

# A versatile additive for paper treatment

Dr Tanja Schaffer of **AllessaChemie** recounts the development of **Allessan APT**

Inkjet printers are the most common type of printing devices used in home environments and they are also widely used in offices. The main advantage these devices offer is good image quality at an affordable price, often equalling or even exceeding that from traditional photographic film.

The best results can be obtained when tailored combinations of printing devices and special inkjet media are used. The market for inkjet printers has grown at a tremendous rate in the last few years, which means that the market for inkjet materials has also increased quite strongly.

Inkjet is a dot-matrix printing technology in which droplets of ink are fired from a small aperture directly onto a specified position on a medium (in most cases paper) to create an image. The printing resolution is mainly determined by the geometry of the printing head and the volume of the ink drops.

Most inkjet devices run with water-based inks, in which ink ejection is controlled by the growth and collapse of a water vapour bubble on the top surface of a small heater located near the nozzle. With a current heating pulse of a few microseconds, heat is transferred from the surface of the heater to the ink, which becomes superheated to the critical temperature for bubble nucleation, around 300°C.

When this occurs, a water vapour bubble instantaneously expands to force the ink out of the nozzle. The bubble collapse, then the droplet breaks off and accelerates towards the paper. This is a very efficient and reliable method of controlling the volume of drops derived from water-based inks.

The physical properties of the ink, like viscosity and particle content, have to be controlled carefully in order to ensure an ejection of uniform small ink droplets and to optimise the resolution of the printing device. In general, the viscosity of water-based inks ranges from 2 to 8 cps to ensure proper drop ejection. However, this typically shows some unwanted effects on the media used.

As soon as the liquid ink droplet contacts the rough surface of paper, it tends to spread along the fibre lines, as well as penetrating into paper sizing and voids. The ink droplets often spread too far and too irregularly to maintain the expected resolution. Although some water evaporation takes place, the drying and penetration of ink into the paper is often not fast enough to fix multiple ink drops on the same spot within very short time intervals.

This all results in ink spreading, inter-colour bleeding and consequent limitations on image quality. Penetration into the paper reduces the colour density and therefore the colour brightness, of the image. Thus, all of these effects limit the technical performance of standard inkjet printing devices.



Logically, major improvements in the quality of inkjet images cannot be achieved by further improvements to the printing devices alone. What are needed are optimised systems of printers in combination with dedicated inkjet media, such as special inkjet papers that have undergone a specific surface treatment to overcome the aforementioned limitations. Such a treatment must balance many design parameters, including drop volume, evaporation rate, penetration rate and the porosity of the medium.

A special surface coating can also limit the effects of spreading and absorption and thus lead to more brilliant colours and an increase in the resolution the printer can achieve. Even other disadvantages, like long drying times for example, can be improved by using specially coated inkjet papers.

Another disadvantage of inkjet images, which previously could not be solved via conventional coatings, is their limited resistance against water. The ink is not strongly bound on the paper and can be re-dissolved quite easily by moisture. It will also be dissolved and smeared by working with a standard highlighter on inkjet print-outs. Both effects still limit the use of the inkjet technology for many high performance applications.

The use of specially coated paper can overcome some of the limitations of common inkjet technology. However, even special papers cannot improve the limited water-resistance of the inkjet images. Therefore numerous chemical substances have been tested for their performance in coatings for paper to optimise quality and build a basis for a further extension of the application fields of inkjet technology.

Hewlett-Packard (HP) is one of the companies working on paper additives that might improve the image quality in inkjet technology. Quite recently, HP identified some promising lead structures that could be used in coatings for paper, resulting in improved colour brightness, faster ink-drying times

and improved water fastness. However, the material still needed optimisation to show the desired performance and, of course, was not available on a large scale for a reasonable price.

HP subsequently looked for a partner who could help with chemical expertise for the optimisation of the lead substances and selection of the best chemical system and who could also develop a commercial process for the production of the desired material. This resulted in inquiries being made to AllessaChemie, which has a lot of expertise in developing and scaling up commercial processes.

A combination of HP's application expertise and AllessaChemie's chemical know-how resulted in the development of Allessan APT, which is now commercially available on a large scale for the production of highly sophisticated inkjet paper. This is an easy-to-handle aqueous solution that can be applied on paper via a separate coating step or can be added directly in the size-press.

Allessan APT causes colour to be retained near the surface and the liquid ink carrier to be bound on the paper, thus preventing colours from streaking or fading during the printing process, even when exposed to water. The material can decrease ink-drying times and increase colour density to obtain brighter, more vibrant colours.

The combination of special papers treated with Allessan APT and inkjet technology based on water-soluble printing inks can lead to new opportunities and new application fields of inkjet application. This can also increase the future potential of inkjet technology in general.

Close collaboration between HP and Allessa Chemie was crucial to the project's success. Proper project management and clear communication were indispensable factors, given that the two firms are located in different time zones.

All in all, we believe, this was a fairly new approach in the field of industrial chemistry. It shows that close partnership between a chemicals manufacturer and invention-driven companies can boost the fast and successful development of new products and could be a Best Practice example for further developments.

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