FUNCTIONAL INKS FOR DIGITAL APPLICATION ON TEXTILES

A quantum leap in the speed and high precision of ink application has recently made the inkjet process even more interesting for the implementation of finishing chemicals and offers a new and sustainable perspective in surface functionality, reports Dr Reinhold Schneider of DITF

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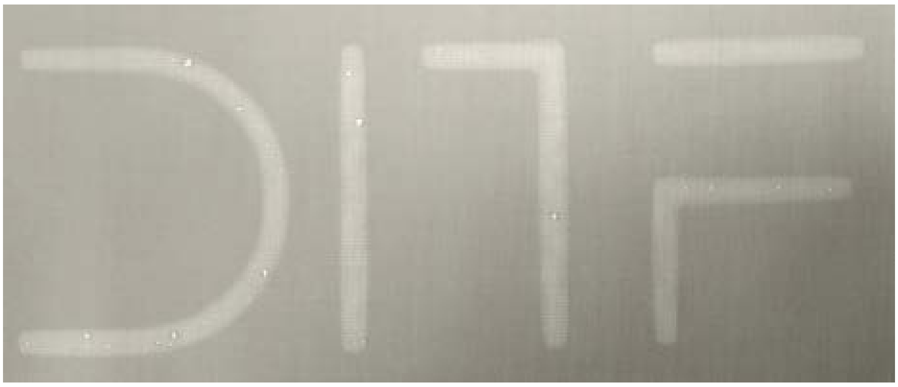

Water- and soil-repellant finishing (wetted fabric)

Digital printing on textiles has developed very rapidly in recent years. While printing speeds were still in the range of a few m^2/h 20 years ago, they are now up to 10,000m^2/h, depending on the printing unit used. This is due to the fact that functional chemicals are not applied over the entire surface. Instead, they are applied in the desired quantity at the designated location in a flexible manner. This means that chemicals can be saved and resources can be conserved.

BOUNDARY CONDITIONS

In general, it does not matter whether colour inks or functional inks are printed with a digital printer. The only decisive factor is whether the required specifications of the printhead can be met with regard to the printability of the ink. The essential boundary conditions are the required ink viscosity and the particle size, which are very specific to each printhead. Most inks for inkjet printing have a viscosity in the range of 2–18mPas and particle sizes of up to 1µm can generally be printed. Higher viscosities of up to approximately 500mPas and particle sizes of up to 20µm can be processed using Chromojet printing. If these boundary conditions are met in ink formulation then, in principle, all functional chemicals can be made accessible for digital printing.

FORMULATION

When formulating functional inks, a distinction must be made between the chemicals. Being present as particles and polymer dispersions or in dissolved form affects how they are bound on the textiles. Functional particles must be stabilised against sedimentation. This can be achieved by adding dispersing agents comminuted to the required particle size in a grinding process. The functional particles can then be fixed on the textile substrate by adding a suitable binding agent. In the case

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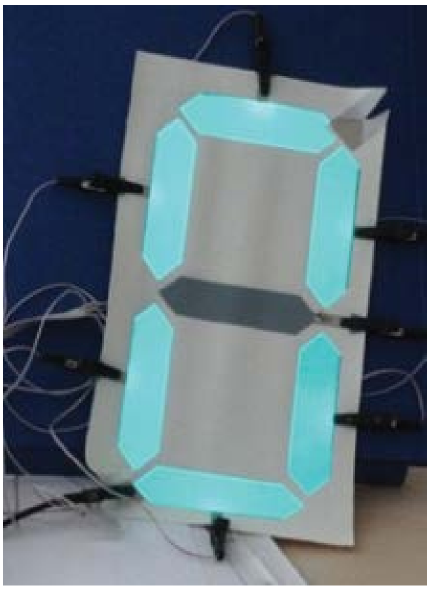
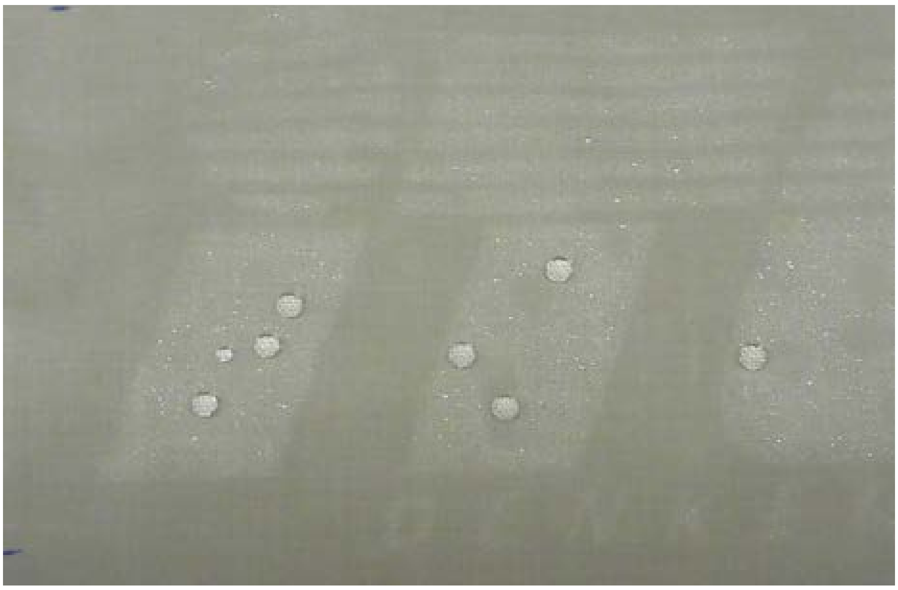


Digitally-printed electroluminescent module



Evidence of water resistance on wetted fabric

Finishing with optical brighteners

“Specific surface resistances of <108 ohms could be achieved with a single print”

of functional polymer dispersions, the particle size boundary conditions need to be met. It is essential to clarify whether the polymer dispersions require additional additives or binders for fixation. Water-soluble finishing chemicals are simply dissolved or dispersed in water in the required concentration. Furthermore, 5–10% of a humectant and up to 3% additives are added to adjust the rheology and the surface tension. The amount of functional chemicals and additives must be chosen in such a way that the target parameters for viscosity are precisely achieved. Subsequent filtration removes excessively large particles and aggregates, as well as precipitations. The filtration process is essential to avoid nozzle clogging.

APPLICATION CONCENTRATIONS

The prerequisite for achieving the desired finishing effect is the achievement of the necessary product requirements. The application concentration of the ink must be higher according to the lower quantity of ink application. This then needs to be compared to the pad application or be achieved by multiple overprinting.

Typical application concentrations of the functional chemicals are in the range of 2–6% for colour pigments and 10–30% for binders and finishing chemicals. The production of water- and soil-repellent inks succeeds with conventional finishing chemicals as an ink with a 5% active ingredient content. Very good water repellency, similar to that of conventional finishes, is thus obtained even after a single print. The wetting liquid (water) rolls off the printed areas completely, while the non-printed areas remain wet. However, oil-repellent effects can only be achieved by repeated printing or by increasing the active ingredient content to 10%.

ANTISTATIC EFFECTS

Inkjet can also produce antistatic effects. For this purpose, inks were formulated using an antistatic agent (5% active ingredient in the ink) and applied to a polyester substrate. As a result, specific surface resistances of <108 ohms could be achieved with a single print, proving the antistatic effect.

OPTICAL BRIGHTENERS

Another interesting example is the digital application of optical brighteners. With a 2% ink, textiles can be tagged with invisible markings that only become visible when exposed to UV light. This allows for fashionable lighting effects.

Other functional inks can be produced in a similar way, which fulfil the functions such as soft handle and UV protection. The creation of flame-retardant effects requires add-ons of up to 20% of active-ingredient content, which is not possible with inkjet printing, since inkjet allows typical application quantities of 20–40g/m^2. In such cases, printing systems such as the Chromojet from Zimmer are required, which can apply an ink quantity of more than 200g/m^2 per pass.

WIDER SCOPE

Special functions such as invisible inks for anti-counterfeiting are possible with an active ingredient content of <5%. A special transparent security ink was developed for brand protection. This enables licensed products to be marked with a printed data matrix code that can be detected with infrared light using an infrared camera.

“Functional particles must be stabilised against sedimentation”

Another special function based on particles is the achievement of electrical conductivity. This is possible with the help of carbon black and silver particles or electrically conductive polymers. Insulating inks based on polymer dispersions are also possible, with an active ingredient content of around 30%.

TEXTILE FINISHING

Functional inks are primarily used in the field of textile finishing. So far, water- and oil-repellent effects – as well as antistatic effects – have been realised in textile finishing. However, the targeted application of softeners and optical brighteners, as well as the imprinting of security markings is also possible. Electrically-conductive and electrically-insulating inks are used in special applications in the field of E-Textiles and Smart Textiles. Such inks can be used for the printing of textile-based heating elements as well as for electrical switches and electroluminescent modules.

CONCLUSION

As these explanations demonstrate, the vision of a digital production of textiles using inkjet printing is possible and a number of digital functions can already be implemented today. Essentially, the problems to be solved are the creation of the required add-on and the avoidance of multiple overprinting. Specifically in the reproducibility of special functions that relate to electrical conductivity. There is still a great need for research so that such electrically-conducting prints fully meet all the technical requirements. These must then be applied to the final properties, such as permanence, resistance to buckling and flexibility. ■

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