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The Functions of Packaging

The packaging is the calling card of a product. It's the first visual and tactile impression the prospective purchaser gains in the shop.

In addition to the information describing the package contents, the packaging provides lots of other helpful references and tips about the goods inside. It tells the purchaser the price, size, condition and texture of the product, where and when it was made and when it should be used by.

Food packaging is an immensely important segment in the packaging sector because it addresses both people's basic needs and quality-of-life issues. It provides the consumer with a range of information that can be of crucial importance to their health: the degree of freshness and ripeness, colour, shelf life, ingredients and nutritional values (such as the number of calories and fat content). But details such as the country of origin, the weight and production methods can also be important factors in consumers' purchasing decisions. Depending on the design, the customer is given suggestions on how to prepare and serve the food, and in what quantities. The packaging also takes on practical functions, such as protecting its contents against damage and preventing them from going bad; it can also play an active role in ripening processes or extend a product's shelf life, to mention just a few examples.

Many of the functions above can only be fulfilled by packaging if the packaging has printing ink applied to it. Ink is the often unnoticed information medium that both simplifies and makes our lives safer in many respects.

More than 95% of all foodstuffs sold on the Western European market are packaged. Over the past years, the share of direct packaging (with no inner bag) has increased. In this type of packaging, the food comes into direct contact with the unprinted inner side of the packaging material. The situation is different when the contents are packaged in an extra inner bag. Unfortunately, it is frequently and incorrectly assumed that this additional packaging provides the contents inside with an adequate level of protection against substance transfers, but not every inner bag offers such protection.

Many of the products packaged by the food industry are organoleptically sensitive. Obviously, the packaging must under no circumstances have a negative influence on the quality of what goes inside it. Changes in smell or taste spoil people’s enjoyment of the products and must therefore be prevented at all costs. After all, one of the main tasks of the packaging is to prevent substances from transferring to the food.

organoleptic: being perceived by human senses. Organoleptics is the testing of foodstuffs in accordance with a specific rating system in relation to the quality-influencing properties, taste, odour, colour, appearance, shape retention and consistency, without the use of aids but purely by means of the human senses.
How Can Substances be Transferred?

Transfer of substances from the packaging to its contents can happen in three different ways:

- Through-migration
- Invisible set-off
- Substance transfer via the gas phase

Like all of the other constituent components that go to make up packaging, printing inks and coatings consist of a multitude of different substances. Substances of low molecular weight from the ink and coating films, as well as from the substrate, can pass through the substrate and to the food inside. This process is known as "through-migration".

Due to the nature of the production process, the side of the packaging that will face the contents of the package in the finished article comes into contact with the printed side while on the press (in the stack or on the reel). This means there is a possibility of colourless and therefore invisible ink constituents being transferred to the food contact side. This transfer is called "invisible set-off". These substances come into contact with the package contents, i.e. with the food, and can be transferred to it. As is obvious from its name, invisible set-off is not visible. By the very nature of things, prints suffering from visible set-off are waste.

Moreover, volatile substances in the enclosed air space inside the packaging can transfer to the food via the gas phase and have a negative effect on its smell or taste.

In Europe folding cartons and to some extent paper wrappers, are frequently printed in the sheet-fed offset process. Standard printing inks for the offset process use vegetable oils, mineral oils or low-molecular fatty acid esters as their solvent, whose migration to the food can be prevented only by the use of barrier layers.

There are three different types of barrier that can be used for this purpose:

- Permanent barriers: glass and metals act as a reliable barrier to ink constituents. In the case of aluminium foil, it has to be thicker than 7 µm. Migration through permanent barriers is inherently impossible. Nevertheless, an eye has to be kept on the possibility of invisible set-off occurring in the finished packaging.
- Plastics films and layers are functionally specific barriers – i.e. plastics possess very different barrier properties in relation to different substances. For instance, while OPP films are a good barrier against water, they provide absolutely no barrier whatsoever to many constituent components of printing inks, such as mineral oils or some photoinitiators. In the case of plastics, the degree of migration that takes place is dependent on the migratable substances, the structure of the plastic layer and the temperature.
- Non-functional barriers: paper and board pose no form of barrier at all to the low-molecular components of printing inks. This means that the solvents described above are able to migrate through the substrate.

**barrier** here is a layer within food contact materials or articles, preventing the migration of substances from behind that barrier into the food and vice versa.
Responsibilities in the Food Packaging Production Process

Clear specifications of the packaging and proper communication during all phases of production is mandatory and helps avoid complaints. The majority of past complaints have been due to the use of materials not according to their intended purpose.

The diagram shows the pieces of information that need to be available by exchange between the parties involved. To produce a safe packaging, it is essential to know the type of product packaged, what production processes are to be used and how the end product will be handled throughout its life cycle.

Fig. 6: Information to be communicated in the packaging chain
Legal requirements

The primary objective of all national and European legislation with regard to food packaging is to protect the health of consumers. Legal requirements for food packaging materials are becoming ever more complex, because EU as well as national legislation have to be complied with.

Unlike EU Regulations, which automatically come into force in every single EU country the moment they are published in the Official Journal of the European Communities, EU Directives have to be implemented in national law by the respective member states. The EU has passed various Regulations and Directives pertaining to food packaging. According to both national and EU law, it is the manufacturer of the food packaging and the marketer of the food who are responsible for compliance with the law.


Regulation (EC) No. 1935/2004 sets the framework of European rules and regulations on materials and articles that, as finished products and under normal or foreseeable conditions of use, are intended to come into contact with foodstuffs.

Under these conditions of use, such materials and articles (and we are talking here primarily of packaging) must be manufactured so they do not transfer substances to the packed food that:

- do endanger human health,
- bring about an unacceptable change in the composition of the packaged food, or
- bring about a deterioration in the organoleptic properties of the packaged food.

In the case of packaging made of plastic or regenerated cellulose, Article 16 obliges the printer or packaging manufacturer to give a written declaration of conformity. To this end, the packaging manufacturer must obtain essential information concerning the design, materials of the packaging and the type of food to be packed, summarise and evaluate the supplier's statements, and demonstrate the packaging's conformity with the valid rules and regulations. Under current law, it is sufficient that the manufacturer of the packaging issues an appropriate declaration which is supported by relevant internal documentation. Such certification can be issued voluntarily also for packaging made of other materials than plastics or regenerated cellulose.

Article 17 specifies that the traceability of materials and articles shall be ensured at all stages of production. This also includes documenting the substances and products used in the manufacture of the packaging.


This Regulation lays down good manufacturing practices for materials covered by Regulation (EC) No. 1935/2004. It covers the same field of application as the Framework Regulation and is therefore applicable to all materials and not just plastics.
The Regulation demands a quality assurance system and a quality control system to ensure ongoing monitoring of the implementation of good manufacturing practices. The raw materials chosen must be specified according to the requirements of the brand owner.

In the Annex of this Regulation detailed rules stipulate that substances from the printed surface are not allowed to transfer to the food-contact side of materials and articles "in concentrations that lead to levels of the substance in the food which are not in line with the requirements of Article 3 of Regulation (EC) No. 1935/2004". The handling and storage of printed materials and articles in their finished and semi-finished states must also ensure that these requirements are met, and as a general rule, the printed surface of a package must not come into direct contact with food.

**Regulation (EU) No. 10/2011** (*"Plastics Regulation"*)

This is a specific measure regulating the use of plastic materials and articles intended to come into contact with foodstuffs. This Regulation took effect on 1 May 2011 and has replaced the previous Directive 2002/72/EC and its amendments. With respect to multilayer materials (such as plastic-laminated board), the Regulation applies only to the plastic layer.

There are no specific measures applicable to printing inks and coatings/varnishes at EU level, neither to printing on the outside nor to printing on the inside of packaging, i.e. on the side that comes into direct contact with the food packaged.

**Resolutions of the Council of Europe**

In the absence of specific legislation, one can refer to Resolutions of the Council of Europe (CoE), a body that also includes non-EU countries, such as Switzerland. Those countries and states that work together to promote matters related to health protection, have joined forces under the "Partial Agreement in the Social and Public Health Field". CoE Resolutions are drawn up in expert committees and adopted by the Committee of Ministers, but they are merely recommendations with no legally binding character.

**National statutory regulations**

**Germany** - The German Foods, Consumer Goods and Feedstuffs Code (*LFGB*) and the German Consumer Goods Ordinance (*BGVO*) regulate the area of food packaging. Furthermore, a series of recommendations drawn up by the Federal Institute for Risk Assessment (*BfR*) regulate the use of substances in food contact materials. However, like the Resolutions of the Council of Europe, these recommendations have no legally binding status. Some important recommendations made by the BfR are as follows:

- 9th Recommendation on "Colorants for Plastics used in commodities"
- 14th Recommendation on "Plastic Dispersions"
- 15th Recommendation on "Silicones"
- 36th Recommendation on "Paper and Board for food contact"

The latter is currently the only basis on which to select and evaluate paper and board intended to come into contact with food.
Germany is presently drawing up an ordinance that will specifically relate to printing inks, and closely follows the Swiss Ordinance.

**Switzerland** - Switzerland’s Federal Department of Home Affairs (EDI) has issued the Swiss Ordinance on Materials and Articles in Contact with Food (Bedarfsgegenstände-verordnung, SR 817.023.21). An amendment adopted on 1 April 2008 introduced rules that apply specifically to packaging printing inks. Since 1 April 2010, only packaging that has been printed with inks that comply with this ordinance is allowed to be brought on the Switzerland’s market.

The key paragraphs of this Ordinance are as follows:

- Printing inks may comprise only substances that are listed in Annexes 1 and 6.
  - Note: the lists in Annex 6 were compiled by the European Printing Ink Association (EuPIA) and adapted by the Swiss Federal Office of Public Health.
- The lists in Annex 6 (“Printing Inks”) are in two sections:
  - Section A: Substances that have undergone officially recognised scientific testing. Any migration limits (SML) specified in this list must be complied with.
  - Section B: Substances that have not undergone officially recognised scientific testing. Migration of such substances must not be detectable; detection limit = 0.01 mg/kg (10 ppb).
- Inks must be manufactured and applied in accordance with Good Manufacturing Practice.

**Summary of the legal requirements**

All regulations, both national and European, are founded on one basic principle: no transfer of substances from packaging to foodstuffs shall be permitted unless the substances are evaluated for food contact.

Even though there have not been any specific legal measures passed for many application areas, the following requirements are generally applied to all food contact materials:

- No CMR substances belonging to Category 1, 2 or 3 are allowed to be used.
- The level of migration of any substance shall remain below defined concentration limits.
- SML or TDI values for toxicologically evaluated substances are to be complied with.
- The overall migration limit of 60 mg/kg (sum of all migrants) must not be exceeded.
- Toxicologically non-evaluated substances are not allowed to migrate; detection limit = 0.01 mg/kg.

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**Notes:**

- **CMR substances** are substances known or presumed to be carcinogenic, mutagenic or reprotoxic for humans.
- **TDI** - The “Tolerable Daily Intake” of a specific substance is defined as the exposure presumed not to be detrimental to the health of people. The method used to calculated this limit value is based on a common international procedure.

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**Abbreviations:**

- **EDI**: Eidgenössisches Departement des Innern (Switzerland’s Federal Department of Home Affairs)
- **EuPIA**: European Printing Ink Association
- **SML**: the “Specific Migration Limit” is the maximum quantity of a specific substance allowed to transfer from a material or article to 1 kg of a foodstuff or food simulant.
GMP – Good Manufacturing Practices

The legal framework for GMP is laid down in Regulation (EC) No. 2023/2006. With respect to the production of food packaging, the Regulation demands that migration, organoleptic changes and contamination shall be prevented and compliance with requirements laid down be ensured. This can only be achieved if all actors in the packaging chain work hand in hand and if the processes are optimised so as to prevent undesired interactions from taking place.

This must be guaranteed

- by an end-to-end exchange of information within the packaging chain
- by monitoring the individual production steps with the aid of a suitable quality assurance system that also takes into account contamination of the products.

This is covered in the relevant GMP recommendations for each individual process step. The process chain stretches from the customer (proprietary article manufacturer), possibly via a packer, to the packaging manufacturer/printer. For all steps and products involved, the respective associations have issued GMP Guidelines. At the front end of the chain are the suppliers of the substrates, adhesives, inks, coatings and fount concentrates, who also have to be considered. Another important step in the production process is, of course, the printing process itself.

GMP for printers/packaging manufacturers

With printers and packaging manufacturers specifically in mind, CITPA and FPE have together drawn up a "Code for Good Manufacturing Practices for Flexible and Fibre-based Packaging for Food" (Version 5.0, June 2009). This GMP code covers the development/design of packaging, its production, but also the raw materials bought in. Hygiene requirements, such as those laid down in the BRC/IoP Global Packaging Standard and HACCP, are also covered. That said, by taking account of migration and organoleptic changes, GMP goes far beyond previous HACCP systems.

As is the case in the production of printing inks, contamination with undesirable substances must be ruled out during the printing and handling of prints, too. This means taking account of the migration issue in all process steps in the production of food packaging.

Demands on presses and the printing process

For example, listed here are the demands on an offset press and the offset process:

- Rollers, blankets and printing units must be free of washup solution residues
- Blanket washer must be a 2-circuit system with pre- and post-washing
- Ink and fount solution must not become contaminated with washup solution
- Only approved special lubricants may be used
- Coating and fount solution system must be easy to clean (encapsulation)
- Anti-setoff powder must be of "food-grade" quality

CITPA: The "International Confederation of Paper and Board Converters" in Europe represents the interests of the national industry associations of paper and board-converting companies in Europe.

FPE: "Flexible Packaging Europe" is the European association that represents companies operating in the flexible-packaging industry.

BRC/IoP: The BRC Global Standard for packaging and packaging materials was developed by the British Retail Consortium (BRC) in cooperation with the Institute of Packaging (IoP). It meets the requirements with regard to food safety, in particular by integrating the HACCP (food hygiene) system and GMP.

HACCP: stands for the "Hazard Analysis and Critical Control Points" concept and is a preventive system intended to ensure the safety of consumers in the context of food.
Potential sources of contamination must also be avoided in all other printing processes. Equally, this applies to postprint finishing processes, such as laminating, gluing and packing.

Factors that Influence Migration

The substrate must satisfy the requirements of food packaging and be suitable for the respective printing process. Its own organoleptic properties must also not be ignored.

Design includes many factors: Selection of the right printing process for the job and the potential for migration must be taken into account. The amount of ink applied to the packaging plays an important role. The proportion of applied ink to the content’s weight and surface must be considered for migration risk assessment.

Transportation and storage, i.e. conditions related to logistics, can influence the occurrence and extent of migration. The prevailing conditions, such as temperature, moisture and ventilation, as well as any strong-smelling constituents that may be present, can also have negative effects on organoleptics and migration.

All parties involved in the production process must exchange as much information as possible between one other in order to assess potential migration risks. The communication chain must be maintained and is one of the biggest challenges in the entire value chain to be tackled. When it comes to materials, the name of the game is traceability; the origins and supply routes of all raw materials used to manufacture a type of packaging must be fully documented.
Only low-migration **inks and coatings** may be used when manufacturing food packaging without a functional barrier, as well as inks that are free of contamination. Admixing of additives that are not explicitly intended for food packaging, is not allowed.

**Adhesives** play a decisive role with respect to both composite (sandwich) materials and folding cartons, and, like other materials, must also be suitable for the application in question. It is also possible for substances from adhesives to migrate to the food packaged, and this is why it is just as essential to select the right adhesive products as it is when selecting inks and coatings.

**Cleanliness** of the press also plays a crucial role. Make sure that there are no residues of standard (non food-packaging) inks from the preceding production run or washup solution in the roller materials or somewhere else in the press.

Many parameters and **conditions** within the press can alter the results obtained when printing. The condition of UV or IR lamps and of curing units, and the level of maintenance of fount solution systems – in unfavourable circumstances, these factors can lead to critical migration risks. Proper maintenance is essential. Always follow the recommendations of the press manufacturer. Suitable construction and press conditions can also contribute quite decisively towards guaranteeing reliable production. As a general rule, the risks are higher when production on a press switches between print runs using standard inks and inks suitable for printing food packaging than they are when a press is used solely with food packaging inks.

Especially when using UV-curing inks, the press **speed** will influence curing of the ink and may result in undesirable migration if curing is incomplete. Check at regular intervals whether the UV lamps emit enough energy at the given press speed to trigger and complete the crosslinking reaction.
Printing Inks for Compliant Food Packaging

The characteristics and properties of printing inks are determined by a multitude of different factors and requirements. In addition to an ink’s printability, its visual characteristics and the properties of the substrate to be used, the information provided in the overview opposite is of crucial importance. The variety of applications results in a large number of formulae that make use of very different raw materials.

The legal requirements with regard to food packaging necessitate special formulation of the printing inks used. To help ink manufacturers comply with these requirements, the EuPIA has published a guideline that lays down rules to be followed when selecting raw materials and during the production of food packaging inks: “Guideline on Printing Inks applied to the Non-Food Contact Surface of Food Packaging Materials and Articles” (EuPIA Guideline).

Raw materials must be selected so that the limits set for evaluated substances are not exceeded in the finished product. Regarding substances that have not been evaluated with respect to food contact, the level of migration in the finished packaging is not permitted to exceed 0.01 mg/kg of food. Substances listed in the EuPIA Exclusion List are absolutely excluded from being used.

The composition of a printing ink is highly specific – dependent on the printing process and on the demands on the finished print product – but basically, all inks consist of a colorant, vehicle, solvent and additives.

Specifically with printing-ink manufacturers in mind, a GMP Guideline has been developed by the EuPIA that forms part of its overall EuPIA Guideline. This Guideline, called “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 into contact with food”, comprises:

- Requirements for the formulation of inks
  - Raw materials must be selected in accordance with the EuPIA Guideline (suitable raw materials only).
  - Packaging design, the production processes and the type of food contents must be taken into account during ink formulation.
  - The ink films must adhere adequately to the substrate.
  - The inks must offer adequate resistance to physical and chemical stresses.
  - There must be no visible set-off.
  - There must be no deterioration in the organoleptic properties.
  - Potential migration, including invisible set-off, must be below applicable limits.
  - All legal requirements must be complied with.

- Requirements for the production of inks
  - Traceability of all raw materials used.
  - Production must be controlled, monitored and documented.
  - Conformity with the product specifications must be checked as part of quality assurance.
  - Test equipment must be monitored.
Requirements for production information (data sheets)
Correct packing into clean containers

MGA® – a special production standard for printing inks for food packaging

With MGA, the hubergroup is currently offering the highest level in safety on printing inks for food packaging. With the use of the “best available technology” substance transfer is kept on a minimum level and contamination risk is excluded. While some ink products in the market place allow higher migration levels, MGA offers highest quality processing properties while guaranteeing for the best migration values.

- Before raw materials are allowed to be used, they must undergo a strict, in-house MGA-specific procedure and be approved for use in MGA products. All migration-capable components are evaluated for food contact in the EU and therefore confirmed to be harmless.
- The exclusive use of approved raw materials is guaranteed by a computer-aided monitoring system that is fully integrated into the MGA production process.
- The purity of all MGA raw materials is guaranteed by appropriate specifications laid down for suppliers, corresponding certificates and regular control measurements conducted in-house.
- All raw materials used in the production of MGA inks, coatings, etc. are stored in separate warehouses.
- MGA inks are manufactured in completely separate production facilities.
- The low-migration characteristic of the inks is checked by the in-house Quality Control department at the end of the MGA production run.
- Batch tracing is guaranteed along the entire MGA value chain, right back to the raw materials.
- Staff receive regular training in the MGA processes.

This set of rules is part of the hubergroup MGA Policy, which is exceeding the demands made by the EuPIA GMP-Guideline.

Solvent-based inks for the gravure and flexo processes

A large proportion of food packaging is printed using solvent-based ink systems. Solvents used in solvent-based inks pose a minor problem with regard to migration. Thanks to the fact that they are highly volatile, they evaporate during the course of the drying process. Removing the solvents from the printed and dry ink film is the job of the printer.

Nevertheless, these inks also need looking at more closely: additives that were used in previously common formulations could possibly possess a certain potential to migrate. Not all of these have been evaluated toxicologically and low specific migration limits have been set for some.

For this reason, the raw materials used to make inks for EuPIA GMP-compliant food packaging must be selected in line with strict rules: additives that are capable of migration may only be used if they have been evaluated for food contact and only then in concentrations below the specified limits. These inks must be formulated and produced in compliance with the EuPIA GMP Guideline. This also includes preventing known potential sources of contamination.
At the huber group, all solvent-based products for the gravure and flexo processes are formulated and manufactured in accordance with the GMP guidelines laid down by EuPIA and will be available manufactured according to the even stricter MGA production standard in the near future.

**Sheet-fed offset inks**

Low-migration sheet-fed offset inks are formulated specifically for printing the outside, i.e. the non-food contact surface, of food packaging. MGA inks, coatings and auxiliaries comply with the EuPIA Guideline.

These products are formulated and manufactured in accordance not only with EuPIA’s GMP Guideline, but the huber group’s own, stricter GMP/MGA Guideline.

MGA products reduce any unavoidable transfer of evaluated substances from the inks on the printed packaging to the food packed inside.

The standards stipulated and applied to MGA inks and coatings also take account of sources of contamination and the intermediates of the raw materials. This is verified in the form of a statement of guarantee. (The “Statement of Composition” declarations, routinely issued, relate only to the components used in the formulae.)

As conventional sheet-fed offset inks dry by means of oxidation, strong-smelling decomposition products are generated. To avoid this, low-odour, low-migration inks dry purely by means of setting and they can only be used to print on absorbent substrates. This also explains why it is absolutely essential that these prints are coated with a suitable water-based coating.

Solvents used in sheet-fed offset inks show a high tendency to migrate if the package contents are fatty. For this reason, the vehicle of low-migration sheet-fed offset inks contains only special vegetable oils or fatty acid esters that are evaluated in the EU for food contact. In view of the fact that mineral oils are not evaluated with respect to contact with foodstuffs, no mineral oil is used in MGA inks.

**UV-curing inks and lacquers**

UV-curing inks and lacquers respond to UV radiation to form a crosslinked and highly stable ink film within just a fraction of a second. A defined application of energy in the UV wavelength spectrum triggers the reaction of the photoinitiators, which absorb the UV light and disintegrate into free radicals. These free radicals are highly reactive molecules that are taken up by the unsaturated double bonds of the UV vehicle components (acrylates) and cause them to polymerise.

By selecting suitable photoinitiators and vehicles, it is possible to formulate UV inks and lacquers that offer very low levels of migration.
Composition of suitable UV-curing inks:
- The substances chosen as photoinitiators are incapable of migrating thanks to their structure once cured.
- The use of highly reactive vehicles enables almost all the substances used to be completely crosslinked.
- Additives in the inks and lacquers and from the raw materials (e.g. stabilisers) that are capable of migrating and do not react to UV radiation must be evaluated with respect to contact with food.
- The inks and lacquers are formulated in compliance with GMP.

UV-curing inks and lacquers are suitable for use in the food packaging segment only when it can be ensured that they fully cure. Whether or not they actually reach this state depends to a great extent on the production conditions (UV lamp output, production speed, absorbency of the substrate, etc.). Even if their formula is suitable in theory, inadequate curing of UV inks and lacquers can mean that they do not comply with the statutory regulations.

Many substrates exhibit a distinct increase in odour after passing through the UV curing unit. This increase in odour on the part of the substrates can frequently be even greater than the odour generated by the cured UV inks and varnishes, a point that highlights how crucial it is to select suitable materials.

Presses that are used for printing with low migration and standard inks (i.e. with standard, UV, hybrid, or conventional standard ink and overprint varnishes) depending on the print job, are problematical. Residues of conventional, non-low-migration inks and washup solutions left on the ink rollers from previous production runs can contaminate low-migration ink and lacquer systems used later in the press. Consequently, the inking and coating units (including the pipework) must be cleaned extremely thoroughly before changing the ink system.

The printer must be aware of the risks involved and the checks to ensure that the entire press is free of contamination take on a whole new degree of importance in daily operations.

**Water-based printing inks for the flexo process**

Water-based inks are used primarily in the flexo process and in conjunction with absorbent substrates (paper, board, cellulose). They, too, are used in the food packaging segment, which is why water-based systems must also comply with the EuPIA Guideline and GMP. What’s more, attention has to be paid to formulation and production when the inks are to be applied to food packages.

Raw materials used in water-based printing inks have to be chosen with care in order to exclude potential migrants; therefore they comply with the previously mentioned strict criteria for raw materials.
The huber group is working on manufacturing all water-based printing ink systems for food packaging on the high quality level of an MGA production process. In the near future the MGA water-based inks will be available, defining a new standard in the area of water-based printing inks.

Selected huber group water-based inks can be used for printing food packaging even today, provided that qualified testing methods for assurance of compliance are conducted by the marketing authorisation holder. Our specialists will gladly assist with consultancy or testing capacities.

Water-based coatings

Due to their very nature, low-migration offset inks possess only limited rub-resistance properties and therefore require a protective coating. In addition, water-based coatings create visual effects, such as gloss or matt finish and a multitude of important surface properties, e.g. specific surface slip properties as required by packaging machines.

The migration potential of water-based printing systems is frequently regarded as uncritical, although some additives for achieving particular properties are either not evaluated or have high migration potential. Consequently water-based coatings which are not specifically recommended for the manufacture of food packaging, are not suitable for this purpose.

A range of water-based coatings with MGA properties are available in the product portfolio of the hubergroup. Those coatings with the MGA attribute do fulfill the strict demands for food packaging production.
Methods of Testing Organoleptic Properties and Migration

To determine whether a particular food packaging conforms to the relevant regulations and guidelines, the following properties are tested:

- Organoleptic properties
- Migration

Verifying organoleptic properties by means of the Robinson test

The organoleptic properties are tested by means of the "Robinson test". The test conditions for paper and board packaging are defined in EN 1230-1 (odour test) and EN 1230-2 (taste test). In the case of the odour test, the print samples are stored in sealable 500-ml glass bottles for a period of 24 hours, for the taste test for 48 hours in a 1-litre preserving jar, together with finely grated whole milk chocolate. A separate sample is required for each test person. Afterwards, an odour and a taste test are conducted in line with a 5-step rating system:

Transfer of odour/taste

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>undetectable</td>
</tr>
<tr>
<td>1</td>
<td>barely discernible</td>
</tr>
<tr>
<td>2</td>
<td>moderately discernible</td>
</tr>
<tr>
<td>3</td>
<td>clearly discernible</td>
</tr>
<tr>
<td>4</td>
<td>strongly discernible</td>
</tr>
</tbody>
</table>

A minimum of six testers is required to make up a test panel. The median of the individual values is taken for the test result.

Determining organoleptically objectionable substances by means of gas chromatography (GC)

Owing to the fact that organoleptic tests are very complex to perform and heavily dependent on the respective test persons, organoleptically relevant substances are also measured using analytical methods. The vast number of chemical compounds in the world make it impossible to analyse everything.

GC analyses are aimed at previously defined substances, such as solvent residues, or, as in this example, highly volatile and highly odorous aldehydes. Aldehydes arise during oxidative drying of offset inks and can be of different chain lengths. Hexanal is deemed to be a kind of "lead substance" (or marker) that is measured by means of what is known as "headspace analysis", in which the sample being tested is sealed in a sample bottle and subjected to increased temperature over a specified period of time. Volatile substances become enriched in the headspace of the bottle and are measured separately in the gas chromatograph by the detectors. Depending on the detection method used, the aldehydes are measured either according to their quality or quantity.
Aldehydes are just one of many possible causes of poor organoleptic properties on the part of print products. Other strong-smelling substances, however, are not measured during an aldehyde test. Analytical testing with the aid of measuring instruments, such as a gas chromatograph, is therefore not in a position to replace the Robinson test.

**Measuring migration-capable substances**

This test method is used to measure the transfer of components capable of migration, with migration being evaluated in accordance with EU Regulation (EC) No. 10/2011 (previously Directive 82/711/EEC) and the standards EN 1186 and EN 14338.

Migration is tested using food simulants, i.e. test media that simulate particular types of food. This is necessary in order to have substances that can be evaluated without any ambiguity with respect to the way they change and without any spurious interactions. Food simulants, their categorisation into various food groups and the test conditions are defined in EU Regulation (EC) No. 10/2011.

- Overall migration: is a non-specific sum parameter that is measured by gravimetric means, i.e. the non-specific recording of the sum of all migratable substances. The limit of quantification is ±2 mg/dm², and the "Plastics Regulation" stipulates an overall migration limit of 10 mg/dm² (for baby food 60 mg/kg). The level of overall migration describes the inertness of a type of packaging.
- Specific migration: the migration of individual substances that is investigated by means of an appropriate analytical method (as a rule, gas chromatography). Specific migration limits have been defined for a range of substances on the basis of toxicity tests.

For example: in the case of migration measurement using TENAX®, the material being tested (the non-printed surface or reverse side of the print) is brought into contact with TENAX®, a food simulant, and stored over a specified period of time at increased temperature. The TENAX® sample is then extracted (washed out with a solvent) in order to separate out the migrated substances, the solvent is removed and the sample examined with regard to quality and quantity.

"Worst-case" calculations are a common method employed for conducting risk assessment. They are conducted on the assumption that the entire content of a substance from the ink formula migrates from the ink layer to the packed food. If all potential migrants from a formula are known, this recognised method can be used instead of a practical migration test.
Summary

The demands being made on food packaging by consumers, legislators and food manufacturers are very high. The specialist products available in today's market enable compliant, i.e. food-friendly food packaging to be manufactured. It is absolutely essential, however, that the right products are selected and correctly and expertly processed at every stage of production. The rules of Good Manufacturing Practice must be applied at all stages of production.

This document can only provide a simple overview of the basic facts of this complex topic. It is intended to draw your attention to the fundamental requirements and highlight our desire to promote and enjoy a close working partnership with our customers, to assume responsibility and foster intensive communication between everyone involved in the packaging production process – this is the model of collaboration we follow in order to produce the best results and best serve and protect the consumer.

As consumers ourselves, each and every one of us relies on the industry to comply with the specifications and limits laid down. The motivating force behind all our efforts, however, must not be merely to remain below the given limits, but to find and implement every possibility for reducing the levels of undesirable contaminants ever further.

This is why our considerable team of specialists works day in day out to enhance existing and develop new products and processes. Whether it's to offer you advise, collaborate on joint projects or fulfil your wishes, we look forward to working closely with you.

Disclaimer

This document is a collection of items of information relating to the printing of compliant food packaging. Please check whether the information contained herein still reflects the current legislation. You will find the date of publication of this document at the bottom of page 2 (the table of contents page) and on the back page. We assure you that the information contained in this document was, to the best of our knowledge, up to date at the time of compilation and that it was in accordance with the legislation valid at that time. However, in view of the fact that applicable legislation is continuously changing and the hubergroup has no influence over the age of individual documents and the correct application of the recommendations contained therein, the content of this document cannot be taken as the basis of any claims made under warranty.
In addition to the information contained in this document, we provide detailed instructions on the use and particular characteristics of products in the huber group’s own technical data sheets. Furthermore, by scanning the quick response (QR) codes below, you can find descriptions published by the huber group on the internet, that relate to products that may be suitable for manufacturing different types of food packaging.

**Gecko®** is our family of solvent-based printing inks for the gravure and flexo processes. A wide range of products are available for the various applications and packaging requirements.

**CORONA-MGA®** is the brand name that covers all low-migration sheet-fed offset inks suitable for printing food packaging made of folding boxboard or paper.

**NewV®** is the huber group’s family of UV-curing ink systems. This category of printing inks also has its own migration-optimised formulations that meet the requirements for food packaging.

**ACRYLAC®** brand epitomises those water-based coatings specially suited to printing food packaging.

**HYDRO-X®** is our series of water-based inks for the flexo process. It comprises products for the entire spectrum of water-based ink applications imaginable.

**INK ACADEMY** holds seminars offering detailed information on all aspects of food packaging printing. It also runs training courses on other topics of relevance to the printing industry.