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Migration from food contact articles and materials

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What can you expect

- definitions and general principle
- some examples
- background migration
- migration from plastics

Definitions

- food contact materials
  - materials in direct and indirect contact with food

  - direct contact : primary packaging material
  - indirect contact : secondary packaging material if a material transfer can be expected
    - e.g. breakfast cereals in plastic bag (primary) in cardboard box (secondary)

Definitions

- food contact articles
  - articles, recipiënts, tools, tubing etc. which come into contact with food during manufacture, preparations, transport, etc.

  - more then only packaging as such !

Which materials ?

- plastics including varnish and coatings
- regenerated cellulose
- elastomers and rubbers
- paper and board
- ceramics
- glass
- metals and alloys
- wood, including cork
- ./..

Which materials ?

- ../.
- textile products
- paraffin and micro-crystaline waxes
- and combined layers thereof

General principle (Regulation 1935/2004)

- contact materials and articles should be suffficiently inert
  - food remains food
  - contact material/article remains contact material/article

General principle (Regulation 1935/2004)

- no transfer of subtances which
  - endangers public health
  - gives rise to unacceptable change in composition
  - gives rise to change of organoleptic properties
    - e.g. solvents with low threshold value

Is this an issue ?

- rapid alert system - RASFF
- 2010 – 231 cases
- 2011 – 308 cases
- 2012 – 287 cases
- 2013 – already 194 cases

Is this an issue ?

plasticizers

aromatic amines, formaldehyde

heavy metals

melamin, formaldehyde

heavy metals

Why of interest?

ITX !!

Nestlé forced to withdraw baby milk

Nestlé has recalled baby milk products from four markets (Keystone)

RELATED STORIES

Nestlé delivers strong first-half figures

Swiss food multinational Nestlé has ordered the recall of baby milk products from five European countries due to ink contamination from the packaging.

The recalls in Italy, France, Spain, Portugal and Greece follow the confiscation of 30 million litres of milk by the Italian authorities. Tetra Pak in Holland confirmed it had produced the faulty packaging.

The traces detected, which came from ink used in the packaging, pose no risk to health, said a spokesman at Nestlé corporate headquarters in Vevey.

He added that the amount recalled in Italy totalled two million litres and that the amounts seized in the other countries were significantly less. The brands concerned are Nidina 1, Nidina 2 and Latte Mio.

The recall was announced after food-safety officials in Rome discovered that a batch of milk due to expire in September 2006 had been contaminated by a chemical that leaked from the packaging.

The Dutch subsidiary of the Swedish packaging company Tetra Pak confirmed that it had produced the packaging for the recalled products.

A Tetra Pak spokeswoman said the firm was aware of the problem and had changed its production methods in September.

"No health risk"

Nestlé's Italian headquarters in Milan said in a statement that the substance found in its milk brands – identified as Isopropilthioxantone (ITX) – is not dangerous to health.

"This decision was taken as an extreme precautionary measure to reassure consumers, even if ... Nestlé believes that the level of ITX measured in the tested products does not represent a health risk," the statement said.

FOOD productiondaily.com

Breaking News on Food and Beverage Processing and Packaging

Chemical under review after showing up in food

4-MBP!!

By Jane Byrne, 24-Feb-2009

Related topics: Cleaning / Safety / Hygiene, Packaging Materials, Quality & Safety

Migration of a chemical from external cereal cardboard packaging into the food has prompted the European Commission to request a risk assessment on the substance from the European Food Safety Authority (EFSA).

The German authorities alerted the Commission through the Rapid Alert System for Food and Feed (RASFF) regarding the migration of 4-methylbenzophenone, a component of the inks used in the food packaging.

A German customer of a Belgian cereal manufacturer had discovered the presence of the chemical in the chocolate crunch muesli product at levels amounting to 798 µg/kilogram parts per billion (ppb) and notified the relevant authorities.

BP!!

FOOD productiondaily.com

Breaking News on Food and Beverage Processing and Packaging

Benzophenone from packaging taints Italian couscous

By Rory Harrington, 22-Jul-2010

Related topics: Quality & Safety

German safety authorities have seized tonnes of couscous from Italy that were contaminated after the chemical benzophenone leached from the packaging.

Higher than permitted levels of the chemical were detected in 15,620 cartons of the foodstuff, the Federal Office of Consumer Protection and Food Safety (BVL) told FoodProductionDaily.com. Some 7.8 tonnes of the product were immediately withdrawn by retailers and wholesalers after the problem was discovered by official inspections.

On July 13, Germany notified the Rapid Alert System for Food and Feed (RASFF) that levels of the chemical reaching 1559 µg/kg had been detected in the couscous imported from Italy,

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Methylnaphthalene!!

FOOD productiondaily.com

Breaking News on Food and Beverage Processing and Packaging

Kellogg issues massive recall as tainted packaging sparks health fears

By Rory Harrington, 28-Jun-2010

Related topics: Cleaning / Safety / Hygiene, Packaging Materials, Quality & Safety, Contamination

Kellogg Company has recalled 28 million boxes of breakfast cereal in the United States over fears an unknown chemical that has tainted its packaging could cause diarrhoea and vomitting.

The company told FoodProductionDaily.com that it believes an unidentified wax-like substance has migrated from the inner packing into four kinds of the cereals marketed largely for children. Kellogg said the threat of serious health problems from contaminated packaging was small but warned "sensitive" consumers to avoid eating the cereals.

Wax-like substance

"Our chemistry team is working to isolate the exact substance," said spokeswoman Adaire Putnam. *"At this time, we know it's a wax-like compound that can produce an uncharacteristic off-taste and smell."*

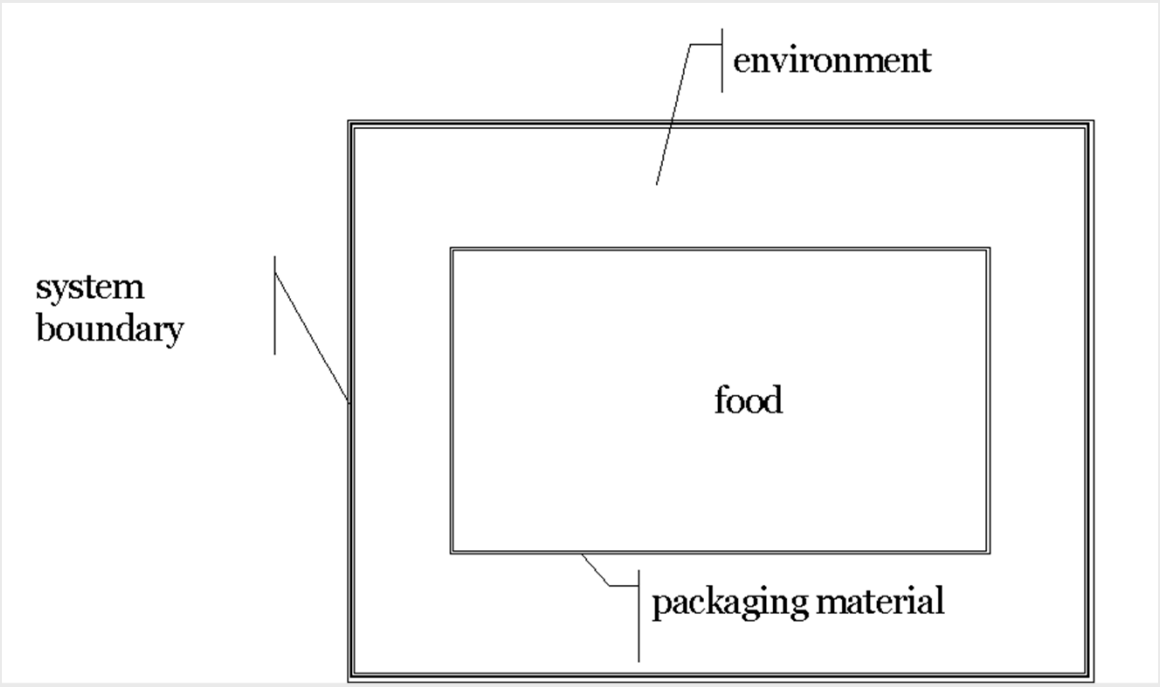
Kellogg said the liners had first been used in March this year and since then the company has been contacted by around 20 consumers complaining of stale, metallic and soap-like smells and tastes. Some five people were said to have reported nausea and vomiting, said reports in US media.

It is understood the company began contacting its commercial customers last Wednesday and raised the alarm with the public on Friday over a total of 1.7 million cases of its Corn Pops, Honey Smacks, Fruit Loops and Apple Jacks breakfast cereals. The 28 million packets have been distributed nationwide with best before dates ranging from 26 March, 2011, to 22 June, 2011.

All the tainted packages were produced at the firm's facility in Omaha, Nebraska. The company has *"destroyed the inventory in its control"* and was working with its customers to withdraw the product from circulation, Putnam added.

Background information on migration

- what is migration ?



Background information on migration

- mass transfer :
  - macroscopically
  - microscopically
  - submicroscopically : molecular level
    - permeation
    - migration

Background information on migration

- permeation:
  - transport of components from environment to the food via contact material or vice versa
  - impact on quality of food (loss of aroma, off flavours, contamination)

Background information on migration

- migration:
  - mass transfer between contact materials and food or vice versa
  - from contact material to food: migration
  - from food to material: negative migration
    - aroma scalping
    - oxgen scavengers
    - oil absorption by polyolefins
    - …

Background information on migration

- migration:
  - migration of toxic components : safety issue
  - too high material transfer : material not inert
  - migration of desirable substances (active packaging materials):
    - antimicrobials
    - anti-oxidants
    - …

Migration from plastics

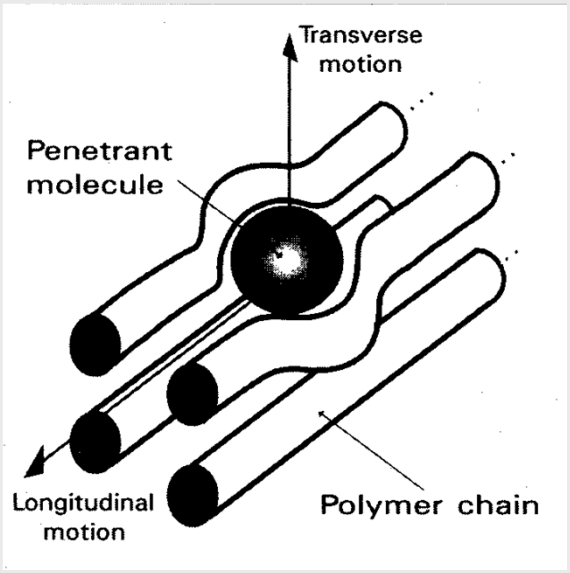
- plastic :
  - polymer : main structural component of plastic, macromolecular in natureμ
  - substances with MM < 1000 Da usually cannot be absorbed in the body ➔ potential health risk is minimal
  - potential problem ➔ low molecular substances

Migration from plastics

- low molecular substances
  - residual monomers and oligomers
  - additives
  - technical aids: emulsifyers, initiators, etc.
  - catalysts (used fto initiate polymerization)
  - colorants
  - impurities (NIAS – non-intentionally added substances) and reaction products

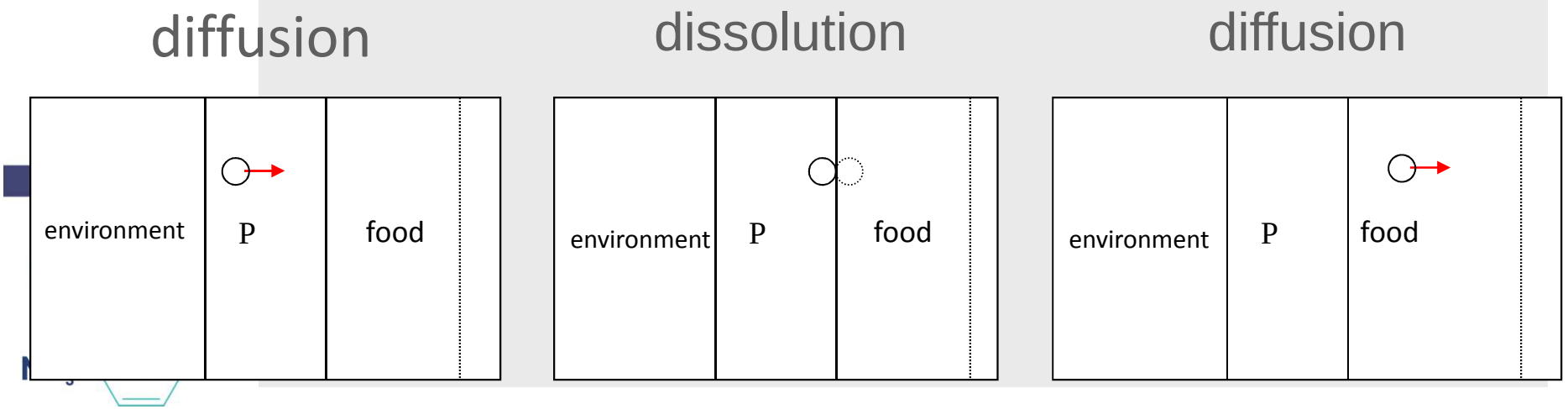
Migration from plastics

- low molecular substances
  - not bound to polymeric matrix
  - free movement between polymer chains



Migration from plastics

- multistage process
  - diffusion in polymeric matrix
  - dissolution in food
  - diffusion or convection in food matrix

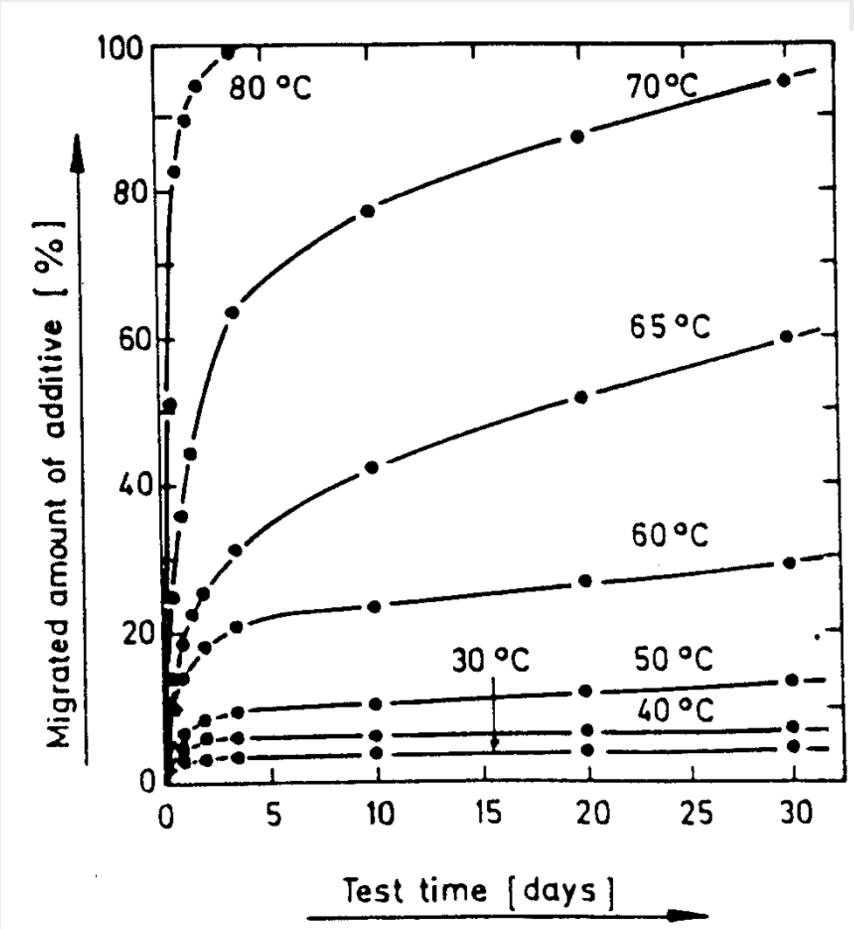


Migration from plastics

- diffusion driven process
  - time dependent
  - temperature dependent

Migration from plastics

- diffusion driven process



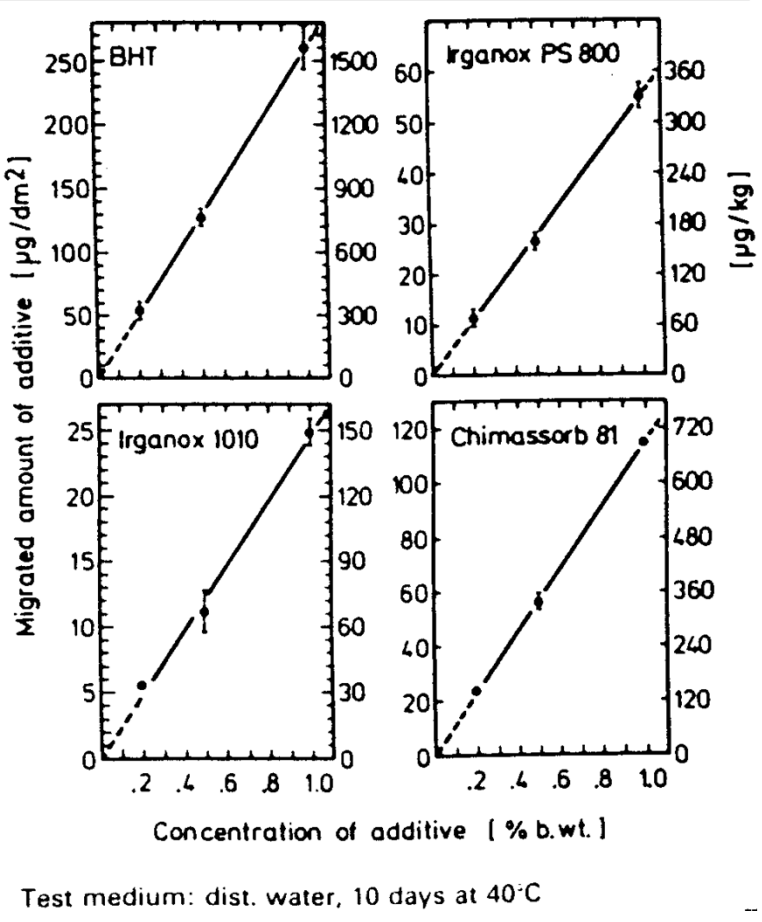
Migration from plastics

- diffusion driven process
  - time dependent
  - temperature dependent
  - type of molecule and in particular molecular weight

Migration from plastics

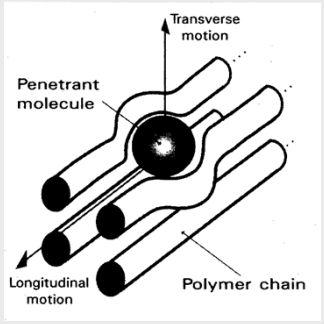
- diffusion driven process

  - MW BHT : 220
  - MW Irganox 1010 : 1178
  - MW Irganox PS 800 : 514
  - MW Chimassorb 81 : 326

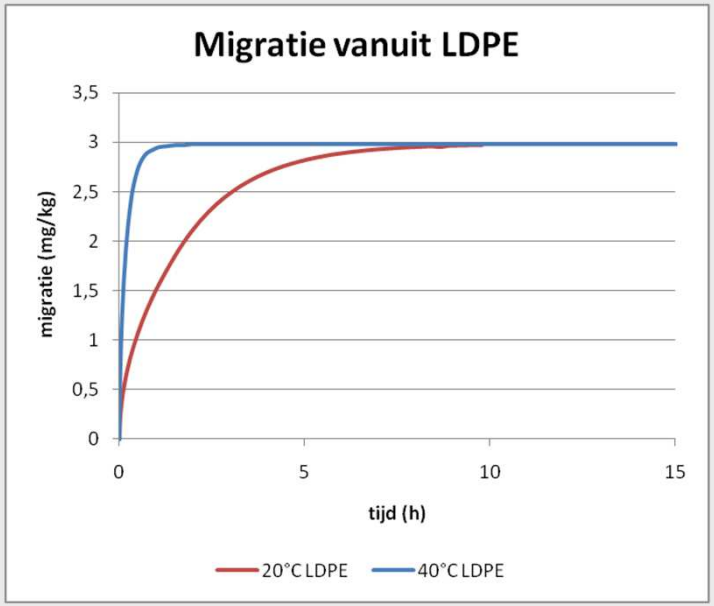


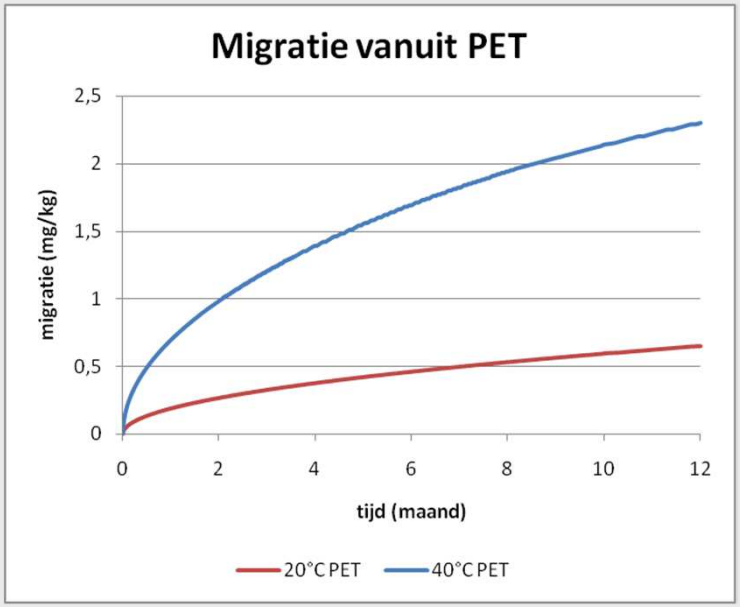
Migration from plastics

- diffusion driven process
  - time dependent
  - temperature dependent
  - type of molecule and in particular molecular weight
  - type of polymer



Migration from plastics



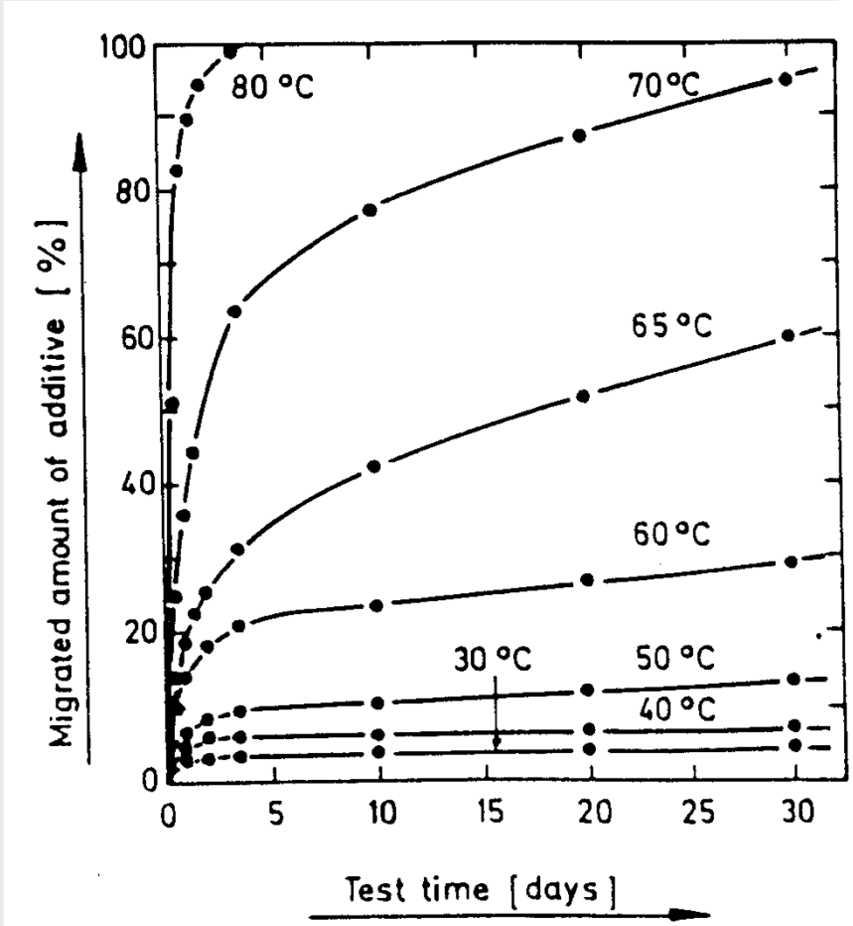


Migration from plastics

- dissolution driven process
  - temperature dependent

Migration from plastics

- dissolution driven process



Migration from plastics

- dissolution driven process
  - temperature dependent
  - food vs migrating substance

Migration from plastics

- general trends - critical parameters
  - fat containing foods
  - high temperatures
  - long contact times

- on basis of these basic phenomena
  - specification of relevant test conditions
  - specified in the legislation

Legislation

Food simulant	Abbreviation
Ethanol 10 % (v/v)	Food simulant A
Acetic acid 3 % (w/v)	Food simulant B
Ethanol 20 % (v/v)	Food simulant C
Ethanol 50 % (v/v)	Food simulant D1
Vegetable oil (*)	Food simulant D2
poly(2,6-diphenyl-p-phenylene oxide), particle size 60-80 mesh, pore size 200 nm	Food simulant E

Legislation

- A, B, C - hydrophylic
- B when pH < 4.5
- C alcoholic foods upto 20% ethanol or if relevant amount of lipophylic substances
- D1: oil in water emulsions, alcohol content > 20%
- D2: free fat on surface
- E : dry foods

Legislation

- Regulation 10/2011 - how to evaluate migration
  - worst foreseeable conditions
  - food simulants are used
    - for some specific foods - specific simulants

Legislation

		A	B	C	D1	D2	E
04.05	Processed vegetables:						
	A. Dried or dehydrated vegetables whole, sliced or in the form of flour or powder						X
	B. Fresh vegetables, peeled or cut	X					
	C. Vegetables in the form of purée, preserves, pastes or in its own juice (including pickled and in brine)		X(*)	X			
	D. Preserved vegetables:						
	I. In an oily medium	X				X	
	II. In an alcoholic medium				X		

Legislation

- Regulation 10/2011 - how to evaluate migration
  - worst foreseeable conditions
  - food simulants
  - contact times and temperatures

Legislation

Contact time in worst foreseeable use	Test time
t ≤ 5 min	5 min
5 min < t ≤ 0,5 hour	0,5 hour
0,5 hours < t ≤ 1 hour	1 hour
1 hour < t ≤ 2 hours	2 hours
2 hours < t ≤ 6 hours	6 hours
6 hours < t ≤ 24 hours	24 hours
1 day < t ≤ 3 days	3 days
3 days < t ≤ 30 days	10 days
Above 30 days	See specific conditions

Legislation

$$t2 = t1 * \text{Exp}\ ((-Ea/R) * (1/T1-1/T2))$$

Ea is the worst case activation energy 80kJ/mol

R is a factor 8,31 J/Kelvin/mol

Exp -9627 * (1/T1-1/T2)

t1 is the contact time

t2 is the testing time

Legislation

Conditions of contact in worst foreseeable use	Test conditions
Contact temperature	Test temperature
T ≤ 5 °C	5 °C
5 °C < T ≤ 20 °C	20 °C
20 °C < T ≤ 40 °C	40 °C
40 °C < T ≤ 70 °C	70 °C
70 °C < T ≤ 100 °C	100 °C or reflux temperature
100 °C < T ≤ 121 °C	121 °C (*)
121 °C < T ≤ 130 °C	130 °C (*)
130 °C < T ≤ 150 °C	150 °C (*)
150 °C < T < 175 °C	175 °C (*)
T > 175 °C	Adjust the temperature to the real temperature at the interface with the food (*)

(*) This temperature shall be used only for food simulants D2 and E. For applications heated under pressure migration testing under pressure at the relevant temperature may be performed. For food simulants A, B, C or D1 the test may be replaced by a test at 100 °C or at reflux temperature for duration of four times the time selected according to the conditions in Table 1.

Legislation

- Regulation 10/2011 - how to evaluate migration
  - worst foreseeable conditions
  - food simulants
  - contact times and temperatures
  - screening methods can be used
    - if material is not compliant - confirm with standard method

Legislation

- screening methods
  - replace specific migration with overall migration
  - determine residual amount of substance in material and assume total migration
  - migration modelling (if overestimated)
  - food simulants substitutes (not specified, overestimation)

Migration tests in practice

- filling of contact material
- films: in migration cell

Migration tests in practice

- overall migration :
  - volatile simulants
  - oil - more difficult – determination of absorbed oil
- specific migration :
  - analytics …
  - simulation
- volatiles
- bio-activity tests

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