FEDERAL MINISTRY
OF HEALTH

SUMMARY

Aluminium is the most abundant metal in the earth's crust although it does not fulfil any biological functions due to its low bioavailability. This light metal has become an essential **material** in many areas – from aircraft construction to the packaging industry. As it offers so many advantages it is also used in numerous consumer products which we come into physical contact with, for example food additives, cosmetics and medicinal products.

This light metal was first industrially produced in its pure form only 150 years ago. Its low specific weight and good mechanical, electrical and thermal properties have made it one of the world's most frequently used metals after iron and steel. Worldwide production is approx. 45 million tons per year. Aluminium can be processed in casting and plastic deformation such as rolling and forging as well as with extrusion presses and waste materials can also be recycled.

Small amounts of aluminium from natural sources can be found in **foods**. However, of greater significance is the aluminium which can be traced back to additives containing this or which gets into food via contact materials. Most unprocessed foods contain less than 5 mg aluminium per kilogram although the aluminium content of individual foods can vary in individual countries. Aluminium based food additives may increase aluminium intake. For health reasons the European Commission no longer approves the use of certain food additives which contain aluminium, has restricted their use or reduced the maximum permitted amounts. Investigations of products in the European market revealed that some baby food products contained high levels of aluminium which could lead to the tolerable weekly intake (TWI) set by the European Food Safety Authority (EFSA) at 1 mg per kilogram body weight being exceeded.

Due to its low specific weight, high resistance and thermal conductivity aluminium was used soon after 1900 – initially in the military – for kitchen devices, cutlery and water bottles. Whether this **food contact material** is harmless to health and non toxic and whether aluminium from kitchen equipment can be transferred to food during preparation has been much discussed. However, it has now been established that during contact with acidic foods and fruit juices and in longer preparation times, small amounts of aluminium may migrate into food. The resulting exposure should be avoided. Authorities and experts, therefore, recommend avoiding the long term contact of acidic or salty foods and drinks with aluminium. Furthermore, producers should also try to reduce the migration of aluminium into food from food contact materials containing aluminium as much as possible.

Aluminium and its compounds are also used for various purposes in **cosmetics**. Most frequently used, in a high concentration, are aluminium chloride and aluminium chlorohydrate due to their ability to reduce sweat secretion. These compounds are found in most deodorants and antiperspirants. Current studies show that these products can contribute significantly to consumer's systematic exposure to aluminium. The French authority AFSSAPS, therefore, recommends a reduction of the maximum concentration of aluminium in cosmetics to 0.6 %.

Many biochemical processes are influenced by aluminium but little is known about the exact mechanisms of its **toxicity** although the cell toxic and particularly the neurotoxic potential is certainly clear. It is thought that aluminium is a contributing factor in a series of illnesses – in particular of the central nerve system but also relating to metabolism. However, a direct association between aluminium exposure and disease development has only been proven in three diseases – dialysis encephalopathy, osteomalacia (softening of the bones) as well as aluminosis (lung disease caused by aluminium dust). Three organ systems are clearly affected by the toxic effects of aluminium: the haematopoietic system, the nerve system and the bones. It is widely regarded that the main point of entry into the body is the GI-tract although aluminium may also be absorbed via the skin, mucous membranes and lungs. Recent investigations reveal that even only small amounts of aluminium – if absorbed by the body over a longer period – can trigger negative effects or increase the negative effects of another origin.

At industrial **workplaces** at which aluminium is manufactured and processed, exposure may occur through aluminium dust which is easily inhaled. Particularly severe forms of lung damage have been observed in employees who inhaled fine aluminium particles during welding and grinding and who were involved in the manufacture of small, metallic aluminium flakes, so-called “pyro powder”. Despite all occupational hygienic measures, the health risk remains high. Epidemiological studies also revealed severe nerve and brain damage amongst employees who had been exposed to aluminium for longer periods of time in the form of steam or dust.

Alzheimer’s disease – dementia is an increasingly common disease which involves the progressive decrease of cognitive functions followed by death. An association of this disease with exposure to aluminium is a controversial topic which is currently being discussed. Some observations support this theory: (1) Aluminium has neurotoxic effects; (2) it is possible for aluminium contained in food and drink to enter the blood circulation and the brain; (3) small amounts of aluminium can already cause neurological impairment – this is shown in studies of people who inhaled aluminium dust for a long period as well as experiences with intravenously fed people. However, there is a difference in the changes in brain cells in patients with Alzheimer’s and those observed in animal testing or in dialysis patients and it is disputed whether the deposits in the brain which are typical of Alzheimer’s (plaques) contain aluminium in all cases. A direct and sole cause effect relationship between aluminium exposure and Alzheimer’s is unlikely although aluminium may be an important co-factor which promotes the development of this disease. Numerous experts, therefore, advocate minimising exposure to aluminium as much as possible.

There are many causes for **breast cancer** – where hereditary and hormonal factors play just as much a role as environmental factors. In recent decades the number of tumours in the outer and upper sections of the breast have increased. Some scientists believe that the cause of this is in the use of antiperspirants which contain aluminium. Whether aluminium really is a factor in the development of breast cancer remains controversial and is being discussed and further studies which back or refute this hypothesis are needed.

So-called **antacids** are frequently taken without prescription as a remedy for heartburn and stomach complaints and many of these contain aluminium compounds. If the maximum recommended daily

amount is taken, the daily aluminium intake can increase up to 5,000 mg depending on the medication. Small amounts of the aluminium from antacids can be absorbed and enter the organs and bones via the blood circulation. Whether aluminium from these drugs is a factor in the development of Alzheimer's disease is disputed. The use of antacids containing aluminium is also suspected of leading to food allergies. As aluminium can be passed on to the foetus, these medicinal products should not, if possible, be taken during pregnancy or only for a short period. Antacids containing aluminium should only be used in the case of evident symptoms and if prescribed by a doctor.

Drinking water may contain small amounts of aluminium from dissolved minerals. Although the aluminium found here usually stems from aluminium compounds added at the water plant for the removal of organic impurities. Such water treatment methods are not used in Austria. Some epidemiological studies show that in areas with a higher aluminium content in the drinking water (more than 0.1 mg/l) in an increased frequency of cognitive damage and Alzheimer's disease occurs. It is thought that the aluminium dissolved in the water is particularly bioavailable and can enter the brain. Therefore the increased aluminium concentration found in some European countries should be reduced – for example by replacing aluminium compounds with iron compounds in water treatment. In terms of prevention, experts advise priority should be given to reducing the permitted maximum levels for aluminium in drinking water to at least < 100 µg/l and to monitor it in particular in the interest of the elderly who are at greater risk of Alzheimer's disease.

Aluminium and particularly aluminium oxide in **nano-form** are already used in a series of products and applications for example as additives in paints, fuels, explosives, scratch and abrasion resistant coatings, plastic packaging and as filters. According to IKW The German Cosmetic, Toiletry, Perfumery and Detergent Association nanoscale aluminium compounds are not currently used in cosmetics. Some studies *in vitro* and in animals show neurotoxic effects which are generally known for aluminium whereby the nanoscale properties appear to contribute significantly to the neurotoxicity. There are indications that nano aluminium in water can promote the transfer of antibiotic resistance genes between bacteria stems which is why its release into the environment should be avoided.

Long term consumer exposure to small amounts of aluminium from various sources (foods, food contact materials, cosmetics, medicinal products) can lead to the tolerable weekly intake set by the European Food Safety Authority (EFSA) of 1 mg per kilogram of body weight being exceeded. This can present an increased health risk particularly for vulnerable groups of the population e.g. babies, small children, pregnant women, the elderly, people with chronic diseases or those with a relevant genetic disposition.

Following the precautionary principle it is, therefore, advisable to reduce exposure to aluminium from consumer products such as cosmetics or food, as much as possible.