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WHITE PAPER

HOW GREEN IS GREEN ?

Being 'green' is a popular ambition among businesses nowadays, partly because business leaders believe it is a valid objective and partly because it is increasingly expected by governments, consumers and shareholders. For that reason, most companies want to demonstrate that they care about their impact on the environment and consumption of resources. It ties in with being sustainable.

Businesses that pollute and over-consume are not likely to be popular among these external stakeholders or their neighbours and even their own employees. Achieving a truly green status, however, can be more complex than at first it seems. For example, avoiding the release to the atmosphere of potent greenhouse gases from solvents seems an obvious winner. But, if the alternative requires a substantial increase in the consumption of electricity, the benefit may be wiped out by the impact of power generation. To be sustainably green requires a balanced consideration of all the consequences of change, locally and remotely.

In the printing world, 'sustainability' considerations apply mainly to the use of resources, these being primarily inks, media and power — and to the impact of waste produced in the form of gaseous, liquids and solids. There is no escape from the fact that the overall picture is often complex. Thus, simplistic solutions should be treated with caution.

Because, in the printing industry, we only recently started to climb the "green" learning curve, we are faced with fragmented information and an array of guidance and regulations. There is no one-stop source of rules and regulations; instead they come from European, national and local governments with added input from environmental and health & safety organisations.

Part of the answer is to work with partners that have already studied these requirements and are able to provide facts and information for you and your customers to make a considered choice, balancing business performance with environmental responsibility.

The purpose of this white paper is to provide print providers and end-users with an insight on 'green' issues relating to wide-format digital printing.

WIDE-FORMAT INKJET PRINTING

In this White Paper

The Printing Process and Going Green

Judged by conventional printing technologies such as offset, screen, flexo and gravure, the printing industry is the 4th most polluting industry in Europe with respect to energy, chemicals and waste. In addition, the paper industry is the 4th largest industrial consumer of fossil fuels, accounting for 40 % of landfill waste and being one of the world's largest consumers and polluters of fresh water.

Digital printing can help printers become greener. Both toner and inkjet technologies facilitate print-on-demand, plus a reduction in material use, inventory requirements, storage space and costs (including heating, lighting and logistics). These criteria are based on digitized pre-press operations that eliminate the plate making process with its associated need for cleaning chemicals and generation of waste.

Inkjet technology in particular only deposits the ink droplets on demand, and its capability to jet very small scalable drop volumes reduces ink consumption even further. It is generally a clean technology, but whatever inkjet ink you choose, the inks will have an impact on the environment and/or the user. The drive here is to minimize the amount needed to create the required image and to formulate the inks to minimize their environmental impact during production and use.

Inks

Ink is an integral part in a printer's 'environmental audit' : from its production through printing to recycling, including recycling of waste ink. The environmental impact of an inkjet ink is not just in the chemistry of the formulation. There is a choice between inks produced using mineral oils and vegetable oils. The type of ink influences the energy used when printing and the steps needed to meet health and safety requirements.

"Often performance is the main factor and to meet customer requirements, a printer may have limited options."

Biodegradability for inks, coatings and plastics is complex, and there is little scientifically-based life cycle analysis research in this area. The amount of ink present on most print products, however, is normally so small that it does not interfere with substrates that do biodegrade.

The decision to choose a particular inkjet system typically is based on the printer's need to balance performance with cost and, now, environmental compliance. Often performance is the main factor and to meet customer requirements, a printer may have limited options. Below we examine some of the current inkjet ink technologies and their environmental impact.

All inkjet inks are made up of four classes of raw materials:

- *Colorants*
- *Resins*
- *Carriers* (water, solvents/co-solvents, monomers, oligomers)
- *Additives*

The ***colorants*** come in two main classes – dyes, which are soluble in the liquid carrier, and pigments, which are solid particles dispersed in the liquid carrier. From the environmental impact point of view, dyes are produced via a chemical manufacturing process, while pigments require large amounts of energy to grind the original materials to the correct particle size.

Resins are polymers, and they bind the colorant to the substrate and provide many of the required end-use properties.

The ***carrier*** is a liquid, allowing the colorant and resin to be printed onto the substrate via the ink delivery system.

Additives are highly refined specialty chemicals that are important in stabilizing the ink and in modifying the physical properties of the ink to suit the inkjet printing system and optimize the substrate interaction.

Water Based Inks

The majority of water based inkjet printing has a low environmental impact; the inks have a water content of up to 85%, with little or no VOC (Volatile Organic Compounds) emissions. However, inks are modified to meet the requirements of the application. The choice of colorants depends on the end use, and media pre-treatment or post treatment may be required. For example, with textile printing, the type of ink is dictated by the textile substrate, and the colorants can be acid, reactive, dispersed dyes or pigments.

"The environmental impacts of dye based textile inks mainly come from the energy required for pre-treatment, fixation, post treatment and wash off procedures"

Although dye based textile inks provide flexible ink formulations, have no milling requirements and operate at lower temperatures than other inks, it is important to look at the total print production process. The environmental impacts of dye based textile inks mainly come from the energy required for pre-treatment, fixation, post treatment and wash off procedures, with associated water usage and dye in the effluent.

Disperse dye inks are also available for dye sublimation textile printing. The fixation process can be either direct-to-fabric via heat fixation (direct disperse inks) or fixation via sublimation (dye sublimation inks printed onto transfer paper). With no pre treatment and no wash off requirements, there are clear environmental advantages to the transfer method; but there is an environmental impact from paper that becomes waste after the image transfer and the energy requirements for fixation/sublimation.

Solvent Based Inks

Solvent inks are now split into different types — ***full solvent, mild solvent, eco solvent and bio inks*** *:*

Full solvent inks are widely regarded as undesirable because of the harmful volatile organic compounds (VOCs) they contain. They have been extremely successful for the display industry, but those solvents that bite into substrates for adhesion also evaporate in the surrounding atmosphere during printing and drying.

"There are also solvent inks on the market that do not require air purification"

These VOCs can be HAPs (hazardous air pollutants) and/or TAPs (toxic air pollutants) and can be subject to low PELs (personal exposure limits). Today, ink manufacturers are selecting different solvents and take more care to provide end users with the relevant information in the related material safety data sheets (MSDS). While equipment is available for ventilation and solvent vapour capture to bring solvent levels in the working environment far below the accepted safety levels, there are also solvent inks on the market that do not require air purification.

More recently there have been developments with bio (organic) inks that are made from renewable sources, such as corn, palm or soy beans. The solvents can be biodegradable and have lower associated PELs.

Latex Inks

"Media choice is restricted because of the heat, to avoid effects such as cockling or wrinkling"

The new generation Latex inks are pigmented and water-based, containing at least 50 % water. They have low VOCs but require special ventilation, de-humidification and air conditioning. Since Latex inks contain at least 50 % water, printing on non-porous substrates can cause coalescence and the printing speed needs to be low enough for the water to evaporate.

Precise temperature control is critical as ink spot size can vary with temperature. The printing and drying process on Latex printers is very energy consuming because multiple heating zones drive the evaporation process. A first heating zone evaporates the water and the second heating zone cures the Latex component. In order for the latex ink to achieve its full characteristics, it is imperative that first all water is evaporated. Only then the Latex particles can coalesce to form a continuous polymer layer, which bonds to the substrate surface. Media choice is restricted because of the heat, to avoid effects such as cockling or wrinkling. Further ink developments are required to reduce energy consumption and these will (as usual in inkjet business) lead to other compromises.

UV Curing Inks

UV-curable inks are seen as a green alternative to solvent based inks and have gained popularity in the wide format market. Their advantages are substrate versatility (rigid and flexible) and the instantaneous curing process. These inks contain acrylate monomers and oligomers, photo-initiators and pigment colorants.

"A fully covered UV machine is the preferred choice"

After application to the substrate, exposure to UV light causes the photo-initiators to start cross-linking, transforming the monomers into polymers. UV curing inks have no VOCs, but they do exhibit low PELs, as uncured ink may cause skin irritations. The most important issue with UV curing is to ensure that the UV ink has been fully cured. Importantly, the design of the printer should avoid the risk of operators being over-exposed to UV and take care of uncured ink fly. In this respect, a fully covered UV machine is the preferred choice.

Media

The environmental mantra is 'Reduce, Re-use, Recycle', in that order, representing a product responsibility paradigm shift from cradle-to-grave to cradle-to-cradle. Recycling is a market-based activity. It requires technology to recycle at reasonable cost, market demand for recycled products and a sufficient volume of material in the waste stream to support the enterprise. If these criteria are not matched, the waste will remain as waste.

Paper is still the most popular medium for most printing jobs, even with a wide-format digital inkjet printer. Paper recovery and recycling is well established. The efficiency and technology is improving all the time, for example with processes to de-ink paper during recycling. For paper and cardboard, certification for sustainable forestry management has been available for a long time. The aim of the FSC (Forest Stewardship Council) set up in 1993 is to preserve the forests and their function as living environments offering sustainable resources and as a buffer against climate change.

PVC is a popular substrate for wide format printing. It has been the bad boy of plastics in the past, but the PVC industry seems committed to developing a sustainable future and is working to increase recovery and recycling of PVC as well as working towards being a carbon neutral industry. PVC can be safely incinerated and the heat generated can be used to generate energy.

"PVC can be safely incinerated and the heat generated can be used to generate energy"

Other plastics can be either classified as *fossil fuel plastics*, when derived from petroleum, or as *bio plastics*, when derived from renewable resources such as vegetable oil or corn starch. Some bio plastics are designed to biodegrade, but others are not. Degradation as such, however, is also not a straightforward matter. A clear distinction needs to be made between ***bio-degradation*** and ***photo-degradation***.

Bio-degradation means that a substance can be degraded by microbes under suitable circumstances. In practice, this means under the tightly controlled conditions of industrial composting installations. Usually, it does not mean that efficient composting is applicable to home composting. Photo-degradation means that degradation is not initiated by microbial action, but rather by ultra-violet sunlight and oxygen.

Although both types of degradation can be applauded from an environmental point of view, there is criticism within the industry that so-called photo-degradable materials do not meet the internationally agreed composting standard, EN13432. This standard has been published by the International Organization for Standardization (ISO) and is recognized in many areas/countries: Europe, Japan and the US. The reason for the criticism is related to the fact that photo-degradation in some cases may be a very slow process, by far not efficient enough to be considered as a method to dispose of rest materials.

Many such synthetic plastics are great for outdoor promotions, for example of 30 to 60 days, but are not always recyclable. Some may linger way beyond their usage period and unless actively recycled will become waste.

Fabrics are generally eco-friendly. Some fabrics, like paper, are manufactured from plant-based materials such as cotton. Other popular fabrics are synthetic polyester and polyamide. In the signage industry fabrics are often preferred for their portability, being lightweight and folding easily. The environmental impact of fabric media stems mainly from the print production processes such as pre-treatment, fixation and wash-off.

Greening Print Production

Print buyers and print consumers are increasingly aware of printing's environmental impact. These customers want wide format inkjet printers to do more than simply print on recyclable/recycled materials.

They are looking for printers to operate in a more efficient and sustainable manner, from start to finish. Making the right equipment and workflow decisions has thus become even more important. Printers are looking for ways to compress the entire production cycle, use less material and produce less waste while ensuring profitability, quick turnaround and high quality.

The following key goals can help in going greener.

- Reduce energy use. Building energy consumption is around half to one third of that used for production. Readily available savings often include lowering heating levels, not lighting areas not in use, excluding draughts and heat loss and computerizing control of heating, ventilation, air conditioning and other support systems. New lighting technologies can reduce the energy needed by 50%. Include energy consumption when selecting new equipment.

- Assess sustainability when selecting inks and coatings. Newest ink sets show significant improvements from the reduction of VOC emissions, while UV curable inks have a good environmental profile from the absence of VOC and the low energy needed to cure them. Ink manufacturers are increasingly using renewable resources. Together with printing equipment suppliers they are also assisting printers to recover and recycle inks and solvents.

- Reduce the use of materials such as paper and opt for environmentally products such as substrates with a minimum fraction of recycled content or environmentally certified papers from the Forest Stewardship Council (FSC) and the Programme for the Endorsement of Forest Certification (PEFC).

- Reduce waste: less material in and less waste out. Waste reduction plans can improve business efficiency by reducing manufacturing and waste disposal costs without compromising quality. Waste is not just solids and liquids; it is also wasted material and time.

- Comply with the health and safety rules for employees and plant/facilities regulations. Emissions of chemicals such as ozone, VOCs and of dust should be strictly controlled; aim to be well below regulatory requirements. Check if personal protective equipment is needed as chemicals in some inks might lead to skin irritation. Set up clear unambiguous information on how to work safely. Last but not least, always motivate to contact local authorities to ask for advice about local guidelines & regulations in function of the supplied MSDS sheets.

- Watch logistics: use lightweight materials and keep packaging to a minimum to reduce transport energy and costs. Use recyclable materials whenever possible. Minimize workflow distances and use best practice operating procedures to improve internal transport efficiency.

- Work with environmentally responsible suppliers that ensure their products conform to all applicable chemical legislation and are available for advice on meeting end-user eco criteria. Look at new technologies to broaden your options for going green to conserve natural resources and to enhance efficiency and profitability.

- Explain your green benefits and be prepared to back up your claim.

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Key Attention Points when Evaluating Wide Format Printing Equipment

Always ensure to double check the marketing statements of manufacturers. Also check that manufacturers' environmental statements are indeed applicable in your country. It frequently happens that manufacturers tend to use US standards for their promotion, knowing that US standards often have a different focus versus European standards.

When evaluating wide format inkjet printing equipment, ensure to make a thorough analysis of all key factors that will determine the carbon footprint of daily production and last but not least your performance & return on investment.

Key factors to take into account :

- Standard configuration of the printer, machine price & possible options
- Ink consumption details
- Electricity consumption of the printer during start-up & during printing
- Capability to print on recyclable substrates, such as non PVC self-adhesive media, recyclable paper, …
- Necessity of special work environment equipment, such as need for air conditioner to extract heat produced by a printer
- Serviceability of the printer & required maintenance cycles
- True performance of a printer (advertised speed versus print quality, throughput, …)
- Whether the printer has features on board avoiding 'trial & error' printing to reach acceptable print quality
- Does your supplier provide correct Material Safety Data Sheets (MSDS), which are relevant for the region in which you are located?

About Mutoh Belgium

Mutoh Belgium nv are a subsidiary of Mutoh Holdings Co. Ltd., Tokyo, Japan (TYO : 7999 "MUTOH"). Founded in 1991, the company's activities encompass sales, technical and commercial marketing, product support, after-sales service and distribution of CAD/CAS hardware (professional sign cutting plotters and large-format full-colour piezo printers for CAD, commercial inkjet printing, sign and soft sign applications).

Mutoh products are distributed via a wide network of authorised Mutoh resellers in the EMEA territory through Mutoh Belgium, Mutoh Deutschland and Mutoh North Europe.

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