ISSUE THREE

2009

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SPECIALIST PRINTING

GLOBAL TECHNOLOGY IN FOCUS

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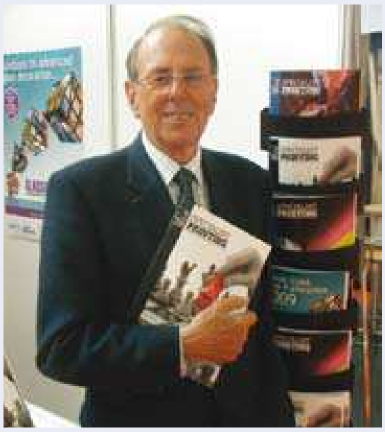
MESSAGE FROM BRYAN COLLINGS



With FESPA Digital 2009 in Amsterdam behind us and SGIA '09 in New Orleans to look forward to, those in the northern hemisphere are contemplating the summer slowdown with some trepidation. Our politicians talk enthusiastically about green shoots but until the bankers start lending to fuel a return to capital investment, many of our readers are going to continue to be scraping the barrel for orders to avoid Chapter 11. Even consumables suppliers are still working at substantially reduced levels, with significant redundancies and short-time working across our industry worldwide.

With this in mind, every issue of *Specialist Printing* reaches a higher level of importance to our global readers. We continue to offer advice from highly experienced writers from many fields of specialist printing, much of which relates to keeping efficiencies high – essential in the present market. Don't forget that to receive the next copy of this valuable journal you must **SUBSCRIBE TODAY** by visiting www.specialistprinting.com/sub_form.htm or go to page 60.

You will also find useful information in this issue about the latest EU directives relating to The Classification, Labelling and Packaging of Substances and Mixtures (CLP). It's interesting that while we in manufacturing are struggling to keep our businesses afloat, the bureaucrats around the world seem to have no problem continuing to spend our money issuing directives at an ever-increasing rate!

Lastly don't forget that if you're involved in decoration of any type of glass then you should be booked for GlassPrint 2009; full details are on page 60 or visit www.glassprint.org

Bryan Collings
Publishing Director, *Specialist Printing*

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Specialist Printing (ISSN 1754-6230) is published by:

Chameleon Business Media Ltd
Changing to meet your industry's needs

Chameleon Business Media Limited
1 Cantelupe Mews, Cantelupe Road
East Grinstead, West Sussex RH19 3BG, UK
www.specialistprinting.com
Fax: +44 (0)1342 322664

PUBLISHING DIRECTOR:
Bryan Collings
Tel: +44 (0) 1227 272095
bryancollings@specialistprinting.com

EDITOR:
Jess White for Tick Communications
editor@specialistprinting.com

DESIGNER:
Alison Smith for Blue Daze Design Ltd
copy@specialistprinting.com

PUBLISHERS:
Frazer Campbell
Tel: +44 (0) 1342 322278
frazercampbell@specialistprinting.com

Debbie Drewery
Tel: +44 (0) 1342 322392
debbiedrewery@specialistprinting.com

Dave Fordham
Tel: +44 (0) 1342 315032
davefordham@specialistprinting.com

ADVERTISEMENT SALES:
Carol Gibbons
Tel: +44 (0) 1425 617429
carolgibbons@specialistprinting.com

ADMINISTRATION AND SUBSCRIPTIONS MANAGER:
Sam Dunmore
Tel: +44 (0) 1342 322133
samdunmore@specialistprinting.com

SUBSCRIPTIONS:
To receive future copies, subscribe at www.specialistprinting.com to get the next 4 issues (covering 12 months) for a total of only €50, $75 or £40.

GERMAN AGENT:
August-Wilhelm Rust
Internationale Medienvertretungen
Tel: +49 6127 660325
Fax: +49 6127 965 9734
info@specialistprinting.com

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ALSO PUBLISHER OF:
glass WORLDWIDE
www.glassworldwide.co.uk

OFFICIAL JOURNAL OF:
CTS & DIGITAL WORKFLOW 2008
european membrane SWITCH SYMPOSIUM 2008
www.ctsforum.org www.euromembraneswitch.org

Printed by Reflex Litho, UK (www.reflex-litho.co.uk)
Royal Mail Periodicals Code for Presstream Y4778

INTRODUCING TINA!

ESMA
Driving Print Excellence

YOU MIGHT ALL KNOW TINA, ESPECIALLY SINCE RECENT TIMES. TINA STANDS FOR: THERE IS NO ALTERNATIVE – IT SOUNDS NEGATIVE BUT SOMETIMES THINGS NEED TO BE DONE! HALFWAY THROUGH 2009 IT IS BECOMING CLEAR THAT THE DOWNTURN IS PROFOUND AND MAY BRING SOME LASTING CHANGES IN BUSINESS FOCUS AND THE BUSINESS LANDSCAPE. MANY COMPANIES AND INDIVIDUALS ARE BEING FORCED TO MAKE A DISTINCTION BETWEEN WHAT IS IMPORTANT TO HAVE AND WHAT IS NICE TO HAVE. WE HAVE EXPERIENCED THIS IN THE LAST COUPLE OF MONTHS WITH OUR ASSOCIATION – SUDDEN UNEXPECTED CHANGES IN THE STEERING COMMITTEE AND THE ECONOMIC RECESSION BROUGHT US TO THIS POSITION.

In the previous issue of *Specialist Printing* our ex-Chairman gave a full interview on the challenges and objectives set by the Steering Committee; unfortunately while the interview's message is still valid, Harutiun Manoukian is no longer taking an active role at Kiian and has therefore resigned as Chairman of ESMA. We have also lost Ingo Kübler, who has left Sefar, and have had to switch to an alternative plan to have a working Steering Committee. It is typical at the beginning of a change that it is most tested in its concept and functionality. We have decided to appoint an interim Chairman until the next General Assembly when a revised Board can be presented for members' approval.

We are pleased to announce our new interim Chairman, Gilles Paglinghi from Mactac Europe, who can represent the best of both digital and screen through substrates. He is our first chairman from the new category of substrates, which are very important to both digital and screen printing technologies. Manuel Zuckerman has been appointed to replace his position on the Steering Committee's pre-press group and Jonathan Sexton from Sun Chemical is the replacement for the inks and chemicals position on the Steering Committee.

We are all looking forward and ensuring that we avoid becoming introverted due to the crisis and work towards the light at the end of the recession tunnel. This is the time to be innovative and creative because we have to lift our horizons beyond the crisis and focus on what will allow us to continue to do business through innovation and differentiation.

This means that, as an association, we need to create renewed values for members and we are planning to announce some further new projects and events in the near future. We started with a new logo, which is the beginning of a new approach. The logo's three blocks show the three printing technologies: screen, digital and pad. It also reflects the important vision that there are three major groups that are important for us: the manufacturers, the printers and the end customers.

Peter Buttiens,
CEO of ESMA SP

FROM THE NEW CHAIRMAN

Gilles Paglinghi

During my time as interim Chairman of ESMA, I will continue to work closely with our CEO, Peter Buttiens, together with the Board and the new Steering Committee members. As already announced, our priorities are the 'remodelling' of the organisational structure and the set-up of the strategies that should be more adapted to present and fast-changing market conditions. This will be presented to the next General Assembly in Nice (France) in March 2010.

Our aim is to bring ESMA to the forefront as the leading professional and non-profit making trade association that is really representative of the global specialist printing industry, so all manufacturers in this field are welcome in ESMA.

We must move ever closer to market needs and trends by integrating environmental concern and the promotion of innovative printing technologies. This will all result in creating more value and will also provide the best support to our members, which remains critical especially during this period of recession.

Gilles Paglinghi,
Chairman of ESMA and Vice President of BU Graphic & Decorative at MacTac Europe SP

Further information:
ESMA, Belgium
tel: +32 16 894 353
fax: +32 16 434 971
email: pb@esma.com
web: www.esma.com

AN INTERVIEW WITH PARNELL THILL

Specialist Printing took the opportunity to have a chat with the NASMA Chairman during NASMA's Spring meeting earlier this year

Parnell Thill, Chairman of NASMA (left), with Specialist Printing's Frazer Campbell

What does the role of NASMA Chairman mean to you?
Since NASMA is a small, intimate executive forum, serving as Chairman of the organisation is an opportunity to participate in the day-to-day shaping of not only the agenda, but the form of the organisation itself. It's a privilege to work so closely with NASMA members, all of whom are industry executive peers.

How long do you expect to be Chairman?
My three-year term expires at the end of 2009.

What would you like your legacy to be after your term as Chairman has ended?
I would be humbled and honoured for my legacy as NASMA Chairman to reveal something of the nature of the evolution of the organisation, not only in form, but in function. NASMA, due largely to its intentionally intimate nature, is ever-evolving. I'd like to think I did my part in facilitating that.

What is NASMA's primary goal?
NASMA's goal is to serve the needs of manufacturers in the specialist printing arena as defined by the manufacturers themselves.

What do you see as being the primary benefits for manufacturers who are members of NASMA?
The primary benefit to members is the provision of a venue in which the concerns of manufacturers, as manufacturers, can be voiced, heard and met.

How can these benefits assist members during the current economic situation?
As we know, the present economic situation affects manufacturers differently than it affects other elements up and down the supply chain. NASMA provides a venue for the exchange of ideas, that is best and worst practices, in mitigating the realities of this challenging economic environment.

How does it benefit the customers of NASMA members to know that their suppliers are members of this elite group?
Customers of NASMA members can be assured that participating manufacturers have, as their primary concern, a fundamental focus on how best to serve them.

Does NASMA have any plans for new projects in the next year?
NASMA will continue to provide members with market information in the manner of our Market Metrics Study, a sort of 'state of the industry' study based on product volume. Another study, the Business Metrics Study, is a newer, potentially even more valuable initiative that serves as a collective barometer of the general health of the manufacturing sector, based on non-product specific data.

Does NASMA have any plans for restructuring or reorganisation? Will any new committees be formed?
Plans for restructuring of the organisation continue as the needs of members evolve.

NASMA is a partner of its European counterpart, ESMA. What are the benefits of this relationship to your members, North American printers and the industry on a global scale?
NASMA's relationship with ESMA is reciprocally beneficial. Indeed, the market we serve is inherently global. As such, the concerns and strengths of NASMA members, in many cases, mirror those of ESMA member markets. To speak of global markets as distinct from North American markets, Asian markets, European markets etc. is like considering a family as distinct from the individual members of which it is constituted: of course the individual members have distinct characteristics and concerns; but the members are necessarily better served when the entire body is considered.

What is NASMA's relationship with show organisers and national associations such as SGIA?
NASMA's relationship with SGIA, in particular, is sound and mutually supportive.

NASMA has sponsored *Specialist Printing* for two years, which has significantly contributed to the magazine becoming established as a leading reference source in North America. What is your comment on the benefits to members and end-users of the sponsorship of a magazine aimed at spreading technology for the good of the industry?
NASMA supports the distribution of industry-enhancing information, including the sort of technical data *Specialist Printing* has consistently published.

In general, could you comment on the current status of the American market and your forecast for the short, middle and long term?
While I'll leave commenting on the macro-economic situation to those claiming expertise in the matter, presently we believe the North American screen printing market is showing signs of 'bottoming out', hopefully foreshadowing a slow climb toward growth. Some equipment sales are actually up slightly, and we know that there is a small increase in the number of small, mostly textile screen printers. Along the way there are some positive, head-scratching anomalies out there that remind us that running a business is an art, not a science. sp

Parnell Thill is Chairman of NASMA and Vice President, Marketing at Ikonics

Further information:
Ikonics Corporation, Duluth (MN), USA
tel: +1 218 628 2217
fax: +1 218 628 3245
email: pthill@ikonics.com
web: www.ikonics.com

STENCIL PRODUCTION GOES DIGITAL

André Peyskens outlines a new package of a direct imaging system, fabrics and photoemulsions for the screen printing market

CATS ARE KNOWN TO GENERALLY LAND ON THEIR FEET AFTER A FALL. SUCH IS THE SCREEN PRINTING INDUSTRY. WHEN THE GENERAL FEELING IS THAT ITS TIME IS UP, IT FINDS NEW WAYS TO PURSUE ITS COLOURFUL JOURNEY. IT IS TRUE THAT THERE MAY BE REASONS TO BELIEVE IN THE PROCESS'S POSSIBLE DECLINE. THE DIGITAL TECHNOLOGY THAT STEADILY DEVELOPED DURING THE LAST 10 TO 15 YEARS HAS MADE US THINK THAT SCREEN PRINTING WOULD FACE A SERIOUS SYSTEM COMPETITION FOR SOME SEGMENT OF THE PRINT INDUSTRY. INDEED BY PRESSING A BUTTON, SITTING IN A CLEAN WORKING OFFICE-LIKE ENVIRONMENT, SHORT RUNS OF MULTI-COLOURED POSTERS OR OTHER GRAPHICS WOULD BE PULLED OUT EFFORTLESSLY FROM A DIGITAL PRINTER – IN ITSELF NOTHING LESS THAN A LARGER VERSION OF THAT CONNECTED TO OUR PC AT HOME OR THE OFFICE, AND WHATEVER THE SHEET SIZE TO HANDLE.

While there is some truth in this, the impact has not been felt dramatically simply because new technologies befriended the printing industry and screen printing is now benefiting from the commitment and contribution it gave to various industrial applications throughout several decades since the 1960s. Let us not forget that the process, while quite basic back then by today's standards, played a substantial role in the growth of the electronic industry. Screen printing was at the heart of the production of printed circuit boards, intricate double-sided boards, multi-layers, hybrid circuits and associated applications.

Today, screen printing is still very active in the ceramic industry, glass decoration, architectural, industrial or domestic; CD, DVD and the likes relied at one time nearly entirely on the process to produce their typically bright and attractive labels. And let us not forget the textile industry, from the simple T-shirt to the high fashion textile decoration. For the process to be maintained in place and continue to flourish it requires flair and the correct vision of the future, together with the appropriate investment in R&D, human resources and equipment. This is the philosophy that every manufacturer needs to follow to stay competitive and give a boost to the industry to which their company is committed.

SaatiPrint has done just that with its continued research and investment for new ideas in technical fabrics, photostencil products and mesh products for other industrial applications. The right package to offer the industry was an obvious target in order to simplify some tasks that were often time-consuming and not systematically easy to control. The company fine-tuned mesh and stencil products to create friendly user consumables, compatible with the technology of today's mature digital era. SaatiPrint has introduced a new package: a digital direct imaging system (see figure 1), a range of dedicated fabrics and photoemulsions.

ENGRAVERS AND EMULSIONS

Direct transfer of an image onto a plate or screen to produce a printing matrix from the command of a PC (known as Computer to Screen / plate technology, or CtS) is not a new concept and has been in production now for a few years for specific screen printing applications. Good results have been reached by taking advantage of the ink jet technology, whereby ink was replaced by a special inactinic wax or other opaque solution sprayed onto the coated screen.

The novelty here was to bypass the use of the increasingly expensive litho films, production time and consumables to produce it. Once imaged, the screen is exposed to conventional UV light (without the use of a vacuum frame) and developed in situ. Also part of the novelty scene, although not strictly 'computer to screen', is the direct projection system which still uses a litho film, albeit in a much smaller size (being enlarged by projection on the screen). This system, however, is today reserved for large size stencils and graphics of medium to coarse image resolution.

CTS TECHNOLOGY

SaatiPrint is developing a more advanced version of computer to screen, ironing out the shortcomings of the previous CtS generation and therefore giving a system with greater built-in capabilities to promote stencil quality, reduce production time and the risk of errors. The novelty is being found at three distinct levels: the imaging system together with a

Figure 1: Computer to Screen imager

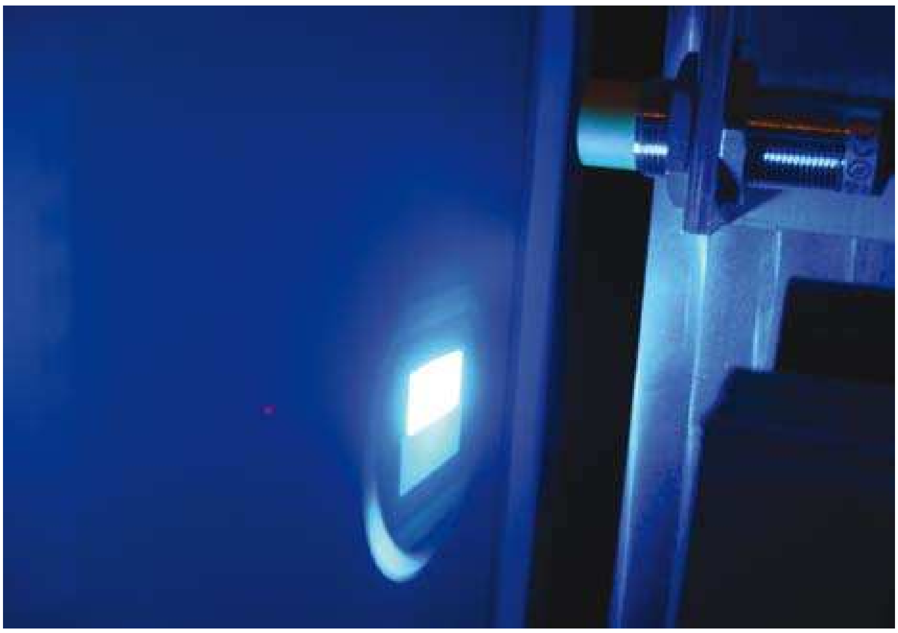


Figure 2: CtS exposure device

range of dedicated screen fabrics and specially formulated photoemulsions. The hardware equipment is manufactured and supplied by the German company CST (Colour Scanning Technology).

Projection systems expose and image the screen simultaneously but still require a litho film and the conventional hardware to produce it. The exposure time will vary in function of the enlargement from the litho and the distance from the projection lens to the screen. The direct imaging system operates directly from a desktop computer file by covering the surface of the coated screen with a substance opaque to light that substitutes the conventional litho film. At that stage the imaged stencil still needs to be exposed to a conventional UV light source.

With CST's DLE (Digital Light Engraver) system, the coated screen is imaged and exposed simultaneously, also directly from a PC file. Once the coated screen has been placed in the imager and the command given from the system's PC, the imaging and exposure process starts. A digital mirror device modulates an ultra-high power UV light source with image data using approximately 800,000 micro mirrors. The digital mirror device moves over the screen in sequence whilst the data scrolls, continuously producing a seamless latent reproduction on the coated screen (see figure 2). Imaging speed is high since each mirror represents one pixel and the image quality is equally high. A resolution of 2500 dpi will soon be possible.

REPRODUCTION PRECISION

The level of reproduction precision with CST's DLE imager is extremely high and does not rely on flair or experience to reach optimum reproducibility. It is systematic. Wax systems may produce slight image spread or a rugged edge that may affect halftone contrast or resolution. Direct projection is equally critical at the exposure phase to avoid light spread at the emulsion level that may easily affect the greyscale screened images.

Other than the traditional production of screens with film and the new techniques such as ink- and wax jet, the photo-sensitive emulsion is digitally directly exposed and polymerised. A DMD chip (digital mirror device from Texas Instruments) projects the pattern with more than 800,000 mirrors of 14 µm size each directly to the emulsion and cures it. Depending on the optical system used, the capacity lies between 500 to 1800 dpi with speeds of more than 30 m^2/h. Well-known film / emulsion manufacturers have emulsions which work with the DLE.

The 'scrolling' provides continuous movement which simplifies the mechanics considerably and increases the imaging speed. Instead of stopping the projected rectangular every time for the light exposure, the exposure-head runs continuously over the screen. During this procedure the micro mirrors are moving in such way that each spot on the screen is exposed to the light for a consistent duration.

Other components contribute to stencil quality, such as screen fabric and stencil emulsions. The CTS system calls for consumables to match the imager's performance. SaatiPrint and its chemical division, Saatichem, offer a range of special screen fabrics and stencil emulsions developed for use with the system.

THE FABRIC SURFACE

This screen fabric has a special surface treatment that will considerably improve stencil adhesion. The DLE system, through its sophisticated UV light transmission technology, can produce finer than average image resolution. Fine details are dealt with every day in screen printing with varying degrees of success, but some situations are more critical to control than others. The most challenging ones are found in halftone reproduction where fine details can occur under two different intricate situations: in some positive or negative areas on the print, which indicates that the stencil image will show a very narrow opening to correspond to the print highlights, and large open areas (uncovering the mesh) to correspond to the shadow areas on the print.

In stencil making this situation has always been difficult to handle.

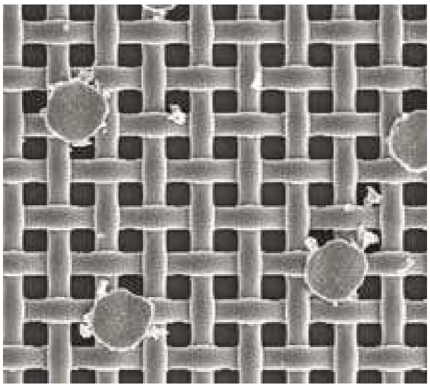


Figure 3a: Shadow area with stencil dots missing

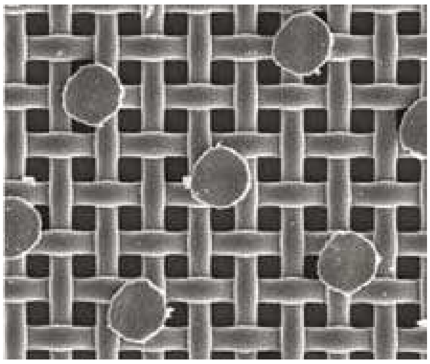


Figure 3b: Stencil on Saatilene CTMesh

Adhesion in the highlight of the stencil is less critical because of the volume of emulsion keyed to the mesh, but a slight over-exposure will lead to poor resolution of the narrow channels forming the dots. This situation is even more critical in direct projection stencil making. However, reducing exposure to secure optimum highlights may affect adhesion of small parts of the stencil as the shadow areas and dots (see figures 3a and 3b) may easily be lost during washout, altering the contrast and details of the print. Finding the right balance is therefore a difficult task exacerbated by the often inconsistent litho quality or light geometry.

It is essential that the fabric surface be adequately prepared. Polyester fabrics, used for their optimum stability, offer a surface that is rather repellent to aqueous solutions in their natural state and without adequate preparation, will not guarantee the adhesion of the stencil emulsion. There are good mesh degreasers on the market today but the strength and formula may vary, as will the method to apply it.

MESH SURFACE MODIFICATIONS

To solve such discrepancies, research on mesh surface modifications was conducted which led to the production of a fabric with greatly improved wettability properties which was ready to use. This fabric is factory treated using the latest surface treatment technology for surface modification (see figure 4b) to give treatment consistency. A test comparison can be conducted by simply wetting the surface of a screen stretched with conventional fabric and one with SaatiPrint's CTMesh. A uniform film of water will immediately be observed on the CTMesh while largely being repelled from the other untreated screen surface.

Scientifically the level of wettability (indicative of stencil adhesion) can be quantified with some instrumentation by which the result is expressed as a contact angle (°), as illustrated in figure 5. A low contact angle (see figure 5b) indicates a high wettability and in turn a high stencil adhesion. This will make it possible to have full control of the greyscale of high density halftones because any possibility of losing stencil dots during washout, or later during printing, is non-existent.

Another aspect of the screen fabric is its colour. Much research had been carried out to determine a dye that would prevent light scattering through the mesh filament. With the DLE imager there is no need to use a dyed fabric. Due to the nature of its light-emitting characteristics, the CTS machine will allow for the light to shoot through the white filament without danger of scattering. Using a white fabric considerably reduces the exposure duration and machine running cost while increasing the useful life span of the light source; it will also help the press operator to set up printing with more ease since white fabrics produce better transparent properties for screen registration and positioning in the press.

STENCIL PHOTO-EMULSION

Stencil imaging with the CTS system is produced by light hardening of the non-image areas of the screen re-composing the original through a step-up procedure. The exposure duration needs to be considered carefully – it is best to select one of the more reactive pure photopolymer emulsions. A problem encountered with pure photopolymer emulsions (stencil emulsions for direct projections, for example) is that definition and resolution are rather poor. This is due to their low solid content necessary to produce low emulsion layer over the mesh to help keep exposure duration within a reasonable time.

To obtain optimum results with the CTS system, it was necessary to review the chemical composition of the emulsion by carefully balancing the product reactivity with a higher solid content. This will give high resolution and definition (see figure 6), with the added advantage of creating stencil coating with low Rz value without having to recourse to special coating procedures. The new CTS photo-emulsions meet the capabilities of the CTS Direct Image Engraver.

The finished stencil offers a light colour that maintains optimum stencil transparency for screen positioning in the press, but offers enough opacity to verify stencil definition and resolution or detect any accidental damage to the emulsion. As no vacuum frame (no glass interference) or litho films are used, no pinholes or other similar defects should occur, removing the need for lengthy stencil retouching.

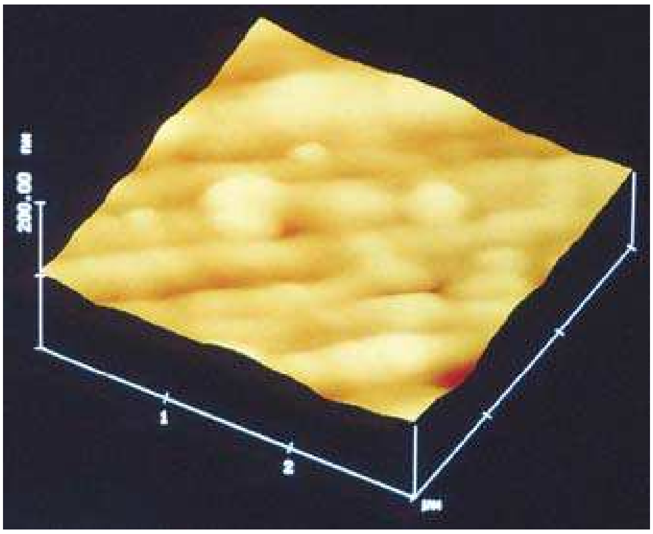


Figure 4a: Microsection of fabric surface from conventional fabric

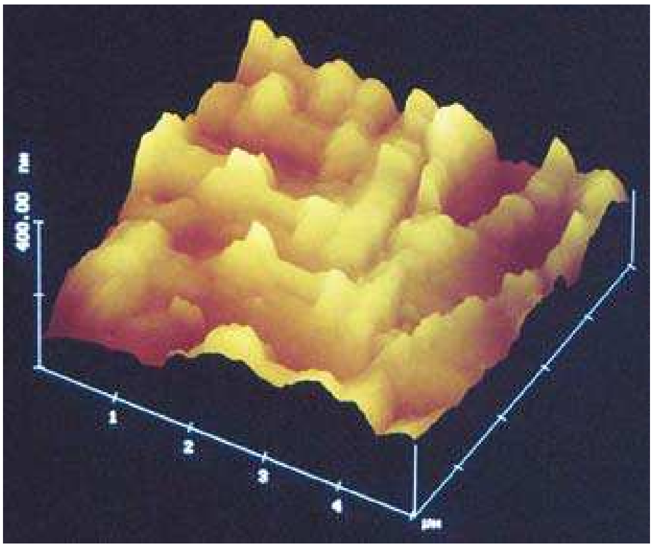


Figure 4b: Microsection of fabric surface from CTMesh

Figure 5a i: High contact angle

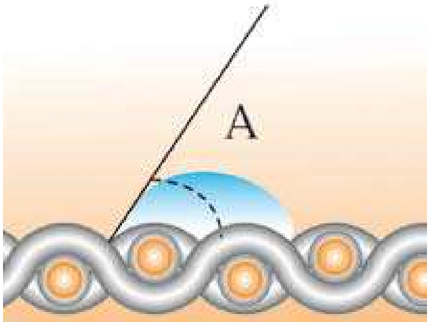


Figure 5a ii: High contact angle

Figure 5b i: Low contact angle

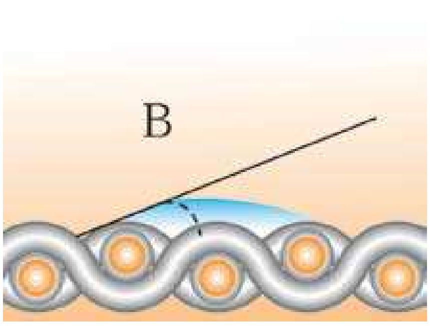


Figure 5b ii: Low contact angle

As for any type of quality stencil making, the usual care should be observed in coating the screen: try and maintain consistent coating thickness at its optimum thickness level. A coating machine will ensure that these conditions are met and the whole process of stencil production will become free from manual handling. Observe correct drying procedures and a clean environment during the coating and drying phases, and the result will be a stencil presenting a quality coating above the mesh of repeatable thickness, a neat shoulder edge and a low Rz value. sp

André Peyskens is Consultant at Saati

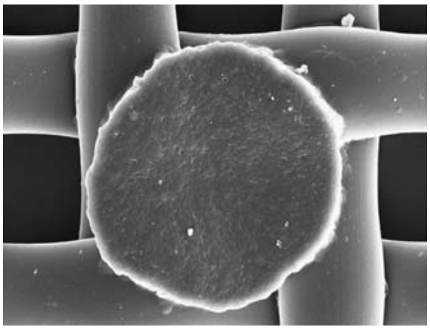


Figure 6a: A sharp and clean stencil dot with Saativit CTS and CTMesh

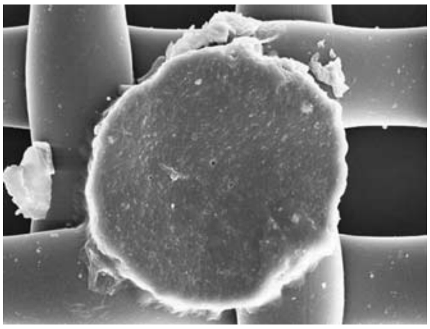


Figure 6b: Conventional stencil and fabric

Further information:
Saati SpA, Appiano Gentile, Italy
tel: +39 031 9711
fax: +39 031 933392
email: info.it@saati.com
web: www.saati.com

SAFER SCREEN CLEANING MAKES GOOD BUSINESS SENSE

Simon Jones highlights the importance of using screen printing chemistry that is safe for both users and the environment

SCREEN PRINTERS ARE UNDER INCREASING PRESSURE TO BOTH PROTECT THE HEALTH AND SAFETY OF THEIR EMPLOYEES AND REDUCE THEIR IMPACT ON THE ENVIRONMENT. WHILE MANY COMPANIES TAKE A RESPONSIBLE APPROACH TO EACH OF THESE ISSUES, OTHERS CONTINUE TO PERCEIVE THEM TO BE SECONDARY CONCERNS WHEN MARGINS ARE TIGHT AND MONEY IS SCARCE. IN REALITY, WHEN IT COMES TO CHOOSING SCREEN CLEANING TECHNOLOGY AND SOLUTIONS, SAFETY AND EFFICIENCY OFTEN GO HAND IN HAND.

Increasingly stringent Health & Safety and environmental legislation means that in many areas, businesses have little choice but to comply with strict standards and guidelines. The consequences of not complying are ever more serious, with managers themselves now liable for heavy fines and even imprisonment in the most serious cases.

In addition to ensuring chemicals specified come with the necessary safety documentation and are used safely and handled correctly, companies also have a legal responsibility to dispose of them properly in a way that doesn't adversely affect the environment and eco-systems. Where potentially harmful chemicals are used this can be problematic and expensive, requiring the use of outside contractors that need to be verified and relied upon to be acting within the law.

Recyclable products will reduce the cost of screen cleaning whilst maintaining quality

GREENER CHEMISTRY

Navigating the maze of legislation that now exists is complex and time-consuming, which makes the use of safer chemicals even more appealing. The latest screen cleaning solvents that have been developed to be safer for both users and the environment require no hazard labelling or instructions. This simplifies things considerably and allows printers to avoid having to spend time and money training staff in the safe handling of potentially dangerous chemicals, or upgrading equipment to achieve compliance with the relevant standards.

These improved products make the working environment significantly safer to work in. Unlike many cheaper options, high quality cleaning solvents have low flammability to reduce the risk of fire, and no harmful chemicals to minimise the chance of dangerous accidents. Many of these are formulated to be water dilutable, so if the solvents are spilled or come into direct contact with users, they can be cleaned up quickly and easily. Furthermore, low evaporation and low odour make the products far more pleasant to use.

Modern screen chemistry is safe to use but still requires a sensible attitude to health and safety

The new generation of safer screen cleaning chemicals are also better for the environment; the products contain no toxic or harmful ingredients and can therefore be disposed of more easily and cheaply, with no risk of environmental damage. With new regulations making disposal an ever more significant proportion of ongoing running costs, this is an important commercial benefit, as well as an ethical one.

CLEANER RESULTS

With even the most persuasive safety and environmental benefits, screen cleaning products still need to be up to the job. While customers are increasingly concerned about the green credentials of their suppliers, they ultimately want to work with a company that they can rely on to deliver consistently good results. For a screen printer to provide this high quality service, often to tight deadlines, the cleaning chemicals chosen must be effective, reliable and affordable.

Even ignoring the potentially serious safety implications of choosing cheaper chemicals to keep costs down, these products are rarely able to provide effective cleaning. For instance, they typically evaporate quickly – at a rate 20 times faster than water in some cases. As a result, it is impossible for them to remain on the screen and in contact with inks and residues for long enough to deliver satisfactory results. More chemicals are then needed to get the screens clean and more wipes required, escalating costs and creating unnecessary waste.

This makes cheaper products extremely ineffective. If the solvent is disappearing into the air and into the lungs of staff, it simply isn't cleaning the screen. So a solvent with a lower evaporation rate is typically much more effective, as well as being safer to the health of users and less wasteful, thereby reducing the impact of cleaning screens on the environment. Higher quality solvents also eliminate or reduce the need for a second haze removal stage, reducing the need for chemicals that can shorten the life of the mesh and allowing screens to be used effectively for longer – and once again keeping costs to a minimum.

RE-USEABLE SOLVENTS

Perhaps the most important benefit of using high quality, safer chemicals is the opportunities for re-use. The advantages include reduced waste, more efficient cleaning processes and the need for less storage space. Essentially, less solvent required to get the screens clean equates to less cost: from purchasing chemicals to the time and resources needed to empty and refill cleaning apparatus, to the disposal of solutions.

The latest generation of screen printing chemicals are specifically designed to be re-used using re-circulation tanks. Re-circulation systems are available that allow ink solids to be separated effectively from the solvent screen wash, increasing the working life of the solution and keeping waste down. Modular stainless steel re-circulation units can be used alongside manual or automatic screen cleaning units to allow users to get more from their solvents, saving a considerable amount of money.

IN SUMMARY

While increasingly tight margins make it tempting for screen printers to choose the cheapest possible products available, these are rarely the most cost-effective or reliable choice in the long term. Cheaper solvents are not typically developed with user safety, the environment or consistently effective cleaning in mind, forcing users to make continuous compromises which can cost them dearly. Cheaper hazardous chemicals require substantial safety documentation, and staff need to be trained and monitored to ensure they are minimising the risks that these products bring into the workplace.

By choosing safer, high quality solvents these issues can be eliminated, leaving screen printers to focus on providing a quality service to their customers. Rather than making printing applications more expensive, working with safer, more environmentally-friendly chemicals can actually be a sound commercial decision, as well as an ethical one. sp

High quality products last longer, perform better and ultimately cost less

Simon Jones is Commercial Manager for CPS at MacDermid Autotype

Further information:
MacDermid Autotype, Wantage, UK
tel: +44 1235 771111
fax: +44 1235 771196
email: pressrelations@autotype.com
web: www.macdermidautotype.com

A PLURAL RESPONSE TO THE ARTICLE 'THE PERFECT MESH'

In his article in *Specialist Printing* issue 1 2009, Steven Abbott offered his view on what's going wrong with our current meshes; here Paul Cylenica and André Peyskens give their response

For a copy of the issue of *Specialist Printing* that contained Prof Abbott's article, email subs@specialistprinting.com

ALL THE MEMBERS OF THE SCREEN PRINTING FRATERNITY WHO ARE INVOLVED IN THE DAILY HANDS-ON PROCESS OF SCREEN PRINTING ARE AWARE OF THE CHALLENGES ENCOUNTERED IN KEEPING THE TECHNOLOGY AT ITS CUTTING EDGE. WE ARE ALL KEENLY AWARE OF OTHER PRINTING TECHNOLOGIES' ADVANCES IN AREAS THAT HAVE PREVIOUSLY BEEN THE STRICT DOMAIN OF THE SCREEN PRINTER. ON OCCASION, WE FIND TECHNICAL ARTICLES WRITTEN THAT ATTEMPT TO APPLY MATHEMATICAL SOLUTIONS AS WELL AS BROAD SUGGESTIONS TO FIX WHAT IS PERCEIVED AS A THREAT TO THE INDUSTRY.

MARKET REALITIES

Today there are screen fabrics of fifth and sixth generation and beyond being used in the marketplace to provide printers with measurable benefits not previously imagined. The developments of different polymers, yarn diameters, performance-enhancing surface treatments as well as new finishing techniques have provided printers with performance capabilities that are far beyond what was possible even just a few years ago.

These technical developments have understandably been hastened by competing printing technology such as digital, as well as added competition from low cost manufacturing regions around the globe. With this backdrop of competition, assertions of job loss and employment decline have been made that attempt to lay blame with a single component of screen printing materials.

REBUTTAL

The article published in *Specialist Printing* magazine (issue 1 2009) titled 'The Perfect Mesh' written by Steven Abbott was recognised by many as being unconstructive, misguided, provocative and to some extent, even unethical.

Firstly, we ask Prof Abbott to provide data to support his claim that "The myth that the ink deposit depends on the squeegee or the stencil has caused more job losses than any other." Really? We wonder where Prof Abbott collects his unemployment data? Making preposterous acerbic claims such as this is totally irresponsible and does nothing to advance the cause of screen printing. His revelation of mesh as the primary factor in ink deposit is about as far from cutting edge knowledge as one can get. No attempt was made to indicate at what level image geometry and stencil thickness, as well as squeegee, is influential, which it certainly is with particular images. Just ask a printer printing a critical near-transparent solid colour if changing squeegee duro has an influence on deposit and resulting visual opacity.

Prof Abbott continues revealing to the reader his perceived "scandal" perpetrated by mesh and ink manufacturers. He advises you to believe, as a rule of thumb, that 30% of ink is left clinging to the threads following a press stroke. We ask: where is your empirical test data? Are we to be convinced of this by the simplistic coloured line drawings he shows of ink encompassing threads? Notice how the ink is indicated as clinging equally around all but the full diameter of the thread. Interesting it would look just like that? We are amazed that he would state such a generalised high figure. This is an absurd 'one size fits all' non-scientific approach. We ask: who is disseminating misleading information to the screen printing public here? Is the figure really 30%? Yes, you printers, please do get under your screens after a print pass and with a lupe, look in the open mesh area and see if you have 30% of your mesh blocked with un-deposited ink. If you do, then you are working with less than zero tension for sure, and you have greater problems.

In another of several mesh mis-statements Prof Abbott makes, he says the following: "To a certain extent, the fibres are locked against each other when they get bent at the knuckles. However, with vibrations, stresses from the squeegee and, even, lubrication by solvents and inks, the knuckles can slip past each other resulting in creep." It is a well known fact that during the heat setting process, mesh knuckles are permanently locked to each other and certainly not to a "certain extent." Threads never ever "slip past each other", even under over-stressed use. Where is the supportive test data, microphotographs, case studies? Who is spreading hurtful myths here? It's also stated that knuckles contribute to mesh markings. Of course they do, if you don't know how to make a proper stencil with appropriate EOM. Maybe Prof Abbott's test screens are only coated with emulsion thickness to a "certain extent"?

Let's be clear here: it's a woven mesh, there will be knuckles! Knuckles are not some evil flaw as was Prof Abbott's attempt to characterise. It is also vital to have a knuckled surface, otherwise there would be no lateral ink flow, as is necessary – even with a thin thread! With regards to the point of manufacturers "needing to make each knuckle identical", we invite all to take a microscope and spend time looking at knuckles and see how many you find that are not identical. While you are doing that, try to measure the amount of "junk that gets trapped in the little spaces" as was so scientifically stated. Prof Abbott's quality of scientific terminology seems to match the amount of empirical test data he had provided.

Mesh manufacturers introduced Theoretical Ink Volume (TIV) in their data sheets over 20 years ago. However let's be very clear here: printers do not refer or depend on ink deposit charts the first day they start screen printing to determine their ink thickness deposit. They work from their experience of pre-existing results and a known set of established screen and press setup parameters, of which mesh is the main, but not only control element. The published TIV data from manufacturers can only be used as a specification to specification relational database for theoretical reference. That data can be, and is, useful to a printer looking to make an adjustment from a known mesh result starting point to another mesh. Never can this data be expected for use to indicate an absolute measured unit that determines final net ink thickness deposit.

To determine final ink thickness under the countless amount of production variables would be an astronomical and pointless undertaking. If you doubt this, find a printer who is printing a critical near-transparent solid colour on his press, then take that same screen to another shop with the same ink and

with a different press setup and squeegee, and see if you get an equal colour match (deposit) as Prof Abbott would have you believe. Manufacturers base their TIV data on relaxed mesh measurements. Every shop stretches their mesh to different tensions and uses a wide variety of press parameters.

The variables that could influence ink deposit are endless, so whether one works from data from a manufacturer's formula or Prof Abbott's simplified formula, in the end it is only possible to show the relative TIV of one mesh spec to another under theoretically identical conditions. It is the printer's task through experience and testing to select the mesh specification and fine-tune all the other influential variables to get his desired deposit, colour and image detail. Most screen printed work in graphics applications is determined by colour match and print detail. Deposit thickness is usually a secondary criterion.

A formula like the one given in the article will never be used as a gauge to decide which mesh count to use in order to aim for an exact ink thickness deposit, whether you deduct 30% as a rule of thumb or not as indicated by Prof Abbott. Can he please explain to us how "partial" elliptical geometry is accounted for in his formula, and also explain how that is relevant to changing a mesh ink volume, whether circular or elliptical? He obviously is also not aware that the thread geometry changes its elliptical shape during tensioning. So, depending on the tension level one stretches to, it will be different in each case! Consider the countless amount of variations of screen, press, squeegee, stencil (ink type thousands here alone) etc. that exist! These types of mathematical debates have been argued many times in the past and in the end, material selection and process variables make any mathematical formula attempt to measure all conditions irrelevant.

Prof Abbott makes numerous statements that are so general that they serve no purpose to render any technical clarity to what mysteries he attempts to expose. He states "if you have a high tension and a very rigid mesh, then the squeegee won't force the mesh into contact with the substrate…" This is not a technically acceptable verbiage conveyance of a printer's problem issues. Absolutely no screen and squeegee geometry data was provided. If you are going to write as though you are the vanguard of protecting jobs for screen printers, then please offer supportive figures of measurement that actually mean something. The screen printing community has used tension meters for many years now and it can be presumed that they are well aware that a given N/cm tension at a given off contact with a particular frame and squeegee geometry will not print. What is the purpose to make such an obvious point here?

In one section of his article, Prof Abbott states: "The perfect mesh would be just a few microns wide…Only nickel meshes can aspire to this ideal." We are not sure if he is talking about woven synthetic nickel-plated mesh or flat surface plate (Stork) type screen? If it is the flat plate type, then his reference is not a comparison that can be made in the context of his article. If it is a woven, is he telling us that nickel-plated synthetic mesh should be used for all screen printing? Nickel-plated mesh has been around for more than 15 years, yet it has not caught on as a mainstream product. Polyester mesh remains king, no argument. Nickel mesh is not being secreted away from the public by the mesh weavers – whatever perceived advantages it may appear to have, the inherent disadvantages have rightfully determined its fate in the marketplace. This reality alone underscores the need for hands-on production experience evaluation as a key ingredient to augment academic supposition.

Prof Abbott states: "It would have been helpful if mesh suppliers gave a figure in their data sheets recording the amount of fibre per unit length but, alas, they don't." Here is another bewildering melodramatic statement. If he did his research, he would find that this data is readily available from some, if not many of the mesh weavers and it is a great way to compare fabric mechanical strength from one mesh to another. However this can also easily be related simply by multiplying the mesh count by the thread diameter. This will give you a mass figure that is comparable and relative to other mesh specs. However, beyond that point, it is not possible that printers would use such esoteric technical data to formulate their specific (N/cm) tension level selection. So what is the point here? A lesson that has been learned repeatedly in the past is that an over-reliance on laboratory data can be costly if used in exclusion of actual historical experience.

To make so many pointed statements with so little supportive empirical laboratory data is really not useful as well as being hurtful to the screen printing community. There are other statement points that we have not bothered to refute here. In Prof Abbott's article he touches lightly on ink metering, mesh strength, mesh reproducibility, mesh knuckle influence, mesh / ink retention, various mesh types, poly, nickel, stainless steel, surface treatments, adhesion, stencil influence and numerous other shortly stated points.
One fact is very evident from his article: a broad derisive address of too many mesh performance points with no supportive data only offers to provide confusion to the readers. Alas, we must ask who is providing more confusion and harm to our brethren on the print floor?

Paul Cylenica and André Peyskens are Marketing Manager and Consultant at Saati

Further information:
Saati SpA, Appiano Gentile (CO), Italy
tel: +39 031 9711
fax: +39 031 933392
email: info.it@saati.com
web: www.saati.com

PRESS MAKE-READY TECHNIQUES

In the first part of his article, Mike Young looks at condition, vacuum holes and timing when preparing the print table for superior print quality

A FEW YEARS AGO WHEN I WAS SELLING SOPHISTICATED SCREEN PRINTING MACHINES, MY BOSS PHONED ME ONE EVENING IN A PANIC: I HAD TO DROP EVERYTHING THE NEXT DAY AS I WAS REQUIRED TO VISIT AN EXTREMELY UPSET CUSTOMER. OUR COMPANY HAD RECENTLY INSTALLED A NEW PRINTING LINE MACHINE AND THE CUSTOMER WAS SUFFERING ALL MANNER OF PROBLEMS.

The only information given to me was that the company specialised in 4-CP displays / in-store media and were continuously experiencing massive dot gain on posters when printing process work on half-size sheets (750 x 1000 cm / 30 x 40 inches) on the new large press (1200 x 1600 cm / 47 x 63 inches) which was recently installed by my company. The problem never occurred when printing full size sheets, only on half size sheets and never on the smaller competitor's press – giving the reason for blaming the new machine and the serious threat of its imminent return and potential lawsuit!

In spite of being armed with limited information, I had a strong feeling as to the cause – poor table preparation. Arriving late afternoon, I could see the printing company from my hotel room, so I wandered across the road to see if I could get a preview of the problem in readiness for the following morning's visit. Almost everyone had gone for the day except the boss and two operators who were working overtime to make up for the shortfall on an urgent shipment as vast amounts of prints were being rejected. As the boss escorted me into the plant I immediately saw the cause of the problem, which reconfirmed my earlier suspicions – and the reason for writing this article, since I realised the same scenario occurs quite frequently.

I returned to my room 10 minutes later, the problem already solved! The lesson here is to never underestimate the smallest or incidental part of press make-ready, particularly when printing 4-CP and other demanding types of fine line work. In this first part of the article I shall examine the first four of six important factors for ensuring print reproduction is not totally lost due to improper preparation of the print table during the make-ready phase of a job.

THE NEED

Not understanding the fundamental requirements of preparing the print table in a suitable fashion so it does not interfere with image quality or productivity will render the end results repeatedly dull and unattractive. Like so many things we tend to do as second nature, other than co-ordinating registration, press operators habitually give little thought to the ins and outs of getting their print table prepared when setting up their machines during the make-ready phase of a job.

Other than textiles, screen printing is an 'off-contact' printing process: the screen must be suspended or separated slightly above the substrate and they only come into contact at the point where the squeegee transfers ink through the mesh. To keep the substrate from lifting and sticking to the screen during the print cycle, a vacuum system holds it down via numerous small vacuum holes built into the print table. However this is not enough because when printing anything smaller in size than the maximum vacuum area, the exposed vacuum holes beyond the substrate must be blocked off (or masked out), either by tape or other suitable masking material, so they do not interfere with the screen separating or the machine's peel-off function.

How this masking out procedure takes place, the materials used and the controlling vacuum power can be highly detrimental to the final print quality; several astute press operators who are fully aware of its implications have told me it matters little what is done upfront in pre-press to improve artwork or controlling colour management with smart software programmes regarding 4-CP – it is all for nothing if the print table is not attentively masked out properly to begin with.

It has generally been the unspoken rule that once registration edge guides have been positioned (if manually applied), screen to substrate registration secured and vacuum holes neatly masked out, it would initially appear the print table is ready for printing. This is not necessarily so – whilst this may be true in a number of instances for less demanding jobs, haphazardly done by not specifically being adapted according to the jobs' requirements and / or substrate type, it will probably create a trail of problems throughout production.

THE FUNDAMENTAL PROBLEM

This is the fundamental problem: when troubleshooting the cause for poor print results, it is seldom traced back to inadequate make-ready, least of all to the lack of suitable print table preparation. Even some of the most experienced operators and supervisors are fooled in this respect, frequently having to grasp for quick solutions to prevent rejects or, even worse, production shutdowns.

Making matters worse, once production has commenced, the commonality with poor table preparation is it can be tough to detect that it is the cause of a problem, especially when initial print results were seemingly acceptable during the start-up and sign-off phase of the job. Functions of registration may look good and secured, taped up or clean masking material may cover the exposed vacuum area and vacuum power applied, so what more is there to do? What could possibly go wrong with a task that is apparently straightforward to complete, particularly when similar jobs have been printed so many times previously without a problem.

Not getting involved in in-depth troubleshooting could be precisely the root of the problem as the typical 'we have always done it that way before, and nothing has changed' stance is taken, regardless of substrate peculiarities or the degree of job difficulty. But something must have changed, it just needs to be determined what. Operators usually take a while to consider the table's condition as potentially being the cause of inferior printing results. Inconsistent registration, image deformity, inferior deposit uniformity, so-called mesh marks, dot loss / gain, loss of print clarity and highlights, poor edge definition, static and other handling problems are just some of the typical hallmarks of a badly prepared print table.

There are at least six factors or concerns involved in preparing a print table for most commercial and industrial / electronic printing applications. Any one of the following can easily lead to problems during production if not taken care of properly:

- Print table flatness and general condition
- Vacuum holes
- Vacuum timing and dwell
- Registration
- Masking out the vacuum area
- Vacuum power.

PRINT TABLE FLATNESS AND GENERAL CONDITION

Can a printing machine print a full size sheet uniformly with, for instance, 50% dot density or a solid area with a semi-transparent ink? Despite what is generally advertised, not all can do so equally – therefore the first and foremost consideration of any flatbed screen printing machine's print table must be its flatness in order to print the maximum size, regardless of image or ink. Without this ability, successful printing across the entire print area in a uniform manner will be almost impossible to realise. The table surface must be absolutely flat and without nicks, dents or burrs etc., particularly around the edges of vacuum holes.

Flatness can be checked quite easy along the table's entire 'X' and 'Y' direction (length and depth) and, if necessary, diagonally with a good engineers' machined straight edge. It is important to note the procedure of how it is checked because I have rarely seen it done properly without first giving instructions. It is simply not enough to carry out this job with the vacuum switched off since it will give a false impression that it is flat. The press should be in a full cycle mode with the vacuum setting at maximum – the operating condition during normal production.

It is very important to carry out the flatness test with a single piece of smooth non-porous material, such as clear film or polyester, covering the entire vacuum area. In this instance, it does not matter if the material contains static, like those backing sheets from capillary stencil films do. The reason for conducting the test in this manner is that all print tables appear to be perfectly flat when not under negative pressure. With full vacuum power on, carefully slide the straight edge across the table in the directions suggested above (see figure 1, over). If the table has a weakness and bows, it will show up under these test conditions.

If it is difficult to observe any discrepancies, either shine a light behind the straight edge or try sliding pieces of paper under it to gauge irregularities. If a variation of just one sheet of paper sounds insignificant in making a difference, consider that many printers have reported that it is more than enough to throw their density numbers off the charts. Subject to the table size, it is safe to assume a variation of two or more sheets of paper can potentially have a dramatic impact on the final print result, particularly with high line count process work.

A twisted table such as one distorted out of shape or bowed in the centre, for example, will probably make fine line / halftone printing exceedingly problematic to perform satisfactorily in those areas. Until the issue is formally resolved, a simple cheat-sheet to overcome some of the problems, used as a short term 'on-press' solution if the table's present condition is enough to affect print quality, would comprise of something like the following:

- reduce vacuum power
- avoid problematic area if possible
- use shorter squeegee length
- consider using softer durometer squeegee blade by 5º as well as multiple composite types of two or more durometers
- avoid using worn down blades (newer blades have more natural 'give' to conform)
- adopt slower squeegee speed for better conformity
- reduce squeegee pressure.

VACUUM HOLES

There are two variables concerning vacuum holes: size and cleanliness. The machine manufacturer predetermines the first so that variable becomes fixed, but the second is completely under the control of press operators. Unless the print table has been previously customised by request, most equipment manufacturers supply presses with their standard size vacuum holes according to the markets they are designed to serve.

For instance, very small holes are ideal for thin flexible, ultra thin delicate substrates (particularly with clear / semi-transparent materials such as films), while medium size is OK for general everyday graphics.

For greater hold-down power, larger holes may be specified for heavy, wavy, thick or rigid materials such as packaging, corrugated substrates, wood and metal etc. The amount of holes and the spacing between them may vary also according to specific needs.

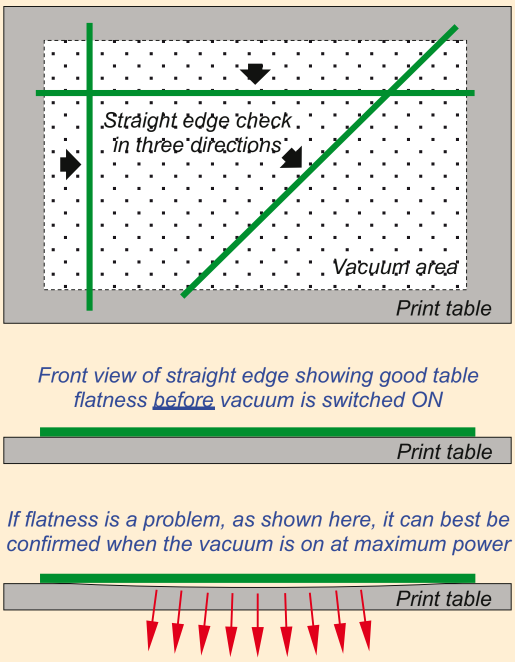
The distinction of hole size and spacing is important to appreciate, especially when considering the purchase of a used printer or a new machine already built and ready to go. Printing with an unsuitable size of vacuum holes will not only slow down production in order to compensate for greater difficulties in handling, but it potentially becomes detrimental to the end print result too.

The other concern is making sure each vacuum hole is clean and not blocked with dried ink or adhesive residues and is, of course, functioning properly. Such a task ought to be part of the weekly or monthly preventative maintenance schedule according to needs. A series of blocked holes will obviously not permit the vacuum to function in that vicinity. With some substrates, this could be noticed in the finished print as a distinctive lost of sharpness (smear-like appearance), as it will not separate cleanly from the screen in the affected area. This is especially true when printing with thin materials that are non-porous. If the blocked area is large enough, a great deal more vacuum (increased velocity) will detrimentally occur elsewhere by default, thus potentially inducing static, which is not exactly creating an ideal scenario for high quality printing (see part two of this article for more information).

Most print tables made for prominent printing machines are constructed using the honeycomb principle, thereby allowing for quick air passage throughout the table. Over the course of time ink and tape residues, readily assisted by aggressive solvents entering the holes, will eventually build up into the table's inner cavities to weaken the adhesive that holds the honeycomb in place, thus causing the table to possibly delaminate. This occurrence is easy to detect by simply pushing down with the palm of the hand over the whole table without vacuum or substrate.

Fig. 1
CHECKING PRINT TABLE FLATNESS

Checking is best accomplished with vacuum power fully on and one piece of non-porous material, such as film, placed over the entire vacuum area



If the table is weak it will bow in the problem area. For most accurate checking, consider shining a torch from the backside of the straight edge or slide paper under it.

VACUUM TIMING AND DWELL

Under ideal working conditions, the vacuum should switch on and hold the substrate down firmly before the next mechanical function takes place. This requirement is imperative with reciprocating table type machines, whereby the table is meant to move into the print position only after the vacuum has completely come on with the sheet firmly secured in place.

The purpose of having correct vacuum timing and dwell (how long the vacuum stays on before the next cycle sequence begins) for flat-sheet printing equipment (excluding sheet-fed cylinders) is twofold irrespective of automation level. Before the table moves into print position (or before the screen descends into print position), the operator has to ensure the substrate is in register and laid out flat without wrinkles or curled up at the sides. With clamshell-type presses, going from lightweight to heavy substrates does not usually present a problem from a timing standpoint because the print table is in a fixed position – only the vacuum dwell needs adjusting to give operators more time to complete manual feeding.

With most types of reciprocating table machines, however, vacuum timing can mean everything because the table moves. While a machine's present no-dwell timing may work well with easy-to-feed lightweight materials for quick processing speed, it might potentially create registration problems when handling difficult curly or heavier than normal materials. In that case, timing should be adjusted to compensate for the additional time required for the operator to manually feed, otherwise the table will start to move into print position while the vacuum is still coming on and the substrate may not have been properly aligned to the register guides.

Even if the substrate was properly registered it may still shift out of register due to the table's instantaneous movement when the vacuum has not had the chance to be fully effective. As with acquiring the same false sense with excessive static in substrates, some supervisors call this a 'false positive' – operators believing their sheets are in register when they are not. To maximise productivity, vacuum timing is usually kept to a minimum but should be increased, as required, to maintain good handling characteristics and retain registration integrity.

REGISTRATION

While this function is a separate and lengthy topic all by itself, artificially placing register guides (those not mechanically incorporated into the machine's table) must be firmly secured in place. A lack of proper procedures such as wrong shape edge guides, using inferior hold-down tape or not positioning to correct in-house standards will probably show up in the finish print as progressive or sporadic misregistration. When using mechanical built-in table register pins / guides, employing more than two along the substrate's long side can also lead to misregistration with multicolour work. This is because most substrates re-orientate themselves once cut so their edges are no longer straight.

In part two of this article I shall continue to examine the final two factors: procedural consideration to mask out the table and the reason for adjusting the vacuum power to ensure the quality of print reproduction is not lost due to improperly preparing the print table. I shall also reveal why the commercial 4-CP printing client mentioned at the start of this article (and the reason for writing it) had needlessly experienced the dot gain problem in the first place. If any reader would like to speculate what caused the problem, please email the Publishing Director. SP

The concluding part of this article will appear in the next issue of Specialist Printing; go to www.specialistprinting.co.uk for details of how to subscribe.

Mike Young is a writer and consultant; he is also a keynote speaker at GlassPrint 2009 (see page 60 for details)

Further information:
Imagetek Consulting International,
North Haven (CT), USA
tel: +1 203 444 5713
email: mikeyyoung@aol.com

DIGITAL PRINTING WITH SOL-GEL INKS

Figure 7: Glass plate decorated with inkjet

In the second part of his article, Ferdinand Trier continues his examination of the mechanics of digital printing onto non-conventional media, and looks at the suitability of printers

COLOUR GENERATION WITH INKJET

The print head of an inkjet system can generate ink drops of a certain size. With some print heads, even the drop size can be controlled over a certain range. To create a random colour from the CMYK system, a number of drops of different colours must be placed on the substrate with, perhaps, some blank spaces left. To avoid blurring the drops should not be placed on the same spot, but next to each other; the area that is needed to display a random colour will therefore be bigger than the area which is covered by one ink dot.

This is why the spatial resolution of an inkjet printer is smaller than the theoretical monochrome resolution, which is given in dpi (dots per inch) in the printer specification. In practical work, this limitation is not so apparent. Where a high spatial resolution is necessary (with sharp, contrasting edges), the colour resolution may be reduced without any resulting problems in its appearance. These details are usually not user controlled – the necessary algorithms are implemented in the printer or the RIP (raster image processor) software.

THE NEED FOR BLACK INK

So theoretically all colours can be generated from the three basic colours, CMY. There are two good reasons to introduce a fourth colour, black (K): a mix of dark colours from CMY would require oversampling (printing two or more dots on the same place), and the pixel size can be smaller with the introduction of black. As we have seen, one dot of black may replace the three CMY dots. While most mixing colours contain an amount of black, the spatial resolution will be improved with smaller pixels. The black colour has at least two tasks: it is needed for mixing the right colours and to get a good contrast.

Figure 6: Inkjet printing on flat glass [3]

It might be useful to add white ink as a fifth colour, especially for printing on transparent media or media with a specific (non-white) colour. White is a non-standard colour and needs additional effort to be handled in the RIP software and for the operator to control the result.

THE NEED FOR 'LIGHT' INKS

Many printers have 'cyan light' and 'magenta light' in addition to the CMYK inks. These light inks have the same colour as the corresponding normal inks, but with less colorant, which makes them appear paler. The light inks are used for printing pale colours where the distance between the single ink dots with normal inks would be very large, because between many unprinted dots, just one printed dot is needed. This would cause a rough and grainy appearance. As a remedy, these areas are printed with the light inks so the density of the printed dots is higher and the grainy appearance vanishes.

Yellow is a very bright colour which does not appear grainy, even when the single dots appear large – this is why 'yellow light' is not needed. For the light inks, the ratio between solvent and solid matter is higher than with normal inks. For porous media this is not problematic but on smooth media, which cannot accept the solvent, the use of light inks is not favoured.

PRINTING IN SEVERAL PASSES

A typical value for the maximum spatial resolution of an inkjet printer is 1440 dpi, which means it can place 56.7 ink dots on a one millimetre length. For mechanical reasons the distance between the nozzles in the printing head must be bigger, so the print head scans the print area in several passes with an appropriate offset. Printing in several passes is also important because, if the print were done in one pass, the ink would blur as the ink is not able to dry quickly enough. For porous media this limitation is not so problematic, but for printing onto smooth media the evaporation of the solvent often limits the printing speed.

Another advantage of printing in several passes is that 'bending', which can be caused by the failure of some nozzles or by inaccurate mechanical control of the print head, is less visible. The disadvantage of printing in several passes is the reduced printing speed. For the best resolution (1440 dpi) and smooth media such as flat glass, 1.5 to 2 square metres per hour seems to be the upper limit for an Epson-based printing machine. A higher printing speed may be obtained if more printing heads are used for the same colour.

IMPROVING SCRATCH RESISTANCE

Typical applications for Sol-gel inks are printing on glass, metal, plastics and leather; figure 6 shows a print on flat glass. As the inkjet printing technique allows a distance tolerance of several millimetres between print head and substrate, it is possible to print on surfaces which are not perfectly flat (see figure 7). With special equipment, it is possible to print on cylindrical objects (see figure 8).

Although the ink dries to a hard coating, the scratch resistance on media such as glass or metal is, even after thermal curing, not as high as with unprinted material. In these cases there are different remedies to improve the scratch resistance of the print.

Figure 8: Decorative inkjet print on a glass tube

IMPROVING MECHANICAL RESISTANCE

The amount of ink needed for an area of a print depends on its colour. In places where intense colour is needed, more ink is used than on places with less intense colour. As a result, the place with less intensive colour is not covered with a homogenous coating, but with single dots of ink. These single dots are less scratch-resistant than the closed layer.

To avoid these single dots it is possible to fill the blank space between the dots with colourless ink – the result is a homogenous layer which has an equal thickness independent of the colour of the print; a welcome side-effect is that the reflection of the print also looks homogenous while the reflection of single dots on a smooth surface looks dull. The disadvantage is that an additional channel for the blank ink is needed and that this channel needs to be supported by the printer software, which is not available on ordinary printers.

LAMINATION AND PROTECTION

Glass panes which are digitally printed can be laminated to form safety glass (see figure 9). To achieve the best adhesion, the print should be flame-treated before lamination. Tests to optimise the process are yet to be undertaken but could show that thermal curing before lamination is not necessary.

Another way to achieve protection is to cover the print with a mechanically robust clear coat. Ormo Print has developed a clear coat (Ormosol Clear coat) which has good adhesion to the print. The clear coat can be directly applied on the tack-free print and needs thermal curing at 160°C. If desired, the top coat can be equipped with a UV-blocker. Figure 10 shows the light transmission of the top coat with UV-blocker.

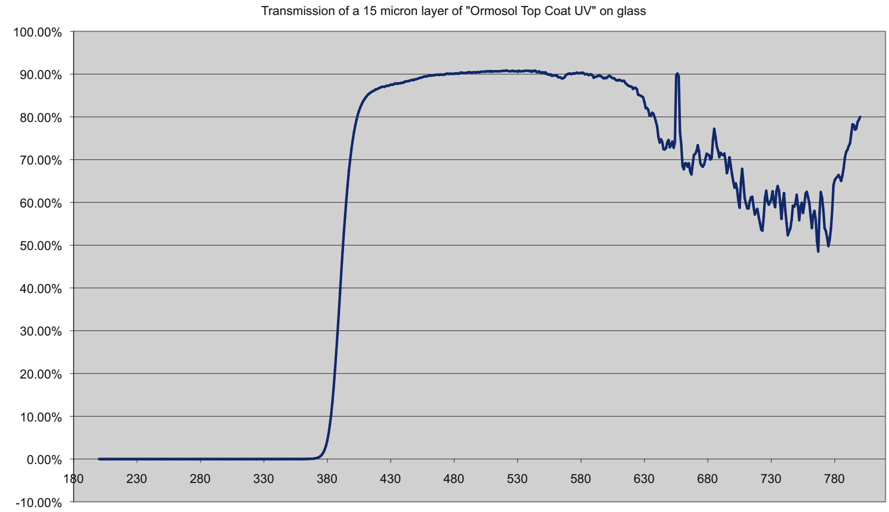


Figure 10: Transmission of a top-coat with UV-protection (Ormosol top coat UV), dry film thickness approx 15 µm

Continued over

Figure 9: Print with CMYK + white ink on glass, then laminated as safety glass [4]

Figure 11: Scratch-proof print on a textured glass

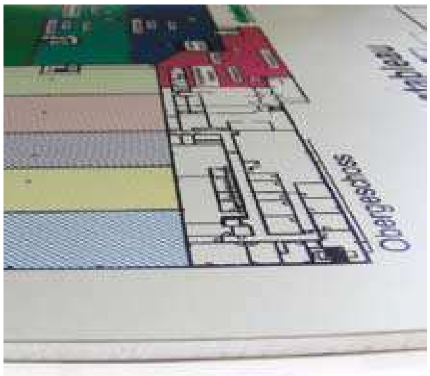


Figure 12: Printing into the anodising layer of aluminium

PRINTING ON TEXTURED SURFACES

Scratch resistance can be obtained when the surface of a hard media is rough or textured before printing – the ink accumulates in the valleys while scratching only affects the peaks. This method works for glass as well as for metal. The rough surface will not be glossy and, in the case of glass, the print will not be transparent, but translucent (see figure 11, previous page).

Aluminium and its alloys can be surface-treated by anodising. In this process the aluminium on the surface is partially changed to aluminium oxide, which provides a hard coating over the original metal surface. The oxide layer is then porous and can be penetrated with dye-based inks (see figure 12, previous page). The oxide layer gives good mechanical protection to the print. To prevent the inks getting washed out by solvent, the pores can be filled with colourless (blank) ink or could be sealed as usual.

Although sol-gel inks give typically hard layers, they are also suitable for printing on soft media such as leather; the resultant print is as robust as the leather itself (see figure 13).

Figure 13: Digital print on white leather

MECHANICS OF FLAT-BED PRINTERS

Digital printing on flat surfaces requires the printing head to scan the printing area in two planes of movement (the x and y axes). To print on objects of different heights it is also necessary to adjust the printing head in the third plane (the z axis). To achieve this, two machine concepts have been established

With a fixed substrate, the object to be printed is supported by a table while the print head is moved in both axes (x and y) – typically a horizontal table places the substrate while the print head is placed in a portal which contains the print head on the x axis. The y guides are placed to the left and right of the table carrying the columns of the portal which also contain the z axis alignment. The maximum size of the substrate is defined by the length of the x and y guides.

With a moving substrate, the object is moved on the y axis while the printing head scans it on the x axis line by line. The z axis alignment is done either at the print head or at the substrate support. The concept follows the plotter concept for endless media on coils, but it is limited to objects that are not too heavy. The maximum printing width is limited by the length of the x-axis guide. If the substrate is moved by friction wheels, the y-axis length is theoretically unlimited.

PRINTER CONSTRUCTION

Due to the high spatial resolution of the inkjet process, a printer needs to be sturdy in construction – any defects in mechanical precision will lead to failures in the print. The print head is usually guided by steel bars and driven by a preloaded steel rope. The measurement of the position is taken at the sledge which carries the print head.

Many flat-bed printers are rebuilt plotters for endless media, where the x-drive and guidance are used. For the y-drive and guidance, different methods are available such as ball screws, tooth belts or toothed racks. For printers with a moving substrate, a direct friction drive is common.

The drive for the z-axis is typically constructed from trapezoidal threaded rods, either in the portal columns or at the table. The demand for accuracy in the z-axis is lower than for the x- and y axes and some clearance in the drive is not problematic, while the z-axis is preloaded by weight.

Printers with a fixed substrate are often available with a vacuum suction table to facilitate the positioning of flexible substrates, reducing the risk of the print head crashing into the substrate. sp

Dr Ferdinand Trier is a professor at Munich University of Applied Sciences

The first part of this article appeared in the last issue of Specialist Printing; for subscription information see page 60

References:
[3] Printed on a 'Practica' poligraf
[4] Printed on a 'Comi Series' Technoplot
Information on the printing machines was collected from manufacturers' publications.

Further information:
University of Applied Sciences, Munich, Germany
tel / fax: +49 89 289 24342
email: trier@hm.edu
web: www.ormoprint.de

SAVE MONEY BY SAVING ENERGY

Sandro Restelli offers an answer for small–to–medium screen printing requirements

GREEN INITIATIVES AND ENERGY CONSERVATION ARE POPULAR BUZZ WORDS AROUND THE WORLD TODAY – CUTTING ENERGY COSTS TO SAVE BIG MONEY IS A GOLDMINE JUST WAITING TO BE TAPPED INTO. THE ECO PLUS UV CURING SYSTEM FROM SIASPRINT IS NOW AVAILABLE FOR BOTH THE MULTIFORMULA AND THE NEW MULTIGRAPHICA. THIS ENERGY MISER INCORPORATES TECHNOLOGICAL ADVANCES DESIGNED TO SAVE MONEY BY SAVING ENERGY, AND IS EXTREMELY USER-FRIENDLY, RUNNING SMOOTHLY AND QUIETLY.

Founded in the early 1960s, Siasprint Service manufactures a range of screen printing machinery from semi-automatics to fully automatics, and has over 300 multicolour presses running. For some time its customers have repeatedly asked the same questions: why don't we build smaller format sizes? What can be done to prevent scratching and shrinkage on the materials we print? How can energy costs be reduced?

To answer these important questions, Siasprint recently launched the modular Multigraphica for small to medium sizes: 76 x 105 cm up to 128 x 210 cm (30 x 40 inches up to 50 x 82 inches), building on the benefits and technology of the Multiformula. The Multigraphica is a belt servo-driven moving vacuum table which can run any material up to 50 mm (2 inches) in thickness. It is for small-to-medium screen printing jobs and operates without shrinking or scratching the printed material, allowing stored parameters to be recalled via programmable functions and dramatically reducing energy, thereby saving money.

EXCELLENT REGISTRATION AND MORE CONTROL

It has excellent registration and offers much more control over the UV curing process. The modular press is available in two, four or six-colour configurations; it features the Eco Plus UV Curing System which replaces the transformer in conventional curing equipment with a PLC-driven electronic control system, incorporates programmable quality control measures for consistent UV output settings and heat-shielded, rotating reflectors.

Once the material is registered on the print table and held in a fixed position via a vacuum, it is transported scratch-free through the printing and curing stations. Heat transfer or build-up is evacuated out of the UV system to maintain proper internal cooling without heat damage to the components, print table or printed material. By removing the infrared heat (a by-product of UV curing) during the curing process and eliminating any chance of heat build-up afterwards or internally within the UV sections, the most heat-sensitive materials can be printed in excellent registration.

COST-EFFECTIVENESS

The Eco Plus UV Curing System is extremely cost-effective compared to a conventional UV system. For example, with direct raw power (the total power installed) a new 6 colour Siasprint Multigraphica 122 x 162 cm (48 x 64-inch) would save around 40-50% annually in energy costs. This overhead for energy cost is paid for with after-tax money; in a typical scenario, based on running three production shifts a day, a predictable payback in energy savings alone would be achieved in less than three years.

Whilst energy costs vary from region to region, the hidden benefits of indirect energy generate further energy savings. When a multicolour press is in stand-by mode, energy is consumed. The PLC-controlled Eco Plus UV Curing System automatically powers down to a 10% stand-by mode – conventional UV systems often power down to 40-50% stand-by mode, which results in 300-400% more energy consumption.

The Multigraphica saves money by saving energy

Easy accessibility aids fast set-up and screen cleaning

The infeed station on the Multigraphica

CONSISTENT UV QUALITY CONTROL

The system's UV lamp reflectors rotate 180° at the end of each curing cycle, directing the lamp energy upwards and dropping power output to the 10% stand-by mode, reducing the exhaust motor speed at the same time to prevent the need for excessive make-up air from the facility. As the heat is shielded during the curing process, the material cannot come into contact with the lamps to cause a fire and the exhaust motor is adjusted down to minimise the facility's resources, such as make-up air for shop heat or air conditioning.

The Eco Plus UV Curing System's heat and energy facets are precisely controlled to save energy. The soft / instant UV lamp starts without a warm-up time and no electrical current peaks, so operators can shut down the multicolour line for any period of time during set-up, breaks, lunch or whenever needed to conserve energy.

The stepless UV lamp output and monitoring device can adjust across the full range from 0-100% (0-160 watts/cm). The milijoule per square centimetre value can be input from the programmable touch panel interface for automatic UV output settings and the UV lamps are continuously monitored to eliminate the curing guesswork and therefore save time and reduce spoilage, which is an important tool for ISO standards or certification and an easy way to ensure that ink suppliers' specifications are met. sp

Sandro Restelli is Managing Director of Siasprint

The programmable touch panel interface stores and recalls repeat jobs

Further information:
Siasprint Service srl, Lainate, Italy
tel: +39 02 93796383
fax: +39 02 93790232
email: staff@siasprint.it
web: www.siasprint.it

CONTROL THE PRINTING PROCESS

Paul Borucki outlines the properties of a solution for printing directly onto garments that reduces labour costs

The 932NDS (single-pallet) industrial direct-on-garment machine

DIGITAL PRINTING DIRECTLY ONTO GARMENTS IS A PROCESS AND CONTROLLING THE PROCESS IS THE KEY. WHEN KORNIT DIGITAL FIRST BEGAN ENGINEERING ITS LINE OF DIGITAL PRINTING EQUIPMENT IN 2003, THERE WAS AN UNDERSTANDING OF WHAT WAS NEEDED TO CONTROL THE PROCESS: DEVELOP A LINE OF EQUIPMENT FROM THE BEGINNING AND PREPARE FOR THE INEVITABLE CHANGES IN TECHNOLOGY. ONLY THEN CAN YOU GAIN CONTROL OF THE PROCESS.

When Kornit made the decision to build an industrial solution for the direct-on-garment industry, it sought out the finest components available. They needed to be robust and capable of being manipulated to allow for the future demand for greater speed. Before the actual printing components could be brought together it was essential to begin with a rigid steel box beam frame to combat vibration. The rapid oscillations of the printing pallets and the print heads lead to vibrations that compromise print quality. When working with drop locations measured in microns, it is critical that the platform is stable to guarantee a quality print; the mass of the frame in Kornit printers is a very stable platform.

As print head technology improves, it gives us the ability to control more rapid firings of the piezo ink jets in the print heads. Kornit Digital uses Spectra's finest print heads. The faster the print heads can be fired the further the goal of building the most efficient, high speed digital printer in the industry can be expanded.

DESIGNING DIGITAL INKS

Increasing the firing speed of the inks jets can be disastrous unless the composition and characteristics of the ink can be controlled. If the ink is not manufactured at the perfect viscosity with the perfect surface tension, the ink droplets will destruct prior to reaching the material, leaving soft, muddy prints. Digital ink must be chemically designed to be projected at high speeds. Kornit Digital develops and manufactures its own line of digital inks so changes can be made to the ink to adapt to changes in the mechanical aspects of the equipment.

Once the heads are firing rapidly and the chemistry of the ink is under control, the printing pallets can be accelerated to match the firing of the ink jets. By using magnetic linear drives in place of conventional motors to drive the motion of the pallets and the print heads, Kornit can alter the speed of the printing pallets on demand. These linear drive components offer accuracy, stability and variability to adapt to changes in the printing speed, print head and ink chemistry technology.

As the ever-developing computer industry offers new capabilities, the ability to control complex computer-driven functions in unison saves valuable seconds on every print. The design of these critical computer programmes by in-house Kornit computer engineers allows the constant development of more efficient programmes to produce a more productive machine.

PRINTING ON WETTING SOLUTIONS

Now that the process is controlled, printing can take place. The garment industry is plagued with variables – each garment manufacturer has a slightly different process that will directly affect the quality and durability of the product. Kornit's approach to controlling this variable is not to print on the garment, but rather to print on a controlled wetting solution (sometimes referred to as a primer or fixation solution). A wetting solution that is applied off-line can lead to variables in the durability and quality of the print. If this off-line wetting solution has dried out or has been affected by other conditions in the surrounding conditions where the garments are stored, the prints may wash out, crack or prematurely fail.

To control this variable Kornit has designed an automatic spraying system, built into its digital printers, that applies the wetting solution to the garment just prior to printing. This reduces labour costs as the garment is handled once by the operator – not once by an off-line person to prep the garments and then by an operator to load the garment to the machine. By applying the wetting solution inside the machine and then printing directly wet-on-wet inks to the wetting solution, a strong chemical bond is formed between the fabrics, the wetting solution and the inks. This is especially critical when printing white inks – the bond between these materials must be strong and flexible to withstand stretching and many washes.

The ability to print on 100% light cotton garments and directly on light and dark coloured 100% polyester and polyester performance fabrics, pigment-dyed fabrics and many other materials with a single ink line has brought flexibility to digital printing companies. These companies can now offer a multitude of high quality products in single and short run prints for the retail market, or produce hundreds of one-off prints for the on-demand internet-based industry. As the speed of the digital equipment continues to improve, this ability is expanding the quantities that can be profitably produced. SP

Paul J Borucki is VP North American Operations for Kornit Digital

Kornit's chemistry solutions

A printed garment

The 931DS (dual pallet) industrial direct-on-garment machine

Further information:
Kornit Digital Ltd, Rosh-Ha'Ayin, Israel
tel: +972 3 9085800
fax: +972 3 9080280
email: yael@kornit.co.il
web: www.kornit-digital.com

HOW TO MATCH TODAY'S LASER CUTTING TECHNOLOGY TO APPLICATION REQUIREMENTS

In the second part of his article, Markus Klemm continues his examination of the various features of laser cutting systems and advises on how to source them

ANOTHER AREA THAT CAN GET CONFUSING TO THOSE WHO DO NOT UNDERSTAND THE SPECIFICS OF LASER SCAN HEAD DESIGN IS THE USE OF SO-CALLED DOUBLE SCAN HEAD SYSTEMS IN THE HOPE OF ACCELERATING CUTTING SPEED. THESE HIGHER-PRICED DOUBLE SCAN HEAD LASER CUTTERS ARE ACTUALLY AT TIMES NO FASTER OR CAN EVEN BE SLIGHTLY SLOWER THAN THE SINGLE SCAN HEAD LASER CUTTERS THAT USE HIGHER WATTAGE LASERS COUPLED WITH MORE SOPHISTICATED ALGORITHMS IN THE LASER CONTROL SOFTWARE. ALTHOUGH THE IDEA OF USING TWO LASERS AT ONCE TO DOUBLE YOUR PRODUCTION SPEED MIGHT SOUND GOOD, THIS CREATES SIGNIFICANT QUALITY ISSUES AND CANNOT TRULY DOUBLE SPEED BECAUSE OF THE PHYSICAL CONSTRAINTS OF PUTTING TWO LASER SCAN HEADS NEXT TO EACH OTHER AND THE COMPROMISES THAT THIS FORCES ONE TO MAKE.

When you are stitching two halves of the web width together, it is often possible to have more parts on one side of the web compared to the other (see Figure 21). In this case a double scan head machine will lose web speed because the laser on the overloaded side will cause a slower web speed. To solve this problem, manufacturers of double scan head systems usually position the two laser scan heads as close together as possible across the web width to create the greatest possible overlap between their two cutting fields.

However for wider material there is always an interplay between the size of the scan heads, how closely they are positioned together, the spot size that results and the extent to which there is overlap in the cutting area of the two scan heads and the related stitching involved. If the scan heads are too large to be placed very close together, there will be less overlap in the cutting area and more need to stitch, which is an eventual challenge to quality (see Figure 22).

QUALITY CONSTRAINTS

If small scan heads are used and positioned closely together, there might be a greater overlap in cutting area but the spot size would need to be much larger – as much as 280+ microns, which is also an eventual challenge to quality. A third option, which also undermines quality, would be to use small scan heads positioned a distance apart for a smaller spot size, but again creating a need for stitching because there is a much smaller overlap in the cutting area (see Figure 23).

Another constraint is that there are always areas beyond the reach of the other laser scan head (see Figure 24), which means that you must contend with the difficulties of stitching two objects together that have been cut by different scan heads. This always means some compromise in quality, because different scan heads will have different temperatures resulting in different drifts during operation. Realistically there are very few laser cutting applications that are forgiving enough for the quality issues that such stitching engenders. It is not only applications with stringent cut-to-print registration requirements that are challenged by stitching the cut images from each of the dual scan heads. For example, if there is an offset of the two cut parts by more than +/- 0.1 mm, this can create a knick during waste removal due to the misalignment during stitching.

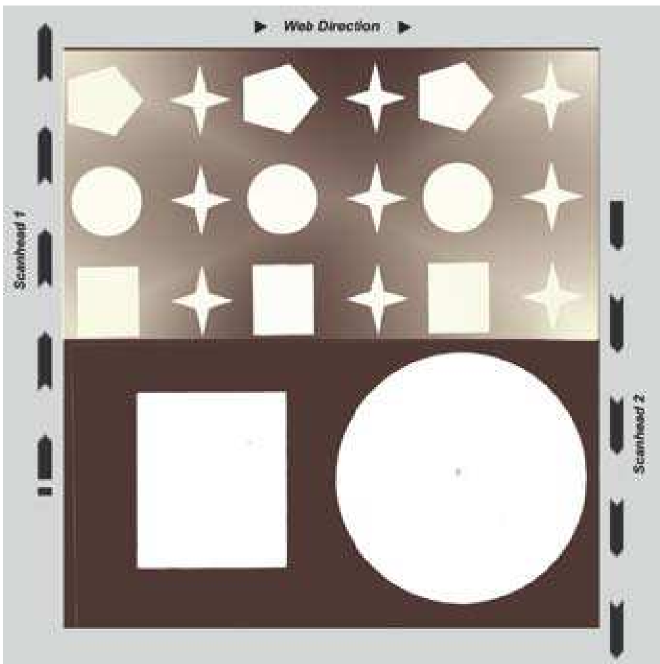


Figure 21: An unequal number of parts on each half of the material

Figure 22: Combining two large heads

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However for wider material there is always an interplay between the size of the scan heads, how closely they are positioned together, the spot size that results and the extent to which there is overlap in the cutting area of the two scan heads and the related stitching involved. If the scan heads are too large to be placed very close together, there will be less overlap in the cutting area and more need to stitch, which is an eventual challenge to quality (see Figure 22).

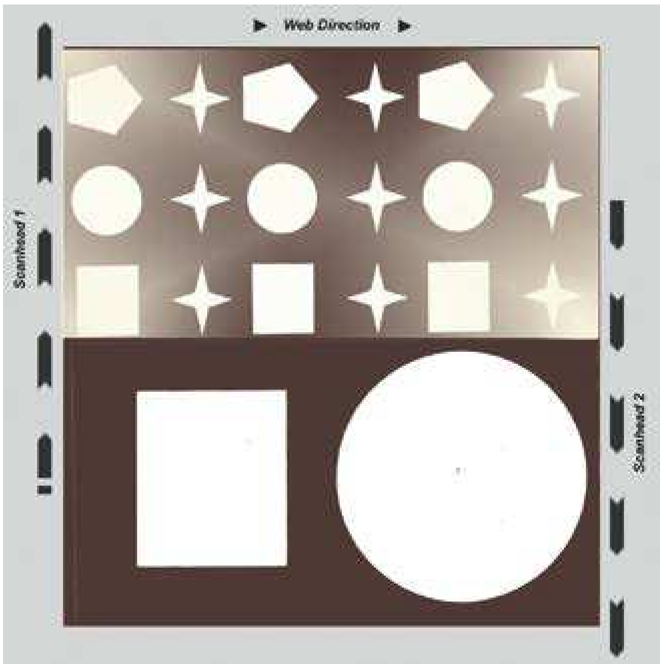

Figure 21: An unequal number of parts on each half of the material

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If small scan heads are used and positioned closely together, there might be a greater overlap in cutting area but the spot size would need to be much larger – as much as 280+ microns, which is also an eventual challenge to quality. A third option, which also undermines quality, would be to use small scan heads positioned a distance apart for a smaller spot size, but again creating a need for stitching because there is a much smaller overlap in the cutting area (see Figure 23).

Another constraint is that there are always areas beyond the reach of the other laser scan head (see Figure 24), which means that you must contend with the difficulties of stitching two objects together that have been cut by different scan heads. This always means some compromise in quality, because different scan heads will have different temperatures resulting in different drifts during operation. Realistically there are very few laser cutting applications that are forgiving enough for the quality issues that such stitching engenders. It is not only applications with stringent cut-to-print registration requirements that are challenged by stitching the cut images from each of the dual scan heads. For example, if there is an offset of the two cut parts by more than +/- 0.1 mm, this can create a knick during waste removal due to the misalignment during stitching.

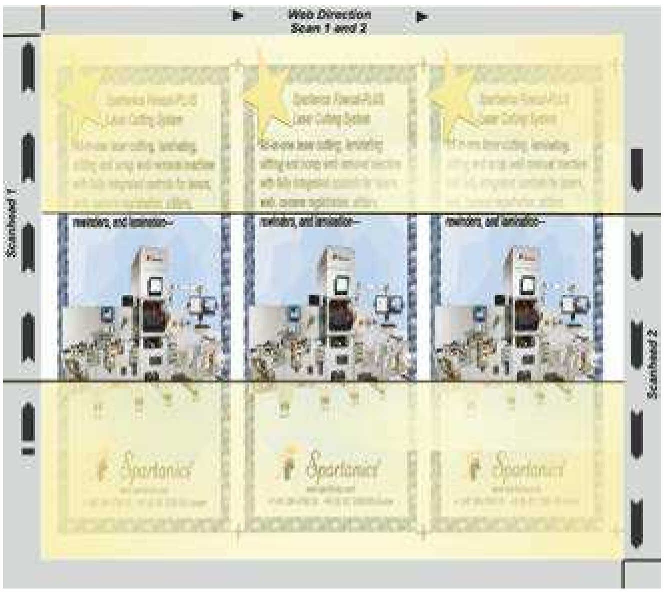


Figure 22: Combining two large heads

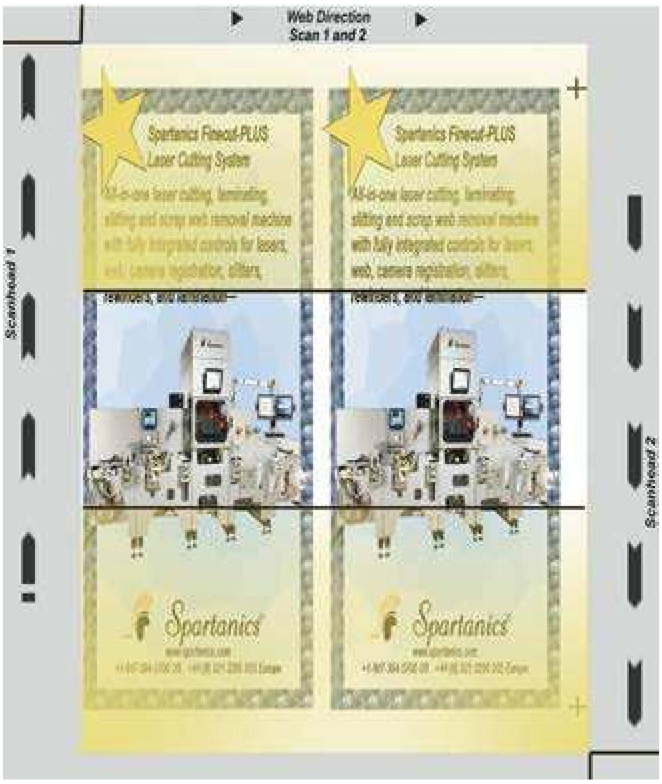


Figure 23: Combining two small heads

Thus the higher cost of double scan head systems is not justified, especially if one compares these systems to single scan head laser cutters that are designed for cutting at higher speeds. Double scan head systems often cannot use the 200-210 micron spot size lasers that avoid the excess heat which can cause problems such as burn-throughs, adhesives sticking to release papers etc. Moreover the costs for higher wattage single scan heads are considerably less than the dual scan head designs, yet the production speed they afford is typically the same or a bit faster.

SYSTEMS INTEGRATION AND PRODUCTION OUTPUT

The quality improvements that are possible when high resolution camera systems communicate to scan head control software to determine required X/Y offsets is only one example of the benefits of

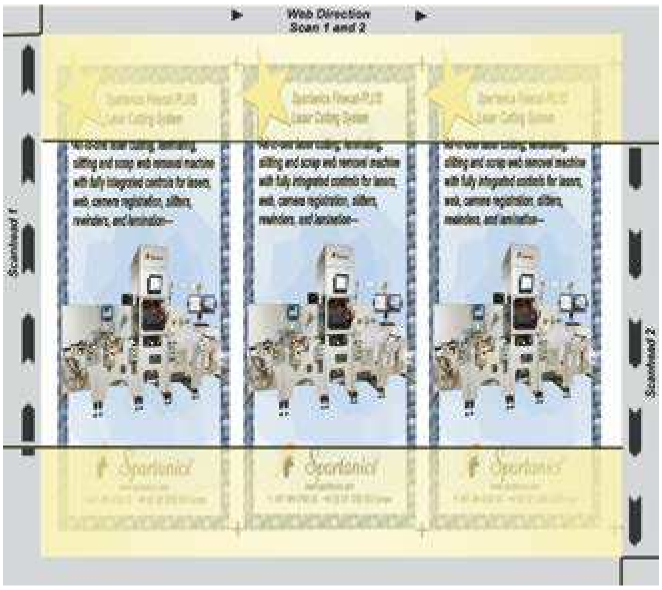


Figure 24: Yellow is cut with either the upper or lower scan heads

systems integration in top quality laser cutting machines. The extent of systems integration in a laser cutting system can largely determine how user-friendly it is to operate and has great bearing on the production outputs that can be achieved. For example, older systems required users to obtain a separate camera system and required operators to additionally master the camera control software; in contrast, today's better quality laser cutting systems come with cameras fully integrated with the laser software. Operators do not have to learn the set-up of a separate camera system as this is now done directly from the laser control software and in the best-in-class systems it only takes three simple steps.

The better quality laser cutting systems with full integration of all system components are the only laser cutting machines one can find in the market today that work seamlessly with variable images from digital printers. These better quality laser cutters allow one to create laser jobs with multiple pictures with different geometries and different step-ups. This is only possible in today's fully integrated laser cutters where there is ongoing communication between the PLC and the camera system. It's a good illustration of why laser cutters that do not feature a high level of systems integration are now obsolete machines – they simply can't keep up with the demands of working with variable data and variable images for which digital printing is so ideally suited.

This same feature of integrating cameras with machine controllers allows today's high quality systems to automatically compensate for variations in prints, such as those that are created by shrinking as inks dry. These better laser cutters automatically account for variations in step-ups from one part design to the next, and can only do so because of that ability for the machine controller to communicate with the camera system.

Because these better laser cutting systems feature full communication between the camera system, the laser software and the machine controller, they can automatically determine the step-up of each job. They are self-calibrating and operator input is not required to measure or input step-ups. Antiquated technology that does not have this level of systems integration simply has no mechanism available to automate the start of jobs, the calculation of step-ups or to compensate for variations in step-ups created by other steps in the production process.

Figure 25: One of the screens used by the operator

FULL COMMUNICATION

In today's systems with a high level of systems integration, there is a new ability to vary the job stop criteria by part count rewound, by rewinder diameter or the rewinder roll length (see Figure 25). Here too, this is only possible because the software that controls inputs, outputs and the laser cutting work together and are fully communicating with each other. This same systems integration feature of top quality systems also facilitates the fastest setup of repeat jobs because all the machine parameters needed for a specific job – web speed, dancer arm pressure, camera system settings etc. – are saved in one file. This means that at the very start of the job you can achieve required cut-to-print accuracy without having to separately reload parameters for different system components.

You also can always identify the better laser cutting systems that have full systems integration by their smart stop systems, which lower quality laser cutters that are devoid of systems integration are lacking. These smart stop systems monitor all possible fault conditions such as web breaks and off-positioning of the dancer arm, or full rewinder rolls. When there is a fault condition anywhere in the system it pauses and the error message is displayed on the operator screen. Such smart error messaging facilitates maximum throughput and is only possible in fully integrated systems where there is seamless communications between operating software for registration, lasers, laminators, slitters and rewinders.

Thus systems integration in the better quality laser cutting machines has a faster throughput. Though throughput varies from one plant to another and one job to another, a reasonable expectation is that throughput with today's better quality laser cutting machines will be significantly faster than what is possible with non-integrated technology.

Better yet, estimating production time is now automated by the software in today's better quality laser cutting machines. These systems' software creates a database that stores laser settings for various types of cuts (e.g. kisscuts, creases) for the particular substrate being cut. Using this data, the same software capability that optimises a job for web speed will calculate this optimum web speed and the production rate that is possible. This job simulation is done by the software before the job is run, and gives users of today's better quality laser cutters an ability to make very accurate cost projections of new job runs.

SELECTING SYSTEM COMPONENTS

You can expect a cost difference of up to 20% between laser cutting systems made from high-end components and those that are made with components of lesser quality. As a manufacturer of both high-end and more affordable laser cutting systems, Spartanics estimates that nearly four times as many users will be adequately served by lower cost systems. It is important to know that your source for laser cutting technology is not tied in with particular component suppliers. Best-match components for particular applications (laser source, laser scan heads etc.) can be sourced worldwide. Lower cost systems can produce high quality outputs if the underlying software engineering and systems integration are expert. Figure 26 outlines some of the key differences between lower cost and high-end systems, and the obsolete technology that they both replace.

Knowing your real quality requirements is the first step in deciding whether your operation is better served by low cost or higher quality laser cutting systems, however there is a baseline of quality that should always be achieved such as avoiding burn-through marks and ensuring that there is a crisp narrow cut precisely following the artwork geometry. A laser cutting machine must have a high quality laser source with a small spot size to achieve these results. In label applications this also allows for much better control of the heat transmitted to the release paper on the back of labels. Inferior laser sources with larger spot sizes often make it difficult to remove the cut labels because melted adhesives cause the labels and release paper to stick together.

If a laser cutting system presents burn-throughs it usually reflects both a poorer quality of software engineering to operate the laser power and an inferior laser source with a large spot size. The soft marking capabilities of today's better quality laser cutters should be considered as a non-negotiable feature, whether a system is high- or low-priced. There are systems at all price levels that can and cannot achieve this level of quality and thorough investigation is required.

POWER CONSIDERATIONS

The wattage of the laser should be carefully considered. Many of the commercially available lasers have the best laser beam quality with full power; if you end up using only 10% or less of the laser power from your laser source you can expect significantly diminished laser beam quality. For example, a converter making kisscuts with easy-to-cut materials that has a 300 watt laser in its cutting system may be using only a small portion of available laser power and would be better suited by a lower watt laser. A converter making many through-cuts, including more difficult to cut release paper, which also wants to achieve high cutting speeds would need that 300 watt laser.

The smaller the maximum working area the smaller will be the spot size of the laser. Smaller spot size means better cuts because the energy is concentrated and you need less laser power to achieve the same depth of cut. Less heat is transferred to the material being cut. Lower-priced systems sometimes use lower cost air cooling for lower power lasers, as opposed to the more costly water-cooled lasers.

Continued over

Laser Comparison

FEATURE	Obsolete Technology	Modern Low Cost	Modern High End
Burn through marks	YES	NO	NO
Pinholes at start/stops	YES	NO	NO
Consistent edge quality	NO	YES	YES
Suitable for cutting adhesive materials.	NO	YES	YES
Consistent quality from closed laser source	Varies	YES	YES
Soft marking capable	NO	YES	YES
Consistent cut-to-print registration at higher web speed.	NO	YES	YES
Optimized for cutting speed	Varies	YES	YES
Optimized for web speed	NO	YES	YES
Double scan head design	Varies	NO	Varies
Faster single scan heads	NO	YES	YES
Systems integration of all control software.	NO	YES	YES
Automatic X/Y corrections during operation.	Varies	YES	YES
Possible to change laser settings directly on laser cutter.	Varies	YES	YES
Possible to change laser settings on-the-fly while cutting.	NO	YES	YES
Able to continuously cut images larger than half of working field without splitting images up.	NO	YES	YES
Minimizes cuts automatically when splitting images.	NO	YES	YES
Automatically determines job step up and position to start cutting.	NO	YES	YES
Job simulation software to predetermine web speed and production rate.	NO	YES	YES
High precision self-calibrating camera registration with simple setup.	NO	Varies	YES
Smart stop system for fault conditions	NO	YES	YES
Variable job stop criteria	NO	YES	YES
210 micron spot size	NO	YES *	YES**
260 micron spot size	YES	YES***	NO
Complete remote diagnostic capability	Varies	YES	YES
Can combine multiple pictures with varying geometries and step ups in single job.	NO	YES	YES
Works seamlessly on cutting variable data images from digital printers.	NO	YES	YES
Highest cut-to-print accuracy for working fields 300+mm x 300+ mm.	NO	YES	YES
Match for tightest tolerance applications for 300+mm x 300+mm working field.	NO	NO	YES
Match for tightest tolerance applications for 200 x 200 mm working field.	NO	YES	YES
For easy recall saves ALL job related parameters in one file including laser, machine and camera settings.	NO	YES	YES
One step repeat job setup	NO	YES	YES
Image stitching	Varies	YES	YES
Automated image splitting for maximum web speed	NO	YES	YES
Lower priced	Varies	YES	NO

*If 200+ x 200+mm working field.
**All size working fields
***If 300+ x 300+mm working field.

Figure 26: Laser cutting technology comparison chart

The edge quality that a particular laser cutting system delivers will vary with the spot size of the laser. In systems with smaller working fields (e.g. 200 x 200 mm field size) this is not so important and one can expect both the better high-end and lower-priced systems to have a 210 micron spot size. If the working field is larger, however (e.g. 300 x 300 mm field size), one needs to be able to use a 280 micron spot size when considering the lower-priced system. As an example, generic label converters might be well-served by a system with such larger spot sizes but those involved in RFID applications might need the greater precision in cutting edge quality.

Smaller spot sizes not only affect edge quality of the cuts, but also affect cutting speed. It is very important to verify that a system can maintain the desired edge quality and cut-to-print accuracy at the maximum cutting speed of the system. Some of the more poorly designed laser cutting systems cannot maintain cut-to-print accuracy over time. The lower cost laser cutting systems may use sensors for registration, or in more demanding applications use the sophisticated camera technology to deliver the very tight tolerances in cut-to-print registration that are typical of high-end systems. If these camera systems are fully integrated with the laser scan heads they are able to apply the offset values to keep cuts to a precise registration. Here too, it is not only the quality of the camera but the underlying software engineering that has great bearing on the tolerances that are achieved at varying speeds.

Figure 27: User-friendly instructional software

USER-FRIENDLINESS

Features that affect user-friendliness and ease of operation are found in both the low-priced and high-end better quality laser cutting machines, reflecting the high level of systems integration in better quality laser cutters at all price points. Smart stop systems, job simulation software, automatic image splitting and optimisation for web speed, variable job stop criteria and one step job set-ups of all operating parameters make these systems straightforward to operate, even for lightly skilled workers. Because the software is handling most operations behind the scenes (registration, web control, laser powering, laminating, slitting) and because there is full communication between different system modules, the operator's work is relatively simple because the software does the difficult jobs automatically.

Some out-of-date designs do not give operators the capability to change job settings while the laser cutting machine is operating, nor directly on the machine. These laser cutters, by forcing operators to stop cutting operations entirely and reload a job from scratch, saddle users with unnecessary drags on production that today's better quality laser systems bypass altogether by giving operators numerous ways to amend job parameters without shutting down the production line.

Spartanics has introduced a step-by-step instructional video wizard for laser cutting as semi-interactive Help Menu options on all of its Finecut Laser Cutting Systems (see Figure 27). These interactive video wizards are designed to help overcome language barriers and to quickly bring workers at all skill levels up-to-speed in operating sophisticated laser cutting technology. They cover a range of topics such as camera set-up, performing test shots and job set-up. When a topic is selected, a short step-by-step interactive video shows the sequence of operational steps required to perform that function on one screen while the operator can directly interact with the laser system on another screen.

SOURCING LASER CUTTING TECHNOLOGY

To begin sourcing the best laser cutting technology for your operation, you must first determine your application requirements in terms of complexity of geometries to be cut, production rates required, sheet versus web and type of materials (PET, ABS, polycarbonate etc.). You should contact several manufacturers that build laser cutting systems to request that samples are run on your materials using a few of your part configurations. The manufacturers should then be able to recommend the model that will be correct for cutting your parts from your materials.

Of course, it is very important to ensure that these manufacturers are equally adept at creating lower-priced laser cutting systems and more sophisticated technology so that they can deliver best-match solutions. If a laser cutting system integrator is tied to particular components (lasers, scan heads etc.), consider it a red flag that they are not set up to match laser technology to real application requirements.

After receiving your cut samples from the prospective manufacturers of laser cutting systems and after receiving their recommendations on the proper model of laser cutter and their budgetary pricing, request a personal visit to manufacturers of interest to see actual cutting of your parts and materials. If you spend one day at the individual manufacturers you should be able to get a good feel for the degree of difficulty in cutting your parts. A visit also provides an excellent opportunity to see the plant, to understand the people that you could be dealing with in the future, and to examine the ease of use of importing drawings of parts into the laser cutter and converting the drawings into a useable cutting path.

It is also advisable to determine the extent of service support that is available from each manufacturer, as this can make the difference between a relatively short period and a much longer period of downtime in the future. Better quality laser cutters, both low-priced and high-end, include complete remote diagnostic capabilities. The best-case scenario of comparative shopping would also include the use of laser cutting system manufacturers' contract manufacturing services. These would provide proof of concept and would allow expert software integrators to fine-tune operations to your exact application requirements. SP

The first part of this article appeared in the last issue of Specialist Printing; see page 60 for subscription information

Markus Klemm is R&D Software Engineer for Spartanics

Further information:
Spartanics, Chicago, USA
tel: +1 847 394 5700
fax: +1 847 394 0409
email: info@spartanics.com
web: www.spartanics.com

OUTLINING CLP LEGISLATION

Elaine Campling explains The Classification, Labelling and Packaging of Substances and Mixtures (CLP) Regulation (1272/2008 (EC))

THE CLASSIFICATION, LABELLING AND PACKAGING OF SUBSTANCES AND MIXTURES (CLP) REGULATION (1272/2008 (EC)) CAME INTO FORCE ON 20 JANUARY 2009 AND ALIGNS EUROPEAN UNION (EU) LEGISLATION WITH THE UN GLOBALLY HARMONISED SYSTEM FOR THE CLASSIFICATION AND LABELLING OF CHEMICALS (GHS). GHS WAS DEVELOPED BECAUSE THERE WERE GLOBAL DIFFERENCES IN CLASSIFICATION AND HAZARD COMMUNICATION SYSTEMS, BOTH FOR CHEMICALS IN USE AND FOR THE TRANSPORT OF CHEMICALS. GHS THEREFORE REPRESENTS THE GOAL OF A SINGLE WORLDWIDE SYSTEM FOR CLASSIFICATION AND HAZARD COMMUNICATION FOR THE TRANSPORT, SUPPLY AND USE OF CHEMICALS.

Put simply, the CLP Regulation is the EU's version of GHS and will eventually completely replace the Dangerous Substances Directive 67/548/EEC (DSD) and Dangerous Preparations Directive 1999/45/EC (DPD), the EU classification and labelling systems for chemicals in use. Provision has been made within the individual transport modes to adopt the GHS criteria.

The CLP Regulation applies directly within EU member states, that is, member states do not need to transpose the legislation into national legislation and alongside the REACH Regulation, the CLP Regulation is being managed by the European Chemicals Agency (ECHA).

BUILDING BLOCKS

GHS was composed of 'building blocks', some or all of which could be adopted by jurisdictions such as the European Union. The building blocks are the hazard classes and hazard categories and the CLP Regulation includes some building blocks not featured in the DSD or DPD. It is reported by European regulators that the CLP Regulation has been developed to maintain the scope as close as possible to the requirements of the DSD and DPD, but there are further notable differences.

The terminology is different: 'preparations' are now 'mixtures', 'dangerous' is now 'hazardous', signal words replace the description of danger (hazard), risk phrases are replaced with hazard statements, safety phrases by precautionary statements and symbols by pictograms. Therefore safety data sheets and labels will look very different from what we are used to (see diagram).

The CLP classification criteria differs with an expectation that more substances and mixtures will be classified as hazardous, and some substances and mixtures will carry more severe hazard classifications. For example, under the DSD there were three acute oral toxicity categories. There are five according to the GHS criteria, but the EU has adopted four of the categories (building blocks). Using the DSD, a substance with acute oral toxicity LD50 in the range 200-300 mg/kg would be classified as harmful, but would be toxic with the skull and crossbones pictogram when classified to the CLP Regulation.

There is a new aspiration hazard class with more stringent criteria, so there will be more substances with this classification. The concentration limits for corrosive and irritant substances in mixtures are lower, so more mixtures will carry these classifications. The CLP Regulation also permits substance suppliers to set higher or lower specific concentration limits.

EXPERT JUDGEMENT

The DPD did not allow any deviation from the classification criteria; the CLP Regulation does by including the possibility of applying 'expert judgement', which has been commended but also criticised. It allows for the possibility of classifying similar mixtures using read-across and application of 'bridging principles' (dilution etc.), but is criticised in part because different classifications for similar mixtures from different suppliers are possible depending on the 'expert judgement' of the classifier, which is itself reliant on an evaluation of available data and information. All available information must be taken into consideration when classifying, which may pose 'judgement', information sourcing and data validity difficulties.

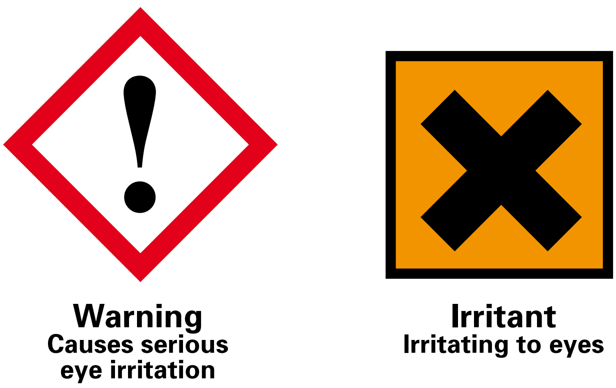
Annex 1 to the DSD has now been deleted and included in Annex VI of the CLP Regulation as a list of harmonised classification and labelling entries. However, Annex VI does not include the 30th and 31st Adaptations to Technical Progress (ATP) of the DSD, which has led to a necessary revision to the CLP Regulation that is expected to be finalised and published later this year. Guidance to accompany the CLP Regulation is not yet finalised but is expected in the autumn, some time after the Regulation entered into force.

A less well-known requirement of the CLP Regulation is that it will be necessary to notify ECHA of the classification of hazardous substances by 1 December 2010, regardless of tonnage level; this includes imported substances and substances in mixtures when the hazard classification of the mixture is triggered by inclusion of the substance. For 'new' substances, this must be completed within one month of placing the substance on the market. It is not necessary to notify ECHA, however, if the substance has been REACH registered by 1 December 2010. This requirement introduces new duties and potential difficulties for importers of mixtures, who must rely on compositional information from suppliers outside Europe.

PROVISION FOR TRANSITION

Transitional provision has been made to allow organisations to prepare for and comply with the new requirements:

- Substances may continue to be classified, labelled and packaged according to Directive 67/548/EEC until 30 November 2010.
- From 1 December 2010 substances must be classified in accordance with both the CLP Regulation and Directive 67/548/EEC until 1 June 2015, but labelled and packaged in accordance with the CLP Regulation.



A GHS label example for an eye irritant: the red bordered diamond pictogram will warn that the contents are irritant, replacing the familiar orange box label

CLP LABELLING

Risk phrases will be replaced with hazard statements:

Risk phrase (DSD, DPD):	**R36** – Irritating to eyes
CLP Hazard Statement:	**H320** - Causes eye irritation

Safety phrases will be replaced with precautionary statements:

Safety Phrases (DSD, DPD):	
Prevention:	**S25** - Avoid contact with eyes
Response:	**S26** - In case of contact with eyes, rinse immediately with water and seek medical advice
CLP precautionary statements:	
Prevention:	**P280** - Wear eye/face protection
Response:	**P305 + P351** - IF IN EYES: Rinse cautiously with water for several minutes

- Preparation (mixtures) manufacturers have until 1 June 2015 before mixtures will be required to be classified, labelled and packaged in accordance with the CLP Regulation.

Substances and mixtures may be classified, labelled and packaged in accordance with the CLP Regulation before 1 December 2010 and 1 June 2015 respectively. However, in this instance both the classification according to the CLP Regulation and the classification according to the DSD and DPD respectively must be provided in the safety data sheet (SDS) for the substance, mixture and in the case of mixtures, the constituents of the mixture.

DEADLINES AND TIMING

Manufacturers of mixtures may want to wait until nearer the 2015 deadline to avoid inconsistency and duplication of effort. The classification of mixtures obviously builds on the classification of substances. Some substance suppliers will adopt the CLP system early and others will probably wait for the 1 December 2010 deadline to approach. Preparation manufacturers will receive some substances conforming to the CLP criteria and others to the DSD criteria; it therefore makes sense for a manufacturer of mixtures to wait, at least until all their substance suppliers are following the CLP Regulation.

It will be important to review existing chemical control measures and revise as necessary, taking into account the impact on other downstream legislation such as Council Directive 96/82/EC on the control of major accident hazards involving dangerous substances, or the Seveso II Directive, as it is more commonly referred to.

ESMA highly recommends that mixture manufacturers give serious consideration to the planning and timing of the transition, particularly in making classification and labelling software changes, purchasing new label stock, the availability of information sources, training and communication. SP

Elaine Campling is Chairman of ESMA's Health Safety and the Environmental Protection Committee and Product Safety Manager for Fujifilm Sericol

Further information:
Fujifilm Sericol, Broadstairs, UK
tel: +44 1843 872030
fax: +44 1843 872074
email: elaine.campling@fujifilmsericol.com
web: www.fujifilmsericol.com

SIMPLIFYING SAFETY FOR SPECIALSIT PRINTERS

Caroline Raine highlights the importance of working in accordance with the latest Health and Safety standards

IN A NUMBER OF SPECIALIST PRINTING PROCESSES SUCH AS SCREEN PRINTING, IT IS VITAL THAT THE NECESSARY MEASURES ARE PUT IN PLACE TO MINIMISE RISK. FOR EXAMPLE, MANAGERS NEED TO ENSURE THAT THE PRODUCTS USED ARE CORRECTLY LABELLED AND COME WITH SUFFICIENT SAFETY DOCUMENTATION, EQUIPMENT HAS BEEN PROPERLY ASSESSED AND CERTIFIED, AND WORKERS ARE PROVIDED WITH THE NECESSARY SAFETY EQUIPMENT.

In April 2009 a UK printing company and a printing products supplier were each fined thousands of pounds for one specific case of negligence: employees at a print works contracted dermatitis from cleaning up a lacquer spillage from the UV coating machine without using protective gloves. Following an inspection by the UK's Health and Safety Executive (HSE) it was found that the lacquer was not supplied with the necessary safety information, nor was adequate training given to the workers on the safe handling of the product.

This case is significant because the Chemicals (Hazard Information and Packing for Supply) Regulations 2009 (CHIP) were used to prosecute the supplier and the printer. This underlines a new willingness on behalf of the HSE to enforce its guidelines legally in line with the UK's Health and Safety (Offences) Act 2008.

So why do these Health and Safety breaches occur when the necessary information is readily available for the manufacturers and users of hazardous screen printing chemicals? One reason is the sheer volume of regulations and guidelines that now exist. In addition to CHIP, companies must also comply with REACH (the Registration, Evaluation, Authorisation and Restriction of Chemicals regulations) and COSHH (the Control of Substances Hazardous to Health regulations).

THE REGULATIONS

The CHIP Regulations 2009 are intended to protect people and the environment from dangerous chemicals by ensuring that suppliers provide clear safety information and package their products effectively. As a result, the manufacturers, distributors and retailers of screen printing chemicals are now required by law to identify potential hazards on the label.

While CHIP previously also covered the need to supply safety data sheets with products, this has now been transferred to REACH; these regulations aim to simplify things by replacing a number of European Directives with a single system. Like CHIP, REACH is intended to increase the protection of people and the environment from the use of chemicals by making manufacturers responsible for understanding and managing the risks of their products.

Manufacturers or importers of substances must now register them with a central European Chemicals Agency (ECHA) to ensure a standard set of safety data is available for their product. If the product is not registered, the data will not be available and the chemical cannot be legally made or supplied. In this way REACH adopts and develops the Safety Data Sheet system of communicating safety information, which will help ensure chemicals are safely managed, handled and used.

Employers in the screen printing industry must also now comply with COSHH to protect the health of workers by controlling their exposure to chemicals. COSHH describes good practice for handling chemicals and outlines a range of screen printing processes and tasks including stencil generation, ink mixing, printing and screen reclamation. As with CHIP and REACH, failure to demonstrate that these guidelines have been understood and followed where possible can result in legal action and heavy fines.

A SINGLE SOURCE

With so much information available and specific Health and Safety issues covered in more than one of the regulations, meeting legal responsibilities can be extremely difficult. As one solution, the National Chemical Emergency Centre (NCEC) has developed an online application to help businesses navigate the latest legislation and guidelines.

ChemeDox is a chemical safety documentation application which makes it easier for screen printers to understand REACH and create COSHH assessments. The online system allows the relevant safety data to be accessed using a search facility to look for chemical products by using shop floor abbreviations and acronyms. As the service is web-based, remote searches can be carried out by authorised personnel.

The ChemeDox search screen

This system provides a safe, secure and robust system for REACH-compliant Safety Data Sheets and associated chemical safety documentation, such as COSHH assessments and risk analysis documents. Users can choose whether to manage their own SDS information or have their SDS library maintained externally. Email alerts can be set up to give users SDS updates while a reporting facility is included to help streamline information management.

SERIOUS REPERCUSSIONS

With the Health and Safety (Offences) Act 2008 now in force in the UK, the consequences of negligence with regards to REACH, COSHH and CHIP are more serious than ever. Businesses can now receive substantial fines and employers can be sent to prison. Failure to comply with the latest legislation is simply no longer an option.

In addition to escaping the serious repercussions of non-compliance, improved Health and Safety efficiency can have a positive impact on a screen printing business, eliminating unnecessary costs and minimising the downtime arising from safety breaches. Using the latest technology, safety can be approached not as an unavoidable expense, but as a way of increasing profitability. sp

Caroline Raine is Senior Consultant at the UK NCEC

Further information:
UK National Chemical Emergency Centre (NCEC), Didcot, UK
tel: +44 870 190 8347
email: maurizio.fantato@aeat.co.uk
web: www.the-ncec.com

MEMBRANE SWITCH TECHNOLOGY MOVES ON

Michelle Adams indicates how a new product could lead to production cost savings in screen printing

EVERY DAY WE DO THINGS THAT WERE ONCE THOUGHT OF AS IMPOSSIBLE (FLYING ACROSS THE COUNTRY ON AN AIRPLANE), UNREALISTIC (USING A LAPTOP COMPUTER ON THE FLIGHT) OR IMPRACTICAL (PULLING OUT A 4 GIG FLASH DRIVE TO USE WITH THE LAPTOP ON THE FLIGHT). THESE ACTIVITIES AND ITEMS HAVE BECOME SUCH COMMON FIXTURES IN OUR DAILY LIVES THAT WE HARDLY GIVE THEM A MOMENT'S THOUGHT OR NOTICE.

What does this have to do with screen printing? It is an attempt to set the stage for concepts in screen printing that many will (and have) said is impossible, unrealistic or impractical, and this article will concern itself with concepts relative to the industrial graphics market, specifically the components and production of the membrane switch.

UV SYSTEM TECHNOLOGY

The primary objective of most (if not all) companies is to meet the requirements of the end user in a cost-effective manner that is profitable to the printer. This can be achieved by using advances in UV technology and processing which allow us to eliminate costly dies, set-up time and handling while increasing shop throughput. Over the last few years UV inks have evolved to the point that the use of UV systems for graphic overlays is not only commonplace, but preferred. However despite the current progress and popularity of UV systems, it is a technology that is still sorely underused.

To better understand how UV inks and systems can affect productivity and profit as it relates to the membrane switch printer, we must first identify the components or layers that make up a typical membrane switch (see figure 1): the graphic overlay, selective adhesive or dome retainer, dynamic circuit or dome, spacer, functional circuit and a pressure-sensitive adhesive.

Although it may look simple enough, a typical membrane switch can require up to 10 process steps, 25 production steps, four assembly steps, three production stops, five dies, five layers of material, as well as a considerable amount of labour hours.

What if, through advances in UV technology and processing, it were possible to eliminate six of the process steps, 11 production steps, two assembly steps, three dies and three layers of material, along with a considerable reduction in labour? Additionally, what if this could be achieved simply by printing the spacer and selective adhesive layer? How is this achieved? To answer this, we must first look at the functional requirements of each layer.

THE SPACER LAYER

The primary function of the spacer layer is to provide a gap between the dynamic circuit and the functional circuit. Although this sounds rather simplistic, there are additional aspects which need to be considered and which will affect the functionality of the spacer; the most important of these is the size or height of the spacer. Spacer thickness will have a direct impact on the force that is required to complete closure of the circuit, the 'feel' of the switch, as well as the size of the switch cavity and dome height used. Until recently this was a problem for printers and limited the viability of using printed spacers in place of traditional die cut spacers. The ability to actually print a spacer that was 5, 10 or even 15 mm thick in one pass, maintaining a consistent deposit thickness throughout a print run with an edge definition rivalling that of a die cut spacer was once thought impossible.

Norcote has formulated a UV ink system which exhibits excellent edge definition, is resistant to reflow at elevated temperatures and high humidity levels, and is compatible with a wide variety of UV curable printable adhesives. Coupled with identifying and refining a printing process which would yield consistent and repeatable results, ink deposits of 5-15 mm have become viable.

THE SELECTIVE ADHESIVE LAYER

UV curable printable adhesives have made significant progress in terms of ease of use, peal strength and functionality, and are quickly catching up to many of the standard tape adhesives currently being used in the industrial graphics market in terms of performance, functionality and peal strength, with the added benefit of reduced cost and waste. With the exception of very high-end applications where high temperature / humidity resistance is required, UV curable adhesives are a viable and cost-effective alternative to traditional tape adhesives.

While many may look at the concept of printing a 10 mm spacer coupled with a UV curable adhesive with scepticism, there are many benefits to replacing the traditional die cut spacer and selective adhesive layer with Norcote's UVS Liquid Spacer, such as a reduction in handling due to the elimination of the spacer material which requires prepping and die cutting, faster and more accurate assembly with less chance of product reject due to assembly error, reduced waste and increased throughput.

To compete in today's global market companies must not only think outside the box, but rather break it down and toss it into the recycling bin. After all, if it were easy, it would have already been done. SP

Michelle Adams is Senior Applications Specialist at Norcote International

Further information:
Norcote International Inc,
tel: +1 765 362 9180
fax: +1 765 364 5408
email: michelle@norcote.com
web: www.norcote.com

Figure 1: The layers of a traditional membrane switch

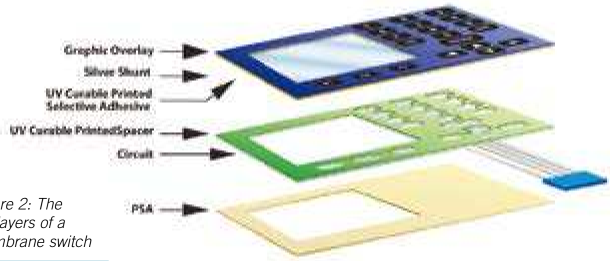


Figure 2: The UV layers of a membrane switch

INKJET-RECEPTIVE COATINGS

Troy Bergstedt outlines the benefits and applications of specialised coatings for ink-receptive media

THE VERSATILITY OF INKJET PRINTING TECHNOLOGY HAS LED TO EMERGING NEW APPLICATIONS AND MATERIALS IN TRADITIONAL GRAPHICS APPLICATIONS, AS WELL AS PRECISION MATERIAL DEPOSITION USED IN A HOST OF SPECIALISED PROCESSES. THE NATURE OF THE PRINT SUBSTRATE, FLUID AND PERFORMANCE SPECIFICATIONS CAN CREATE UNIQUE COMPLEXITIES AND CHALLENGES. A NUMBER OF INK-RECEPTIVE PRINT MEDIA ARE AVAILABLE, MANY OF WHICH MAY PERFORM EQUALLY WELL FOR ROUTINE USE IN A RANGE OF PRINT APPLICATIONS. WITH EMERGING ADVANCES IN TECHNOLOGIES, APPLICATIONS AND MATERIALS, THOUGH, SPECIALISED COATINGS MAY BE REQUIRED IN ORDER TO REALISE THEIR FULL POTENTIAL.

Marrying material characteristics with product performance needs is often a fine balancing act, especially when the technical and practical seem to be contradictory. For instance, formulating a water-resistant or waterproof coating will be challenging when using water-based inks. High levels of ink receptivity, most readily accomplished through increased coating thickness, may have to be achieved by rigorous formulation optimisation in an instance when coating clarity, flexibility and substrate flatness are specified, as these characteristics are often compromised as coating weights increase. For particularly difficult substrates, an additional level of pre-treatment may be needed to make the substrate receptive to the coating.

Additional complexity is required if the coated substrate must be suitable for general use with a range of printers and inks from various manufacturers and suppliers. This will require formulation in view of the desired range of inks, printers, print settings and application conditions. Ink chemistries may also be dissimilar for different colours and subsequently give differential performance with the same ink-receptive coating.

DEVELOPMENT CONSIDERATIONS

One of the first considerations in the development of an application-specific ink-receptive coating is the nature of the substrate onto which the coating will be applied, and how the peculiarities of the material will dictate the coating formulation. The porosity of the substrate can determine the coating method used, as well as the ultimate coating load required. Is there a surface texture that must be preserved, or will levelling of the surface profile be required to achieve the desired print detail? Also, will the coating be partially absorbed into the surface layer, providing enhanced bonding to the substrate, or will coating adhesion be compromised by a smooth, high-gloss surface?

The surface energy can have a profound effect on the quality and robustness of the coated layer, and so may require preliminary surface treatment to accept the inkjet-receptive coating. Miscellaneous additional properties particular to a given application will have to be taken into account, including whether the coating is to be applied to a rigid substrate or must the coating be sufficiently pliable to accommodate bending and / or stretching during printing or end use.

An ink-receptive coating may be used to temper some of the intrinsic absorptive characteristics of the substrate. For example, paper label stock, which itself can be too absorptive, may be coated to allow for rapid printing in label printers while primarily targeting controlled ink absorption and drop spread for optimal image reproduction. The compatibility of the coating and the specific ink used will determine image sharpness, density and dry time. In contrast the formulation goal with PET film is to impart ink absorption to a non-absorptive material, providing controlled drop spread and durability to a surface which would otherwise be prone to beading and smearing. Polyester carrier is commonly used to create photo tools used with photosensitive films and emulsions. The biggest markets with this application are screen printing and decorative sandblasting.

The issues above provide a common starting point in the development of an

Testing D_{max} value, a measure of print density, using a densitometer application-specific coating, but additional questions may be asked as a consequence of the intended end-use of the printed article. Vinyl substrates for banner applications may also need to have an elevated level of durability and resistance to environmental conditions. A combination of durability and rigidly controlled ink absorption and spread may be required when the receptive coating is to be used with textile fabrics. Even chemical reactivity can be a development issue, as might be the case for metallic substrates, which could be prone to corrosion as a result of improper coating formulation.

INK TYPES

The second primary consideration in the formulation of ink-receptive coatings is what type of ink or print fluid is to be used. For most graphics applications requiring a coating layer, print fluids will fall into one of two main categories: dye-based and pigment-based inks. Dye-based inks are liquid colorants which are absorbed by the ink-receptive layer to form an image; they will generally give a higher print density per given drop volume of ink than pigment-based inks. A limitation of dye-based inks, however, is stability – these inks are typically derived from organic compounds and can be susceptible to degradation by ultraviolet light and other environmental factors.

Pigment-based inks, on the other hand, are made up of coloured particles suspended in a neutral carrier liquid. The ink is printed onto the substrate and the carrier liquid is absorbed and ultimately evaporates, leaving the coloured particles to form the printed image. The pigment particles are comparatively more robust than dyes, so degradation of the image from environmental factors takes much longer to occur. This is why pigment-based inks are used extensively for archival images. Print densities of 3.30 and higher are routinely achieved using AccuInk and other dye-based inks when printed with a 12.5 picolitre drop volume. By contrast, a 12.5 picolitre drop volume print using a pigment-based ink typically generates a print density of 2.20-2.50, though these levels can be increased by recent formulary advances and increased drop volumes.

A DEVELOPMENT EXAMPLE

Some of the specific development issues that can arise during the formulation of an inkjet-receptive coating are illustrated by a comparatively simple example: black ink photo tools for screen printing and decorative sandblasting applications, exemplified by Ikonics' AccuArt product line. Some of the key characteristics of a photopositive are clarity, image sharpness and print density. Several factors affect these attributes: clarity (refractive index of carrier, binder and pigment), image sharpness (print resolution, ink bleed and dry time) and print density (ink deposit volume, coating thickness, dry time, pigment pore size and pigment pore volume).

SUBSTRATE SELECTION

PET is a preferred substrate for photopositive applications due to its durability and excellent inherent clarity. PET carriers are available in several thicknesses, and the selection of the optimal film thickness is often revisited during the course of formulation development. When the coating applied to the substrate is dried, the coating material shrinks as moisture is driven off. This shrinkage causes a tension differential between the coated and the non-coated sides of the substrate, which will cause the substrate to curl in the direction of the coated side – 4 mm polyester is typically rigid enough to counteract the tension differential based on typical coating weights.

Thicker polyester is sometimes used to counteract curl when a high degree of ink loading is desired, in which case greater coating thicknesses are required. Thicker substrates, however, can cause issues with the print head hitting the substrate and uneven cutting and chipping due to the rigidity, so their use is somewhat restricted.

Without proper adhesion of the coating to the substrate, chipping or flaking of the ink-receptive coating can occur during roll

Continued over

converting, printer cutting or handling. Corona treatment can be an effective method for increasing coating adhesion, however the potential for variability of the treatment and the diminished effect with time must be addressed for applications in which a high degree of homogeneity and consistency is required. Chemical treatment of polyester is commonly used to ensure good adhesion of the ink-receptive coating to the carrier. PET with various surface priming chemistries are readily available, from which an optimal match to the ink-receptive coating chemistry may be selected.

COATING FORMULATION

Swellable polymer-type coatings are non-porous and absorb ink through a swelling and contracting process. When the ink droplet contacts the surface, the polymer coating swells as it absorbs the water in the ink. Upon drying the polymer contracts back to its dried state, leaving the ink embedded in the coating. These coatings, while economical for general use, are generally restricted to aqueous dye-based inks, remain susceptible to moisture swelling and are not water-resistant.

Microporous coatings use a mixture of pigments and binders to form a porous coating that enables increased levels of ink loading and faster drying by absorption into the pigment pores, rather than by swelling of the polymer matrix. These types of coatings can more readily be formulated for water resistance compared to swellable coatings. Alumina and Silica, as well as other inorganic pigments, are commonly used to formulate microporous coatings capable of absorbing and binding both dye-based and pigment-based inks. There are no overwhelming inherent benefits of one particular pigment over another, apart from chemical compatibility with the binding resin. Considerations when choosing a pigment for a given application include economics, binder compatibility and clarity requirements of the coating.

The crystal size of the pigments typically used in coatings for photo tool media ranges from a few hundred nanometres to several microns. The size of the crystal will have a direct impact on fluid dispersion and the aggregate pore size and volume. Particle size, pore size, pore volume and pigment-to-binder ratio combine to dictate the ultimate absorption capacity of the film for a given coating thickness. The metric for success is an experimental measurement of the opacity in a solid print region, designated D_{max}.

High print density is only part of the equation for an effective photo tool – clarity of the unprinted regions of the film must also be addressed through effective coating formulation. Dispersion efficiency and the resulting pigment aggregate size can have a profound impact on the clarity of the coated film, as inhomogeneities and large agglomerates can create substantial coating

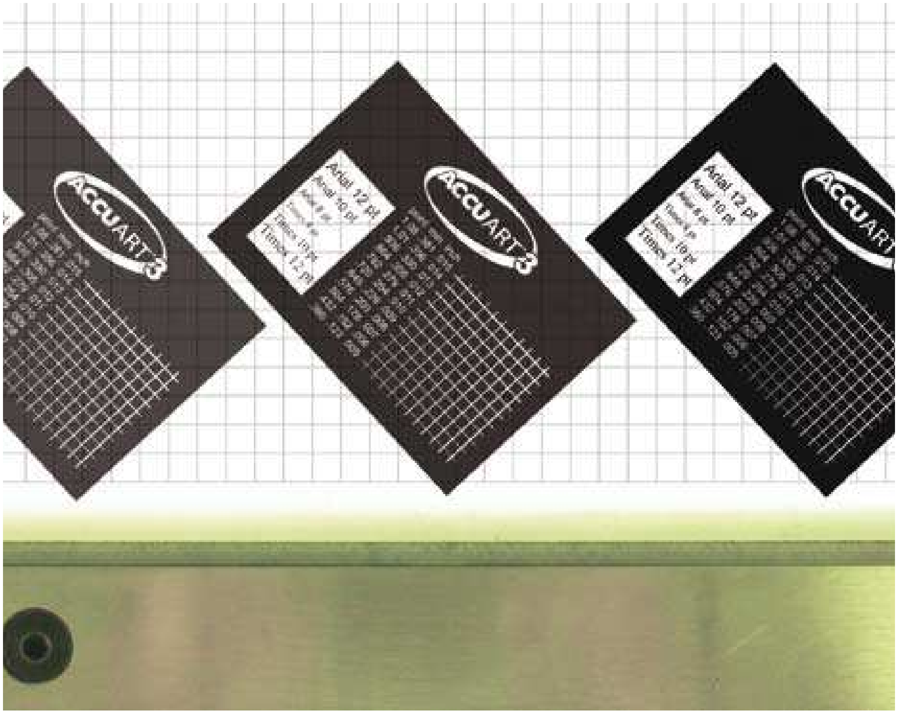


Illustration of pigment ink densities at various drop volumes haze. An additional consideration when formulating for clarity may be the relative refractive indices of the pigment and the binder, as a mismatch here can make film clarity elusive. The degree of transparency can be quantified by instrumental measurement as above, and is designated D_{min}.

PRINT QUALITY AND WATER RESISTANCE

Ultimately, the true test of formulation success comes down to the appearance and performance of the printed article. Ink absorption should be complete without beading on the surface of the film and should dry quickly and thoroughly after printing, so that during handling and use the artwork does not run, smear or stick and compromise the integrity of the printed image. Photo tool applications benefit by a high degree of contrast between the opaque and transparent regions of the printed artwork. This means that the coated film itself must be formulated for high transparency as discussed above. To this end, measured D_{min} values should ideally be at, or preferably below, 0.10.

The complementary specification, D_{max}, is a function of coating formulation, ink type and printer settings. This is illustrated by samples printed on the same film and using the same ink, but at different ink loading levels. The appearance of these under normal viewing conditions may be seemingly equivalent, however the use of backlighting reveals the range of opacity levels that can be obtained as a function of print parameters. In the group shown in the illustration, all were printed on the same coated film (D_{min} = 0.06) with Epson UltraChrome K3 ink. D_{max} values range from 2.25 for the print on the left with a drop volume of 12.5 picolitres to 2.68 with a drop volume of 15 picolitres in the centre, to 3.57 with a drop volume of 20.8 picolitres on the right.

With many types of materials used in the market to create photo tools, a general statement can be made with regards to print density. Low-end materials such as paper vellum and pfx film can generally reach print densities of up to 2.00, medium range materials such as swellable polymer coatings can range in density from 2.75-3.10, and high end materials including microporous coatings yield densities of 3.40 and higher.

The very nature of aqueous inks requires these types of coatings to have an important fundamental property: water receptivity. Although seemingly contradictory, water resistance characteristics are a desirable trait in many photo tool applications. The combination of water resistance of the finished product while maintaining water receptivity for ink absorption can be achieved in microporous coatings by the inclusion of additives in the formulation capable of cross-linking the binder. sp

Troy S Bergstedt is Director, Chemical Research at Ikonics

Further information:
Ikonics Corporation, Duluth (MN), USA
tel: +1 218 628 2217 ext 142
fax: +1 218 628 3245
email: tbergstedt@ikonics.com
web: www.ikonics.com

Transparent packaging shows products off to their best effect, with labels and containers becoming a single entity

LABEL AND GLASS – A PERFECT PACKAGE

Heinz Brocker explains how to achieve striking yet cost-effective labelling by combining different processes inline in the press

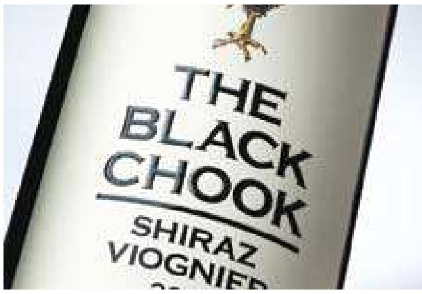
PACKAGING HAS ALWAYS PLAYED A KEY ROLE IN THE SUPPLY OF FOOD PRODUCTS, MEDICINES AND OTHER EVERYDAY BASICS. TODAY'S PACKAGING MATERIALS SATISFY A GREAT MANY REQUIREMENTS RELATING TO PRODUCT PROTECTION, ENVIRONMENTAL ASPECTS, APPROPRIATE POSITIONING, DESIGN, FUNCTIONALITY, INDIVIDUALITY, ORIGINALITY ETC. A GOOD PACKAGING SOLUTION ALSO TAKES INTO ACCOUNT THE TECHNICAL AND ECONOMIC ASPECTS OF LOGISTICS, MARKETING AND USER-FRIENDLY QUALITIES.

The functional requirements of producers, the retail market and legislators are also factored into the equation. First and foremost, packaging needs to protect the product against external influences and keep it in good condition, but additional demands are growing all the time. Buyers decide to buy a product in a matter of seconds at the point of sale. One of the key factors in their decision is the uniqueness of the packaging in terms of design, handling and additional benefits. Ultimately, it is the consumer who determines how the market develops and whether or not a product proves a success.

Glass containers are unique, in particular when it comes to product protection. In addition to their containment function, they keep disruptive influences in check over lengthy storage periods. Glass' real strengths come to the fore in terms of, for example, the effect of atmospheric oxygen on the contents, protection against loss of fizz or taste, light (in particular in conjunction with oxygen), hygiene, migration and interaction with the contents. The industry has many years' extensive experience of using glass packaging and glass containers combined with self-adhesive labels excel in satisfying today's packaging requirements.

SELF-ADHESIVE LABELS ARE IN

The trend towards adding self-adhesive labels to products is being boosted by the resultant increase in product value and the excellent efficiency in production. The glass container's contour and the label design are co-ordinated so that they do not compete with one another, but form a natural entity. Many substrates in different designs are available as basic materials for self-adhesive labels. There are also numerous types of paper with different surface structures (fine, rough, textured) and colours (white or metallic). The selection of plastic films ranges from transparent to opaque, from glossy to matt and, in terms of colour, from white to metallic.



Tactile elements open up a whole new dimension – the 3D look

Adhesives geared specifically to the intended use ensure reliable label adhesion, whatever the conditions – for example, in cold-storage facilities and wet or dry conditions. Today's UV inks and coatings benefit from rapid drying and are known for their durability. Self-adhesive labels are produced on special rotary presses in a single pass, combining various printing, finishing and processing methods. Labels can be die-cut in virtually any shape.

Containers are filled with the end product on a high-throughput filling line and labels are then applied. High-performance installations attach up to 1000 labels per minute in continuous operation. Front and back labels and any additional stickers can be applied in the same pass. Self-adhesive labels can be attached simply and reliably to containers of any shape – round, oval, hexagonal or contoured. Using self-adhesive labels provides great flexibility and ensures maximum reliability in production.

HIGH QUALITY FOR LOW COST

Hybrid printing makes targeted use of properties typical of printing, finishing and processing technologies to create unique products. With the full gamut of printing materials and substrates (shape and colour of containers, colour and texture of contents etc.), the resultant packaging really stands out. Presses that allow flexible configuration and are equipped with state-of-the-art digital drive technology enable creative designs to be produced extremely cost-effectively.

Gallus RCS printing systems produce high quality labels at low costs. Their key strength lies in the fact that both small quantities – where short changeover times are the crucial factor –


The Gallus RCS 330 rotary press benefits from hybrid printing technology for cost-effective production of high quality labels

and large volumes – where throughput is the main concern – can be produced economically. Many different processes are available on Gallus' inline label presses – offset, flexographic, screen printing, hot foil and relief embossing, UV coating and 'hi build' varnishing. Offset or flexographic printing is used for finely graduated motifs or the photographic reproduction of images, while brilliant metallic effects, such as silver, gold or shimmering reflections, are produced using hot-foil embossing.

The ability to apply large quantities of ink and coating is a particular strength of rotary screen printing. The amount transferred is determined by selecting the appropriate Gallus Screeny screen printing plate. High performance UV drying installations ensure curing of UV inks up to approximately 20 gsm and transparent coatings of up to 300 gsm. Screen printing is used if high ink coverage is required for sharp contours and very fine text, or if strong colours are a must.

Screeny screen printing plates make a wide selection of creative effects possible

HAPTIC AND 3D APPLICATIONS

A new field that has emerged involves different applications of haptic elements. Textures with a definite tactile quality, imitation of artistic effects, Braille or patterns improving a product's grip are all attention-grabbing 3D effects that encourage consumers to pick up products at the point-of-sale. There are many different 3D look effects, from hi build and super high build to Braille and all kinds of different textures. One French retail chain has included Braille on its labels for over 1000 everyday products.

One particularly popular effect is the imitation of skin or hide textures (snakeskin, fish skin, leather etc.), other effects include rough, sandy surfaces and water droplets. The 'crafted look' is also becoming increasingly popular. This is achieved by giving texts, individual words or logos an antiquated look and reproducing them in a raised form. Printing fine textures onto plastic substrates can imitate paper textures, thereby extending their use to include wet applications for which paper is not ideal.

Special-effect coatings can incorporate glitter or other special contents. Using a metallic base material and making creative use of the transparency of inks and coatings creates an impressive design with a high-end feel. The enormous technical scope and extremely wide range of combinations means that a huge variety of creative ideas can be realised, and the resultant packaging makes products stand out.

Everyday products such as jams or sauces benefit from high quality labelling

CONCLUSION

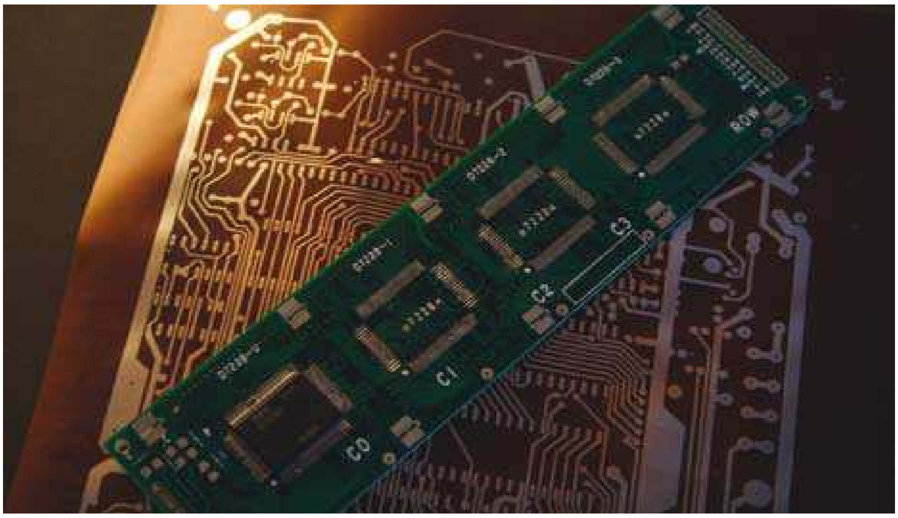
Glass containers combined with self-adhesive labels create a contemporary packaging solution that satisfies the toughest functional, economic and environmental demands. Creative effects applied using screen printing make the packaging even more appealing. This gives the product a higher perceived value and encourages consumers to pick it up and see what it feels like. SP

Heinz Brocker is Manager of Gallus Rotascreen

Further information:
Gallus Ferd Rüesch AG, St Gallen, Switzerland
tel: +41 71 242 84 00
fax: +41 71 242 89 85
email: heinz.brocker@gallus-group.com
web: www.gallus-group.com

SCREEN PRINTED ELECTRONICS

Wim Zoomer uncovers the versatility of screen printing as a technique used in electronic applications



A rigid and flexible printed circuit board

IN THE 10th CENTURY THE JAPANESE SUNG DYNASTY WAS ALREADY USING SCREEN PRINTING TO CREATE GRAPHIC ART. STENCIL PIECES WERE CUT AND HELD TOGETHER BY GLUING HUMAN HAIR. SCREEN PRINTING WAS USED AS AN OPAQUE INK DEPOSIT THAT COULD REPEATEDLY BE APPLIED ONTO RICE PAPER. NOWADAYS SCREEN PRINTING HAS EVOLVED INTO A RECOGNISED TECHNIQUE BUT IT IS STILL THOUGHT OF AS THE 'HIGH INK DEPOSIT AND OPAQUE INK DEPOSIT' PRINT TECHNIQUE.

At present ink deposits of between 6 microns for a full colour image and approximately 300 microns for Braille applications are common for graphic screen printing applications.

Screen printing is suitable for different kinds of ink such as solvent-based, water-based, plastisols, enamels for glass and UV-curable inks.

Using the correct fabric, stencil, ink and print conditions, 70 micron lines and spaces for high volume screen printing jobs are feasible. Advanced screen printing processes applying optimised screen printing machines, nano-conductive paste and ultra-fine fabrics with the best emulsions are capable of printing even finer lines and spaces. Screen printing is an exceptionally versatile technique.

FUNCTIONAL SCREEN PRINTING

Several companies use screen printing. Besides the graphic printers there are industrial screen printers who do not decorate paper or a plastic substrate and do not print a product to increase attractiveness. This category uses screen printing as a part of its production process. Industrial screen printers print a function, such as a printed circuit board, a solar cell or banknotes.

Industrial screen printers are hard to find, since screen printing is an integral part of their production process and is used to produce a function by printing. Besides screen printed security and indicator features, a considerable part of the industrial applications is occupied by the group of 'printed electronics'. Some interesting printed electronic devices related to screen printing include printed circuit boards (flexible circuit boards and hybrid circuits), solar cells, ultra-thin batteries, RFID tags, EL displays and blood glucose sensors.

PRINTED CIRCUIT BOARDS

A printed circuit board, or PCB, is the main part of an electrical device such as a television, telephone or computer. A printed circuit board has active or passive components such as resistors, capacitors, transistors and switches. Photolithography and screen printing are the most common techniques to produce PCBs; the choice between them is quantity- and therefore cost-based. The relatively expensive photolithography method is used when the print job is limited or if the lines and spaces are finer than the capabilities of screen printing, which is used for large quantities.

The board of a PCB is usually a copper laminated resistor, such as Pertinax (FR2) or Polyester (FR4), and manufacturers also use Teflon and polyimide. Commonly both sides of a PCB are covered with approximately 30 to 60 microns of thick copper laminate. The screen printer applies a positive image of the electric circuit with a UV-curable etch resist on one side of the board. After curing, the unprotected copper is removed by etching with ferric chloride which dissolves the copper from the board, leaving the conductive copper circuit. The other side of the board is made in the same way.

The circuits on both sides of the double-sided PCB are connected by holes drilled in the board. The contact between both sides is established by silver conductive ink which is screen printed in the hole. This technique, called through-hole (screen) printing can be followed by through-hole plating.

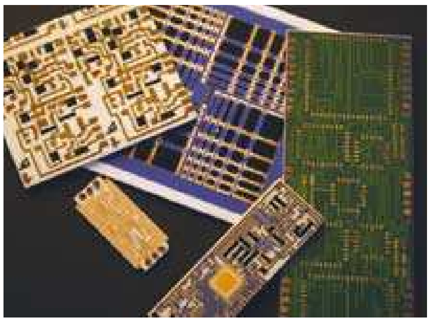
FLEXIBLE PRINTED CIRCUIT BOARDS

Flexible printed circuit board manufacturing has been developed to pack more functionality on a smaller board area at reduced cost by etching copper-clad substrates after screen printing the image of the electronic circuit. Screen printing a continuously moving reel (reel-to-reel) is a cost-effective way to produce high volumes of flexible printed electronics. Initially used for military applications, flexible boards were also used for automotives such as air bags and consumer electronics with limited space, such as computers.

HYBRID CIRCUITS

Advanced screen printing techniques and inks are used to print extremely compact electronic circuits with less then 50 micron lines (using conductive pastes) and space on small ceramic substrates. Thick film technology enables high performance hybrid electronic circuits with maximum reliability for aerospace and defence applications, amongst others. Extremely high or low temperature resistance is a common requirement.

After screen printing the pastes are heat-treated at approximately 850°C to remove the solvents and to obtain the required characteristics. Using this technique and



Hybrid circuits based on thick-film technology different pastes, components such as resistors (to cover and protect the electronic circuit), capacitors and transistors can be printed. A resistor is formed between two conductive pads by screen printing a carbon paste with a certain resistivity. The required resistance is achieved by trimming the carbon patterns using a laser.

A multilayer printed circuit board consists of a stack of a large number of layers (the printed circuit board layers are separated by an insulation layer) connected through the substrate or the screen printed insulation layer.

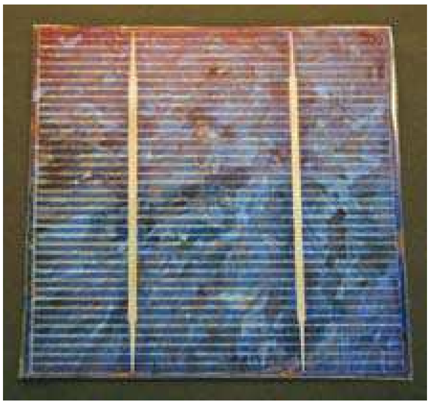
SOLAR CELLS

Solar or PV (photo-voltaic) cells are devices to convert solar energy into electric power. A rigid solar cell consists of a silicon wafer of approximately ¼ mm thickness. Several cells are connected to a panel. The wafer's surface is chemically treated. The white or grey lines at the front of the wafer are screen printed silver power collectors; the widest two lines are bush bars and the fine lines are fingers.

In order to collect the maximum amount of solar energy the silicon wafer surface should be as large as possible. This means that the fingers should generally be less than 100 microns wide. The dried and fired solvent-based ink deposit is approximately 10 microns. The manufacturer uses 325 to 400 mesh stainless steel fabric for this application. Current requirements are fired lines of 50-60 microns wide and 15-25 microns high; these high requirements increase the performance of the stainless steel fabrics, direct emulsions or capillary films and the silver particle size in the conductive inks. Optimal print conditions are achieved when the screen empties completely so the fabric produces minimum image deformation and a minimum of fabric wear and tear. The squeegee must be relatively hard to print the required fine line definition.

Contemporary developments are flexible solar cells. The manufacturing process is similar: on top of the plasma-coated thin silicon layers on a flexible polyester web, the silver conductive busbars and fingers are flatbed or rotary screen printed. The resistance of the silver ink is low enough to allow practical use after thermal curing. The power of a 1 m^2 panel made of flexible solar cells is approximately 35 Watts, which is suitable for battery chargers for camping, caravanning and yachting.

The latest developments are organic dye solar cells with nano-particles converting solar energy into electricity. A possible application is to integrate such a module into building or office façades to power promotional façade designs, since the screen printed electricity-generating film between two glass panes is ultra-thin and therefore almost invisible. The efficiency of organic dye solar cells is relatively low, so they are no threat to conventional silicon solar cells.

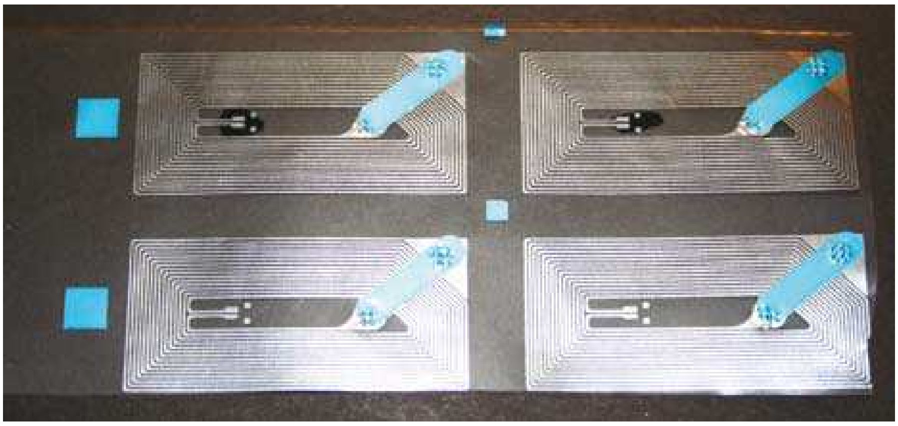


A rigid solar cell

ULTRA-THIN BATTERIES

Electronic equipment can often be used almost anywhere – laptops, calculators, mobile phones, digital cameras etc. have batteries that allow a cordless use of several hours. As electronic devices become thinner the battery for the power supply has to become slimmer due to space requirements. Currently a special battery can be made that is almost as thin as a piece of paper; due to its size and flexibility it is used for several disposable applications such as gift cards, luggage tags, powered smart cards, electronic games and medical devices.

These low-cost and environmentally-friendly ultra-thin batteries work like the



A HF RFID antenna

common battery. The cathode and anode of the battery consist of chemicals directly printed onto thin substrates using standard screen printing machines. Polyester fabrics are the preferred image carriers since the chemicals used can be aggressive and may attack the metal screen printing fabrics. Reel-to-reel screen printing is a suitable solution, allowing a higher production speed and an easier handling of the web during and after printing and curing.

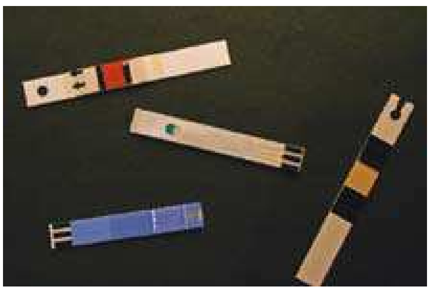
RADIO FREQUENCY IDENTIFICATION

RFID or 'Radio Frequency Identification' is the non-contact storage and retrieval of data using tags connected to products or human beings which can be identified by radio waves. RFID tags are expected to replace bar codes. An RFID tag commonly consists of a chip for storing and processing data and an antenna for receiving and transmitting the radio signal. They are used for product tracking and animal identification, such as luggage handling at airports, books at libraries, cows at farms, supply chain management in supermarkets, toll cards, and for identification purposes such as access cards, passports etc.

Passive RFID tags are tags without an internal power supply that use the electric current induced in the antenna by the incoming radio frequency, allowing the chip to transmit a response. A 13.56 MHz high frequency (HF) antenna can be used for a read / write distance of approximately 30 cm. These credit-card sized metal antenna coils are commonly made by screen printing the solvent-based silver conductive ink. A dried silver deposit of approximately 10-15 microns is sufficient to meet the conductivity requirements. Another option is to screen print an etch-resist onto a copper or aluminium laminate. The printed laminate is subsequently fed through an etch machine; the exposed metal dissolves in the etching agent and the position of the electrically conductive circuit is protected by the etch-resist.

Ultra-high frequency (UHF) antennas have a thinner metal (copper, aluminium, silver) dipole antenna. These antennas are used for relatively long read / write distances of approximately 5 metres for pallet tracking.

EL (electroluminescent) lamps and EL integrated into membrane switches



Blood glucose test strips

ELECTROLUMINESCENT DISPLAYS

Electroluminescence is an optical light effect created by a material emitting light induced by an electrical power. Electroluminescent lamps are paper-thin (less than 1 mm), flexible and lightweight, and are used for low-cost backlighting of large size flexible displays, portable instruments, emergency illumination, safety signs, automotives etc.

An electroluminescent lamp is actually a screen printed AC parallel-plate capacitor sandwiching a light-emitting phosphor dielectric. The AC applied voltage rapidly charges and discharges the current used, zinc sulphide (ZnS) doped with manganese (Mn). The current excites the manganese and results in the emission of light during each charge-discharge cycle. The electro-luminescent display also consists of a clear conductive front and back electrode with a transparent electrically conductive indium tin oxide (ITO) coat; the barium titanate dielectric is the third component to create the light-emitting capacitor.

Screen printed silver conductive ink connects the AC power and the interior of the front and back electrodes. The light-emitting substance is also screen printed. The front electrode is the light-emitting side of the lamp consisting of a clear substrate with a conductive thin layer of ITO. The screen printed silver busbar delivers the current to the ITO; the phosphor layer is underneath, followed by an insulating layer of screen printed barium titanate. The final screen printed layer is the rear electrode.

BLOOD GLUCOSE SENSORS

Millions of people suffer from diabetes. Diabetics have to monitor their blood glucose regularly. They can use a biosensor, which is a device that uses an immobilised enzyme to measure the concentration of glucose in the blood. The result determines how the patient has to act. A measurement kit is an essential tool; new methods to determine the glucose concentration in human blood are being continually developed. One method is to create a colour-change comparison that is determined by the blood glucose concentration.

The blood glucose concentration can also be measured using an electrical potential difference which is converted into a glucose concentration and shown on a measurement device. These blood glucose tests require a measurement device, a drop of blood and a small sensor. The sensor is provided with a chemical substance, the enzyme, causing a chemical reaction with the blood sugar and creating a typical electrical potential change depending on the amount of blood glucose.

These sensors are commonly provided with a micro electrical circuit of approximately 15 microns of screen printed conductive silver. The amount of the chemical substance is critical since this amount influences the measured value, so screen printing is the most suitable technique to deposit both the silver conductive ink and the chemical substance accurately and consistently. The amount of sensors needed and the requirements for the essential parts of the sensor, such as the conductivity of the electronic circuit and the amount and consistency of chemical required, justify the application of reel-to-reel flatbed or reel-to-reel rotary screen printing.

Wim Zoomer is Freelance Editor at Technical Language

Further information:
Technical Language, Boxmeer, The Netherlands
tel: +31 485 52 22 90
fax: +31 485 52 22 90
email: wimzoomer@planet.nl
web: www.technicallanguage.eu