EU Ecolabelling

The EU Ecolabel
Environmental criteria for printed matter

Draft Background report

SIS Ecolabelling

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1 Background

1.1 Introduction

The Swedish Competent Body, SIS Ecolabelling, has been commissioned by the European Commission to take the lead for the development of criteria for printed matter.

Printed matter is used for a variety of different applications. The first thought is the paper printing, which is about 75 % of all printings. Only newspaper printing is estimated to be 35 % of all printing. Among the paper printing there is also minor printing of for example envelopes and wall paper too.

Other types of printing are also the printing on different plastic materials. These are both for everyday use as for example plastic envelopes as well as more seldom printing, as T-shirts with the plastizol based printing.

When briefing about the printing, we must also remember the printing on different metals. There are screen-printing used on for example instruments and other machines as well as printing on different cans.

But there are still a lot of other materials used as substrates for printing, and in this background report, our ambition is to touch the main materials. The possibility to take the various substrates into account when the criteria are developed and to cover them will be discussed during the AHWG and the EUEB meetings.

1.2 Time schedule

The development of criteria began during the spring 2003. In order to get updated information and information about the status, a number of questionnaires were sent out to both the printing industry and to the suppliers of the industry. The questionnaires were specific for the different technologies.

The collection of background material took place mostly during the first part of 2003, and the first draft background report were developed during the autumn.

The first AHWG is scheduled to take place on November 21st in Stockholm.

EUEB will have the opportunity to discuss the outcome from this meeting on it's meeting in December, and also to take a decision whether or not to continue with the criteria development

If the decision is to continue, there is a theoretical possibility that the final draft will be ready for voting on the Committee meeting in September 2004. If so, there will be a possibility to apply for the label already during 2004.

2 Market situation

A large amount of printed matter is produced every year in Europe. In this survey an effort was made to find out how large the real amount is. However, it appeared to be a very difficult task. Most of the European countries have no official statistics on produced printed matter and the production of chemicals, or the statistics is compiled in a way that the data from different countries can't be compared. Some countries have also started collecting the data for the statistics quite recently. Printed matter includes a great variety of product types produced by different printing technologies on different subsrates, which may be one of the reasons for the difficulties to find and collect adequate statistic data on the production in the European countries. A rough estimation can, however, be made for the paper-based printed matter indirectly by means of the amount of graphic paper and inks consumed in Europe.

The amount of printing ink has been estimated to constitute approximately 1-3% of the weight of the printed matter based on paper. The consumption of the graphic paper in EU was 71 252 000 tonnes (Source:CEPI) (Including graphic paper, newsprint and packaging paper) and the consumption of printig inks were 987 000 tonnes in the year 2000. The consumed amount is considered stabile and variations occur mainly due to the economical situation of the European countries.

The amount of printing inks used in printing of fabrics, plastics and metals is also assumed to be considerably high.

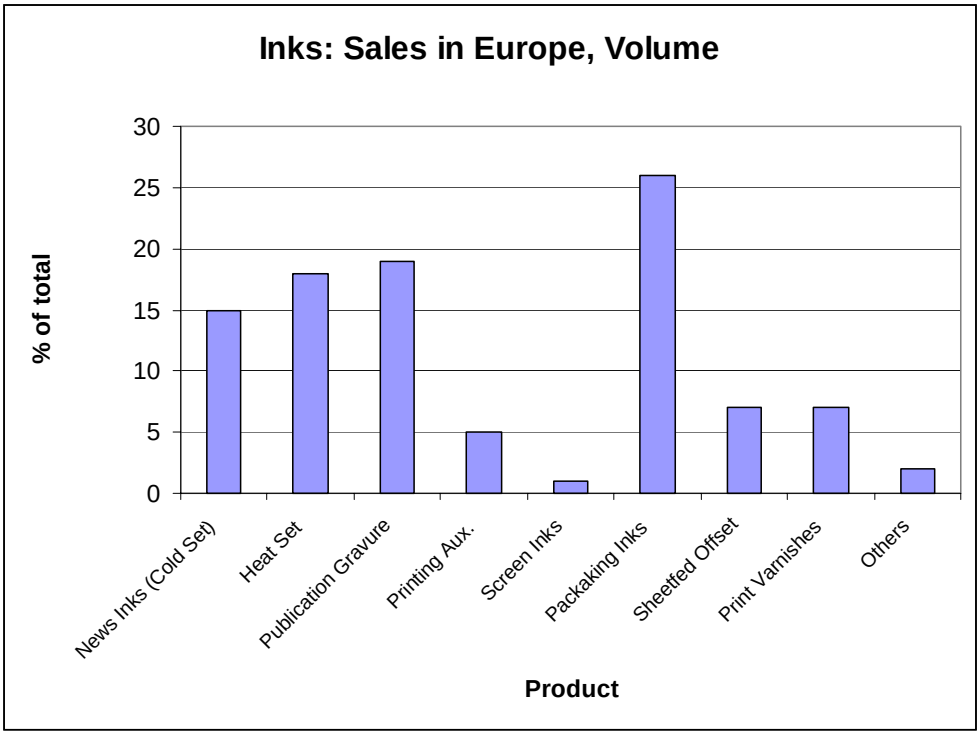
The figurex shows the shares of the different kinds of inks.

The consumption of the graphic paper in Europe in the year 2000 is shown in the ***figure 2*** for the individual countries. The ***figure 3*** shows the consumption of the newsprint and the ***figure 4*** the consumption of other graphic papers than newsprint. The ***figure 5*** shows the consumption of the packaging paper in the same countries.

The total consumption is highest in Germany, United Kingdom and France and corresponds to nearly 60% of the total consumption in EU.

2.1.1 Figur 1

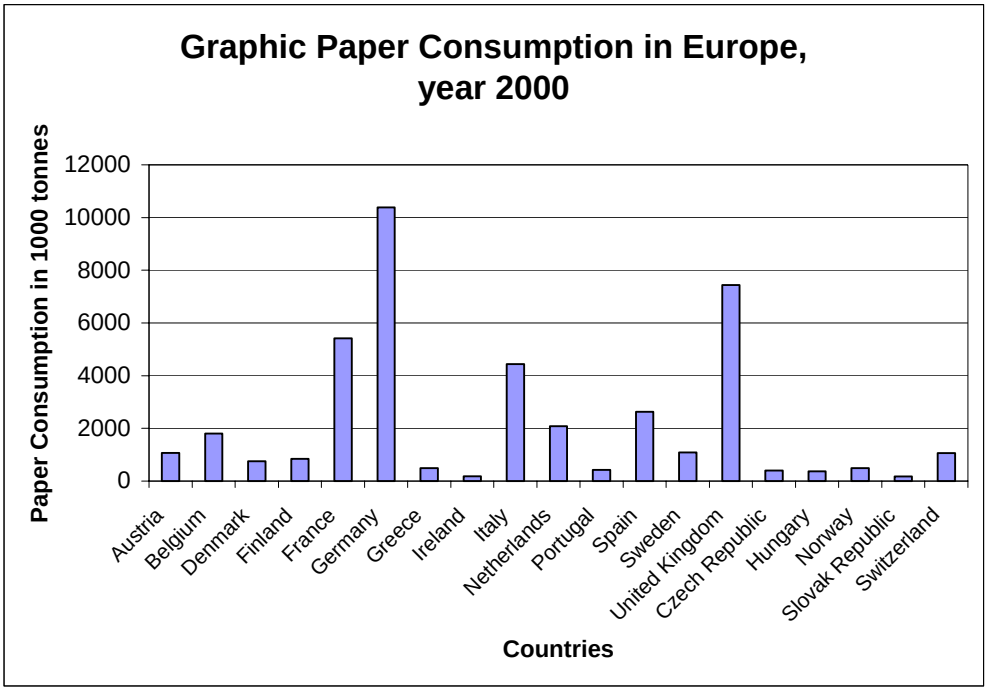
(Source: CEPE, 2001Statistics)



2.1.2 Figure 2

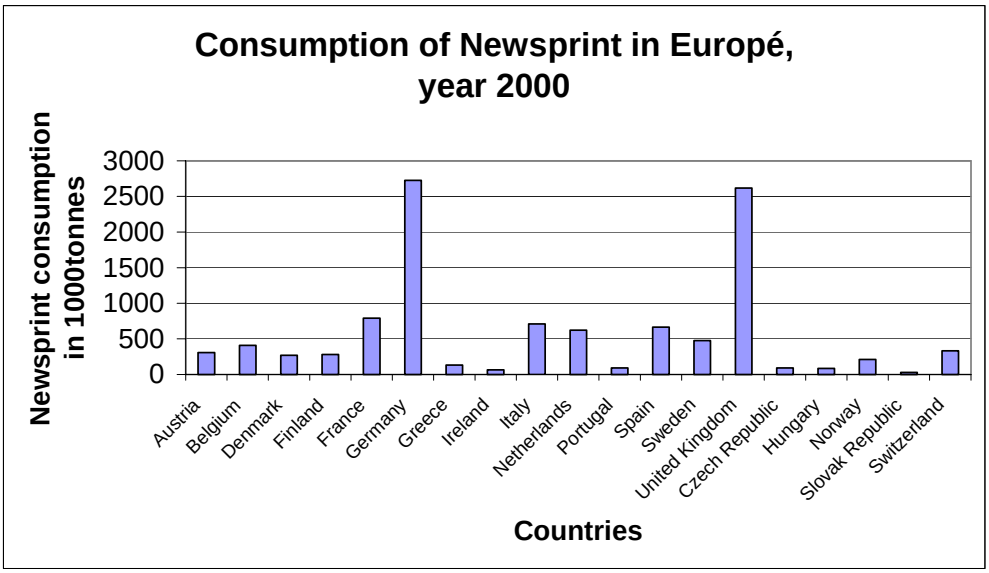
(Source: CEPI, 2000statistics)

2.2



2.2.1 Figure 3

(Source:CEPI, 2000statistics)



2.3 Figure 4

(Source: CEPI, 2000 statistics)

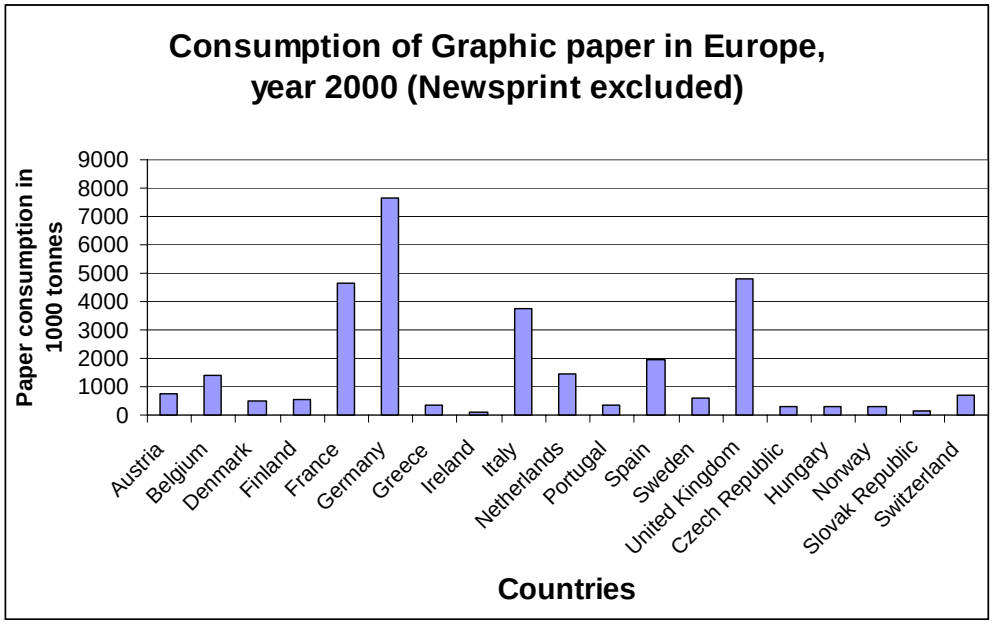
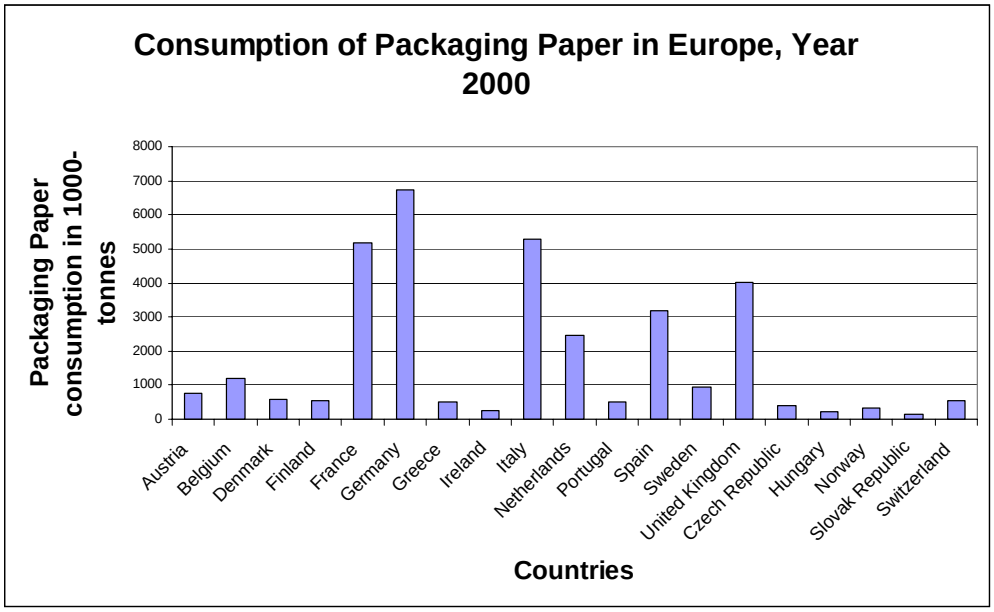


Figure 5
(Source: CEPI, 2000 statistics)



In the different printing technologies the image transfer from the plate to the substrate is based on different physical principles. Therefore the printing inks must have specific properties. The inks are based on different solvents, mineral and vegetabilic oils or water. Today about 50% of the inks are solvent based and about 20% of the inks are classified as hazardous to health mostly due to the organic solvent content of the product.

From the environmental point of view a considerable improvement would be made if all inks were based on water. However, this cannot be accomplished owing to the different principles of the different printing technologies. For instance water-based inks cannot be used in offset printing. The use of inks based on vegetable oils instead of mineral oils has therefore increased in offset printing in the Nordic countries for environmentally reasons. In cases where the composition of the printing inks cannot be changed, the environmentally improvements can be accomplished by closing up the processes and taking care of the harmful chemicals in an adequate way. The increasing changeover from the traditional film plates to the CTP (Computer to plate) technology minimises also the use of harmful chemicals and film

The different printing technologies are not fully compatible. The offset printing dominates the printing industry in Europe accounting for as much as 50% of all conventionally printed material. Flexographic printing accounts only for 15-20% of all conventionally printed material but represents more than 35% of printing within the packaging industry. The market for offset printing is decreasing and increasing for the flexographic and digital printing.

The various electronic/digital printing processes is gradually becoming a major force in the industry and have created to a great extent new market opportunities and niches rather than being a replacement for conventional printing processes.

As digital printing systems are constantly developing, there will, however, be a lot of changes during the next 10-15 years in digital printing. Some of the more advanced machines can produce prints that compete with the more traditional printing processes. An increasing amount of jobs are taken away from the traditional printing processes, especially sheet-fed offset printing and screen-printing.

3 Experiences from the Nordic Ecolabelling

The Nordic Ecolabelling, the "Swan"[1], developed ecolabelling criteria for printed matter 1996. The criteria became a success at once in Sweden and after a couple of years even in Denmark. Today, there are totally about 400 licenses in the Nordic countries and the criteria have been revised twice.

There is no doubt that the ecolabelling has had a great influence on the environmental development of the production of the printed matter. The main area of the influence has been the production of chemicals in the Nordic market. The use of washing liquids containing aromatic solvents has decreased and the use of less volatile solvents has increased. The adhesives and inks containing phthalates have appeared from the market. The ecolabelling has been a far more effective tool than the environmental mandatory legislation to get rid of certain harmful chemical substances.

When the first printing houses had applied for ecolabelling licenses, certain producers start producing special chemicals that met the ecolabelling requirements in a minor scale. However, when the number of the license holders increased, there was a change so that the special "Eco" products became the standard products and the products that did not meet the ecolabelling criteria, became the special ones.

Other example of impact of the ecolabelling criteria is the development of the treatment of the silver containing rinsing liquid from the film development process. Earlier the rinsing liquid was discharged untreated to the sewage. There were certainly legislation limiting the concentrations of the silver in the wastewater but the limit was expressed as mg/l wastewater which was easily met by diluting the wastewater with clean water.

The "Swan" criterion on silver discharge was therefore expressed as mg/m² film that made it necessary to treat the rinsing water or reuse it. At the beginning the applicants of licenses invested in ion exchanges for the wastewater treatment which, however, turned out to be a quite expensive way. So were also the closed up systems where the liquids were reused and discharged to the sewage. When the number of the printing houses with an ecolabelling licence gradually increased the rate of the demand for the closed up system also increased. The investment cost for such plants were therefore decreased making them available even for the smaller printing houses. Today the cost for a closed up washing systems for film developing is so reasonable that several printing houses even outside the ecolabelling system have afforded to install that kind of system, in Sweden.

The ecolabelling criteria on printed matter include also requirements on the printing paper. The used paper must meet the criteria in the criteria document for ecolabelling of printing paper (in Nordic Ecolabelling scheme or in the EU Flower scheme). Today the most printing paper mills in the Nordic countries and even many mills in central Europe co-operate with the Nordic Ecolabelling and have had their products assessed for the use in ecolabelled printed matter. This means that the ecolabelling of printed matters have impact far beyond the printing houses and have directed also the pulp and paper production to an environmental better production.

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1 Nordic ecolabelling is the official joint ecolabel for Sweden, Denmark, Norway, Finland and Iceland

4 Printing technologies

4.1 Introduction

The printing of paper has been used since the 14th century and of cause the technologies have developed a lot since then. A variety of different technologies are used, depending on the final product.

In this survey, only the most frequently used technologies will be comprehensively described. The development is moving fast and the older technologies are being substituted. For example some of the printing works are developing towards the photocopying today and
he borders between these technologies are dizzy and floating.

The printing technologies differ a lot within the European community and the acceding countries. An assumption is that when old printing technology is replaced, the replacing technology in one single step pass several ones and the most up-to-date technology will be used, if it is possible by economic and practical reasons.

4.2 Printing processes overview

The printing industry is a very diversified industry, owing to the multiplicity of printing processes utilised, the size of the plants, and the products it produces.

Letterpress was the earliest form of printing but has been superseded by *lithography (offset)*. Today letterpress finds only limited applications in simple text, such as business cards.

Electronic/digital printing processes have developed during the last fifteen years. Electronic/digital printing include xerography and laser printing; ink jet printing; magnetography; thermal printing; ion deposition printing; and direct charge deposition printing.

Lithography, gravure, and flexography are the dominant processes; lithography is the most widely used printing process today. The various electronic/digital printing processes are gradually becoming major forces in the industry and have to a great extent created new market opportunities and niches rather than being a replacement for conventional printing processes.

Conventional printing processes can be divided into three major steps: prepress, press, and postpress.

- All prepress operations follow the same initial stages of converting the original matter, which can be of either conventional or digital origin, into an image carrier such as a plate, cylinder or stencil. The image carrier is used in the printing processes to transfer the printing ink onto the substrate (paper, board, plastic, etc.).
- Press refers to actual printing operations.
- Postpress primarily involves the assembly of printing materials, and consists of binding and finishing operations.

Individual graphic companies may incorporate a whole series of processes, from original pattern to finished product, but many specialise in, for example, printing, reproduction, or bookbinding. A single

printing plant can also utilise several different printing processes, such as offset and screen, or different types of offset, such as sheet-fed offset and heat-set web offset. Many printing plants have now also complemented their equipment with different kinds of digital presses.

The choice of printing process is usually based upon technical and commercial considerations, such as length of run, required print quality, choice of substrate, speed of printing and drying, and the end use of the product.

A wide variety of products are produced and printed on many different types of materials. Examples of products that can be produced are newspapers, magazines, books, greeting cards, calendars, brochures, leaflets, stamps, labels, business forms, passports, cheques, tickets, envelopes, paper or plastic bags, food packaging, gift-wrap paper, cans, decals, T-shirts, and wall coverings. Depending on the printing process, the substrates for printing can be different types of papers, coated and uncoated boards, corrugated boards, plastics, metal, ceramic, glass, cork, wood, and fabrics.

A printed matter is made up of differently sized dots (screened), which are created with a special camera or with the help of a computer (scanner). Colour pictures are separated and a picture is made for each colour: yellow, blue, red, and black. These colours are always used when printing a colour picture, and are printed separately on top of each other. The four primary colours are often called process colours, and a colour scale called the European Scale is principally used. To create spot colours, e.g., a special colour for a logotype, a different colour scale, named PMS (Pantone Matching System), is used. The PMS-scale consists of thirteen primary colours, but by mixing these before printing, a large number of colours can be created.

In the following description of the different printing processes, only the most typical inks are mentioned. For every printing process there are many varieties of printing inks. There are many factors that affect the ink formulation, such as the type of printing press, printing speed, type of substrate, or the intended use of the printed product (food wrappers, wallpaper, etc.).

A rough ”tree structure” of the most frequent used technologies, which are briefly summarised in this report, might be a help to get a apprehension of the different technologies. A deeper description can be found in the technical annex to this report. In the technical annex illustrations to the different technologies will also be found.

Lithography (Offset) printing
- Sheet fed printing
- Heat-set web printing
- Cold-set web printing

Flexography printing
- Sheet fed presses
- Web presses

Gravure printing
- Publication gravure
- Packaging gravure printing

Screen-printing
- Flatbed screen presses
- Cylinder screen presses
- Rotary screen presses

Letterpress

Electronic/Digital printing
- Ink jet printing

- Xerography and laser printing

5 Summaries of the printing technologies.

5.1 Offset (lithography)

Offset is the dominating printing technology, accounting for about 50% of the market. The market for offset is decreasing due to new technologies.

The principle of the offset technology is that the printing and non-printing areas are on the same plane and the base for the technology is that ink and water do not mix. A modification of the traditional offset is water free offset.

The offset technology is used for newspaper, magazines, books, leaflets, etc. The printing is mostly on paper but can be done on various kind of board, metal foil, metal and plastic, too.

At first an image of the material to be printed is produced, the so called "pre-press". The pre-press is similar to all printing technologies exempt for the digital printing, where this step does not exist.

In principal the conventional printing form consists of an aluminium plate, covered with a thin light sensitive coating. The image is placed on this covered plate and it is all exposed with light. The image will then be copied to the plate and after washing off the unused light sensitive coating, the plate is ready for use in the press. The newer technique for producing offset plates is CTP, computer-to-plate. This technique needs no light sensitive coating and uses instead a digitally driven laser in an image-and a plate setter. This new technique is still expensive, but it will be more and more common.

The printing can be done in several ways.

- *Sheet-fed offset printing*, This is used by a majority of the smaller offset printing plants.

  The ink used is usually oxidising ink, and in order to dry the ink different methods are used to prevent the colours smear into each other in multicolour presses.

  The offset needs dampening solutions. The solutions are delivered in a concentrated form, and are diluted. The most common additive used in dampening solutions is IPA, isopropyl alcohol, and the IPA might be added to a rate of 2-15%. The majority of the used IPA is evaporated into the air during the printing process.

  In the sheet-fed offset presses, usually smaller runs are printed. The presses are therefore usually cleaned between the runs, and in larger runs, also during the runs. There are different kind of washers for the rubber blanket such as washblanket systems and brushsblanket systems. There are also manual cleaning, when solvent-soaked rags or sometimes water-soaked rags are used.

- *Heat-set web offset printing*,
  Products printed with heat-set web offset printing are usually printed on coated, glossy paper, and the products printed can for example be magazines and catalogues. The printing is done on both sides simultaneously, and the presses are going day and night, seven-day a week.

  The ink used is different to the ink used for sheet-fed offset. The dyestuffs are carried on high-boiling solvent that immediately evaporates after the printing when the web passes through a drying tunnel with a temperature of 180-200^{o}C.

The ink rollers and the blankets need to be cleaned between the runs and sometimes also during the runs. Modern presses have usually automatic cleaning systems, and there are a variety of types of them.

Also the heat-set web offset presses need damping and damping solutions, and the IPA is the most common additive. A rough estimation is that 10-20 % of the used IPA and solvents are burned in the dryer for the ink, and the remaining 80-90 % is discharged as fugitive emissions.

- *Cold-set web offset printing*
  Products printed with this technology are usually products as newspapers, directories and books with nothing but text or only few illustrations, and the substrates are uncoated wood-containing paper or recycled waste paper.

  The ink used dries through adsorption or oxidation, and by help of an UV- or IR-dryer, depending on the ink used the drying can be accelerated.

  Like the former technologies, the ink rollers and blankets need cleaning and the presses need damping and damping solutions. There is though a difference, as the newspaper presses do not use IPA.

The chemicals used in the image and plate preparation are among others silver halides, hydroquinon, aluminium and solvents as for example ethylene glycol. During the printing process, there are a lot of chemicals too as pigments, solvents, IPA, polypropylenglycol ethers and surfactants.

The environmental impacts from the prepress are mostly discharges to water. These discharges are from the film and plate production and are mainly silver and film developing chemicals in the rinsing water. The plate production can also result in COD emissions and increased levels of copper or the rinsing water can be inhibit the nitrification.

During the printing the environmental burden can be emissions to air as VOC, IPA ozone or NO_x. The discharges to water can also be of various kinds as fountain solutions, surfactants with low biodegradability and sometimes also ink residues.

Potentials for improvement and foreseen improvements for the offset printing:

- Image and plate preparation: if a developer is re-used, the amount of developer can be reduced by 40%, and by re-use the fixer, 70% of the fixer can be saved. The rinsing water can be recirculated and treated to reduce emissions of for example the silver content. In the future, the processes will be more digitalized and the film process will disappear with the CTP technology.
- Printing: substituting high vapour pressure organic solvents with low vapour ones can reduce the VOC emissions. Automatic cleaning systems will limit and usually also reduce the used amount of cleaning solvents. Reusing them after distillation can also reduce the used amounts of solvents. The amounts of IPA can be reduced if the water quality is high, and in some damping systems, the IPA can be substituted by alcohol substitutes. For the heat-set offset, an afterburner will reduce the amount of gases. In the future development of direct to press systems will reduce the emissions from the prepress, and more automatic press operation will optimise the printing and use of chemicals, cleaning solvents etc. A step forward has also been the development of a "vacuum cleaner" that clean the paper web from loose paper fibres so the blankets will not need cleaning every day or week or not even each month.

5.2 Flexography

The technology is built on the principle that the ink is applied on a raised relief surface, and is the predominant printing technology for packaging material. This is the technology used for the ”potato printing” though it of course is more developed for the printing industry. The printing material can be any from paper, board, plastic to metal foils.

To produce the flexographic plates for printing, there are two steps. First a photographic plate with the image to print is produced, and the image is then transferred to the printing plate.

The printing can vary between different technologies. Usually a cylinder press is used. The ink feed system can also vary. Only one colour at a time could be printed, and only one side of the printing material. The ink used is liquid and is either solvent or water based.

Examples of chemicals used are:

- Prepress, image preparation: silver halide, hydroquinon, sulphamic acid, thiocarbamide
- Platemaking: photopolymers, hydrocarbons
- Printing: solvent- and waterbased inks, solvents as different alcohols, alkyl acetates, glycolethers etc

The environmental impacts from the flexographic printing are during the image preparation and platemaking, manly discharges to water. These could be silver and developing chemicals, and cleaning agents containing chromium. Some of the heavy metals that are resulting from the plate making can be reduced by sedimentation. The water from washing the printing plates can be contaminated with reactive photo polymers, which can have an inhibiting effect on the nitrification process in the water treatment plants. It is though possible to pre-treat the wastewater.

The printing phase will result in VOC emissions to the air. The exhausted gases can be treated in an afterburner, when the VOC oxidise mainly to CO_2 and H_2O. Also the printing phase will also result in discharges to the water which might inhibit the nitrification process in the water treatment plant.

Potential for improvements and foreseen improvements for the flexo printing:

- Image preparation: the photographic process will be replaced by digital technology. Today there are improvements to get by re-using developer, fixer and recirculate the rinsing water and also to reduce the silver content in the rinsing water.
- Platemaking: the laser engraved rubber plates will be more common, but today it is possible to use water washable plates and re-use and filter the water used for developing the plates.
- Printing: there are several improvements that are possible to do, as for example to avoid evaporation of solvents from the ink by enclosing the ink chambers. Solvents and waste inks can be reused or the emissions reduced if they undergo distillation.

5.3 Gravure

Gravure printing uses the technology of a depressed surface for the image. This printing technology is particularly used for long print runs and high quality printings. It is used on a variety of printing materials, paper, board, plastic, textiles etc. The gravure printing is used for a lot of applications like printing wall paper, imitation tiles for flooring, furniture laminates as well as for magazines and catalogues.

The gravure image carrier consists of a cylinder, with copper layers in which the image is engraved and the copper layers is covered with chromium, to get a more durable surface.

The printing is usually highly automatic and consists of multiple printing units, one for each colour and each paper side that can be eight to ten units. As the speed of the presses is very high, it can be 15 meters per second or even more, the ink used must dry very quickly

Usually the solvents used are toluene and xylene and waterbased inks are rarely used.

Today it is common to use toluene recovery systems, which enable the reuse of the solvent.

Chemicals used are mainly those for developing images and cylinder preparation. For the printing phase, solvents as toluene and xylene are used.

The environmental impact from the gravure printing to water is during the pre-press phase and cylinder preparation are mainly metal ions as Ag, Cr^3, Cr^6 and Cu. The metals are possible to reduce by sedimentation. The emissions to air can be HCl, Cr^6 and VOC.

During the printing phase the main emission to air is VOC. Usually some kind of recovery system is used and a high percentage of the solvents used can be reused. But the printed product still contain minor amounts of solvents when it is finished. Minor amounts of the solvents used will also be found in the steam from the recovery plant. In case the printing ink is water based, the press can be cleaned with detergent or solvent containing water. Without pre-treatment, this water will disturb the water treatment plants.

Potential for improvements and foreseen improvements for the gravure printing:

- Image preparation: the amounts of developer used can be reduced with 40% by using a regenerating system, and the fixer used for developing the film can be reduced with 70% by reuse. The rinsing water can be circulated and the silver content reduced. In the future this part will probably almost disappear as the process will be more digitalized.
- Cylinder preparation: treatment of the wastewater will reduce the metal ion content, and by using a buffle separator, the chromium emissions can be reduced. The filmless engraving will increase and new laser technology will be developed, and copper will be replaced with cheaper alternatives.
- Printing: today it is possible to reuse solvents and waste inks, which will decrease the waste and reduce the solvents used. The wastewater when using water based ink can be treated and also reused for cleaning. Continuously measure and control of the recycling plant and improvement of the management can improve the effectiveness of the plant. The effectiveness will be even more improved if the recycling plant is volume controlled instead if concentration or time controlled.

5.4 Screen

Screen-printing is a stencil process, and the image carrier is called a screen. The ink is squeezed through the screen, when the screen outside the image to be printed, is covered.

This technology can be used on almost any substrate, as paper, metal, glass, textile, plastics, cork, leather etc. The screen-printing is particular suitable for short-run works and the printing plants are mostly micro or medium size enterprises, SME-s.

To produce the stencil for the transfer of the image to the screen, first the image is produced. The image is then transferred to the stencil. This can be done in several ways. The function of the stencil is to cover the non-printing area of the screen. The most simple is a hand-cut film stencil that is stuck to the screen.

When the stencil is transferred to the screen, light sensitive emulsions, water sprays, degreasing agents and abrasives are used.

The printing can be anything from manual to fully automatic. A flatbed press consists of a bed, holding the substrate, a carriage and a squeeze, and the cylinder press is of similar construction.

The inks used are the traditional solvent based, UV-curable and water-based. For textile printing also plastisols and water based inks are used.

Several chemicals can be used during the printing phase depending on which kind of ink is used, substrate etc. The pigments are inorganic or organic, the bindings can be resins, cellulose derivatives, polyacrylates,

polyurethane etc. Examples of solvents used are glycols, aliphatic and aromatic hydrocarbons, cyclohexane, glycol ethers and water.

The stencil preparation and the printing and drying phase will result in significant VOC emissions when solvent based ink is used. The vapours are usually not recovered or treated in an after burner.

Potential for improvement and foreseen improvements for the screen printing:

- Image preparation: using a regenerating system can reduce the amounts of developer used, and reusing can reduce the fixer used for developing the film. In the future this part will probably almost disappear as the process will be more digitalized.
- Stencil preparation: in the future will the process be more digitalized and the amounts of used chemicals will diminish, and laser engraved plates will become more common. More use of non-volatile ink removers and water based fillers would reduce the VOC emissions.
- Printing: also in the printing phase would the VOC emission be reduced by using water based ink, and the development of water based ink is continuing, so that these inks can be more widely used.

5.5 Letterpress

Letterpress is the oldest printing technology. It is replaced more and more by the offset and the flexography printing. The technology is a relief technique similar to the flexography.

The printing substrate is mostly paper and the most common products are for example labels, business cards, vouchers, letterheads and overprinting on envelopes.

The image is transferred to the printing plate. Earlier the plates were made by alloys, but today the plates are usually made by UV light sensitive photo polymers.

The inks used for printing are very similar to the ones used for offset printing. Originally the inks for letterpress were based on oil but today other kind of inks is also used. During the printing, the press must often be cleaned between the press runs.

During the platemaking VOC is emitted when solvent based wash-outs are used, but the process are usually done in closed equipment's to avoid emissions to the air. VOC is also emitted during the printing phase when cleaning the press with solvent containing agents.

Potential for improvement and foreseen improvements for the letterpress printing:

- Image preparation: using a regenerating system can reduce the amounts of developer used, and reusing can reduce the fixer used for developing the film. In the future this technology will be replaced, and therefore there is no development of this technique to expect.
- Plate making: the use of water-washable plates or laser engraving plates instead of solvent-washable plates will reduce the VOC emission..
- Printing: also in the printing phase would the VOC emission be reduced by using cleaning agents with low vapour pressure as the vegetable oil based cleaning agents.

5.6 Digital printing

In digital printing, the digital files go directly from the creator to the press, computer-to-print, CTP. The digital printing can be of two different types, either fixed image data or variable data. The printing can be used for printing one single copy up to thousands, and the substrate depends on the printing system. The substrate can be paper, textiles, metals, glass, plastics, etc.

The process with fixed image data has a printing process similar to the offset printing and waterless offset technology is used for the printing.

The variable image data printing has a lot of different technologies as for example electrostatic and ink-jet. The digital printing systems are constantly developing, and there will be a lot of changes and new technologies within the coming years.

The inkjet operate by directing small droplets of ink from a nozzle direct onto the printing substrate. There are a variety of different technologies used for this.

Potential for improvement and foreseen improvements for the digital printing:

- Today digital printing is considered the cleanest technology of all printing technologies. In order to save energy, the equipment ought to have a stand-by function when not in use and cartridges for toners and powders should be reused if possible.

5.7 Post-press or finishing

Almost all printed products need finishing operations.

For products made of paper or paper board, the finishing can be cutting, folding, gathering and stitching but also binding, varnishing and laminating. In for example the binding and varnishing operations, adhesives and laquers can be water- or solvent based.

Potential for improvements and foreseen improvements for the post-press and finishing operation:

- Adhesive binding: by using solvent free adhesives, emissions of VOC can be reduced. Development of solvent free adhesives, that will not create problems in the de-inking and recycle process.
- Varnishing and lacquering: use of water-based or UV-drying lacquers would reduce the emissions of VOC. It would also be possible to use treatment equipment for the exhausted solvent containing gases
- Laminating: the potential is the same as for varnishing

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6.2 Web sites(http://)

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