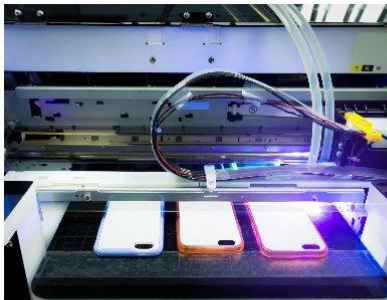




Types of Printing Processes Used In Manufacturing [Whitepaper]



This whitepaper from [Sofeast](#) brings together several different resources in order to provide an introduction to the different types of printing processes used in manufacturing that we work with here in Asia and your suppliers may be using.

The objective here is to outline as many of the following points as possible for the different types of printing processes:

- Your printing options on both hard and soft goods
- What types of surfaces/materials/products can it be used on
- The relative cost (compared to other printing methods)
- Durability of the printing
- Precision (for example, silk screen prints are easy to do in large quantities, but they are often a bit off if the template is not perfectly positioned every time)
- If the printing method is either eco-friendly or bad for the environment

Please note, any sources quoted from will be shown like this within the whitepaper [X] and are collected at the close of each section.

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Vinyl Printing



Vinyl printing is commonly used when producing posters, banners, and signage. Your design is provided to the printer as a vector file and printed onto vinyl which is then cut and affixed to a sturdy, smooth background with adhesive.

Flex printing is a type of vinyl printing more likely to be used on various surfaces and items, often clothing. It has a similar finish to vinyl printing, but it is applied with heat and pressure.

Vinyl printing lends itself better to smaller runs due to the setup required between different designs.

What types of surfaces/materials/products can it be used on?

At its simplest form, vinyl printing involves the use of large, wide-format inkjet printing machines to reproduce images on huge rolls of coated plastic. These rolls are specially coated/treated to receive inks and enable high-resolution image reproduction. Moreover, printable vinyl rolls generally have an adhesive back [1].

With the help of this glue, you can paste your vinyl prints on different surfaces like plastic, metal, glass, etc. While vinyls generally work very well with smooth surfaces, media having specialized glue can even adhere to textured surfaces like concrete and brick walls [1].

Self adhesive vinyl is perfect for flat surface applications such as store or car windows, rigid materials including pvc, foam board, acrylic, acp panels, or walls. Adhesive vinyl is ideal for

both outdoor and indoor use to serve all home decoration, business signage, and advertising needs. Self-adhesive vinyl is typically used for home or office wall decoration, flooring, on vehicle or retail store windows, wall covering and many more. It is most commonly used for printing eye-catching advertisement graphics and materials for businesses. [3]

Relative cost (compared to other printing methods)

[Based on service fee] The standard for digitally printed vinyl banners is \$8.00/sq foot. For a simple, one color banner in “cut vinyl”, you can price it more economically, in the \$5.00 – \$8.00/sf range, then add a little more for two or three color designs. [2]

For self-adhesive vinyl, according to directbannerprinting.com, costs start from as low as \$0.66 per sq ft for orders above 200 sf ft. [3]

Durability

Vinyl is a very durable plastic that can withstand many years of wash and wear [5]. Vinyl printing uses durable, waterproof, scratch-resistant inks, which means it's perfect for creating a wide variety of internal and external signage. Vinyl materials are capable of enduring everything from heat and sunshine to cold and wet weather, making them a sound investment [7]. Under normal use, a shirt with vinyl printing should last more than five years [4].

Precision

It depends on the equipment used. When a computer operated vinyl cutting machine is utilized, it makes precise and accurate cuts along the self adhesive vinyl of your chosen design [6]. Vinyl printing is best suited for simple graphics. If you're looking to create basic shapes or text-based designs, this is the method to use. With vinyl printing, there's no way you can come up with true gradients (blending of colors); fine details will easily get lost [4]. Furthermore, each design must be cut individually. Thus, vinyl printing is best for small quantities [6].

Vinyl printing's impact on the environment

Vinyl stickers are a massive contributor to the micro plastic tragedy that is plaguing our waterways. As a vinyl sticker starts to break down it creates these tiny plastic flakes that end up in every marine ecosystem. Not only are vinyl stickers not recyclable or compostable, but they also create plastic flakes as they break down in the landfill that contaminate our waterways [8].

Meanwhile in the vinyl printing shirt business, the inks involved in print are often some of the most problematic materials. Many traditional inks use solvents or eco-solvents (the latter being less environmentally friendly than they sound), which mean they exude a cocktail of chemical emissions when they're used. This isn't good news for the planet [9].

There are, however, alternatives. UV-curing or water-based inks are far less harmful in terms of emissions, and they're becoming more commonplace in the industry. There are also inks that are designed specifically to break down easily during recycling (which is particularly relevant for printing on paper and board). What's notably helpful for print suppliers is how widely accessible these have become for use in some of the most popular print equipment [9].

The substrates – the things that actually get ‘printed on’ during a project – involved with large format print also have a pivotal role in sustainability. Traditionally, many ‘go-to’ substrates have been high in PVC. This is problematic, simply because the production, use, and disposal of PVC-based products involves heavily toxic, non biodegradable materials migrating into the environment [9].

Sources

1. <https://orchiddigitals.com/what-is-vinyl-printing/>
2. <https://blog.signwarehouse.com/a-basic-guide-to-pricing-signs-banners-and-signs/>
3. <https://directbannerprinting.com/product/adhesive-vinyl-printing/>
4. <https://www.hamblyscreenprints.com/screen-print-vs-vinyl-t-shirt-printing/>
5. <https://blog.printsome.com/transfer-printing/>
6. <https://www.ukpos.com/printing-and-branding-vinyl-graphics>
7. <https://www.perfectcolours.com/blog/2015/04/22/what-is-vinyl-printing/#:~:text=Advantages%20of%20vinyl%20printing&text=They%20are%20designed%20to%20last,of%20internal%20and%20external%20signage.>
8. <https://clarifygreen.com/environmentally-friendly-stickers-for-home-and-business/>
9. <https://www.presson.co.uk/environmentally-friendly-large-format-printing/>

Solvent Printing



Solvent printing is a commercial version of your home inkjet printer and is well-used by companies who produce signage and banners due to its durability and waterproof nature.

The printer is a large inkjet which prints liquid ink (solvent which does not contain water) onto your surface (substrate). Unlike home printers, the new technology for commercial inkjets means that the designs and colours are vivid and do not suffer from lines or breaks due to different ink drop sizes, and they tend not to bleed, either.

The solvent-based technology adheres ink to your substrate. The process entails mixing pigment and a solvent to create liquid ink. The printer head then transfers the liquid onto a substrate, as the solvent evaporates a hard layer of ink remains. [9]

Solvent printing does include a 'curing' time of around 24 hours, so it is not the fastest type of printing to be ready for use, although, once cured, it is durable for many years.

What types of surfaces/materials/products can it be used on?

Solvent printing uses many common roll media for printing, such as photo paper, heavier papers for posters, canvas, cotton art paper, uncoated vinyl, and more. Vendors often have a 'solvent' section for their roll media.

Relative cost (compared to other printing methods)

[Based on raw material cost] Solvent inks cost 50-75% less than water based ink – this is a substantial savings considering it is the most expensive consumable you purchase [2]. For a low-density image, it is estimated an average ink cost of \$.16 per square foot with an average media cost of \$.30 per square foot, for a total of \$.46 per square foot. For a high-density image, an average ink cost will be \$.28 per square foot with an average media cost* of \$.30 per square foot, for a total of \$.58 per square foot [3].

Durability

Durability is connected to the type of solvent ink used. Manufactured from petroleum-based substances, the inks contain substances such as acetone to help them dry: mild solvents and eco solvents which are less harsh. Mild solvents generally use Glycol or Glycol Ether. These Eco and Mild solvents have slower drying times due to the lack of acetone. Solvent prints are fully waterproof once dry. [8]

The most important advantage of solvent inks is that there is no top-coating required (with the exception of the more environmentally-friendly eco-solvents). This means no giclee varnish or coating is necessary to properly protect your prints [2].

- **Hard solvent**, which is the most toxic of all types of solvent. It is also the most durable of the solvent inks. Its durability is estimated at about 3-7 years [1].
- **Mild solvent**, it is more susceptible to abrasion and scratches, and is also less durable (approx. 2 years) [1].
- **Eco-solvent**, this ink also has its disadvantages, i.e. lower resistance to external conditions (UV radiation, water) and mechanical damage (durability is estimated at less than 2 years), the need for lamination, and a higher price [1].

Precision

Solvent printing technology is designed for everyday long-term and high volume production runs [2]. Several printing machines are available for high precision solvent printing [4].

Solvent flex printing machines have a comparatively large drop size. The print heads on solvent machines spray ink drops of size 40 – 60 picoliters. This larger drop size does result in slightly grainy image reproduction.

Typically, solvent ink prints are of a lower resolution than their eco-solvent counterparts. But this does not matter because when a solvent print is set in an outdoor location, it is generally viewed from a long distance. [10]

Solvent printing's impact on the environment

Solvent inks contain volatile organic compounds (VOCs), which cause ozone pollution when released into the environment and react with nitrogen oxides. The reaction also leads to health problems like asthma, emphysema and bronchitis, so printing workers are regularly exposed to health hazards unless given protection [7].

Thus, it is eco-friendly only when eco solvent is used. Eco solvent is harmless to health and the environment. The eco solvent printing represents in fact eco-friendly technology. The ink's pigments production is the process of ether fractions extraction from refined mineral oil. Additionally, these inks are much safer in usage, because of a little odour. Secondly due to

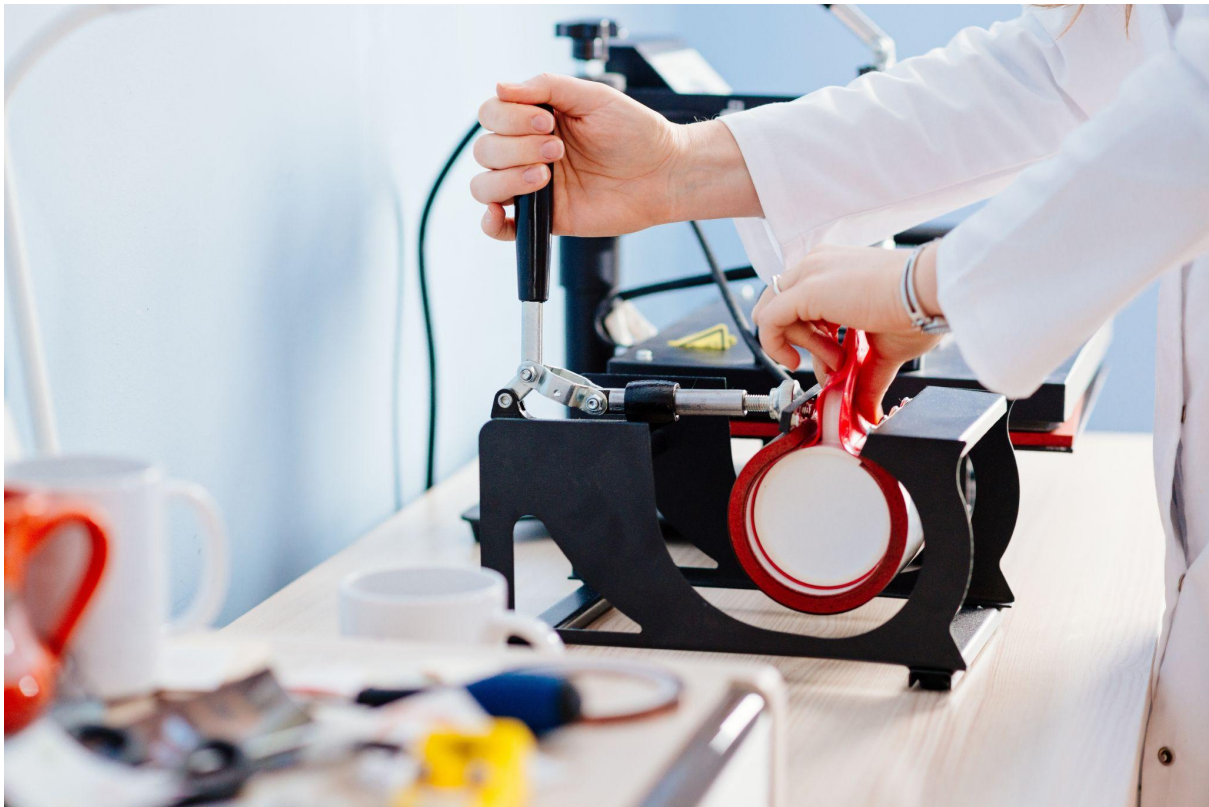
lower VOC content compared to the solvent inks. As a result the eco solvent prints are biodegradable. In consequence they are not dangerous for the environment. The images printed in this technology suit both indoor and outdoor applications [5].

The eco solvent ink also offers many of the same benefits (if not much-improved advantages) of other tried and tested ink formulations. They offer fast drying times and a much wider color spectrum — a great improvement because many printers complain about slow drying times for other large format ink formulations [6].

Sources

1. <https://www.jardcreative.com/blog-en/what-is-solvent-printing-its-pros-and-cons>
2. <https://blog.breathingcolor.com/solvent-vs-water-based-printers/>
3. <https://www.pako.si/roland-ink/eco-sol-max-eco-solvent-inks#:~:text=Low%20Running%20Costs&text=16%20per%20square%20feet%20with,46%20per%20square%20foot.>
4. <https://www.largeformatprintingmachine.com/sale-10666183-1-6m-high-precision-large-format-multifunction-printer-eco-solvent-1600mm-inkjet-digital-printer.html>
5. <https://ikonosmedia.eu/news/is-eco-solvent-printing-really-eco-friendly/>
6. <https://medium.com/@earljtrepanier/what-is-eco-solvent-ink-and-its-benefits-f7616c342740>
7. <https://wideformatonline.com.au/features/special-reports/9304-eco-friendly-and-heavily-pigmented-eco-solvents.html>
8. <https://www.bannerworld.co.uk/blog/large-format-printing/what-is-solvent-printing/>
9. <https://duggal.com/solvent-printing-vs-uv-printing-2/>
10. <https://orchiddigitals.com/solvent-eco-solvent-or-uv-inks-comparison/>

Thermal Printing



Thermal printers reproduce a digital image on special coated thermochromic paper by heating the paper in line with the design and the paper blackening with transferred pigment where it is heated. The heated print head moves over the paper to create the image.

Thermal prints do not smear in comparison with liquid inks, therefore the printing is durable.

Thermal printers are used most commonly to create labels, safety signs, wayfinding markers, barcodes, shipping labels, and other heavily-used items [1]. Thermal transfer printers can print documents, labels, and signs that meet various needs, including durable arc flash labels, text and graphics-based floor marking, and labels meant for extreme conditions such as cold storage [1]. Most professional and industrial label printers let you choose between two thermal printing methods for label printing: thermal transfer and direct thermal [3].

What types of surfaces/materials/products can it be used on?

In thermal transfer printing, you pass the material to be printed, together with ribbons (black or others), past the thermal print button and computer-controlled heating elements. The material can be, as mentioned, thermochromic paper, but also plastic and other surfaces. The ink ribbons consist of a foil with ink that is transferred when heat is applied [5].

Ink ribbons [5]:

- Wax – for paper/cardboard at low temperatures
- Wax/resin – for PVC/polyethylene/polyester/polypropylene, smear and scratch resistant
- Resin materials are optimally prepared against influences at high temperatures

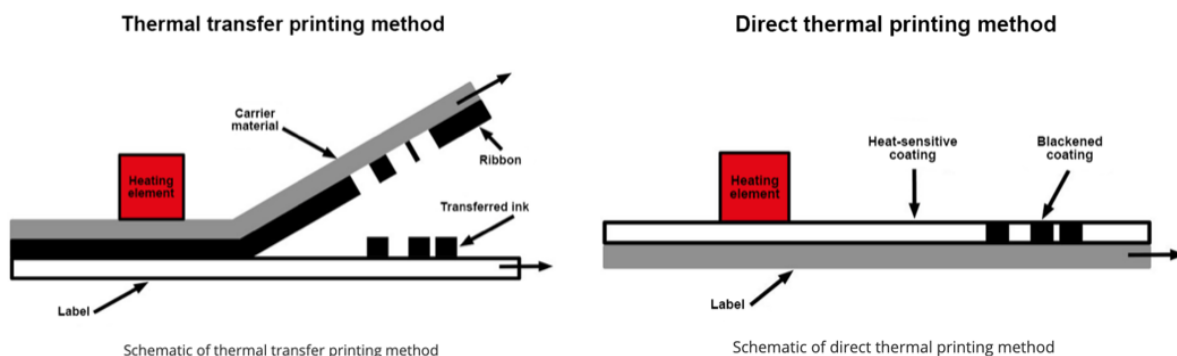
How do the two thermal printing processes work?

You should always adjust the quality of the ribbons to the material to be processed and the purpose. For paper, wax ribbons are used at low temperatures, while film labels with special requirements should be processed with resin tapes at comparatively high temperatures [5].

The colour of the rolls reaches the label at certain points when exposed to the heat and leads to durable, very good results. The colour film is melted and transferred at the points, so to speak. It is located on the material. Here, a difference to other thermal printing processes can also be seen. For example, with dye-sublimation printing the ink works its way into the material, whereas with direct thermal printing you don't use any ink at all and the heat only blackens the paper (with the design you want) [5].

The print head consists of tiny heating elements (dots) that heat up in selected areas to produce the desired print image. Therefore, the rather general term thermal printer may be used for direct thermal label printers as well as for thermal transfer printers. Their printing resolution is determined by the size, number and arrangement of heating elements, specified in dots per inch (dpi). It is usually 203, 300 or 600 dpi. The higher the number, the higher the print resolution and quality [3].

The actual difference between the two methods is in the surface that is heated by the print head: Thermal transfer printing uses a wax- or resin-based ribbon that transfers ink onto the label when heated. Direct thermal printing, on the other hand, uses heat-sensitive labels which blacken where they are heated directly [3].



Relative cost (compared to other printing methods)

The specialty materials used in the thermal printing process are considerably more expensive than their inkjet counterparts; even the most basic thermal printer may cost hundreds of dollars [1].

There's one other small difference that's become important in the battle between thermal and ink: the use of company logos on receipts. As it turns out, this is a key factor in the cost of paper, and tips the break-even point in favor of thermal if you want your receipts to have a distinctive look. Ordinarily, plain receipt paper can be had for as little as 40 cents per 150-foot roll, while thermal paper comes in longer rolls (220 or 230 feet) that cost around 80 cents – so you get 25-30% more paper for your dollar with the standard variety [6].

Durability

The thermal transfer printer represents a very durable acquisition and proves to be robustly designed [5]. Labels and signs created with thermal printers (thermal transfer) last longer and stand up to a wider variety of weather conditions than those printed with ink [1].

Meanwhile, direct thermal creates a product that is extremely sensitive to heat, light and other environmental conditions (label will darken when overexposed to such) [3].

Precision

Thermal printers with inkjet systems use ink cartridges with lots of tiny chambers that can be heated by an electric impulse. The heat provokes the building of a small vapour bubble which pushes the ink through the nozzle. The tension of the vapour bubble, as well as the surface tension of the ink drop, cause the ink to hurl back within a fraction of a second. Precise and high quality prints of text, barcodes and graphics can be achieved [4].

However, thermal printers print fewer colors, and the high heat limits wax and resin choices; both factors limit color and application options [1].

In case of color precision, thermal transfer wins over direct thermal [4]:

- **Direct thermal:** This type of thermal printer needs special thermal paper, which reacts with the heated printhead. Where the printhead touches the paper, it turns black. The modern thermal paper is much more resistant to environmental influences than before so that the colour stays fresh for several years.
- **Thermal transfer:** This system uses colour foil, or thermal-transfer-foil, to get the print on the paper. The printhead is equipped with hundreds of tiny heating elements that can be computer-control activated. The foil runs between the printhead and paper and is melted by the printhead where the heating elements are activated. The plain surface of the foil achieves a fine and sharp print with a slight shine. The advantage of the thermal-transfer system is the longer shelf life of its prints compared to the direct-thermal prints.

Thermal printing's impact on the environment

First and foremost, direct thermal labels are much more environmentally friendly. As the printers do not use a ribbon, it reduces the amount of non-recyclable waste and by-products. As they have a lower shipping weight, your carbon footprint will be greatly reduced [7].

Thermal transfer printing involves a ribbon which recreates a printed image on the label while direct thermal printing passes the paper directly over the thermal print head. Direct

thermal printers are often preferred due to their lack of costly materials such as ink, toner, and ribbons, as well as for environmental concerns. However, it's important to consider the final destination of the labels as durability and readability can sometimes be an issue [2].

Sources

1. <https://www.graphicproducts.com/articles/thermal-printers-vs-inkjet-printers/>
2. <https://greatlakescomputer.com/blog/5-surprising-statistics-about-thermal-printers>
3. <https://www.weber-marking.com/blog/thermal-transfer-vs-direct-thermal-printing/>
4. <https://www.weber-marking.com/glossary/thermal-printer.html>
5. <https://www.ghost-white-toner.com/process-different-surfaces-with-thermal-transfer-printer/>
6. <https://www.digitalcheck.com/receipts-thermal-ink-costs/#:~:text=Ordinarily%2C%20plain%20receipt%20paper%20can,dollar%20with%20the%20standard%20variety.>
7. <https://cutsheetlabels.com/blog/pros-cons-direct-thermal-printing/#:~:text=First%20and%20foremost%2C%20direct%20thermal,footprint%20will%20be%20greatly%20reduced.>

Silk Screen Printing



Silk screen printing is one of the oldest forms of commercial printing, it first appeared in a recognizable form in China during the Song Dynasty (960–1279 AD), and is still incredibly popular to this day! Basically, ink is transferred onto the product to be printed through a substrate and the design is created via a blocking stencil.

It's a labour-intensive process, but can be used on many types of product and material.

How does the process work?

Silk screen printing uses a single-colour polyester screen which allows ink to pass through it. The stencil of the design is printed on a transparency, layed on a screen layered with emulsion, and exposed to a bright light. The emulsion is then washed away leaving only the template from the transparency which does not harden as it is protected from exposure. Later, this screen is placed over the item to be screen-printed and ink is squeegeed over the screen. The unexposed area has no hardened emulsion and allows ink through onto the surface of the item.

If a design has more than one element with different colours, different frames will be used per element and colour. Finally, the ink is set through the application of heat and is ready for use.

There is much more involved in the process behind silk screen printing fabric, which requires a high level of skill and expertise to be executed correctly. Due to the high precision production of screen printing [4]. Screen printing is done completely by hand from start to finish and requires an extensive set-up procedure prior to each print. Due to this, screen

printing is generally reserved for larger bulk orders to ensure that it's a cost-effective process. For smaller order quantities, digital printing is generally the preferred method [5].

What types of surfaces/materials/products can it be used on?

Silkscreen is the world's favourite printing method. It allows you to print on an almost limitless range of surfaces with an almost limitless range of inks. [3]

Different inks can be used to work with a variety of materials, such as textiles, ceramics, wood, paper, glass, metal, and plastic. As a result, screen printing is used in many different industries, including [1]:

- Balloons
- Clothing
- Decals
- Medical devices
- Printed electronics, including circuit board printing
- Product labels
- Signs and displays
- Snowboard graphics
- Textile fabric
- Thick film technology
- Pinball machines

Silk-screen printing ... is the most-used by companies when printing designs onto products of different sizes and materials.

It has been used for more than 100 years in the commercial and artistic sector and is mainly used for printing images and designs on t-shirts, tote bags, paper, wood, ceramics and other materials. [2]

Relative cost (compared to other printing methods)

[Based on service fee] Most shops charge anywhere from \$10 – \$30 per color per screen on a shirt. If you are printing less than 50 shirts and have more than 3 colors in the graphic, the cost will be much higher per shirt due to the set up costs [8].

While screen printing is ideal for products in high volumes, it isn't as cost effective if you have only a few items to print. The setup time is complex and involved so printing in low quantities won't necessarily provide you with a cost effective result. [6]

Durability

Silk screen prints are resistant to many washing procedures [2]. Screen printed designs are typically much more durable than the likes of heat press or digital designs which is due to the technique laying down thick layers of ink which are absorbed by the material, leading to enhanced durability, especially when a product will be under direct contact with sunlight, often causing them to fade which is a common characteristic of digital printing, for example [6].

Precision

Screen printing is the best option for designs that require a high level of vibrancy, when printing on dark shirts, or for specialty products. The ink in screen printing is applied thicker than digital printing, which results in brighter colors even on darker shirts. [8]

The placement of the template on the substrate is critical, as designs can be a bit off if the template is not perfectly positioned every time. Human error is a large risk factor here.

Silk screen printing's impact on the environment

The main components of silk screening are the chemicals in the ink, solvents, and cleaning agents -- and their potential use and waste in silk printing. There is also the clean up process that is involved using these toxic chemicals that end up going down drains and into the environment and the atmosphere. However, there are two mediums that are most commonly used in this printing process: solvent-based and water-based. Water-based ink sounds eco-friendly and a number of companies tout these inks in their marketing [7].

As a silk printing chemical, water-based inks are theoretically better for the environment. They contain less oil-based chemicals and are less harmful to habitats. However, they are watery and as such, they have to be washed off the screen and into a drainage sink. Even if a closed loop recovery method is used, some drainage is inevitable. Along with this, there is more waste [7].

Solvent-based inks come with their own share of problems. They contain endocrine disruptors in the form of phthalates and volatile organic compounds, or VOCs. These are harmful if released into the environment in their wet form. A way to get away from this is to use 100 percent phthalate-free ink. This form of plastisol ink can be scooped back into its container and reused over and over, making this environmentally friendly. There is no waste. So if you plan on taking this avenue, you should make sure that your print supplier reclaims unused ink from the screen rather than enable it to enter water sources [7].

Many printers are now using soy, pine, and citrus-based inks and chemicals and these have proven to be eco-friendly and sustainable. Other inks to look for are those that are PVC, phthalate, lead, and heavy metal-free as well as those that do not contain the ozone-damaging VOCs chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), aromatic hydrocarbons, or any other volatile solvents [7].

Sources

1. <https://www.gooses.co.nz/About+Us/History+of+Screen+Printing.html>
2. <https://camaloon.com/blog/what-is-silk-screen-printing>
3. <https://www.foldmagazine.com/silkscreen-printing>
4. <https://www.biddlesawyersilks.com/services/screen-printing/>
5. <https://www.biddlesawyersilks.com/what-is-screen-printing-the-process-explained/>
6. <https://blog.evans-graphics.co.uk/blog/the-pros-and-cons-of-screen-printing.html>
7. <https://www.mjspackaging.com/blog/going-green-the-eco-friendly-advantages-of-silk-screening/>
8. https://www.customink.com/help_center/screen-vs-digital-printing

Heat Transfer Printing



Heat transfer printing uses a heat press to transfer a templated design onto the substrate/material being used. For the template the design is printed on heat-transfer paper using inkjet, pigment, or sublimation ink, which means that when heated it will stick to the surface being printed onto.

Heat transfers are a vibrant, soft, and lightweight alternative to traditional screen printing. They are an ideal way to print complex, multi-color designs on apparel, hats, tote bags, and coolers. Another advantage of heat transfer printing is the easy setup. Since this process doesn't involve the use of screens, [it's faster and more affordable]. Additionally, water-based heat transfers are PVC free, so you can feel good about wearing an eco-friendly print. This form of printing is suitable for all fabric types without water proof coating; cotton, polyester, blends, and nylon [6].

What types of surfaces/materials/products can it be used on?

While heat transfer can be done on most materials if done carefully, it is most compatible with cotton, cotton blends, and acrylic fabrics. Heat transfer is also commonly done on polyester and polyester blend fabrics, but polyester is typically temperature sensitive, so low-temperature heat transfer films are necessary to prevent scorching or discoloration.

Other sensitive materials include synthetic fabrics, leather, nylon, and rayon. Always make sure to check the tags on your garment to see if the fabric is heat sensitive. [7]

Relative cost (compared to other printing methods)

Heat transfer printing is inexpensive even for small runs of printing. But it is expensive to set-up and expensive to run large batches [1]. On average, it costs \$5 per shirt with heat transfer printing [3]. For the average Heat Transfer Printing Company, 2.3 CENTS per square inch is average. That's also the same as .023 dollars per square inch [4].

Durability

Garments printed through heat transfer methods are of high quality and they tend to have high resolution images. Heat press methods can take you 2 to 3 minutes to print a single fabric item [5].

If you are going to deal with complex color designs, then heat transfer will be ideal compared to screen printing [5].

Heat transfer printing is widely used as it creates durable, heat resistant, adhesive and water-resistant designs [2], although the print may fade with washing over time [1].

Precision

- Represents fine details or small text better than other printing processes, such as screen printing or embroidery, especially when digital heat transfer is used as it prints at 1200dpi and 266 lines per inch which is photo quality.
- A transfer, since it is flexible, is one of a few methods of decorating shaped products, (such as a round water bottle) [8].

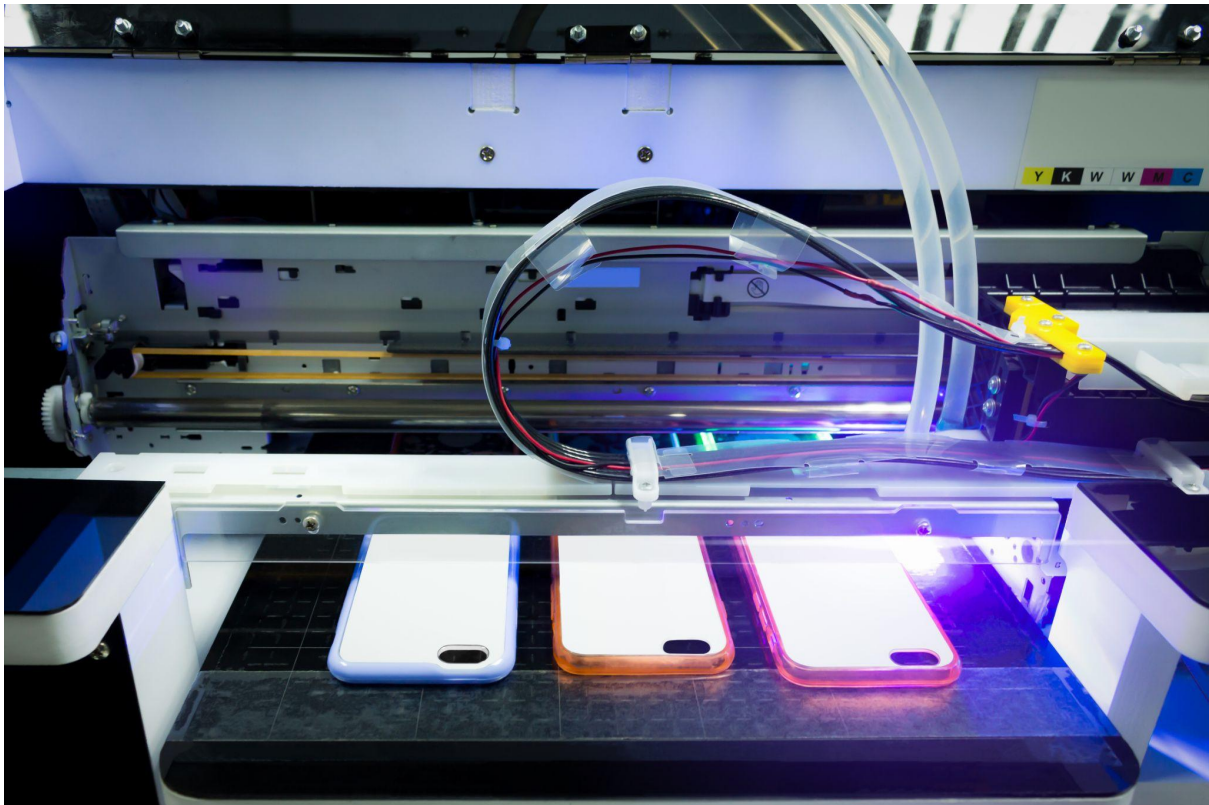
Heat transfer printing's impact on the environment

There is very little waste associated with the heat transfer process, making it one of the most environmentally friendly custom decoration types [7]. There may be some off-cuts of the heat transfer paper, but that's about it.

Sources

1. <https://vividcustoms.com/discover/overview-of-screen-printing-the-pros-and-cons/>
2. <https://www.thefunkypeach.com/heat-transfer-printing>
3. <https://www.t-shirtforums.com/threads/t-shirt-costs-when-using-a-heat-press.772354>
4. <https://digitalheatfx.com/2017/12/heat-transfer-printing/#:~:text=It%20works%20out%20to%20only,better%20your%20price%20will%20be.&text=For%20the%20average%20Heat%20Transfer,square%20inch%20as%20our%20average.>
5. <https://tshirtprofessional.com/heat-press-vs-screen-printing/>
6. <https://superiorinkprinting.com/water-based-heat-transfer-printing/>
7. <https://www.merchology.com/pages/custom-heat-transfer-capabilities-applications>
8. <http://www.cdigital.com/blog/digital-heat-transfers/benefits-digital-heat-transfers/>

UV Printing



If you've ever been to the mall you may have seen nail bars with rows of customers sitting with their hands under small UV-emitting devices which are curing their nails. Well, that's the same technology as is used in commercial UV printing!

This is a modern printing technology that is growing in popularity due to its quality, durability, flexibility, and speed! Instead of hours or even days to cure, UV printing is cured and ready in just minutes, and it also prints really well onto plastics or non-porous materials (as ink doesn't need to absorb into the substrate), which are both major benefits.

What types of surfaces/materials/products can it be used on?

UV printing is a unique method of digital printing utilising ultraviolet (UV) light to dry or cure ink, adhesives or coatings almost as soon as it's hit the paper, or aluminium, foam board or acrylic - in fact, as long as it fits in the printer, the technique can be used to print on almost anything [1].

Relative cost (compared to other printing methods)

[Based on Starting from \$2.00 per sq ft³. The color ink costs: around \$1 / m² (full range printing, full color standard non-single color), color + white cost: : around \$2 / m² (Note: The above plus color part adopts high-precision full-width printing capacity for normal production.) [2]

A comparison with Pad printing:

PAD PRINTING

\$46 in consumables, \$40 labor, 2 hours to complete (not including cleanup)

\$86 at 2 Hours to complete

UV PRINTING (COMPRESS IUV-600S)

66¢ in consumables (ink), \$20 labor, 1 hour to complete

Less than \$21 at 1 Hour to complete.

Therefore, UV Printing is better than 1/4 of the cost of ink, and 1/2 the time as pad printing!

Durability

The advantage of UV printing is its good durability. UV printing technology is based on applying a thin layer of ink on the surface of the material, which instantly hardens (polymerizes) under the influence of UV lamps. UV ink does not smell after printing, so this printing can be used not only for outdoor advertising, such as, for example, solvent printing, but also indoor applications. Neither water nor even most chemicals can wash away the image made by a UV printer [5].

Acting more like a thin sheet of liquid plastic, UV inks provide excellent rub, chemical and light resistance, along with outstanding color consistency and superior gloss [4].

Precision

The UV digital printing is suitable for medium to high accuracy printing precision and for medium to small lot production [6].

UV printing allows for high-gloss levels, vibrant colors, an array of coatings and printing that's crisp and has a nice finished look. That's because UV inks tend to sit on top of the printed surface, rather than being absorbed into it. The end result is sharper and crisper. [8]

UV printing's environmental impacts

UV printing is considered to be one of the greenest printing methods as it's so 'clean' and uses solvent-free inks.

Due to avoiding solvents, evaporation is minimized, there are far fewer emissions of volatile organic compounds into the environment compared to other inks. [9]

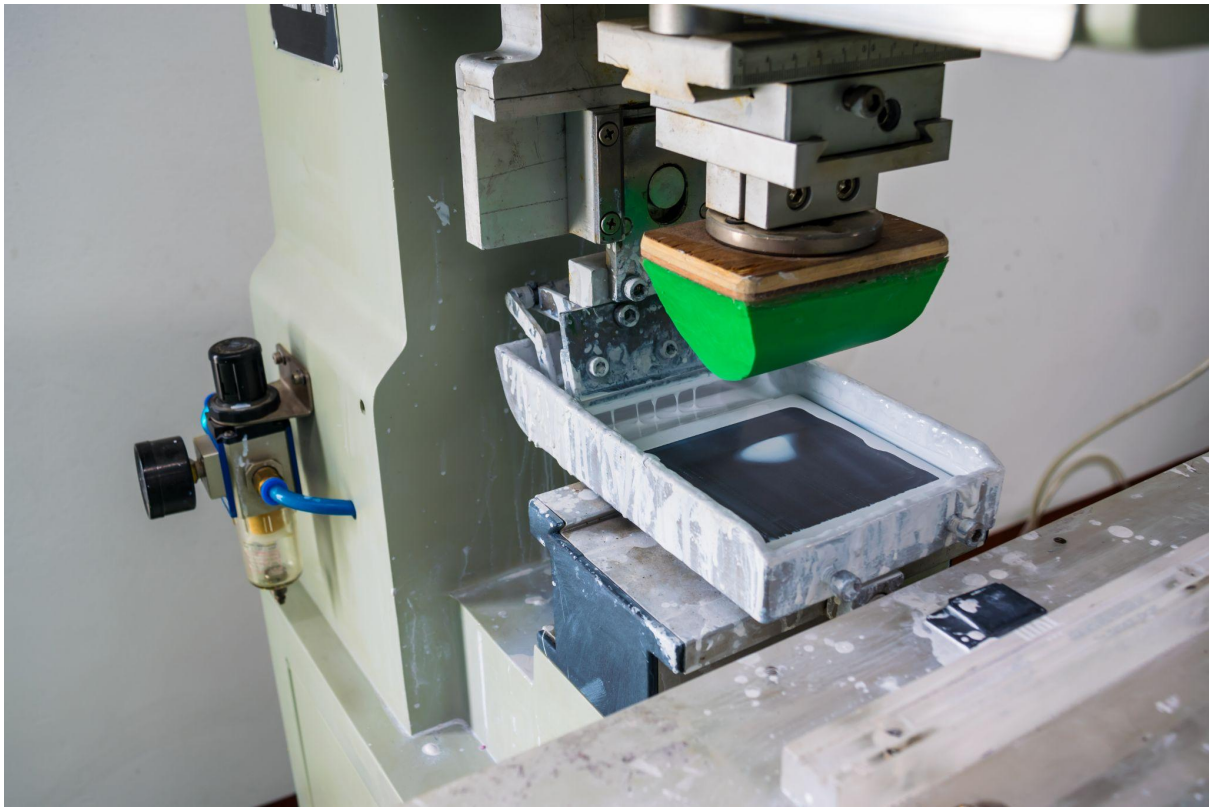
Most traditional solvent-based inks have 60 – 70 percent solvents, which contain VOC toxins that have to evaporate off. In other words, 60 – 70 percent of the ink is being "wasted" in the printing process. Needless to say, having these solvents evaporating into the air isn't good for your employees or the environment.

UV inks are environmentally friendly, because unlike solvent-based inks, 100 percent of the ink is used. UV ink is a two-part acrylic epoxy, the A part is the ink itself with receptors to be activated by the B part which is UV light. The UV rays from a light source quickly activate and start a cure process to harden the ink, rather than being evaporated like solvent based ink. [10]

Sources

1. <https://www.azom.com/article.aspx?ArticleID=15936#:~:text=UV%20printing%20is%20a%20unique,to%20print%20on%20almost%20anything.>
2. <http://www.asuvj.com/en/new/UV-printing-costs.html>
3. <http://nobleprinters.com/uv-flatbed-printing.html>
4. <https://barcode-labels.com/durable-uv-ink-printing/#:~:text=Another%20benefit%20of%20printing%20with,already%2C%20it%20gets%20even%20better!>
5. <https://bigprinter.com/news/uv-printing-resistance/>
6. <https://mimaki.com/application/solution/uv-printing.html>
7. <https://compressuvprinter.com/pad-printing/>
8. <https://printfinishblog.com/2009/04/benefits-uv-printing/>
9. <https://1touchpoint.com/blog/5-reasons-to-choose-uv-printing>
10. <https://printfinishblog.com/2009/03/environmental-benefits-printing-uv-ink/>

Pad Printing



The name gives a big clue to how pad printing works. The process involves transferring ink from a silicone pad onto the item you want printed. You could think of it as like those stamps you probably used to make crafts when you were a kid – though obviously professional pad printing is much more sophisticated! [4]

Pad printing operations are used in a wide variety of industries, most prominently: industrial, promotional, and garments. Popular pad printing applications: pens, garment tags, flash drives, silicone items, and watch faces [2].

What types of surfaces/materials/products can it be used on?

Pad printing is a printing method that allows the transfer of a 2-dimensional image onto a 3-dimensional object. While just as effective for flat surfaces, this process is most often used for printing on parts that are round, have complex curvature, that are round, have a concave or convex surface, or have recessed or raised areas [1].

The pad printing machine holds both the pad and the product steady and then presses the pad into an ink plate, which has been tailored to the shape of your logo or artwork. The pad is then pressed onto the object and left to air dry. It's pretty straightforward [4].

Pad printing is a relatively modern process, especially when compared to screen printing, which dates back centuries and is often preferred as it makes it easier to print unusual shaped objects [4].

Relative cost (compared to other printing methods)

[Based on raw material] Pad printing inks ranges from about \$90-\$175 per liter [3].

PAD PRINTING

\$46 in consumables, \$40 labor, 2 hours to complete (not including cleanup)

\$86 at 2 Hours to complete. [8]

Durability

The durability depends on the cure. It is necessary to note that the final durability and resistance of a two component ink is reached after full cure has taken place. Cure times range from 24 to 72 hours [5]. Hardener for pad printing ink acts as a catalyst that assists in the curing process. Adding hardener will often make prints more durable and able to withstand abrasion [2].

Precision

Pad printing uses a silicone pad to transfer an image onto an item. The machine holds the product steady and presses it into an ink plate before it's stamped by the pad. Pad printing can successfully decorate three-dimensional parts because while transferring the image to the part, the silicone pad wraps around or adapts to the shape of the part without distorting the image, given some image size restrictions. Extremely fine detail and tight multicolor registration are readily achievable with pad printing [1].

Pad printing machines are incredibly versatile because the equipment can print on nearly any substrate quickly. Pad printing is generally a quick process. One complete print cycle takes only seconds (depending upon the number of colors) and can often print upwards of 1000 parts per hour [2].

While pad printing is great for achieving accurate results, it is slightly limited in terms of speed. You usually have to apply multiple colours separately, so there is a slight risk of registration. [4]

Pad printing's impact on the environment

Pad printing has the potential to be the best solution for eco-friendly printing, however, with the usage of certain chemicals, an increase in waste, and an inefficient manufacturing process, it all goes downhill [6].

Pad printing ink is typically solvent-based, meaning it has a solvent additive either pre-mixed or added to the ink. Is solvent-based ink bad? It really all depends on the solvent added to the ink. There are solvents available with less harmful ingredients. The ink itself is a mixture of pigment and resin with a few extra ingredients [6]. An eco-Friendly Universal Ink Cup designed for pad printing is available on the market [7].

Sources

1. <https://www.uniquepadprinting.com/what-is-pad-printing>
2. <https://www.inkcups.com/pad-printing/>
3. <https://compressuvprinter.com/pad-printing/>
4. <https://www.tampocanada.com/pad-printing-vs-screen-printing>
5. <https://www.decotechgroup.com/library/pad-printing/tech-bulletin-pad-print-101/>
6. <https://www.inkcups.com/blog/eco-friendly-pad-printing-101/>
7. <https://news.thomasnet.com/fullstory/eco-friendly-universal-ink-cup-is-designed-for-pad-printing-606986>
8. <http://www.asuvj.com/en/new/UV-printing-costs.html>

Hydrographic / Water Transfer Printing



Image credit: [8]

One of the most artistic styles of printing, hydrographic printing, also known as water transfer printing, is a unique process that adds visual appeal to three-dimensional surfaces. [5]

A painted substrate, which could be an entire product like a motorcycle helmet, is dipped into water which has a polyvinyl alcohol hydrographic film floating on top of it. This film includes the design to be printed and can feature many colours and complex patterns. The clear film is water-soluble, and dissolves after applying an activator solution. Once dipping is begun, the surface tension of the water will allow the pattern to curve around any shape. Any remaining residue is then rinsed off thoroughly. The ink adheres to the desired surface and it cannot be washed off easily. It is then allowed to dry [9] and then clear-coated with automotive-grade urethane.

What types of surfaces/materials/products can it be used on?

Transfer printing can be widely found on automotive interior parts with a woodgrain pattern, furniture, cell phone cases, and water bottles [5].

Any non-porous hard surface that can be submerged in water can be decorated with water transfer printing. Another good rule of thumb is if you can get paint to stick to the object most

likely you can decorate it with this process. Examples of such materials are: plastic, glass, hardwoods, fiberglass, ceramics, and metals [1].

Relative cost (compared to other printing methods)

[Based on service fee] 50¢ Per Square Inch [4].

Most hydrographics shops who decorate alloy wheels charge around \$75 to \$80 per wheel, depending on labor costs and customizations. If hydrodipping is part of a wheel painting package, the cost may be higher.

Durability

Hydrographic finishes are very robust and will last for many years under normal use. However, similar to your car finish, the paint of hydrographic can scratch if the product is abused. Scratching the protective clear coat can cause failure to the hydrographic finish [3].

The durability of your finished item depends on the clear coat used. For instance, if you use a high-quality automotive clear coat on your item, longevity should be as good as a paint job on a car [6].

Precision

Hydrographic printing is a well-known technique in industry for transferring color inks on a thin film to the surface of a manufactured 3D object. It enables high-quality coloring of object surfaces and works with a wide range of materials, but suffers from the inability to accurately register color texture to complex surface geometries. However, with computational hydrographic printing, a new method that inherits the versatility of traditional hydrographic printing, while also enabling precise alignment of surface textures to possibly complex 3D surfaces [7].

Hydrographic printing's environmental impact

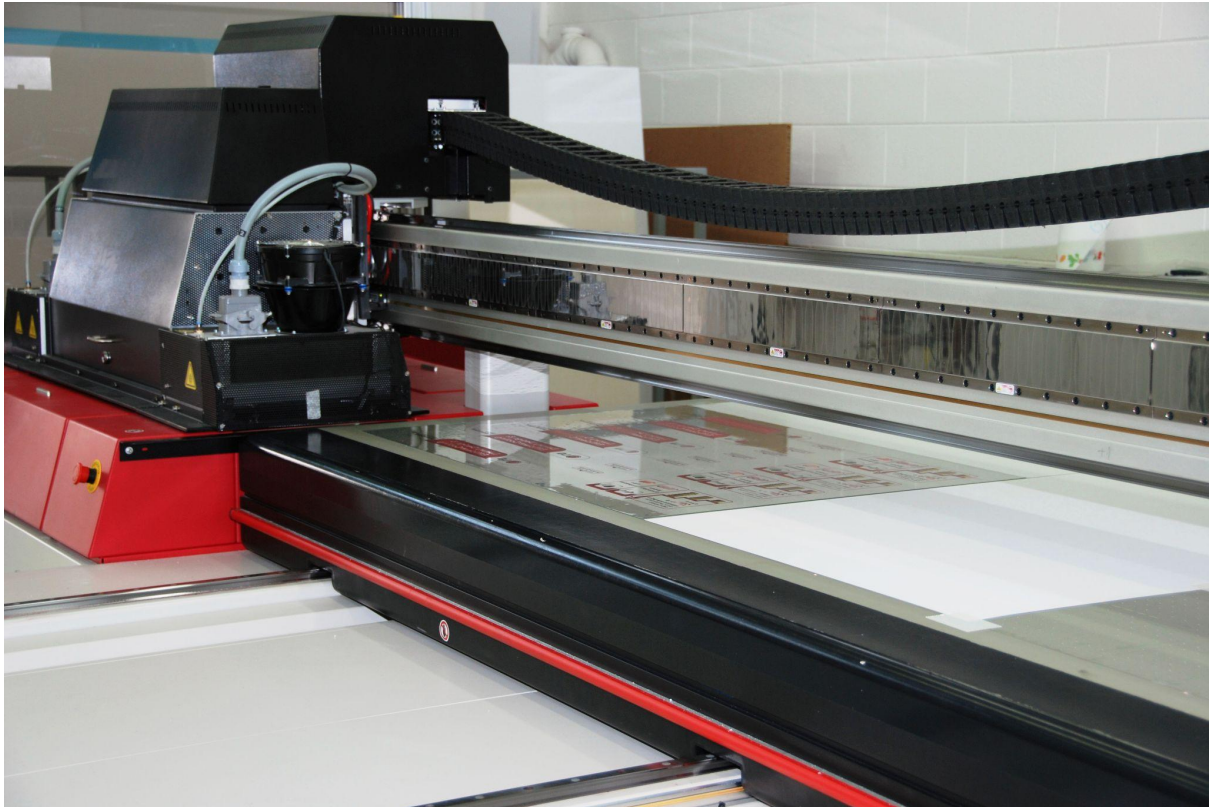
Aside from the paint and clear-coat used for the item to be printed, which may be either green or not particularly environmentally friendly, the water transfer printing process is fairly green and has no bad effect on the environment. Once the PVA film is dissolved in water, specific microorganisms will cause it to degrade. When treated with activated sludge, solutions of PVA will be decomposed into water and carbon dioxide. [10]

Sources

1. <https://www.mydipkit.com/info/>
2. <https://plasticsdecorating.com/articles/2016/a-new-look-at-an-old-technology-water-transfer-printing/>
3. <https://www.finishtek.com/2019/12/does-hydro-dipping-wear-off/#:~:text=Hydrographic%20finishes%20are%20very%20robust,failure%20to%20the%20hydrographic%20finish.>
4. <https://utahhydrographics.com/pricing/>
5. <https://www.monosol.com/applications/transfer-printing/>
6. <https://dipwizard.com/durability-of-hydrographics/>

7. <https://www.researchgate.net/publication/283889665> Computational Hydrographic Printing
8. By Deeppaint - Own work, CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=30034440>
9. https://en.wikipedia.org/wiki/Water_transfer_printing
10. <http://plasticisrubbish.com/2014/07/12/whitby-goths-and-cocoa/#:~:text=It%20has%20no%20any%20bad,i nto%20water%20and%20carbon%20dioxide.&text=Water%20content%20of%20the%20water,can%20ch ange%20with%20environmental%20humidity>.

Latex Printing



Similar to solvent printing in that a wide format inkjet printer is used to print on a variety of materials, latex printing is a newer technology that is increasing in popularity.

As the successor to solvent-based technology, latex printing has wider applications, offering quicker turnaround times and superior quality output.

Latex ink printing also has no lengthy curing requirements so the profit potential is greater. The colors are solid, the consistency outstanding, and latex ink printing does a spectacular job since it can be printed on an assortment of coated or uncoated substrates and media.

Because heaters dry the latex as it comes off the printer, the output can be rolled or applied (in the case of vehicle decals) immediately after printing. The finished printed product is durable, long-lasting, and eco-friendly. [1]

What types of surfaces/materials/products can it be used on?

Latex printing involves using print heads to effectively distribute water-based inks onto a diverse range of media. This type of printing is ideal for accommodating everything from custom wallpaper projects, vinyl banners, and posters, to see through vinyls and photo text. [2]

The low ink fixation temperature [for curing] allows for latex ink to print on a wider range of media including heat-sensitive materials such as PET and ultrathin materials. [3]

Relative cost (compared to other printing methods)

If you are into printing high volumes, then running costs become even more critical. Latex ink will cost around £85.00 for a 775ml ink cartridge, while a Roland Versacamm ink will cost £82.00 for a 440ml cartridge. Add to this the fact that there is usually a 10-15% wastage of ink when cleaning an eco-solvent printer when compared to the Latex printer, and further savings will easily be made. [6]

Unlike solvent printers, latex prints come out dry which allows you to accept jobs and deliver on the same day. This enables latex printers to turn jobs around up to 40% faster than eco-solvent printers. [7]

However, competitors claim:

It may cost an additional \$1,500 to set up two completely separate electrical breakers to produce the extremely high heat they need to cure.

Latex printers can also cost you up to 40% more to operate over time vs. eco-solvent printers over time due to more expensive inks, needing to replace printheads every couple months, and complex maintenance.

Latex printers demand up to three times more energy to print vs. some eco-solvent printers. [8]

Durability

The latex ink has a performance comparable with solvent ink for preferable prints for signage displays including characters, illustrations, photographs, and background color gradation printing. Additionally, latex has a glossiness equivalent to the solvent, and has outdoor weatherability that is crucial for outdoor signage. [3]

Their high adhesion and outstanding scratch resistance allows you to assemble and cut without chipping and to laminate with ease. [7]

Precision

With up to 1200 dpi resolution available, a latex printer can help your business ensure the professional print quality that your customers demand. [7]

Not only is HP Latex printing of the very finest quality, but it is also consistent. There is no drop-off in quality between the first and last item in any print run, month after month. The reason behind this lies with the printer heads of both systems. For an eco-solvent printer, the normal piezo printhead will have 180 nozzles per inch and they get worn out and damaged, requiring costly replacement. The HP Latex printhead has 1200 nozzles per inch and they don't wear out the same way, they are easier to clean, and a constantly running algorithm means if any nozzle gets damaged or blocked, it can be immediately substituted. Every print coming off an HP Latex printer will look as good as when the print head was brand new. [6]

Note: Specific to HP latex printing, although other brands are available and will have similar features.

Latex printing's environmental impact

The ink is water based so does not contain harmful solvents and has never contained heavy metals like nickel. Unlike solvent and eco-solvent inks, costly ventilation is not required. The ink does not pose health risk to users and saves energy at the same time as there is no need for filtration units that would be required for solvent and eco-solvent printers. [4]

Signs printed with latex ink can be displayed in sensitive places like dining rooms and healthcare facilities without worry. Materials printed with latex ink can be recycled more easily. These new inks aren't flammable, and they don't contain hazardous air pollutants. [5]

Sources

1. <https://www.prigraphics.com/blog/latex-ink-printing-vs-solvent-printing/>
2. <https://www.perfectcolours.com/blog/2018/02/26/latex-ink-vs-solvent-ink-which-is-best-for-the-job/#:~:text=Latex%20printing%20involves%20using%20print,through%20vinyls%20and%20photo%20text.>
3. <https://mimaki.com/supply/ink/latex.html>
4. <https://www.perfectcolours.com/blog/2014/06/03/how-green-is-hp-latex-printing/>
5. <https://britteninc.com/blog/articles/the-benefits-of-latex-printing>
6. <https://www.entwistlegroup.com/news/what-is-the-difference-between-latex-printing-and-eco-solvent-printing>
7. <https://www.csdinc.com/blog/latex-printer-graphics-professionals/>
8. <https://printers.signwarehouse.com/>



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