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Overview of colour dispersions in cosmetics

Colour cosmetics are a ubiquitous element of personal care products, owing to the diversity of applications in which colour can be used. End-use applications include liquid and powder foundations, BB creams, concealer, blush, eye liner, eye shadow, lipstick, mascara, skin care and sunscreens. The colouring material in a particular formulation depends on the desired colour effect. For example, in the case of a shimmering eye shadow, a one-hundred micron interference flake type material could be used, whereas in the case of a foundation, pigments less than one micron are used for a skin tone match. To formulate with pigments in powdered form requires proper handling and processing prior to and during formulation. Using colour dispersions alleviates these types of intermediate steps and offers benefits of colour development with consistency of batches. Dispersions of metal oxides and organic pigments in multiple carriers are typically available. Only homogenisation may be required to have a successful, final product based on a colour dispersion.

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Dispersion overview

A material defined as a dispersion is characterised as particles that are dispersed in a continuous phase of a different composition. Dispersions are structured to include a pigment, a vehicle, and a dispersant. First is the vehicle. This is essentially the liquid that the particulate medium is dispersed in. The next element is the dispersant. The dispersant functions to assist in wetting out the pigment, prevent settling, and stabilise the pigments by ensuring pigment separation in the dispersion. Wetting out the pigment is important to increase the concentration of the pigment in the chosen vehicle. Often the pigment includes a surface treatment. This is the solid being dispersed. The treatment aids in helping to wet out the pigment, achieve a uniform dispersion, and allows for a higher solid content. Additionally, treatments can help to neutralise a charge on the outer surface of a pigment and to help reduce the aggregates to make smaller size pigments. Treatments reduce the friction and adsorption on pigments so more concentrated dispersions can be achieved.

Pigmentary grade pigments encompass titanium dioxides (TiO_2), iron oxides, and lakes which are useful materials for a chemist to employ in colour formulations. Typically, particle sizes of these materials are greater than 0.2 microns suffering the common drawback of agglomeration within formulation. Particle size of the aggregates is an important parameter since it has direct correlation to colour strength, gloss, and opacity. In theory, the highest colour intensity generates more opaqueness and is achieved when the dispersion particle size in formulation is at a size closest to their primary state. Colour dispersion materials boast small size particles which are fully dispersed. By using dispersions, the internal forces are reduced thus limiting re-agglomeration and reduced settling for the most effective product.

Figure 1: *Drawdowns displaying the highly natural appearance of transparent iron oxide dispersions (left) versus a traditional colour dispersion (right).*

In addition to the previously mentioned pigmentary grade pigments are transparent iron oxides. These useful materials exhibit a natural finish on the skin (Fig. 1). Additionally, they are known to contribute to UV attenuation by boosting SPF and adding UVA protection in sunscreens. These materials provide a tint to a formula for the purpose of reducing the appearance of whitening, and chalkiness. In ethnic products, transparent iron oxides provide a natural look through the balance of transparency and coverage. Dispersions of transparent iron oxides tend to agglomerate more than the traditional type due to their smaller size resulting in difficulty in dispersing these particles. The solution is to use dispersions and surface treated powders of transparent iron oxides for easy incorporation into formulation. Suitable vehicles of these particle materials include silicone emulsifiers, esters, and volatile non-D5 silicones.

The motivation for using dispersions

There is a large motivation behind using colour dispersions in formulations in lieu of powdered pigments. Using a dispersed material alleviates the need for grinding, providing for reduced handling. These types of materials facilitate high loading levels of solids in formulations. With that said, a noteworthy achievement of these dispersions is the ability to obtain full colour development in formulations. Using a dispersion that imparts higher

colour strength of pigments provides more room in a formula for other materials. A highlighted feature particularly for the formulator is that these dispersions are easy to incorporate with mixing and homogenising. Since batches are consistent this will eliminate some colour correcting issues and generally colour dispersions offer better stability in a formula. Finished products offer improved wear and pleasing aesthetics such as better skin feel since incorporated pigments are treated. Dispersions are also easy to use for colour correcting and better batch consistency of colour or transparency. Colour consistency between batches for reproducible results means global plants will have uniformity since there is access to the same materials. With these materials, there are fewer issues with streaking and better mass tone to skin as in the case of foundation formulations. From a manufacturing perspective these dispersions are highly cost effective. These products eliminate the need for labour, equipment, and time to plan processing and to make the actual grind. This in turn contributes towards energy conservation in the manufacturing process. Furthermore, many incoming quality control checks on pre-shipments are eliminated by utilising these materials.

Pigments such as iron oxides/transparent grade iron oxides, TiO_2, ultramarines, organic lakes, and carbon black, in treated and untreated form, are typically used in colour cosmetic formulation for enhanced skin feel and high colour intensity of the pigments. The available pigmentary grade dispersions on the market are plentiful with key emphasis on the varying carriers available namely water/glycol, silicone fluids, esters, hydrocarbons, natural oils, and volatile non-D5: ethyl trisiloxane, trimethyl siloxane, dimethicone and trisiloxane. This variety essentially allows for dispersion products to be used in most formulations where these products are applicable.

Dispersions in esters/oils

Falling under the category of dispersions in esters/oils is a range of products where featured materials will be discussed. Dispersions in synthetic wax (SW) and treated with isopropyl titanium triisostearate, [INC: Synthetic Wax (and) Pigment (and) Isopropyl Titanium Triisostearate] are highly stable dispersions of pigments with excellent affinity for the skin, due to the isopropyl titanium triisostearate (ITT) treatment. Furthermore these pigments impart gloss. Pigments prepared in this manner include TiO_2, iron oxides, and organic lakes. These types of dispersions have preferred use in emulsions (W/S, W/O, S/W, and O/W). They may also be used in anhydrous, non-volatile and volatile systems. Finished emulsion formulations include liquid and cream foundation, cream-to-powder make-up, concealer, mascara, lipstick, and blush. In anhydrous systems these colour dispersions can be successfully used in eyeshadow, concealer, and lipsticks. Synthetic wax dispersions using organic lake pigments possess higher colour strength compared to non-dispersed lakes. Their preferred use is in anhydrous non-volatile and volatile systems. Also use can be found in emulsions (W/S, W/O, S/W, O/W). Anhydrous systems where these colour dispersions find applicability are in lipstick and blush. Emulsion systems that are suitable are liquid and cream foundations, cream-to-powder makeup as well as lipstick and blush.

Dispersions in isononyl isononoate and treated with isopropyl titanium triisostearate (INBP) have hydrophobic traits and are dispersible in oil. A full line of pigments and lakes are available on the market prepared in this way giving the possibility to create a full range of shades using a single series (Fig. 2). These types of materials are excellent when applied to anhydrous non-volatile and volatile systems such as lipsticks, blush, and other stick form finished products. They may also be used in emulsions (W/S, W/O, S/W, and O/W) such as liquid and cream foundation, cream-to-powder makeup, lipstick and blush.

Figure 2: *Displays the possibility to create a full range of shades using a single dispersion series.*

A noteworthy dispersion in this category is the octyldodecanol (OD) with jojoba ester treatment (Fig. 3) for natural formulations. This natural pigmentary dispersion series is Ecocert approved for 2014. Solids content is high ranging from 55%-75%. These materials are applicable in emulsions, and hot pours.

Dispersions in silicone emulsifiers

Falling under the category of dispersions in silicone emulsifiers is a range of products ideal in emulsion systems (W/S, and W/O). These materials can also be used in anhydrous non-volatile and volatile systems. Preferred emulsion-based applications are liquid and cream foundation, cream-to-powder makeup, concealer, mascara, lipsticks, and blushes. In anhydrous systems, these are ideal in eyeshadow, concealer, and lipsticks.

FAS Dispersions [INCI: Pigment (and) Cyclopentasiloxane (and) PEG/PPG-18/18 Dimethicone] (Fig. 4) have good coverage, very low odour, are very stable, have high solids content, and strong colour strength. An alternative to the traditionally defined FAS dispersions is utilising a hybrid TTB treatment in conjunction with FAS. This TTB treatment is a crosspolymer formed at the surface of the pigment offering versatility to this dispersion by adding benefits such as super dispersibililty in silicone-based systems, a hydrophobic and lipophilic nature, stability over a range of pHs, and better affinity to skin than common silicone coatings.

Figure 3: *Drawdowns of OD dispersions.*

Dispersions in water/glycol

These materials are best used in emulsions (O/W, S/W, W/O, W/S) and also aqueous suspensions. The GLW series is a water and glycerin system [INCI: Pigment (and) Water (and) Glycerin (and) Sodium Polyacrylate (and) Cellulose Gum]. The WBG series is a water and butylenes glycol system [INCI: Pigment (and) Water (and) Butylene Glycol (and) Cellulose Gum (and) Sodium Polyacrylate]. Preferred GLW and WBG applications in

emulsions are liquid and cream foundation, cream-to-powder makeup, concealer, mascara, and blush whereas in suspension form they are best for oil control liquid makeup.

Dispersions in aqueous acrylic resin

The acrylic resin is represented by acrylates/ethylhexyl acrylate copolymer. Uniquely this imparts a very water-resistant and flexible film with high colour strength. These WSJ series dispersions have high solids content and a fast drying time. In this series there are pigment colours of (yellow, red, and black) iron oxides, blue ultramarines, TiO_2, and black 2. Recommended applications for these dispersions in emulsion systems are sunscreens, liquid and cream foundation, cream-to-powder makeup, concealer, mascara, and blush. For oil suspension formulations applicability are in sunscreens and oil control liquid makeup.

Dispersions in volatile non-D5 silicones

These dispersion products have preferred use in emulsion systems (W/S and W/O) and also in anhydrous volatile systems. FAND dispersions are silicone dispersible, hydrophobic materials which are excellent for cold emulsions and gels. PMLVP series employs isododecane and are excellent when incorporated into volatile systems. Preferred usages are in cold emulsions; applicable in mascara, eyeliner, foundation, concealer and blush.

Figure 4: *Displays a FAS dispersion; FAS50R6SI.*

Conclusion

Colour dispersions are convenient and effective tools to be used in colour cosmetics. The product options available are immense allowing these materials to be used in practically any formula situation. Furthermore, the added benefits of eliminating the initial handling and preparation of pigment powders alleviate cost and time. These benefits are extended into final formulation since dispersions are of high quality, consistency, and are easy to use and incorporate. PC

References

1 Oyarzun JM. *Pigment processing: physico-chemical principles*. Hannover, Germany: Curt R. Vincentz Verlag, 2000

2 McKay RB. *Technological applications of dispersions*. New York: Marcel Dekker Inc, 1994.

3 Author not listed. (20 September 2013). *Pigmentary grade dispersions*. [Retrieved 25 February 2013, from www.koboproducts.com].

4 Schlossman ML. *Method of incorporating cosmetic pigments and bases into products containing oil and water phases*. US Patent 4877604 A – filed 4 September 1987 and granted 31 October 31 1989.

5 Author not listed. (10 February 2012). *Hybrid surface treatment*. [Retrieved 24 July 2013, from www.koboproducts.com].