrance does not support its positioning. It is critical that product developers work very closely with fragrance suppliers to assure that the perfume is an excellent fit for the product concept.

In the case of bath products, the fragrance has the opportunity to perform several times: It can make the bath water smell nice; it can scent the entire room; it can leave a lingering scent on the skin; and, in the case of aromatherapy fragrances, it can provide specific effects such as calming or invigorating benefits.

Effervescent products are excellent delivery vehicles for fragrances. The CO_2 gas evolved by the effervescent reaction helps lift and disperse aromatic compounds in and around the areas where the product is being used. Several ways to increase the fragrance lift of effervescent products even further are discussed later.

Table 1 summarizes the fundamental fragrance performance of the various effervescent product forms. Tableted forms like disks and marbles are high density, so they sit on the bottom of the bathtub as they react. This means that fragrance will be released relatively slowly, perhaps over 2-7 minutes depending on tablet size. If the product contains an emulsifier, the fragrance will be distributed throughout the bath water. This maximizes the scent of the water itself and provides a product that is not a mess to clean up. If there is no emulsifier, the perfume oil will float on the water's surface. This maximizes its release into the air and the room. It will also maximize the amount of fragrance that remains on the skin as the bather pulls his

In greater depth: For a primer on effervescent technology, visit The Cosmetics & Toiletries magazine Web site at www.TheCosmeticSite.com.

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or her body through the layer of perfume oil. This is not to say that a non-emulsified perfume oil is required to deliver excellent fragrance performance to the air, room and skin. These performances can be delivered with well-designed, non-messy emulsified perfumes.

Molded products react much more quickly than tablets. They also tend to float. This means that the fragrance will be released very rapidly on the surface of the water. Much of the fragrance will go directly into the air, scenting the entire area. Some of the perfume will, of course, remain in or on the water, depending on whether an emulsifier is included in the formula.

Granules act a lot like tablets in that they are dense and sink while they are effervescing. However, since they are small, the granules will be pretty much dissolved by the time they hit the bottom of the tub. At most, they will last on the bottom for 30 or 40 seconds. This means that the fragrance release from granules will be very quick. Another important point about fragrance release from granules is that this form allows consumers to easily measure out the amount of product being used. Thus, they can control the amount of perfume being used to their personal preference.

Effervescent powders are low in density. They basically flash as they hit the water's surface, providing a very quick burst of fragrance. Like granules, powders make it easy for the consumer to vary the amount used.

Maximizing Fragrance Impact

As was mentioned earlier, the effervescent reaction, via its generation of CO_2 gas, helps propel fragrances into the air and water. This performance can be maximized via a new, patented, technology that improves fragrance volatilization from these products.[2]

This formulation approach is called effervescent/exothermic technology. It combines an effervescent matrix with a material that gets warm when it gets wet. The resulting combination of fizzing and warmth synergistically boosts the release of volatile materials.

Table 2 illustrates how this technology works. Formula 1 is an effervescent/exothermic product. It contains an acid, a carbonate and a material that has an exothermic heat of hydration or solution. In this case the exothermic material is magnesium chloride. It has a heat of solution of about 36 kcal/g-mole. When a 30-gram tablet of this composition was placed in 50 ml of 25°C water, a 29°C temperature rise was observed. This formula's dissolution time was very reasonable at about 7 minutes, and the subjective evaluation of the fragrance lift was very good.

The Importance of Fragrance Selection – A Personal Reflection by Allen Rau

I learned an important lesson about the power of fragrance early in my career. My first project as a fresh-out-of-college product development engineer involved a possible perfume change for a popular dishwashing liquid.

The immediate task was to assess which of two fragrance candidates consumers would prefer. I marched out to the pilot plant and mixed up a drum of unfragranced product. I split this batch in two and added perfume A to one half and perfume B to the other half, assuring that both products were identical except for the perfume. My team placed these products in a paired comparison product test. When the results came back a few weeks later, we found that one product was preferred — not just for fragrance quality, but also for cleaning dishes, cutting grease, foaming enough, on and on — right down the line for all of the important product performance attributes.

The lesson was clear: The choice of the proper perfume has a significant effect on how consumers perceive a product. It can make a marginally performing product a big winner. Or, on the flip side, even a product with excellent technical performance can be hurt in the marketplace if the fragrance doesn't communicate properly. Even with the tight product introduction schedules that all developers face, it is critical to spend significant effort making sure that fragrance screening and selection are truly optimized for the product concept.

Table 1. Olfactory Performance by Product Form

Product Form	Performance
Compressed Products	High Density-Effervesce at Bottom of Tub, Slow Fragrance Release
Molded Products	Low Density-Effervesce on Water Surface, Rapid Fragrance Release
Granules	High Density, Small Particle Size Releases Fragrance Quickly while Product Sinks
Powders	Low Density, Small Particle Size Flashes Fragrance at Water's Surface

Table 2. Exothermic-Effervescent Technology to Improve Olfactory Stimulation

Formula	1	2	3	4
Acid	✓	✓		✓
Carbonate	✓	✓	✓	
Exothermic Material	✓		✓	✓
Temp. Rise (°C)	29	-5	19	9
Dissolution Time	6:57	10:03	29:45	40:32
Fragrance Lift	Very Good	Poor	Poor	Poor

In comparison, Formula 2 is a standard effervescent product. Here the temperature actually decreased 5°C. This is not surprising given that the effervescent reaction is endothermic and the release of carbon dioxide gas has a cooling effect. While the 10-minute dissolution time may be a bit long, it should be reiterated that this experiment was conducted at 25°C, quite a bit cooler than typical bath water temperature (usually around 40°C). So 10 minutes is not a surprisingly long dissolution time for a 30-gram tablet in cool water. The fragrance lift generated by this product was poor compared to the exothermic/effervescent combination.

Formulas 3 and 4 show products that are not effervescent. They simply have the exothermic material in combination with either the carbonate (Formula 3) or acid (Formula 4). Here the temperature rises, but dissolution times are so long that the fragrance lift is dramatically diminished. Thus one can see that the combination of effervescence and warming creates a product with improved lift of volatile materials.

Products that utilize this technology should be produced as tablets since they are the easiest form to keep dry. It is even more important to maintain dryness with the exothermic material present than it is with conventional effervescent products, since premature hydration of this material will render it unable to perform its function in use.

This technology opens the door for some unique products such as fragrance tablets to be placed on the floor of the shower, which are activated by the constant stream of water hitting them. These tablets could be used to deliver aromatherapy oils or room freshening benefits. Another idea is to put small tablets into a vase or goblet and use them to fragrance an area.

Yet another new technology for improving fragrance delivery from effervescent products takes advantage of the low density of molded effervescent products in combination with a surfactant.[3] It is well known that surfactants' natural tendency to migrate to water/oil, air/water and air/oil interfaces allow them to form lathers or foams. These foams are thin films of surfactant and oil rich water that have large surface areas in contact with air. When surfactants carry fragrance into foam, the perfume oils have large surface areas from which to diffuse into the surrounding air. Thus, the foam bubbles help deliver fragrance.

Since molded effervescent products react turbulently on the surface of the water, they can help whip up a foam. Tableted products cannot do this since they react on the bottom of the tub.

Table 3 illustrates this effect. As you see, the molded product has a density less than 1, so it will float. It also has a high dissolution rate, greater than a gram per second. The result is a consumer-acceptable foam layer. A tablet made with the same formula as the molded ball has a much higher density and a much lower dissolution rate. It does not create a nice bubble bath.

Visual Stimuli

On the store shelf, product shape, color and texture all contribute to the message sent to the potential consumer. Visual performance signals are possible during product use, too. For instance, water color can be changed, the degree of turbulence that the product creates can be controlled, foam can be included, and lingering color flecks can be added.

Coloring effervescent products is straightforward. Dyes, lakes and pigments can be added without trouble. Sophisticated manufacturing equipment and techniques can create products that contain multiple colors. For instance, a tablet press fed by hoppers of different colored materials can produce striped products. Bilayer tablets can be manufactured in much the same way. Speckled or variegated products can be manufactured by mixing colored granules into the unpressed or unmolded powder. Both tablets and molded shapes can be manufactured using these techniques.

Glitter can be added to effervescent products. Metallic glitter gives a sophisticated look to the product but, since it does not dissolve, leaves quite a mess in and around the bathtub. Kids, particularly teenage girls, love it; their moms are not so keen on the idea. A solution to this is water-soluble glitter. This material is available in many colors. The colored flecks tend to float on the foam's surface, giving it a speckled appearance. As they dissolve, their color spreads out a bit giving a "melting" look. It imparts a sparkly look to the product and does not cause a mess in the tub.

Bulk herbs, botanicals and even dried flowers can be added to molded products. These give an interesting natural look to the product and they create a kind of "tea" in the bath water. One concern is that they can create quite a mess. However, if the materials have large enough pieces, they can be cleaned up fairly easily.

Product shape, of course, is easily modified by choosing appropriate tooling. Hearts, eggs, balls and disks are all common shapes. Shapes as complex as flowers, snowmen and angels have been produced.

Table 3. Foaming-Floating Technology to Improve Olfactory Stimulation

Process	Density (g/cc)	Dissolution Rate (g/sec)	Foam Acceptability
Molding	0.90	>1.0	Excellent
Tableting	1.43	<0.5	Fair

Producing Effervescent Products

There are four major methods for making effervescent products.

Direct compression is the most commonly used method because it is the simplest and most cost effective. In this technique, dry materials are blended and then compressed directly on a tablet press or other compression machinery.

Wet granulation requires some or all of the formula's components to be wet with a small amount of a solvent, generally either water or alcohol, during the mixing process. The solvent causes powdery material to aggregate into granules that can be efficiently processed on compression equipment. Since that solvent can actually start the effervescent reaction, it must be added under carefully controlled conditions and then must be completely removed from the mixture. This is achieved through oven drying or vacuum treatment. A secondary benefit of processing effervescent materials this way is that dyes can be used in place of lakes or pigments to color the product itself. The addition of the solvent solubilizes the dye, spreading it evenly in the bulk mixture. Bright product colors can be achieved this way.

Dry molding is the favorite process of the homemade bath bomb producers. In this process, the dry components are mixed with oils, pressed into molds, and then oven dried to bind everything together.

Wet molding, like wet granulation, requires the addition of a solvent. After the solvent is added, the mixture is formed in molds and then allowed to dry either in ambient conditions or in ovens. Both wet and dry molding processes are much like forming wet sand into a sand castle…elegant results are possible, but noticeable flaws occur easily.

Table 4 compares some key attributes of products produced using the various manufacturing methods.

Table 4. Production Method Comparison

Molding	Direct Compression	Wet Granulation	Dry Molding	Wet Molding
Cost	Lowest	Low	High	High
Product Density	1.6-1.8 g/cc	1.6-1.8 g/cc	0.9-1.1 g/cc	0.9-1.1 g/cc
Dissolution Time	2-7 minutes	2-7 minutes	1-3 minutes	1-2 minutes
Stability	Moisture proof wrap and/or desiccant required	Moisture proof wrap and/or desiccant required	Relatively stable to ambient humidity	Relatively stable to ambient humidity

Foaming products, like the one discussed earlier, can add to the visual experience. Everyone who has seen a picture of a woman, sitting in the tub, sipping champagne, understands that bubble baths are one of the most well-known looks of luxury.

Tactile Stimuli

When it comes to bath products, the sense of touch focuses on two areas: the feel of the water and the feel of the skin, both during and after product use.

Water effects center on three main areas: foam, emolliency or slip, and the feeling of massage from the effervescent reaction. Skin effects include the use of emollients and polymers and the incorporation of materials that can cause the skin to tingle.

In the water, approaches for creating an acceptable foaming product and for adjusting the reactivity of effervescent systems have been covered above. Effervescent product formulators have learned that the feel of the effervescent CO_2 bubbles rising from the product creates a very relaxing environment. Consumers who use effervescent foot and nail soak products particularly appreciate this effect. It is like a mini-massage.

As one can imagine, emollients, humectants and polymers are frequently added to effervescent bathing products. Developers must remember, however, that when any of these materials are added they must be in virtually anhydrous forms. Usage levels for these materials range from 0.5-5%. Commonly added emollients include vegetable oils such as sunflower oil, jojoba oil and almond oil and esters such as IPM and the various benzoate esters. Humectant polymers such as PEG and polyquaternium-10 have been used successfully.

Materials that cause skin tingling sensations are also interesting. Menthol is the most common of these materials, but one must be very careful not to use too much menthol in bath products. The tingling effect might be just a bit too localized. In foot and nail soaks though, menthol provides a very stimulating effect.

For effects on the skin, the materials used are much the same as those used to modify the feel of the water. An additional type of material to consider here is a vasodilator. There is a great deal of published literature that indicates that dissolved CO_2 can act to dilate the skin's surface capillaries.[1,4-7] This should provide the bather with a feeling of warmth.

Effervescent Bath Product Forms

Effervescent bath and shower products come in many shapes and forms. Since compression processes are the most economical way to manufacture effervescent products, tableted marbles and disks have become the most common shapes for today's effervescent bath items. These tablets weigh generally between 3 and 50 grams. The consumer will use from one to perhaps five or six per bath depending on the size of the tablet and the product concept. Shapes other than disks and spheres are possible with the use of appropriate tooling. Tableted shapes, however, are usually symmetrical and they always have a vertical band around their equators.

Molded shapes are larger than tablets. They can range anywhere from about 75 grams up to 400 grams. The consumer generally uses only one piece per bath. So-called bath bombs, bath balls and bath fizzies are molded shapes. Hearts, flowers, eggs and other shapes can be molded.

Granules are small pieces of fully formulated product that have been compacted and sized. The advantage to granular products is that it is easy for the consumer to measure and use as much product per bath as desired. Granules can be easily scooped or poured into the bath whereas tablets and bath balls are difficult to break into smaller units.

Effervescent bath powders are usually simple raw material blends. Like granules, powder dosage is easy to control. However, since non-compacted powders have high surface areas, they tend to be highly reactive. This makes product stability difficult to achieve with effervescent powders.

Auditory Stimuli

Hearing is not a sense that is normally aroused by cosmetic products. However, effervescent products can stimulate this sense. The fizzing sound of these products is an essential part of the experience of using them. Tailoring the effervescent reaction to be fast or slow will affect the audible effect. The sound is part of the fun.

Another type of auditory stimulation can be achieved by utilizing crackling granules. Crackling granules are not effervescent in the sense that they use the acid/carbonate reaction to generate carbon dioxide, however, they are the direct result of carbonation. Crackling granules are created by entrapping pressurized CO_2 in a solid, water-soluble matrix. The matrix is usually composed of an amorphous sugar blend that actually encapsulates the gas. When these granules contact water, the sugar dissolves, releasing the tiny pockets of gas with a lot of noise.

An interesting audible product is a blooming bath oil that incorporates crackling granules. This type of product will disperse a self-emulsifying bath oil that crackles for several minutes. The duration of the sound will depend on the size and quantity of the granules and, of course, the water temperature. Durations of 2-3 minutes are not uncommon, but it can go on for 5-7 minutes. In order to stimulate other senses, the granules and/or the oil can be colored to give interesting effects. A US patent application for this technology has been allowed.[8]

Conclusion

As you can see, effervescent technology opens the door to many multi-sensory product possibilities. New formulation approaches such as exothermic effervescent shower tablets, floating/foaming molded fizz balls and blooming bath oils with encapsulated carbonated granules add multi-sensory stimuli to this product category. These technologies can simultaneously arouse the olfactory, visual, tactile and auditory senses to new levels. Thus product formulators and developers now have novel options for creating new product concepts that increase consumer involvement with their creations. The more involvement consumers have, the more delighted they will be.

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