A poisoned chalice?

With the need to reduce the amount of secondary and tertiary packaging for environmental reasons greater than ever, the risk of potential contamination due to ink migration is rising. **Nick Coombes** reports on a topic that is vexing the packaging industry.

There are several types of ink migration, and all can occur with varnishes and coatings. One type, for example, is penetration through a porous material, or straightforward set-off in the stack of material or on the reel. This is usually a result of inadequate drying. However, migration can also occur by vapour phase transfer or by distillation.

It is the transference of one substance to another that is a major problem with food packaging because it cannot always be detected by smell, a change in colour, taste or touch, otherwise known as organoleptic properties. Often, the only way it can be picked up is by employing highly sensitive chemical tests, carried out under strict laboratory conditions and using spectroscopy or chromatography equipment. As food varies in its consistency, simulants that mimic the behaviour of the product are instead used to create a more stable test sample.

Foods with large surface areas and/or high fat content are more susceptible to ink migration because they have the capacity to absorb the migrating chemical. High fat-content foods also have the ability to soften 'fully dry' inks and varnishes, leading to possible contamination where there is direct contact. And the longer the period of contact, the greater the problem.

Meanwhile, conventional oil-based inks and varnishes, which emit aldehydes during oxidation, cannot be used for chocolate packaging because of their ability to absorb fat. However, cereal packaging, for example, has a low risk of contamination through migration, unless it's a chocolate variety. Straight chocolate poses one of the biggest risks, while another problem product is tea, where the paper used for the tea bags is porous, so susceptible to absorbing chemicals migrating from the packaging.

The size of the printed image, the weight of the food, the time spent in contact, and the temperature at which the product and packaging are stored together, are all factors, as is the quality of the substrate.

One potential problem area is the photoinitiator. The well-documented case in 2005 involving a Nestlé product in a Tetra Pak container – which revolved around ink set-off in the reel and the fact that the PE inner packaging was able to absorb chemicals used in isopropyl thioxantone (ITX) – permanently damaged the credibility of ITX. Subsequently, 4-methyl benzophenone (4-MBP), often used for cereal packaging, was banned, despite tests proving that it was unharmful.

Both incidents resulted in the development of a new range of 'safe', albeit more expensive, photoinitiators as well as low-migration inks and varnishes over the past decade. But even then, the slow setting and lack of oxidative drying of conventional inks requires a WB coating to be used. Similarly, with low-migration UV inks either a WB or appropriate UV lacquer is needed to 'seal' the ink surface.

The latest UV polymeric inks have, however, been tested and approved across a range of substrates from board to film, and meet with the legal criteria of less than 10 parts per billion of unknown substances.

Monomers have been shown to be the main culprit in migration, owing to their low molecular weight and small particle size. The problem is twofold: monomers lower the ink viscosity and are cheap. The solution is to use a polymeric photoinitiator, enabling the elimination of monomers. The latest UV formulations have large particles with high molecular weights, and therefore low odour and migration capability. With low-migration conventional inks becoming available, tests are underway to establish whether they can meet standards already being achieved by their UV counterparts.

EU legislation

So, who bears the responsibility for this potential hazard? A raft of EU legislation covers the subject, and for many involved in trying to meet the latest requirements there is a feeling that the target is constantly moving. In general terms, materials that come into contact with food should not pose a health problem, nor bring about an unacceptable change in the composition or organoleptic characteristic of the food. Technically speaking it is the producer of the finished package who takes the rap, but of course with so many

Table 1. Legal requirements for food packaging

Region	Relevant legislation	Main relevant aspects for the food packaging chain
Europe	Regulation (EC) No 1935/2004 of the European Parliament and of the Council	• No unacceptable change in food characteristics
	Commission Directive 2002/72/EC	• Setting out of migration limits for substances
	Commission Regulation (EC) No 2023/2006 (effective April 2010)	• Need to operate to Good Manufacturing Practices (GMP)
	Ordinance of the FDHA on Materials and Articles (817.023.21) (Switzerland only)	• For Switzerland only: All ink raw materials for food packaging have to be listed
USA	FDA	• Functional barrier required in case of direct food contact of the ink
Canada	CFIA & "Health Canada"	• Setting out of food packaging standards • Recommend "Letter of No Objection" for any packaging that may come in contact with food (unless functional barrier)
Australia/NZ	Australian Standard AS 2070-1999	• Strong reference to the EU approach
Japan	Food Sanitation Law	• Contamination of foodstuff by their packaging must be avoided
China	Legislation GB9685-2008	• List of materials that are allowed to be used in food packaging

Source: Flint Group

constituent parts making up that carton or wrapper or pouch, the buck is normally passed to the converter.

Ink company ICEArets cites an example of two official bodies that offer contradictory advice, with the EuPIA recommending the use of tailor-made low-migration and low-odour inks and varnishes as laid down in its own guidelines, while ECMA's view is that other inks and varnishes should be substituted for UV where primary food packaging is involved. The problem is not simply related to UV, nor to certain elements within the inks and varnishes; what is important is whether there is direct contact between the print and the foodstuff, and this includes items such as window-patch substrate and the adhesive used.

Good manufacturing practice (GMP) is vital, so careful monitoring of items such as solvents, washes, cleaning chemicals, oils and greases on the production floor is essential. Of no less importance is an awareness of monomers from plastic substances or coatings, hydrocarbon distillates or minerals from inks, low molecular-weight components from board or adhesives, and any by-products associated with drying or curing.

According to the printing and packaging company the Flint Group, the same printing ink system can be safe or unsafe for use on food packaging, according to the material it is printed on, printing conditions, the food that is packed with the printed packaging, the conditions during the packaging manufacturing and filling (for example applied temperatures), and the way the food packaging is intended to be used.

The responsibility for safety lies with the company that places the product on the market, and that can be interpreted as the converter, the packer, the retailer, the substrate manufacturer, the ink manufacturer, or the brand owner – the simple answer is that no one is allowed to shirk their duty of care. ■