ISSUE 3
2011

GLOBAL TECHNOLOGY IN FOCUS

DIGITAL SCREEN AND PAD PRINTING

SPECIALIST printing worldwide

Sponsored by

CSGIA

CHINA SCREEN PRINTING INDUSTRY ASSOCIATION
CSPIA
中国丝网印刷行业协会
China Screen Printing Industry Association

ESMA
Driving Print Excellence

NASMA

SGIA

LOW MIGRATION INKS – A COMMITMENT TOWARDS CONSUMERS' HEALTH AND SAFETY

Dr Wolfgang Schäfer and Pascal Iffland observe the responsibilities of packaging chain stakeholders

In 2005, isopropyl thioxanthone (ITX), at that time a widely used photoinitiator in UV-curable printing inks, was detected in baby milk. Later, in 2009, benzophenone and 4-methyl benzophenone were reportedly found in breakfast cereals. These incidents created a stir among food and cosmetics' manufacturers and triggered an intensive discussion in the ink industry about the need to introduce low migration inks to ensure product safety. All stakeholders agree that inks should not contaminate packaged foods.

Printing inks and varnishes for food packaging are an important segment for most ink manufacturers. The food packaging market is divided into two categories – firstly, inks that come into direct contact with food and, secondly, inks that are used for printing the surface of primary or secondary packaging, and do not come into contact with food. This latter category accounts for a much larger share of the market.

The framework regulation (EC) No. 1935/2004 applies to materials and items intended to come in contact with food. Article 3 contains the general requirements for food packaging, stating that: "Materials and articles, including active and intelligent materials and articles, shall be manufactured in compliance with good manufacturing practice so that, under normal or foreseeable conditions of use, they do not transfer their constituents to food in quantities which could endanger human health or bring about an unacceptable change in the composition of the food or bring about a deterioration in the organoleptic characteristics thereof".

Article 17, addressing the packaging chain, requires stakeholders to ensure the traceability of materials and articles at all stages by means of an appropriate control system.

The GMP regulation (EC) No. 2023/2006 defines good manufacturing practices for materials and items. These apply to all printing inks and varnishes intended to come into contact with food. The regulation's most important articles mandate the establishment and implementation of a quality assurance and control system. Annex 1 sets out detailed rules for the formulation and application of printing inks and varnishes.

The Swiss government has passed the Ordinance on Material and Articles in Contact with Food (SR817.023.021). This introduces a series of legal requirements for food packaging inks and varnishes, including a positive list of substances allowed in the formulation of these

inks. It also specifies the permitted migration limits.

The Council of Europe (CoE) Resolution AP (89)1 addresses the use of colorants in plastic materials coming into contact with food. It recommends that colorants meet a set of purity criteria.

To date, there is no specific EU legislation concerning printing inks or varnishes for food packaging. EUPIA has published several information sheets to support members. The EUPIA Exclusion List for Printing Inks and Related Products provides information on selection criteria, and lists substances that may not be used as raw materials in the manufacture of printing inks and related products.

In addition, the EUPIA Guideline on Printing Inks applies to the non-food contact surface of food packaging material and products. The guideline is based on current European legislation and provides detailed recommendations as to how to formulate printing inks. EUPIA also offers Good Manufacturing Practices for the Production of Packaging Inks Formulated for Use on the Non-Food Contact Surfaces of Food Packaging and Articles Intended to Come in Contact with Food and an informative leaflet entitled Printing Inks for Food Packaging. All of these can be found at www.eupia.org.

The packaging supply chain is very complex, starting with raw materials from the chemical industry such as binders and pigments. It also includes substrate manufacturers (paper, board, PE films and PP containers), ink and varnish suppliers, converters, co-packers, brand owners, retailers and finally consumers.

During the manufacturing process, there is a potential risk of contaminating the product. All stakeholders in the supply chain have to co-operate closely, as the ink manufacturer cannot guarantee compliance with requested migration limits acting on its own. Many sources can affect the final packed food.

MIGRATION OF INKS AND VARNISHES

Migration is the transfer of substances from the print on the outer side of the packaging, or the packaging substrate itself, to the packed food. Inks and varnishes may pose a migration risk if there is no effective barrier between the packaging and the content. All types of migration are heavily influenced by processing conditions.

Types of migration

Food may be contaminated by different kinds of physical migration:

- Diffusion migration – Due to their chemical characteristics and molecular size (molecular weight < 1000 daltons), some substances, known as migrants, are able to migrate from the printed side through the substrate onto the unprinted side.
- Set-off migration – Migration of substances from the printed side to the unprinted side of another sheet in a stack, roll or stacked container.
- Gas phase migration – Migration due to the evaporation of volatile materials by heating food in its original packaging or by steam distillation during cooking, baking or sterilisation.

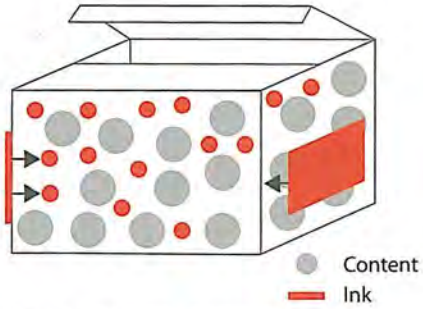
POTENTIAL MIGRANTS

In fact, any substance in an ink or varnish with a molecular weight of less than 1000 daltons is a potential migration risk. Molecules that weigh more than 1000 daltons may still migrate, but pose little danger to human health. Typical migrants include:

- residual monomers from substrates and ink or varnishes
- photoinitiators or break-down products from curing
- non-reacted substances due to insufficient curing
- additives such as flow agents, flexibilisers, plasticisers, surfactant treatment on pigments and dispersing agents
- residual solvents from inks and cleaners

Official toxicologists perform toxicological evaluations of relevant substances. The results of these evaluations are used to compile positive lists of approved substances. Some of these are given a specific migration limit (SML), based on extensive evaluation. The SML (expressed in milligrams/dm^2) defines the maximum acceptable amount that may migrate into the packaged food. In respect to substances that

Continued over



Migration from the printed side through the substrate

Migration of substances from the printed to the unprinted side

do not have an SML, food packaging regulations specify an overall migration limit (OML). This is the maximum amount of all substances (added together) that may migrate into the packaged food. All non-evaluated substances should not be detectable – this means less than 10ppb (parts per billion).

PREVENTATIVE MEASURES

Converters and brand owners can comply with existing food packaging regulations by:

- Introducing appropriate packaging (such as adding an effective barrier)
- Controlling the composition of the raw materials
- Testing the finished product
- Monitoring hygiene during the manufacturing process.

Requirements for UV-curable screen-printing inks

INK FILM THICKNESS CURING/TYPE OF SUBSTRATE

The level of migration depends on a variety of parameters such as curing conditions, ink film thickness and type of substrate. For this reason, the ink manufacturer Marabu recommends conducting a migration test on the printed product.

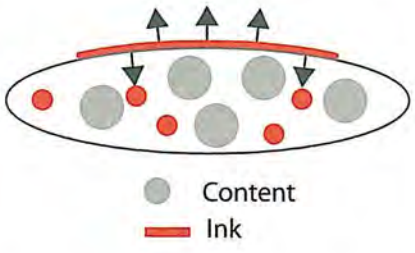
INK FILM THICKNESS

The thickness of the ink film on the substrate reflects the type of mesh. The mesh manufacturer provides information about the theoretical ink deposit. Generally, the ink film thickness should not exceed 10µm (micron).

CURING CONDITIONS

The following factors increase migration:

- UV inks not fully cured
- Insufficient UV power under UV lamps if processed too quickly
- Old UV lamps
- Dirty UV lamps and reflectors



Migration due to the evaporation of volatile materials

TYPE OF SUBSTRATE

Packaging can safely be printed with UV-curable inks if aluminium foil is used as a barrier.

LOW MIGRATION INKS FROM MARABU

External analysis of inks by accredited laboratories has demonstrated that, when the ink is correctly applied onto the right packaging material, the legal migration limits can be met. Marabu has developed low migration inks for different applications:

For container printing UltraPack UVFP is a UV curable low migration ink, formerly tested on the market as 5035. UVFP is mainly used for printing on food, cosmetic and beverage packaging.

For rotary screen printing UltraRotaScreen UVSF 174 is a new high-opacity and low-migration pre-print white for label printing, and is UV-curable and silicon free for printing on self adhesive foils. UVSF 174 is high-gloss, highly reactive and suitable for printing in combination with low migration flexographic inks. This makes it suitable for overprinting with UV-curable inks, and, at machine speeds of up to around 60m/minute, meets all given requirements such as drying and adhesion.

Low migration is a hot topic that has drawn the attention of three stakeholders. First, food and cosmetics' manufacturers have been demanding better solutions, to avoid products that are harmful to consumers' health. Second, ink manufacturers have reacted quickly, bringing low migration inks to the market. Finally, legislators have to drive, and in some cases to force, the launch of low migration inks, as a commitment to consumer safety. ■

Dr Wolfgang Schäfer is Director of Product Development & Customisation and Pascal Iffland is Product Manager Label and Bottle Printing at Marabu

Further information:
Marabu GmbH & Co KG, Tamm, Germany
tel: +49 7141 6910
email: info@marabu.de
web: www.marabu-inks.com