

UNIQUE FLUORECENT PIGMENTS!

Functional pigments: Two series of newly developed formaldehyde-free daylight fluorescent pigments show that formaldehyde can be eliminated without compromise, both in solvent-based and in aqueous formulations. The new technologies outperform their formaldehyde-containing predecessors in all important properties, especially with regard to lightfastness and storage stability.



Goalkeeper gloves, a technical masterpiece

For about a decade now, fluorescent paints have been an integral part of many sporting goods. Fluorescent pigments are used in the production of diving suits, swimming aids, skis, bicycle helmets, balls of all kinds, sports shoes or goalkeeper gloves. In addition to the visual appearance, of course, the functionality of the respective sports article is a decisive criteria. For example, goalkeeper gloves (picture above) are real technical masterpieces. Meanwhile, there are special goalkeeper gloves for the different grounds on which games are played on and even for different weather conditions. Whether a team wins the World Cup or the European Championship or not depends also on the goalkeeper being able to hold the ball securely. In this connection the latex adhesive foam of the gloves play an

important role. The production of latex adhesive foams is a very critical application where high temperatures, water and ammonia (simultaneously base and solvent) could attack the pigment particles. The neutrality (inertness) of the new luminous pigments with regard to functionality in the described application promises far-reaching neutrality and stability in other coating systems and paints with demanding process parameters. The ARAQUA fluorescent pigments withstood very well similarly difficult process parameters during the production of the limited edition of Coca-Cola glasses available in neon yellow and neon pink at McDonald's in the summer of 2017. The company planned a six-week sale, but in fact, they were sold out after only one week.

Away from formaldehyde

Stable luminescent pigments are usually produced on the basis of formaldehyde. Since January 1st, 2016 formaldehyde has been classified as a carcinogen throughout Europe; but the decision to do this was already made in June 2014. It is therefore all the more important to replace old technologies with new formaldehyde-free production methods without compromising on the most important functional properties of daylight fluorescent pigments. In the case of goalkeeper gloves, these are in particular the adhesive properties of the pigments in addition to luminosity, migration and light stability. The product safety must not be at the expense of grip and colour brilliance. Instead, the switch to formaldehyde-free formulations should also be used for further product improvements. This could be achieved with two series of newly developed formaldehyde-free daylight fluorescent pigments for solvent-based and for aqueous formulations. Rui Patrício, the goalkeeper of the new European Football Champion kept the ball safely with the goalkeeper gloves owing their bright colour to these pigments, and in the final match against France the glowing gloves could not be overlooked. The advantage of daylight fluorescent pigments (TLP) for aqueous applications over TLP for solvent applications is that they require less hardening and a lower degree of cross-linking. This enables finer grinding and is associated with an increase in colour strength. Older formaldehyde-free technologies used polyester chemistry, which, however, have considerable stability deficiencies when stored in aqueous formulations. However, the newly developed formaldehyde-free technology for aqueous formulations based on hybrid polymers is stable. In addition, the new fluorescent pigments show a significant improvement in light stability to 70-100% compared to the



Bright Coca-Cola glasses thanks to ARA-
QUA technology

conventional fluorescent pigments based on melamine-toluene-sulfonamide-formaldehyde resins and even 350-500% compared to their counterparts based on benzoguanamine-formaldehyde resins.

Critical properties of daylight fluorescent pigments

Fluorescent pigments are usually solid solutions (encapsulations) of fluorescent dyes in resins and polymers. The dyes are usually physically and partly also chemically bound to these carriers. The development of naphthalimide- and xanthene fluorescent dyes in Germany and England in the late 19th and early 20th centuries marked the beginning of this class of effect pigments. Advances in polymer chemistry opened the door to new solid solutions of known dyes and other dyes available later - and thus to the further development and increasing marketing of fluorescent pigments. Today, research and development focus on improving important functional pigment parameters, such as light stability, heat

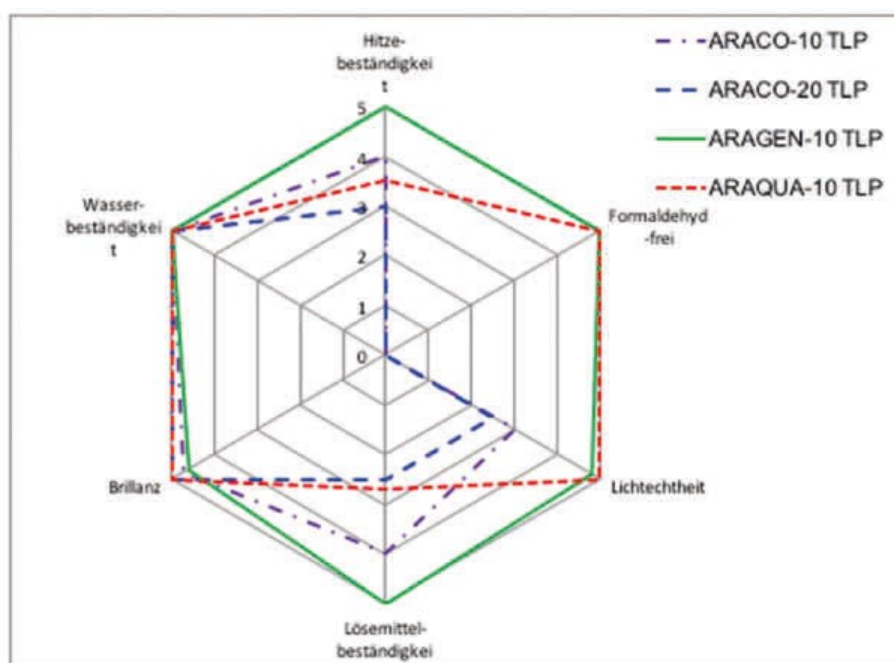
stability, colour strength, brilliance, opacity or transparency, solvent and water resistance, the prevention of migration, efflorescence and the escape of residual monomers. In particular, the replacement of formaldehyde in the formulations is on the agenda. Using the melamine-formaldehyde pigments as an example it is explained which parameters can be modified to improve the technical performance of fluorescent pigments and where are the limits. Finally, the latest results and progress in research for better fluorescent pigments will be presented. Compared to the formaldehyde-containing fluorescent pigments, the new ARAQUA and ARAGEN fluorescent pigments have the following properties:

1. Similar brilliance & colour intensity
2. Higher light fastness: approx. 2 times higher compared to conventional formaldehyde-containing fluorescent pigments and 3 to 5 times higher compared to the benzquuanamine pigments

3. Better water resistance and compatibility of the ARAQUA fluorescent pigments
4. Better and longer shelf life of the coatings produced with them
5. Higher alkaline resistance
6. Better solvent resistance of ARAGEN fluorescent pigments
7. Significantly higher heat resistance of the ARAGEN fluorescent pigments

Based on a new hybrid technology, the formaldehyde-free ARAGEN (AG-10)-TLP for PVC, PU, latex and solvent formulations as well as their counterparts for aqueous formulations ARAQUA (AQ-10) were developed.

In contrast, the new TLP grades use a formaldehyde-free hybrid polymer technology. In the case of the pigments for aqueous formulations, the polarity of the surface is also increased making them particularly easy to integrate. The lower degree of crosslinking enables finer grinding. This way the best results are achieved in aqueous formulations and oil or



GRAPHIC: ARALON COLOR GMBH

Stability properties of the formaldehyde-free series AG-10 and AQ-10 compared to the formaldehyde-containing series (AC-10 & AC-20).

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naphtha formulations are also possible. A comparison of the properties of the two new formaldehyde-free TLP types and two formaldehyde-containing TLPs is shown in the graph below.

Conclusion

With the new technologies described above, we have taken a huge step towards our target of a comprehensive formaldehyde-free production and application of fluorescent pigments. The new technologies outperform their formaldehyde-containing predecessors in all important properties, especially in terms of light and storage stability. The renunciation of formaldehyde is possible without any compromise, both in solvent formulations and in aqueous formulations. The neutrality (inertness) of the new fluorescent pigments under extreme conditions (high process, thermal and chemical loads) is equivalent to far-reaching neutrality and stability in other coating systems and varnishes with demanding process parameters.

Results at a Glance

- Formaldehyde is classified as a carcinogen
- Conventional formaldehyde-containing daylight fluorescent pigments should therefore be replaced by formaldehyde-free ones - without compromising on critical functional properties.
- Two series of formaldehyde-free fluorescent pigments for solvent-based and for aqueous formulations have been newly developed.
- Compared to formaldehyde-containing grades, both show at least equal brilliance with considerably improved light fastness and storage stability. The solvent resistance of the new series designed for solvent-based formulations is significantly higher.
- The new daylight pigments use a formaldehyde-free hybrid polymer technology. In the case of pigments for aqueous formulations, the polarity of the surface is also increased, making them particularly easy to integrate.
- The lower degree of cross-linking enables finer grinding
- The formaldehyde-free daylight pigments for aqueous formulations are particularly suitable for aqueous coatings, aqueous artist paints and aqueous engraving, transfer and screen printing inks.