

Requirements and conditions for the use of anodic coatings on aluminum in the food industry

According to Regulation (EC) No 1935/2004, materials and articles intended to come into contact with foodstuffs must be manufactured in such a way that, under normal or foreseeable conditions of use, they do not release any constituents on foodstuffs in quantities suitable to:

- a)** endanger human health, or
- b)** to cause an unacceptable change in the composition of the food, or
- c)** to impair the organoleptic properties of the food.

Regarding aluminum and its intake, there are health risks due to toxic effects on the nervous system, fertility and unborn life as well as bone development. Some time ago, aluminum was also associated with the development of Alzheimer's disease or breast cancer, but this has not yet been scientifically confirmed.

Humans ingest aluminum through food and drinking water as well as through consumer products containing aluminum, such as tableware or food packaging, cosmetic articles and pharmaceuticals. Aluminum is only absorbed into the human body in small quantities through food intake and is usually excreted again via the kidneys. In the course of life, despite everything, there is a certain accumulation of the metal in the human body in very different concentrations.

The European Food Safety Authority (EFSA) has set a tolerable weekly intake of 1 mg of aluminum per kilogram of body weight for dietary intake. According to EFSA, aluminum intake from food contact materials usually contributes only a small proportion to the total exposure of aluminum from consumers compared to aluminum intake from food. A corresponding resolution of the Council of Europe therefore sets a release limit of 5 mg per kilogram of food for aluminum for metallic food supplies (cooking pots, dishes, packaging, etc.).

Aluminum is chemically resistant in the pH range of approximately 4.5 to 8.5 due to the formation of protective oxide layers. Media with pH values below or above (acids and alkalis) dissolve the oxide layer, aluminum is attacked and aluminum ions go into solution. It has been proven that increased release occurs when, for example, aluminum (consumer goods such as foil, aluminum trays, cooking pots, baking trays) comes into contact with foods containing salt or acid. Depending on the duration of contact and temperature (increased reactivity), the entry rates of aluminum are many times higher than the applicable limits, especially when the food is kept warm for a long time.

Technically, the use of aluminum and aluminum alloys in contact with almost pH-neutral foodstuffs is regulated in the European standards EN 601 (cast aluminum alloys) and EN 602 (wrought aluminum alloys) and corresponding limit values for alloy components are specified. For implementation in practice, DIN EN 573-3 exists with reference to the respective semi-finished products for use in contact with food.

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Special requirements for the chemical composition of packaging and packaging components made of aluminum and aluminum alloys are specified in EN 14287. Pure aluminum and mainly wrought alloys from the classes AlMg, AlMn, AlMgMn and AlMgSi or cast alloys of the types G-AlSi, G-AlSiMg and G-AlMg are suitable for the food industry and have proven themselves in practice. In the case of increased corrosion resistance requirements, only aluminum materials with a copper content of less than 0.2% should be used.

To further improve corrosion resistance, consumer goods and components in the food industry are often subjected to surface treatment, e.g. by anodic oxidation (anodizing). The general requirements for anodized products that come into contact with foodstuffs are regulated in DIN EN 14392. This includes specifications for the aluminum alloys and the anodization process, including sealing. Our hard anodic process HART-COAT®, for example, also increases abrasion resistance and improves corrosion behavior due to its hardness. In principle, however, the recommendation is to use the anodized aluminum food contact materials only for pH-neutral foods.

In addition to the general recommendations and the above-mentioned regulations, the proof of suitability for materials and articles for food contact is carried out based on suitable verification tests.

The most important requirement is to know the "normal or foreseeable conditions of use", because the laboratory tests necessary to prove conformity must reflect the "worst case" of these conditions in the best possible way (see EDQM guideline "Metals and alloys used in food contact materials and articles"). The focus is primarily on:

- a) the type of food to come into contact with the material,
- b) the duration of the contact between the material and the foodstuff and the temperature prevailing during it, and
- c) the ratio of the amount of food to the area of the material in contact with it (kg or liter per dm²).

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Based on these parameters, migration tests are used to investigate which substances the material releases into the food and in what quantities. If the surface is also subjected to mechanical stress due to dispersed particles, friction of dry food or direct contact with other materials when the surface is used, these conditions must also be simulated as best as possible in the laboratory tests.

For our HART-COAT® coatings, the analysis must be provided according to the alloying elements of the base material, these are, for example, aluminum, iron, copper, zinc, manganese and chromium. For the sealed variants HC-PLUS, the release of PTFE/PFA must also be investigated. The analysis is conducted, for example, using ICP-OES or ICP-MS. The determined values are then to be evaluated regarding the EDQM Guide and Regulation (EC) No. 1935/2004. Numerous testing laboratories and institutes offer corresponding tests.

In view of the wide variety of conditions of use, it is not possible for Aalberts surface technologies to make general statements about the suitability of its coatings for contact with food. It is therefore the customer's responsibility to have the assessment or tests adapted to his individual application carried out by a qualified test facility and to prove the conformity of his product. Aalberts surface technologies is happy to support its customers in this regard.

Sources:

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