Fragrance Stability

How to avoid problems

Unexpected stability problems from fragrances are rare when products are designed with stability in mind

photo: Yeko Photo Studio, Shutterstock.com

Designing the right fragrance for the right product requires thought and communication. Unexpected problems from fragrances are rare when products are designed with stability in mind, as Penny Williams from Orchadia explains.

A perfume in concentrated oil form, if stored well, is usually stable for years. Once a perfume is introduced into a cosmetic application things can become trickier.

The most common problems with perfumes relate to colour. Perfumes can cause immediate discolouration or cause colour changes over time. Perfumes can be involved in other changes of appearance, for example they can change the viscosity of emulsion systems and be the cause of sediment appearing in alcoholic fragrances. It makes commercial business sense to provide stable products for many reasons including avoiding customer dissatisfaction and preventing different batches of the same product looking different on a sales shelf. Additionally, a requirement of the Cosmetics Regulation is to provide (appropriately) stable products. So, perhaps it may seem simpler to use fragrances which are colour neutral and avoid any ingredients with potential for change. However, is this even possible or desirable? What is a stable perfume? A perfume which is stable in the cosmetic product base and packaging at the percentage used in the conditions of expected use does not mean no change or colour is allowed. Often there are competing requirements between product attributes and some compromise is required.

Avoiding discolouration

Some fragrances require discolouring ingredients to smell authentic. A good example is vanilla which naturally contains vanillin, responsible for providing the distinctive odour. Vanillin, along with ethyl vanillin and several other commonly used fragrance materials can contribute to the discolouration of cosmetic products. It depends on the ingredient level in the fragrance, the fragrance dosage in the product and the type of cosmetic product.

For certain products it is appropriate to confine the fragrance choices and sacrifice some odour character in pursuit of a stable white product. Other really effective approaches can be to add UV absorbers to slow down the changes, reduce the percentage of discolouring materials or perfume or, where possible, to alter the pH of the product to slightly acidic to inhibit discolouration. As consumers are familiar with real vanilla an authentic vanilla fragrance is often required. This has led to the widespread use of discolouring vanillin in cosmetics and toiletries and to some interesting ideas on presenting them. Packaging ideas includes disguising the discolouration, through the use of opaque bottles, to using proud and clear bottles containing body lotion with a caramel appearance.

photo: Anna Subbotina, Shutterstock.com

Vanillin, responsible for providing the distinctive vanilla odour, can contribute to discolouration of cosmetic products

Top tips for stable perfumed products

- thinking about stability early – thinking positioning, perfume, product and pack
- using a fragrance designer who is a member of IFRA (the International Fragrance Association)
- communicating with fragrance designers so they know the relevant product
- fragrance should be designed for the base taking into account pH and other factors
- using appropriate protection such as anti-oxidants to inhibit oxidation and UV absorbers to restrict the effects of sun and shop lights on the product

How to manage colouration

For products with a high fragrance percentage, like fine fragrances, perfume may be the key contributor to colouring the product. Often concentrated perfume is pale yellow, but it can be much darker, depending on the ingredients used. Natural perfume ingredients can be dark in colour and also have batch to batch colour variability which may need to be carefully managed.

As with discolouration there are several ways of managing the effect of perfume oil colouration. Different approaches include: allowing the colour to be part of the product, giving preference to light coloured perfume oils, using colours in the final product to enable an acceptable product colour, and using opaque packaging to limit visibility if the colour is undesirable.

What consumers expect

There are shifts in consumer expectations about product appearance over time. In the past products tended to be darker and more variable. Market position plays a significant role too. D design led products, ingredient or fragrance led products and niche products show a different tolerance for colouration. This can be observed in the fine fragrance market: **Estée Lauder Youth Dew**, launched in 1952, is proudly dark in colour whilst **Paul Smith Women** launched 2000 is coloured pink. The pink colour must have been a perfume development challenge, impacting on the choice of ingredients. **Liz Earle's Botanical Essence** perfume launched 2012 is dark in colour due to the high natural content, but has been wrapped in an attractive opaque white bottle.

Colour changes in perfume oils

Perfume oils can become lighter or darker over time, though normally these changes are minimal and do not cause problems in use. Citrus oils in particular, and also blue chamomile, can bleach with age and contribute to a lighter colour. Reactions between fragrance materials can contribute to colour changes, usually resulting in a darker colour. A Schiff's base is a reaction product between aldehydes and methyl anthranilate, each product has a characteristic deep colour. Methyl anthranilate and hydroxycitronellal react to form Auranthiol, named after its deep golden colour. Auranthiol's odour is really useful for the authentic note of honeysuckle as well as being useful for other floral effects. Schiff's bases can be deliberately introduced into fragrances but they can also form over time, after fragrance production.

Trace metal contamination can contribute to unexpected and undesirable colour changes in perfume oils. The main cause of this is damaged metal drums where the lacquer lining has become compromised and perfume oil comes directly into contact with the metal. To determine the cause of an orange or red hue on a perfume oil, examining the drum is a good first step.


photo: Estée Lauder

In the past products tended to be darker – Estée Lauder's Youth Dew was launched in 1952

Improving other visual effects

Perfumes may affect the viscosity of detergent bases or cause them to go cloudy. To improve these effects there are several possibilities: Fragrance can be added at a different point in the production process, it can be partially solubilised before addition, or the salt level or surfactant level in the base can be adjusted. If these steps don't solve the problems an alternate fragrance may be required.

Perfumes may contain ingredients which can cause sedimentation in alcoholic fragrances. Some natural materials contain waxes which usually remain dispersed in the perfume oil. However, after introduction to an alcohol base they may cause a sediment to form. This can be easily overcome by encouraging sediments to form and filtering them out. To do this, the alcoholic product is chilled to promote the waxes to fall out of solution. Once the sediment formation is stable it can be removed by filtering – this is part of the maceration process. The process usually takes 48 hours, however can take longer depending on the formulation, ingredients and dosage.


photo: Paul Smith

The pink colour must have been a perfume development challenge, impacting on the choice of ingredients

Maintaining perfume odour-stability

Most fragrances are odour stable in concentrated oil form for years if they are stored well. Some of the discolouration problems can also impact on odour. For example Schiff's base formation can contribute to changes in odour, which are usually subtle. Some fragrance ingredients can oxidise, e.g. lemon and orange oil. This makes their odour flatter and less sparkly. To help reduce oxidation problems the use of anti-oxidants in perfume ingredients and perfume oils is commonplace (but not a certainty).

Odour stability once a fragrance is in the base product is more complex and can be affected by many factors. The base, the packaging and the perfume need to be considered together to achieve appropriate stability:

- Does the base have a high or low pH? Not all perfume ingredients are stable across the pH range.
- Does the base have a high surface area, e.g. talc? Increased surface area gives a larger area for oxidation to take place.
- Is the packaging permeable? Talc in a cardboard tube suffers from a high surface area product with oxygen migration possible through the packaging, easily doubling the problem.
- Is it an alcoholic (ethanol) based product e.g. fine fragrance? There is potential for ethanol to react with fragrance ingredients over time giving an "off" smell. UV Absorbers and anti-oxidants in the base formulation help to inhibit this and enhance colour stability, too.

Optimizing the manufacturing process

For many fragranced products the point at which the fragrance is added is relevant to the end result. If the manufacturing process of a cosmetic product involves heat, when should the fragrance be added? Adding fragrance when a product is too warm can possibly drive off fragrance volatiles or promote reactions, potentially changing the odour. A stability problem in the final product can arise, for example, from the production process.

In the production of fine fragrances and other alcohol-based perfumes, the maturation time (how long a fragrance is left after blending) and maceration time (how long fragrance is left in alcohol prior to chilling and filtering) can also be important factors in product quality. It sounds a little like witchcraft, but many fragrances require some time to mature and then to macerate in order that they smell their best and this impinges also on the quality assurance area. Monitoring the manufacturing process results in a more consistent product, helps avoid instability and makes it easier to spot and remedy any problems.

Conducting stability tests

Stability tests are routinely conducted in conditions which represent potential storage conditions and are used to to predict long term stability, including ultra violet light to re-produce the effects of sun and shop lights, and an oven which offers a speeded up view of long term stability. Ideally, the unperfumed base should be tested in addition to perfumed base as this helps determine the role the fragrance is having on product stability. It also allows the odour of the product base to be smelled during the assessments. When the samples are reviewed for odour, the order in which they are smelled can contribute to the results, for example the sample smelled first usually appears to be the strongest. The preferred order for smelling stability samples relates to the relative stability of the storage conditions. As a rule of thumb refrigerated samples have to be smelled first, then ambient samples, then oven, then UV. Additionally, all of the unperfumed base samples have to be smelled before the perfumed samples to best detect odour changes..

Other resources

Fragrance Safety – International Fragrance Association: www.ifraorg.org
The Personal Care Association – Cosmetic Europe: www.cosmeticseurope.eu
Perfume Training: www.perfume-training.com
Clear talking targeted at consumers about cosmetic products www.thefactsabout.co.uk

Penny Williams
Perfume Consultancy
Orchadia Solutions, Thrapston
Great Britain
pennyw@orchadia.org
www.orchadia.org