Designing and Printing on Polymer

By Sean McLean, Design Engineering Manager, De La Rue

Here at De La Rue we have been designing and printing on polymer for almost 10 years. We have worked in four De La Rue print locations and with 15 external print partners to quickly and continually advance our understanding of the substrate and its characteristics. Our experience enables us to share knowledge and support others through an accelerated version of our journey, using our know-how and minimising challenges along the way.

We have come to learn that polymer is a better technical solution for the printing of banknotes, and though it presents some challenges to overcome during the early transition phase, that challenge is rewarded with greater stability, cleaner print and consistency of performance.

The role of the Design Engineering function in De La Rue is to continuously improve that solution and to realise the vision for the end banknote design in a way that complements the manufacturing process and fulfills the needs of the end users. As a printer ourselves, we recognise the need for efficiency and performance in order to keep the total cost of ownership for currency down.

The design and manufacture of any new banknote requires careful consideration. Banknotes are technically advanced and complex, with each denomination having its own unique design. This means that expert know-how, modelling techniques, design rules, proofing prototypes, and sometimes even pre-print trials (or 'zero production runs') are required to optimise the design and machine set up prior to commencing full banknote production. This is true irrespective of whether the banknotes are paper or polymer.

All new banknote designs have to consider aesthetic themes, symbolism, security feature selection, the needs of all end users (including specific groups, such as the partially sighted) and how the notes will interact with the cash cycle. Any changes in size or the positioning of machine-readable features will need to be evaluated in the context of the cash cycle, irrespective of whether you are designing paper or polymer banknotes.

There are however specific areas of consideration for polymer…

Polymer provides a smoother surface to print on, which results in a much finer and sharper printed line compared to paper notes. The size, format and overlapping of printed colours requires careful consideration, using optimised design rules based on a deep understanding of the polymer printing experience, to best realise the benefits of the substrate.

The greatest design advantage for polymer is the substrate itself becoming an integral part of the total banknote design. Unlike paper, which carries the design, polymer is a fundamental and active participant in the design. By integrating all the elements of the banknote into the design, it intensifies the beauty, adds intuitive security and functionality to the banknote. This is delivered via complex windows and striking features, whilst still allowing for control, stability and performance in the printing process.

The flexibility of the substrate also allows for multiple routes to polymerising banknotes, depending on the desired approach. It can be inserted into an existing family as a faithful conversion, where the watermark subject is traditionally replicated in the clear window. This way, with some adaptation of the line work via polymer design rules, we can recreate the existing note and maintain the public familiarity whilst introducing a new substrate.

Alternatively, the change to polymer can be used to include more features such as MASK™, GEMINI™ and holograms in the window, whilst again maintaining the identity of the current note.

Finally, of course a full new design can be created, taking all elements into account and tailoring it to the new substrate. Almost all the traditional banknote security features are available on polymer, which means even significant design changes can carry all the familiar features of the previous series in the interest of continuity.

Throughout the design process we work in tandem with the print site on a phased transition from design to manufacture, following the banknote from end to end, ensuring the design translates into a high performing banknote. Many of the steps we have taken to this point serve to mitigate risk and enable the printer to faithfully reproduce the banknotes over and over.

Once into manufacture, things are far more familiar than new users of polymer may expect. We get asked many questions such as whether machines need upgrading, if there will be static issues or whether special inks are needed. We printed our first polymer banknotes on 25-year-old machines without any modifications, we don't use anti-static equipment (polymer has coatings which dissipate static) and we modify the inks slightly and add driers.

That is not to say that no consideration is needed when changing to polymer, we must respect the differences and account for them.

Depending on the age and condition of the machines, there may be a delivery or feeder which needs a service, or some slight adjustment to the air in the delivery, but this is not the norm. Polymer has a narrower operating window compared to paper, but this is more than compensated for by the reduction in variation of polymer versus paper. The challenge is only about finding the center of the new operating window and how to stay there. If we design with polymer in mind, control the printing process and materials with known parameters and techniques then the experience will be comparable, if not better, than on paper.

It is well documented now that our Debden site in the UK, coupled with a rigorous Operational Excellence model using techniques from the automotive and aerospace industries, has seen a record-breaking increase in throughput and performance since switching to polymer. The machines run at speeds of up to 10,000 sheets per hour, on both polymer substrates and paper, switching between as necessary.

Today over 140 banknote denominations are in circulation on polymer and the number is growing, with more commemorative notes also issued. It is hoped that De La Rue's recent webinar 'Printing on Polymer', supported by Note Printing Australia, has helped to dispel some of the myths associated with polymer banknotes and demonstrated that it is very possible (sometimes even advantageous) to print on polymer banknotes.