The major problems of modern production: the tenfold tin cost increase within the latest 50 years and the use in production process of highly toxic components. According to the proposed production process, a thin (0.1-0.3 μm) protective luminous texturally-composite tin coat is obtained using a low-toxicity sulfate electrolyte of increased stability. Then a passive film is applied onto the tin coat in a chromium-free low-toxicity electrolyte (instead of the coat fusion operation).

The basic production items are:

- The developed tinning technology that provides formation on the canned food steel sheet of a textured coat comprised of compositions with certain preliminary specified axial texture components (100)[hkl] and (101)[hkl]. Forming of a specified texture in tin coats leads to an increase of their protective properties while maintaining the adhesive strength and plasticity characteristics. This ensures an adequate corrosion resistance of the passivated tinned sheet in various model and foodstuff media while the tin coat thickness is brought down to 0.1-0.3 μm. Operating characteristics of the electrolyte remain stable over its whole operating time due to the preclusion of meta-tin acid precipitate formation. The increased electrolyte resistance against the influence of oxidizers due to an aggressive suppression of the transition reaction of the bivalent tin to its tetravalent state increases the duration of the tinning electrolyte stable operation by 10 times. A method is proposed of electrochemical tinning of steel sheet at the tin deposition rate of 0.1-0.15 μm/s.

- The developed passivating technology that provides forming on the tin coat of a colorless protective film, and whose usage eliminates the energy-consuming operation of fusing the obtained coat. A method is proposed for cathode passivation of the tinned steel sheet during 2-3 s.

Innovative Aspect and Main Advantages

The proposed canned-food steel sheet production process is based on three potential inventions that are grounded on the usage of the recently found phenomenon of the structure formation in the metallic materials being electrochemically deposited via a metallic liquid. These inventions are comprised of the development of electrolytes and methods of electrochemical treatment of steel sheet and are aimed at maintaining the quality of the canned food steel sheet while reducing its production cost and making its production more environmentally friendly.

The major advantages of the new production technology:

- A reduction of the tin coat thickness from 1.15–1.2 μm to 0.1–0.3 μm while preserving its protective and decorative properties, with the resulting reduction of the tin and electric energy consumption.

- Increased rate of tin deposition onto the steel sheet to 0.1-0.15 μm/s.

- Elimination of highly toxic components during the electrochemical deposition of the tin coat onto the steel sheet and its subsequent cathode passivation.

- Increased tinning electrolyte resistance against the influence of oxidizers that increases the duration of its stable operation by 10 times and more.

- Replacement of the energy-consuming operation of coat fusion on the steel sheet with the operation of tinned steel sheet passivation.

- The production process does not require any capital expenditure and is applicable on the existing equipment.

- The developed additives to the tinning and passivating electrolytes are not expensive, readily available and low toxic.

Areas of Application

- Canned food industry: manufacture of food cans.
- Foodstuffs industry: production of canned food.

Economic Effectiveness

It is known that more than 300 million of food cans are opened daily in the world, and the share of the tinned steel cans (as the main canned food tare) comprises 2/3 of the total amount of food cans. Let us assume that the production cost of the tinned steel sheet for manufacturing one can is brought down by as little as two cents, and the quantity of the major tinned sheet producers in the world is about ten. Then the economic effectiveness of the proposed new production technology for one company will reach more than 400 thousand USD per day or about 150 million USD per year.

Besides, not less than 20 m t of canned food steel sheet is annually produced in the world, while tinned steel sheet comprises about 2/3 of the total volume, that is 13 m t. Let us assume that the capacity of one steel sheet producer approximately equals one tenth of the annual world volume, that is about 1.3 m t of tinned sheet per year. It is known that with the reduction of the tin coat thickness from 1.15 μm to 0.4 μm the tinned sheet production expenses are reduced in the average by 119 USD per ton of steel sheet. Then the economic effect of the implementation of the new technology of producing steel sheet with the tin coat thickness 0.1–0.3 μm will amount per one producer minimum 150 million USD per year.

Stage of Development

Patenting of the inventions.

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