Секція проблем техніки і нових технологій

QUALITY CONTROL FOR ALUMINIUM FOIL PRODACTION

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There is a large amount of research that is directly related to the production of aluminum and aluminum products. This is due to the complexity of the technological process [1, 2], on the one hand, and the rather wide use of aluminum products in various industries and economy, on the other hand.

The aim of the article is to investigate the basic principles and methods of quality control in the production of aluminium foil. Considerable attention is paid to the comparative characterization and analysis of quality control features depending on the type and purpose of aluminium foil.

Aluminium foil is widely used in many areas of various industries and is indispensable in everyday life and construction. It is achieved by rolling aluminium ingots at different temperatures, which results in the final shape of the product. Foil is non-corrosive and highly impervious to gases and vapours. Foil has a high degree of resistance to chemicals and static electricity. Foil has thermal insulation properties.

According to its type and purpose, aluminium foil is mainly divided into three categories: cold-rolled foil (food foil); aluminium foil for technical purposes; aluminium foil for capacitor production.

Aluminium food foil is now a sought-after product in many areas: for packaging foodstuffs such as coffee, confectionery, sauces, spices, tea; for baking, freezing various foods, as a sealed package for various cooked meals [3].

Quality control of food foil. Foil is received in batches. A batch shall consist of aluminium foil of the same kind, of the same brand, of the same size, with the same thickness accuracy, in the same condition and shall be accompanied by a single document of quality bearing the trademark or name and trade mark of the manufacturer; name of country of manufacturer; legal address of manufacturer and (or) seller; nominal designation of foil; lot number; conformity mark (for certified foil); lot weight; bar code (if any). For inspection and measurement of all foil grades, 5 % but not less than two rolls of foil are taken from the batch. To check the odour, technological grease, porosity and adhesion of the paint coating to the foil, 5 % of foil rolls, but not less than two, shall be taken from the batch. In order to control the chemical composition of the foil, the manufacturer takes samples of liquid metal from each casting, and the consumer company takes one batch of foil from the batch [4]. The width of the foil is measured with a metal ruler. The presence of grease is also checked. To check the specific capacity from one roll of foil is taken from a batch of at least 0.7 m long. Samples are taken and prepared to determine the chemical composition. It is allowed to use other methods of control and measuring instruments, providing the necessary accuracy, established by the standard.

Technical aluminium foil is widely used in the space and aviation industry; vapour barriers; insulation; ceiling and wall insulation; pipe insulation; insulation of stove, chimney and heating systems; electrical engineering; refrigeration, engine cooling systems; heating and air conditioning systems.

Quality control features of technical foils. For inspection and measurement, 3 to 5 m of foil shall be uncoiled from the roll; inspection shall be carried out without using magnifying devices. Foil with thickness from 0.007 to 0.050 mm inclusive is checked with a measuring head. Foil with thickness of 0.060 mm and above shall be measured with a micrometer with a spherical tip. To determine the mechanical properties, a piece of foil with a length of at least 2 m shall be cut from each selected roll to make three specimens. Tensile test specimens shall be cut in the form of strips with a width of (15,0 ± 0,20) mm and an allowable difference between the maximum and minimum width along the length of the working part of the specimen of 0,10 mm, the working length of 150 mm. Samples shall be cut out along the rolling direction [5]. Foil specimens 0.007–0.100 mm thick are cut out with a blade on the glass using a metal ruler; thicknesses above 0.100 mm are cut out with guillotine shears or produced on a milling machine. Other methods of specimen fabrication are allowed, providing the required accuracy and absence of tears, burrs along the length of the specimen. The chemical analysis is carried out according to the requirements.

To determine the time resistance the sample is subjected to tension under the action of gradually increasing load until failure. The highest load preceding the failure of the specimen is taken as the load P_{max} corresponding to the time resistance. To determine the length of the specimen after fracture, the fractured parts of the specimen are stacked so that their axes form a straight line. If, after testing, there is a gap due to metal caking and other reasons, it is included in the post-breakage length of the calculated part of the specimen. The corrugation of the foil edge is checked by wrapping it around a mandrel with a diameter of 100–120 mm. If the waviness does not disappear, the foil roll is rejected [6].

Aluminium foil for capacitors can be divided into the following types: low voltage anode aluminium foil; high voltage anode aluminium foil; cathode aluminium foil.

Quality control of foil for capacitors. According to the precision of fabrication, aluminum foil for capacitors are divided into the following kinds: normal and high. In terms of material condition, aluminium foil for capacitors is divided into the following types: soft foil (with annealing) and hard foil (without annealing). Time resistance of soft foil with thickness of 0,007 mm for power capacitors shall be not less than 40 MPa. On customers' request, for foil type 2 made of aluminium grade A99, time resistance of soft foil shall be not less than 32 MPa, and the relative elongation of soft foil – not less than 4.0 %. Tensile test specimens of foil in the form of strips along the rolling direction with a width of (15,0 ± 0,20) mm and an operating length of 150 mm shall be subjected to tensile testing on a tensile testing machine. Methods for checking the electrical parameters of low-voltage and high-voltage foil: shaping samples of etched foil; measuring the shaping voltage; measuring the capacitance; checking the stability of the oxide layer. Methodology for checking the electrical parameters of cathode foil: test procedure; capacity measurement; stabilisation quality control.

The analysis of features of quality control of aluminium foil depending on its purpose was carried out: cold-rolled food foil, aluminium foil for technical purposes and aluminium foil for capacitor production. Technical specifications and standards have been studied and the main parameters and characteristics have been identified for further research.

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КОРОЗІЙНА СТІЙКІСТЬ КОМПОЗИЦІЙНИХ МАТЕРІАЛІВ Cu–NвC, ОТРИМАНИХ МЕТОДОМ ЕЛЕКТРО-ПРОМЕНЕВОГО ВИПАРОВУВАННЯ-КОНДЕНСЦІЇ

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Одним з методів поліпшення характеристик міцності міді є дисперсне зміцнення. Для конденсованих із парової фази композиційних матеріалів ефективне зміцнення матриці може бути досягнуто за умов якщо крайовий кут змочування θ міддю тугоплавкими сполуками, вибраними в якості зміцнюючої фази менше 90 ºС. Оскільки крайовий кут змочування карбіду ніобію рідкою міддю за температури 1100 ºС у вакуумі становить 70 ºС, то можна передбачити, що карбідне зміцнення мідної матриці буде ефективним. Крім того, доцільність застосування карбіду ніобію в якості зміцнюючої добавки мідної матриці обумовлена його високою температурою плавлення, можливістю конгруентного випаровування, високим модулем пружності, не розчинністю і не взаємодією з міддю за високих температур. Композиційні матеріали Cu–NbC отримували методом високощвидкісного випаровування-конденсації у вакуумі на установці L-2 [1].