NSCG Newsletter

Title: Conference Report Preservation and Conservation Issues Related to Digital Printing October 2000

Author(s): Carter, J.

Source: Carter, J. (2001). Conference Report Preservation and Conservation Issues Related to Digital Printing October 2000. *NSCG Newsletter*, *Issue 16*, 14 - 21.

URL: http://www.natsca.org/article/641

Conference Report
Preservation and Conservation Issues Related to Digital Printing
October 2000

Julian Carter, Conservation Officer (Zoological Collections), National Museums and Galleries of Wales, Cathays Park, Cardiff, UK, CF10 3NP.
E-Mail: Julian.Carter@nmgw.ac.uk

Introduction
This two day conference was held at the Institute of Physics, London. The conference was divided into two sections. The first dealt with materials and technologies, whilst the second covered issues related to preservation and conservation. The following has been compiled the talks given at the conference, and is presented as an overview of the information given.

Materials and Technologies.
Commercial printing is experiencing great changes as digital printing technologies continue to develop at a rapid rate. Digital printing is enabling publishers to exercise greater flexibility in how, and what, they publish. Many academic titles are now printed on demand, with the publishers holding no stock of the title. Digital printing is also enabling 'out of print' books to be easily reprinted in small runs, and there is a growing market in personalised material where the purchaser selects what part of a publication they require e.g. course notes. It is envisaged that in the next 5 – 10 years digital printing will account for 10% of all commercially printed material.

However there are still a number of problems with commercial digital printing. Colour costs are still very high, and although many publishers use the same paper quality as traditional litho printing, the overall durability of the prints is unknown. Such issues with the inks and toners used in the digital print process need to be resolved before acceptance in hard copy archiving.

Digital printing has also made the world of quality publishing available to the home or small office. This has lead to a plethora of small scale publi-

cations churned out on home computers. Such publications can be of great value, representing local culture, language and folklore; or could be the production of identification keys or species lists. The problem is one of trying to archive this information, and the durability of the papers and inks used to produce the material. Essentially these publications are endangered documents because of the small print runs and low quality of product material.

There is also the wider challenge of trying to track bibliographic information. The digital age makes it very easy to alter a publication. The ease of data transformation affects the authenticity of digital data, and has associated data protection problems. Digital documents should hold data on changes made to the original data to allow referral to the original reference. There is also the problem of copyright as information becomes increasingly online. Will we require digital archaeologists to access these digital archives in the future?

Digital Print Systems
There are a number of key digital printing technologies now available. Monochrome printing can now be considered a reasonably stable and mature technology, it is colour printing that is developing very rapidly. These technologies, commonly known as non impact printing or variable image printing, offer more flexibility than traditional Litho printing. Essentially the technologies available are;
Electrography. This is the technology that is used in a photocopier or laser printer and uses an Organic Photoconductor (OPC) drum to apply the image to the paper. Dry toner technology uses powdered pigments, but a liquid toner, where the pigment is carried in an emulsion, can also be used. Originally the dry toner systems used a milled pigment which gave irregular particles. This has now been improved through the use of synthetic polymer toners which have a more consistent particle size.
Inkjet Technologies. A number of techniques are used at the ink-head.

- Drop on Demand (DOD) can apply the ink in a number of ways. Heating is known as thermal drop and the ink needs to be able to withstand a wide range of conditions. Piezo electric uses a small current to apply the drop, and this allows the ink chemist to be more flexible in design. Once printed UV or IR can be used to cure the ink.

- Continuous droplet inkjet. These run at higher frequencies than DOD heads. The ink droplets are streamed by charged plates.

Modern methods of manufacture are constantly improving inkjet technology. The actual ink jets can now being manufactured using semiconductor production methods, allowing the ink-head to be formed from silicon wafer. Inkjet technology is still rapidly developing, and offers great flexibility in the range of inks that can be used, and the variety of substrates that can be printed on.

Dye Diffusion Thermal Transfer (D2T2). A thermal transfer ribbon contains the dyes which are applied through a thermal head. Dyes need to have high thermal stability.

Papers and Inks.

Paper factors: Whatever ink technology is chosen, the paper used is still a very important choice. The development of digital printing has required papers to be adapted for the printing processes used. Electrographic monochrome printing is now a commodity process, but early paper grades did not accept toner well. This lead to the development of 'enhanced toner grip' papers. However the result is now that the best paper to use will depend on the machine being used for printing. For example the commercial Xeikon digital press has over 500 qualified grades of paper. Papers developed for use with toners need to be smooth, have a stable surface charge and have stable moisture properties. Colour electrographic printing use charge generation in materials to help give colour. Toners can be about 90% resin, with 5 to 10% colorants, and use charge generation materials as additives.

Inkjet systems, while not as fast as electrographic systems, will print on a wider range of substrates from textiles to specialist art papers. The quality of the printing is a combination of the inks and their colorants, the ink volume, the tonal balance and the print head paper gap (effects definition). The development of inkjet papers needs to consider a number of factors;

- The whiteness of the paper: usually defined by the pulp used.
- Consistency of thickness: required to achieve a consistent definition.
- Good fibre formation to reduce pinholes in the matrix.

- Internal and surface sizing: this effects the sorption of the ink carrier into the paper.
- Smoothness and porosity: prevents ink drop splash and creep and gives texture to the paper.
- Archival properties.

Increasing use is now made of coated papers in digital printing. The development of coatings helps give the paper the correct 'feel' or look, but is also an important part in the control of the ink media on the paper. Increasingly this is leading to the development of matched media. This is where the ink and the paper are developed together. Coated papers come in a variety of types:

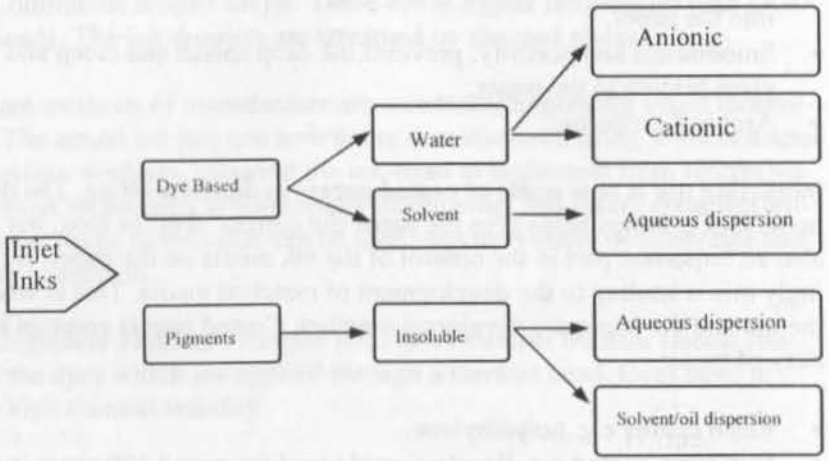
- Resin coated e.g. polyethylene.
- Non-resin coated e.g. Baryto coated (used for over a 100 years in traditional photopaper); clay coated; rawbase.
- Films, such as aqueous coated polyester.

The resulting paper structure can be a simple coating over the paper base, or much more complicated, using multiple layers to control how the paper handles the ink, responds to colour and its overall durability. The top layers in resin coated papers are know as the receiver layers, and overly the resin coat. The receiver layer is important in that it handles the sorption of the ink carrier, controlling the movement of the dye on the paper. These receiver layers (of which there can be up to 6) can be of two distinct types;

- Swellable polymers such as gelatin – these are slow to dry.
- Microporous coatings – faster drying due to capillary actions.

Underneath the receiver layers, the resin and the paperbase, can often be found a polyethylene back coat, designed to stop paper cockle and curl when it is printed.

The inks used in inkjet systems are available in a wide range of formulations depending on the nature of the print-head and the substrate to be printed. The following chart summarises the range of inks available;



When a dye based ink-drop hits the paper, the dye is 'fixed' in the top layer, while the ink vehicle is absorbed into the lower layers, and this is where the receiver layers control the rate of drying. Dyes tend to use additives such as sulphonic acid, which has a good hydrogen bonding characteristic, to aid diffusion into the coating of a paper. Fixing the dye in the receiver layer also helps to reduce the effects from oxidation and other degradative mechanisms. Pigment based inks reside on the surface, making the inks slow to dry and to have problems with smudge and smear. This can also make the mixing of secondary colorants very difficult with pigment based inks.

The range of dyes and pigments makes colour printing with inkjet technology a complex subject, but this is an area that is seeing constant development through the synthesis of specific dyes which need to be light stable, have equal fade, water-fastness and a good black. Colorants in inks can be summarised as follows;

Pigments ⟺ Azos ⟺ Xanthenes

⟵ Duller but more stable ⟶

The stabiliy of the image is not only dependant on the colorant, but on the substrate and the environment. Inorganic pigments are the most stable due to their ionic lattices, but their colours are very limited and tend to dull. The colouring power is very poor and many are confirmed or suspected poisons and carcinogens. Organic colorants are less stable, but give virtually unlimited colours, which are vivid and high colouring, and which tend to be safe. Organic colorants can be natural dyes; man made or organic pigments.

Conservation Issues

There are a number of key issues arising from digital printing. The most obvious concerns relate to the archival quality of the different types of digital prints. How long are they going to last? What are the effects of environment? How will the colours fade? Also of growing concern to conservators is how do you identify the digital print process that has been used? Many artists are now using digital printing, and many of these are mixing the process with traditional printing media such as silk screen. This can make the identification of the processes used in such material very difficult. This is becoming more complex as digital print technology continues to develop and improve. This is resulting in the development of a web site through the Electronic Media Group of the American Institute for Conservation. The site is being designed to pool information on digital printing as an aid to identifying digital prints.

Tackling the immediate issue of the archival quality of digital printing. This is a terribly difficult query to answer. The quality of digitally printed media is going to vary, depending on the process used (electrographic or inkjet), the machine used and the paper media selected. Archival testing of electrographic prints has demonstrated this variability. Recent work on electrographic prints at the Graphic Technology Research Association in Germany found;

- Variability in rub resistance of prints between machines. This is due to the differences in the way machines treat papers e.g. Canon and Xerox put a thin layer of silicon over the print resulting in more durable images.
- Lightfastness tests, using Blue Wool standards and Xenon arc lights, found electrographic prints to be very good.

- Print finish was tested with a peel force tester. This found great variability between the different printer manufacturers, with Canon tending to be the better.
- Influence of the paper. Not every paper can be used with every printing process. Certain papers will be better for each printer type.

The Centre de Recherdes sur la Conservation des Documents Graphiques in France have looked at the light stability of ink jet prints. Their studies utilised artificial ageing tests on prints made with the IRIS process on a variety of supports. Colour photographic prints on Fuji Crystal Archive and Fuji Pectro were used for comparison. The test were carried out using metal halide and fluorescent lights. The dye fading was monitored using densiometry, and measured as a percentage change from known standards. This work found that dye mixes appear to have faded less, whilst differing supports gave differing fading levels to the dyes, although coating treatments did help improve dye stability. It was also found in this study that exposure to the different light sources gave variable results e.g. it was noted that the fluorescent lights damaged prints more than higher levels of exposure with a metal halide light. This suggests the influence from the spectral distributions of different light sources.

Work at the Library of Congress in the USA has looked at the effects of humidity levels on IRIS inkjet prints. The work found that in high humidity there were shifts in the orange tones. This is due to the magenta dye being more soluble as a result of its smaller molecular size, causing a decided magenta shift. Recent developments in inkjet dyes have attempted to resolve this by making the magenta dye molecules larger.

The thermal stability of inkjet prints has also been looked at form a conservation perspective. At the Camberwell College of Arts, some preliminary work used accelerated ageing at elevated temperatures. Colour changes are not a linear function of duration of thermal ageing. There may be an induction period before rapid change occurs. The colour stability is going to relate to the area of colour, its tone, the substrate used, the ink used and any coatings. This study used 59% RH and 80°C in an unsealed environment, with air being allowed to circulate. The sample patches were aged for 14 days and then examined with a chromometer and spectrometer to assess movements in colour. After 14 days it was found all the papers

tested had yellowed significantly. The colour patches showed no significant dot spread, but all had perceptible colour changes with all the ink paper combinations tested. Much of this change in colour can be attributed to the yellowing of the paper substrate, causing a loss in brightness and an increase in yellow saturation.

In Summary

Digital printing is a rapidly developing technology. This pace of change presents may issues to users requiring archival quality, and has related conservation issues. However the quality of digital printing is constantly improving, and some manufacturers are making great claims as to the long term stability of their latest ink and printer ranges. However of equal importance to image quality is the quality of the substrate used. Think carefully about the paper that is used, and be aware that there is increasing development towards matched media.

Information Resources

- Preservation of Inkjet Hardcopies. http://www.knaw.nl/ecpa/publ/jurgens.html
- Digital Prints: Technology, Materials, Image Quality and Stability. http://www.foto.unibas.ch/~rundbrief/les33.htm
- Wilheim Research – testing of inks and papers. http://www.wilhelm-research.com/
- American Institute for Conservation. Useful for the Electronics Media Group and their associated links on digital printing. http://aic.stanford.edu/