Acrylamid

in Lebensmitteln

Acrylamide: History, Uses and other Facts

- Acrylamide which was synthesised for the first time in 1949 is a substance with a long history of use.
- It is typically produced as a 30-50% aqueous solution.
- Up to 99.9% of acrylamide in the EU is used for the production of polyacrylamides.
- The residual content of acrylamide in the polymers is kept well below 0.1% w/w to avoid classification as a Category 2 carcinogen under the Dangerous Preparations Directive.
- Acrylamide was not identified as a degradation product of polyacrylamides.

Acrylamide: History, Uses and other Facts

- For consumers coming into contact with the polymer, *only the residual monomer* in the polymer is a potential source of exposure.
- *Poly*acrylamide is used in cosmetic preparations (rinse-off and non rinse-off skin products) at a level of up to 2%.
- The usual specification calls for a maximum monomer level in the polymer of below 0.01% .
- Total daily exposure to acrylamide resulting from the use of non rinse-off skin products has been calculated to be 65 µg. For rinse-off products the corresponding value is 2.4 µg per day.

  (EU Risk Assessment of Acrylamide; rapporteur UK)

Acrylamide: History, Uses and other Facts

- Polyacrylamide is used in the pulp and paper production industry as a binder and as a retention aid for fibres. It may be used as component of paper and paperboard. The maximum content of acrylamide in paper is assumed to be 15 µg/kg. Exposure to consumers is negligible
- Polyacrylamides have been used as dispersants and bindings in coatings. Water-based paints containing 0.1-0.5% poly-acrylamides have improved pigment suspension and flow. Analysis has indicated that the residual monomer is present in a concentration below the detection limit of 0.01%. Hence there is likely to be negligible exposure to consumers.

(EU Risk Assessment of Acrylamide; rapporteur UK)

Acrylamide: History, Uses and other Facts

- The largest use for polyacrylamides is in the treatment of municipal drinking water and waste-water. Polyacrylamides act as flocculants or coagulants to condition sludge, to clarify raw water and to treat effluent streams from sewage plants.
- The maximum possible concentration of acrylamide in drinking water from water treatment works using polyelectrolyte flocculants is 0.125 µg/l.
- Assuming 2 litres consumption per day, and a worst-case situation where 100% of the available acrylamide enters the drinking water, then it is estimated that exposure would be up to 0.25 µg/day

  (EU Risk Assessment of Acrylamide; rapporteur UK)

Grout

A thin coarse mortar poured into various narrow cavities, as masonry joints, rock fissures etc., to fill them and consolidate the adjoining objects into a solid mass.

Websters Encyclopedic Unabridged Dictionary of the English Language

Use of acrylamide-based grouts

- The major end uses of acrylamide grouts were sewer line sealing and manhole sealing.
- Acrylamide grout is also used for geotechnical applications involving manual injection techniques. In these applications, the grout is applied to soil or rock formations. Geotechnical grouting includes for example water cut-off in mines and reservoirs.
- A derivative of acrylamide, N-methylolacrylamide (NMA) may also be used in grouting applications. Acrylamide grouts generally consist of a mixture of acrylamide and a cross-linking agent. When the acrylamide grout polymerises it solidifies into a stiff gel that is impervious to water and contains less than 0.05 % free acrylamide.

Use of acrylamide-based grouts

- However, NMA has the potential to regenerate acrylamide. Mixed, but not yet polymerised product might therefore lead to exposure to higher concentrations of acrylamide than expected.
- In Southern Sweden (Hallandsås) an 8.6 km long tunnel was built through a bed-rock ridge. The ridge had a very high water content. Because of major problems with water leaks, the NMA containing grouting agent "Rhoca Gil" (Rhône-Poulenc) was used in late spring 1997. Unfortunately, the formation of the gel and the polymerisation process did not meet the expectations of the manufacturer.
- A few weeks after use of the grout commenced, adverse effects symptoms characteristic of exposure to acrylamide were observed in workers at the tunnel.

  (EU Risk Assessment of Acrylamide; rapporteur UK)

Determination of haemoglobin-adducts in blood samples from tunnel workers

- Törnqvist and co-workers have analysed blood from 77 tunnel workers.
- The mean value found was 0.24 nmol acrylamide adduct/g of haemoglobin. The highest concentration was 4nmol/g.

Dates of publication of major findings

1993
A method for the determination of adducts of acrylamide to haemoglobin is applied for dose monitoring in persons occupationally exposed to acrylamide.

Bergmark, E., Calleman, C.J., He, F., and Costa, L.G. (1993) Determination of hemoglobin adducts in humans occupationally exposed to acrylamide. Toxicol. Appl. Pharmacol. **120**, 45-54.

Dates of publication of major findings

1997

In studies of occupational exposure to acrylamide, a conspicuous background level (approximately 40 pmol/g of globin) of an adduct that seems to be identical with the adduct from acrylamide is regularly observed in control persons without known exposure to acrylamide.

Bergmark, E. (1997) Hemoglobin adducts of acrylamide and acrylonitrile in laboratory workers, smokers, and non-smokers. Chem. Res. Toxicol. **10**, 78-84

Dates of publication of major findings

2000

It is hypothesised that intake of fried diet might lead to exposure to acrylamide and be the causative in the building up of the back-ground level of the adducts to haemoglobin of acrylamide. The influence of intake of fried diet on the levels of adduct monitored is studied in rats and the identity of the adduct is confirmed.

E. Tareke, P. Rydberg, P. Karlsson, S. Eriksson, and M. Törnquist (2000) Acrylamide: A Cooking Carcinogen? Chem. Res. Toxicol. **13**, 517-522

Dates of publication of major findings

2002

The content of acrylamide in different foodstuffs was investigated. The GC-MS method that had been applied in the studies of animal feed was further improved and simplified. A LC/MS/MS method was developed that analyses un-derivatised acrylamide. The analytic results obtained with these two methods are in full agreement.

Internet Publication of the Swedish National Food Administration.

Tareke,E., Rydberg,P., Karlsson,P., Eriksson,S., and Törnqvist,M. (2002) Acrylamide: A carcinogenic compound formed during heating of foodstuffs. *J.Agric.Food.Chem*.

European Prospective Investigation into Cancer and Nutrition (EPIC)

The European Prospective Investigation into Cancer and Nutrition (EPIC)

- ✓ was initiated in 1992,
- ✓ studies the role of nutrition and lifestyle in cancer etiology,
- ✓ uses data from 520,000 people in ten countries: Denmark, France, Italy, Germany, Greece, Netherlands, Norway, Spain, Sweden and United Kingdom.
  (See http://www.iarc.fr)

Preliminary statistical analysis on dietary acrylamide exposure

The Unit of Nutrition and Cancer of IARC reported a *preliminary statistical analysis on dietary acrylamide exposure* and its main food sources estimated at the population level from a large sample of

24-hour diet recalls (N= 36,900)

collected from the 10 Western European countries participating in the EPIC

including 2121 middle-aged persons from Heidelberg and 2299 from Potsdam.

Objectives of the analysis

Two of the main objectives of the analysis were to:

- ✓ estimate and compare the mean population acrylamide exposure, expressed in micro-grams consumption per kilogram of body weight and per day (µg/kg bw/day),
- ✓ describe the nature and magnitude of the potential food sources of acrylamide exposure across 10 European countries participating in EPIC.

Definition of relevant food groups

On the basis of the information provided by the Swedish National Food Administration on their web site a restricted number of foods or food groups was selected
It was also assumed

- ✓ that no other important sources, which may vary across countries, contribute significantly to the intake of acrylamide.
- ✓ that broad food categories have the same concentration of acrylamide across countries.

Initial list of food items used to estimate mean population acrylamide exposure

- ✓Deep Fried potatoes (French fries),
- ✓Fried/stir fried/sauted potatoes
- ✓Potato crisps
- ✓Other crisps
- ✓Crispbread
- ✓Toasted/grilled bread
- ✓Breakfast cereals (*)
- ✓Salty biscuits
- ✓Dry cakes/biscuits

(*) Muesli, branflakes and porridge were excluded from this group

Some selected results

- The mean values of Acrylamide exposures are in the order of 0.14 (women) to 0.15 (men) ug/kg bw/day in Germany.
- "*Potato and potato products*" make the largest contribution (about 50% in Germany) to the total intakes in all countries except Italy, particularly when "*deep-fried, fried potatoes and potato crisps"* are combined together. Potato crisps represent ≤ 7% of the total acrylamide intake in both genders in Germany.
- "*Dried cakes/biscuits*" also contribute quite significantly to the total intakes in all countries (≥ 20% in Germany).

What has been done by the BgVV?

- 26 April: First report to ministry and preliminary information of the public;
- 14 May: National Expert Consultation;
- 25-27 June: Participation in FAO/WHO Expert Consultation (chair)
- 1 August: Proposal of an „action value“
- 29 August Public information meeting with subsequent panel discussion
- End of April – End of August:
  - Establishment of an analytical method,
  - successful participation in a ring test,
  - organisation of a proficiency test,
  - initiation of research,
  - advice and reporting to government,
  - reporting to Parliamentary Committee,
  - comprehensive information of the public and other interested parties

Explanation

On 1 August 2002 the BgVV proposed an “action value” of 1000 micrograms acrylamide per kilogram food.

- Acrylamide is probably carcinogenic for man.
- The action value serves as the first step in the graduated, efficient control and minimisation of undesirable levels of acrylamide in foods.
- It is a temporary value and should be reduced from time to time depending on the findings obtained about the avoidability of acrylamide levels in foods and should differ for specific products or product groups.

Explanation

- This proposal has been made against the backdrop that at present the formation of acrylamide cannot be avoided in certain foods and that maximum levels cannot yet be proposed.
- Independently of this, there is the internationally accepted principle that the acrylamide levels should be reduced as far as possible ("as low as reasonably achievable" – ALARA). The proposal of an action value does not mean that avoidable levels can be tolerated below this value.

Explanation

- The action value should be seen as an appeal to manufacturers and control authorities to take the necessary steps:

  Ø When this value is exceeded in specific products, manufacturers should determine the causes of the formation of this substance first and foremost for those products and, if possible, introduce short-term changes to the processes used.

  Ø The control authorities should immediately inform the manufacturer of results above this value and ask him to undertake clarification studies and possible minimisation measures.