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## ХАРАКТЕРИСТИКИ СОЛЬВЕНТНОЙ ПЕЧАТИ

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*Данная статья посвящена изучению технологии сольвентной печати и выявлению преимуществ по сравнению с другими видами печати. Актуальность данной темы обусловлена постоянным развитием технологий в области цифровой струйной печати. Целью данной статьи является анализ технологии сольвентной печати как одного из видов цифровой печати и выявление ее преимуществ. Для завершения исследования будут рассмотрены все аспекты печати: сам процесс, виды чернил, материалы, допечатная подготовка. Согласно скромным данным по этому методу за 2020 год, будет проведено сравнение с нецифровыми аналогами в полиграфической промышленности.*

**Ключевые слова:** сольвентная печать, широкоформатная печать, чернила, печатные материалы.

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## **CHARACTERISTICS OF SOLVENT PRINTING**

*This article is devoted to the study of solvent printing technology and the identification of advantages compared to other types of printing. The relevance of this topic is due to the constant development of technologies in the field of digital inkjet printing. The purpose of this article is to analyze the technology of solvent printing as one of the types of digital printing and identify its advantages. To complete the study, all aspects of printing will be considered: the process itself, types of ink, materials, prepress. According to modest data on this method for 2020, a comparison will be made with non-digital counterparts in the printing industry.*

**Key words:** solvent printing, wide format, ink, printing materials

Solvent printing is a sustainable way of applying an image to the surface of a material by dissolving the upper layer with ink and introducing pigment particles into the dissolved layer. In fact, solvent printing will make the image part of the medium. The first wide-format printer appeared in 2001 thanks to the Gandhi brothers from America. "Wide format" - means that it is capable of printing on sheets of large width: A3, A2, A1, A0 and more. PVC film, banner, banner mesh, paper and more if UV curing technology is used.

Roll-printed material is mounted on the back of the equipment using special mounts. The rollers press the carrier against the rotating shaft and determine its uniform flow. In order to properly place the layout and get a minimum of waste material. The carrier passes through three heating zones:

- preheating;
- heating of the print zone;
- heating after printing (drying).

To improve the quality of the picture and increase the speed of drying of the paint. Different materials and inks have their own temperature conditions, the violation of which leads to poor quality printing.

Due to the insufficient temperature, the ink will not dry completely or unevenly distributed on the surface, forming a spotting. Too intense heating effect. The printing mechanism will look like black stripes on the material. Heat treatment of the media occurs in automatic mode.

Ink is applied to the material using a special device - a print head. It is a metal plate with small holes. The droplet volume may vary due to the piezoelectric element.

Ink is supplied in a print head with solvent-resistant tubes - from a cartridge or from a continuous ink supply system. The image from the image that you want to print is transferred to the printer from the computer using special software. Due to the fact that they do not need constant monitoring [1].

Solvent salts are a mixture of aromatic hydrocarbons characterized by low naphthenes, paraffins and unsaturated cyclic hydrocarbons, which are added to the ink to lower viscosity. The solvent dissolves the pigment in the ink. In addition, the drying process is regulated, and the durability of the paint increases. But solvents are not safe substances. They include cyclohexanone, a substance hazardous to human health and emitting a sharp toxic smell. Cyclohexanone is so toxic that print workers are forced to wear masks and gloves; the room where the printer is located must have powerful ventilation.

There are four types of ink.

Solvent, rigid solvent (solvents, solid solvents) are the most aggressive and toxic components that provide maximum resistance to impact and maximum breadth of choice of print media. Contains a cyclohexanone cycle component recognized as harmful to humans and the environment. Personal protective equipment should be used for printing. They are used for printing outdoor advertising (3-5 m) with low resolution (360 dpi) and large drops (40–80 pl). Printed products have a pungent odor and cannot be used for internal printing. Cost is the lowest solvent based price.

Low-solvent (weak solvents, weak solvents, mild solvents, lightweight solvents) - have a low or zero characteristic of the hexanone cycle, less smell of the finished product, less impact on the environment and humans. They still require the use of personal protective equipment and ventilation when printing. Allow printing with the best quality (720 dpi) for ventilated interiors. The cost is greater than that of hard-solvent ones.

Eco-solvent ink (eco-solvent) - ink with a low content of volatile compounds and especially small parts of the pigment. Weak odors or its absence, the absence of harmful substances for the environment and human solvents while maintaining the requirements for the use of ventilation systems when printing. Allows you to print with high resolution (1440 dpi) and provide

internal and photographic quality. The cost of equipment for printing with such inks is lower than analogues; the cost of the ink itself is higher [2].

Bio-solvent ink (BIO solvent, bio-solvent) - inks produced from plant materials (grain, corn) are positioned as not containing aggressive solvents and the safest in the solvent-based ink group.

Comparison was made with offset printing, flexography and gravure printing. During the comparison, the advantages and disadvantages of each species were identified.

Offset printing is a type of flat printing in which the image is not transferred directly, but indirectly through the offset cylinder. For 2020, this technology is the most massive and popular for printing books and journals. The main advantages are the relatively low price of the product, as well as the ability to reproduce the smallest details. The disadvantages include the low production speed of the order and the irrationality of printing small circulations. Solvent large format printing is much more expensive than offset printing. In terms of excretion, solvent printers also lose because they are not designed for this type of product. Solvent printing is not very fast printing, but this method does not have a prepress stage in the classical form - this technology does not require the production of photoforms, which saves time, so the order can be ready the next day. Also in this case it is absolutely unimportant what size of circulation is, it is possible to print from 1 copy.

Flexography is a type of letterpress, the only difference is that flexography uses flexible forms and liquid paints. Flexographic printing will be considered, because it is more common than high. This method is mainly used for printing packaging products (various labels, boxes), as well as for printing book, magazine and advertising products. The main advantage is the ability to print on a large number of materials, because the ink is fixed by evaporation of the solvent. The disadvantages include toxicity, strong dot gain and the

appearance of a highly noticeable edge effect during printing due to the peculiarity of the printing form, difficulties in reproducing in the shadows and high lights (in the shadows this turns into a plaque, and in the light it is impossible to print small elements), this implies the impossibility of printing small pins. As in offset technology, printing of small circulations is impossible. Compared to this printing method, solvent printing does better in reproducing a small dot and small pins, as well as solvent printing allows printing on films of any thickness and format.

Intaglio printing is a method of printing when printing elements are lower than white space in level. Printing takes place with large engraved shafts. Since paints are liquid based on volatile solvents, the list of printing materials is about the same as flexography. The main advantage is the high print run stability of the printing form, which allows you to print a huge order (from about 1,000,000 copies). Also, the advantages include smooth tone transitions and realistic colors, the maximum likeness of copies. The main disadvantage is the high price for the manufacture of molds. In addition, there is a sawtooth edge in dash and text elements, which does not allow printing of small details and small pins. As for color rendering in solvent printing, the colors are very saturated and bright, perhaps brighter than in real life. Solvent printing has no problems with uneven edges due to the lack of shapes, but there is a printing feature associated with the irregular raster that is used on machines. Due to the spraying of paint, the effect of graininess on the image or plaques can be obtained, which will interfere with perception [3].

To sum up everything about the solvent printing I need to add that images created using this technology do not fade in the sun, do not get wet in the rain. Neither wind, nor snow, nor frost are afraid of them. Solvent-printed products can be displayed on the street without additional protection (lamination).

All advantages:

- can be printed on media without prior preparation;
- ink dries quickly;
- a large selection of print materials;
- a wide range of colors and shades;
- realism and brightness of the picture;
- resistance of images to the action of alcohol, abrasive products;
- the colors remain bright for three years;
- the picture does not crack, does not wash off and does not crumble;
- the cost is lower than that of other types of printing;
- the ability to print small runs;
- low time costs;
- the ability to print large format canvas.

Disadvantages of solvent printing:

- high toxicity of paints;
- unpleasant pungent odor;
- low resolution image.

Based on the foregoing, taking into account the characteristics of the press and the materials on which it is printed, we can conclude that the main scope of the technology is the production of wide-format outdoor advertising. These are low-resolution images that look great from afar - on huge banners and stretch marks. According to solvent technology, they also print: stretch ceilings, light structures, citylights ("sidewalk panels"), photowall-paper, advertising for vehicles, exhibition stands and flags, interior printing and souvenir products.

Lets de-mistify some myths about eco-solvent inks. There are distinct quality differences between eco-solvent and latex that don't support the idea of the inks having "comparable" color output [4].

Eco-solvent has a wider color gamut than latex that is especially noticeable in bright red, orange, magenta, blue, cyan and green output. The other

significant color difference between the two ink systems is in the “glossy” quality of eco-solvent.

With a latex system, the water-based ink is thinner and more ink must be jetted and dried to achieve the same color density as an eco-solvent ink system. In addition, Roland’s superior variable droplet technology prints eco-solvent ink in seven different droplet sizes, allowing for finer details, smoother gradations and a less “grainy” appearance when compared to the 12 picoliter fixed dot droplet size of latex [5].

The time needed for curing (or outgassing as it’s often called) with an eco-solvent system has been exaggerated. Furthermore, the debate about curing should not merely be about time, but also include discussions about overall quality and versatility when comparing eco-solvent to latex.

A popular claim is that eco-solvent inks need days to cure before lamination. The truth is, it all depends on the material, saturation, application and other individual factors. Sometimes users will laminate immediately and sometimes they will wait. There are vehicle wrap users that use Eco-Sol MAX ink systems day in and day out, without their business slowing down. With good time-management and planning, curing time is not the issue that latex manufacturers might have you believe.

While best practices suggest leaving eco-solvent prints to cure, they always cure properly – even with high ink loads. In comparison, latex printers are known to have problems curing ink onto the edges, thereby reducing the usable area of a substrate. With eco-solvent printing, there are no wasted prints with uncured areas and no wasted printing costs associated with leaving unprinted margins near the edge to solve drying issues. The claim that latex is an eco-friendly option, while eco-solvent is the choice for the less environmentally conscious is simply not true. In reality, Roland Eco-Sol Max inks are



Greenguard Gold-Certified for low VOC's and indoor safety, the same as latex inks [6].

Because eco-solvent inks are thicker, with more pigment, they need less ink to print a specific color. They also require significantly less heat to cure and less time to print than a latex system. Latex machines require a 220v outlet to run them and users will need special electrical installation. In our opinion, that seems like a lot of power requirements and doesn't support the latex claim to be more environmentally friendly! In addition, using all that latex ink is not too good for your wallet either – you'll pay considerably more in running costs each year. However, a lot of manufacturers consider that advantages of solvent printing outweigh all the disadvantages.

In the ink, the pigment is dispersed in an organic solvent, and thus the ink is quick drying due to the volatility of the solvent. This property enables direct printing onto PVC, which are extensively used for both indoor and outdoor signage and displays. In addition to excellent weatherability and rub-fastness, our unique inkjet technology provides super-high picture quality without a granular appearance. Furthermore, “ease of maintenance” and “cost effectiveness” are also favorable features of this ink. Mimaki solvent inks are reputed worldwide for their beautiful long-lasting nature and are used as a standard ink for signage printing.

The solvent ink enables direct printing onto PVC, the most popular media for signage display printing, as well as on non-ink-receptive layer coating media. Mimaki solvent ink ensures signage and display production that is cost effective.

Premium Coating Eco Solvent Printing Ink is made of a dye/solvent (mainly water) and various additives such as a moisture absorbent, a surfactant, a dispersant, an antioxidant, an anticorrosive agent, an acid-base stabilizer, a light stabilizer, and the like.

The color is bright and pleasing. Commonly used are: magenta, pure blue, yellow, black and other colors, in order to enhance the performance of transition color and gray tone, add light color / light blue / medium gray / light gray and other colors to make the color of the print More rich and round. The requirements of dyes for Water Based Eco Solvent ink are (1) good water solubility; (2) strong tinting strength; (3) bright and pure color; (4) stable and unsatisfactory aqueous solution; (5) strong color and weather resistance. The dyes used to make water soluble inkjets are primarily acid dyes and direct dyes. The cost of inkjet with a direct dye as a colorant is much higher than that of an acid dye. Advanced inkjets on the market use direct dyes as colorants.

Weak solvent inks were developed under this circumstance. First, they were used on high-precision Epson nozzles. Taking Mimaki JV3 as an example, the image precision made with Vivid Color Eco Solvent Ink is comparable to that of water-based ink, and can be applied to no-coating. The substrate of the layer is also UV-resistant and suitable for outdoor use, so it quickly becomes the darling of a new generation of inkjet printing.

In recent years, some “experts” have pointed out that paper books, cinemas, and physical stores will disappear. The emergence of products such as the Internet, DVDs, and online retailers will have some impact on traditional products, but in fact, traditional products still It is part of our lives.

Similarly, the wide-format inkjet printing market has seen many new technologies in recent years. Many “experts” expect to completely eliminate the use of Eco Solvent Printer Ink in the future, and the demand for solvent-based/weak-solvent wide-format inkjet printers will grow annually. The rate may not be as big as it used to be. However, solvent/weak solvent type inks have the advantage of cost, which makes them competitive in the market, and they are likely to still occupy a large part of the market for the foreseeable future.

Dye inks, sublimation inks, etc. do not pose a threat to Mimaki Solvent Ink, and print service providers (PSPs) simply add these other inks and technologies to their existing workflows to diversify and expand their business. Not a “replacement” of weak solvent inks.

1. When the Eco Solvent Printer Ink is transported in winter, especially in northern China, it is recommended that the transport time should not exceed one week at low temperature (minus 10 °C or lower). If this time is exceeded, it is recommended to use insulated containers or vehicles with good insulation conditions.

2. Galaxy Eco Solvent Printer Ink storage warehouse should have certain insulation conditions, if you do not have this condition, it is recommended to install heating or air conditioning, it is best to keep the storage environment temperature 5-30 ° C, air humidity 25-70%, to ensure the normal storage of ink.

3. Place the spare ink next to the printer at least 24 hours before the ink is used in the printer cartridge/main ink tank. In order to replace the ink, the backup ink is close to the temperature of the ink in the printer cartridge/main ink tank. (It is recommended that customers also use this method for printing materials)

The solvent ink prints are ideal for outdoor signage. The prints show little fading/degradation because of direct sunlight, and have high weatherability in rain/snow, and they also have high rub-fastness [7].

Solvent printing is a sustainable way of applying the image to the surface of the material by dissolving the upper layer with ink. Most often, printing with solvent ink is used in the manufacture of banners, posters, stickers on large format billboards. Unfortunately, solvents are not safe substances. But you can protect yourself from exposure if you observe the precautions in the printing process. The room must be equipped with a powerful exhaust hood. All fumes during the drying of the paint should be weathered, and the master is better to

work in a respirator. Therefore, it is better to immediately purchase high-quality equipment or seek the help of specialists. To sum up, the technology of solvent printing has got many advantages and disadvantages and it is up to you whether to use it or not.

#### Список литературы

1. Макачев А. В мире техники. Научный журнал. 2011. № 6. 40 с.
2. Эко сольвентные чернила. URL: <https://www.fcolor.com.cn/eco-solvent-ink/> (дата обращения: 05.03.2020)
3. Полиграфический портал PrintInfo. URL: <https://print-info.ru/articles/solventnaya-pechat.html> (дата обращения: 05.03.2020)
4. Петров С.А. Издательское дело. - М., Дрофа, 2017.
5. Новиков Д.В. Специальные виды печати // Полиграф. - 2019 - №3- С. 14-16.
6. Отечественное книгоиздание / под ред. О.И.Ленского. - М., Наука, 2019.
7. Полиграфические процессы. // Полиграф. - 2010 - №10 - С. 24-28

#### References

1. Makachev A. V mire oborudovania [In the world of technics]. Nauchniy zhurnal [The science journal]. 2011. No 6. 40 pp. (in Rus.).
2. Ekosol'ventnyye chernila URL: <https://www.fcolor.com.cn/eco-solvent-ink/> [Ecocolvent inks] (date accessed: 05.03.2020)
3. Poligraficheskiy portal PrintInfo. URL: <https://print-info.ru/articles/solventnaya-pechat.html> [Printing portal PrintInfo] (date accessed: 05.03.2020)

4. Petrov S.A. Izdatel'skoye delo [Printing business]. - M., Drofa, 2017.
5. Novikov D.V. Spetsial'nyye vidy pechati [Special kinds of printing]// Poligraf. - 2019 - №3- S. 14-16
6. Otechestvennoye knigoizdaniye [Native bookmaking]/ pod red. O.I.Lenskogo. - M., Nauka, 2019.
7. Poligraficheskiye protsessy [Poligraphy processes]. // Poligraf. - 2010 - №10 - S. 24-28

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