Metallurgical Plant and Technology G 25074

ISSN 0935-7254

MPT INTERNATIONAL

3
June
2008

Experience with surface inspection technology

The new blast furnaces at ThyssenKrupp Duisburg

Insoluble anode technology for tinplate production

Tenova has developed a new tin dissolution process based on the technology of insoluble anodes. The application of the Tenova Insoluble Anode Technology minimizes the amount of sludge produced and hence the loss of tin. Main benefits are improved coating quality, better process control and elimination of phenol vapours in the working environment. The process is based on the oxidation of metallic tin granules by the tinning electrolyte flowing in a dissolution reactor. The electrolyte is then saturated with pure oxygen. The article describes the very satisfactory results reached in tinplate produced with insoluble anodes.

Giovanni Astengo, **Tenova Strip Processing**, Genova, Italy; Thomas DeLoia, **Tenova Strip Processing**, Canonsburg PA, USA

Contact: www.tenovagroup.com
E-mail:
stripprocessing@it.tenovagroup.com

The use of soluble anodes is generally known to be advantageous because the tin plated-out on the strip can be automatically produced by the dissolution of tin from the anodes. On the other hand, there are many disadvantages. The most important one is the necessity to drain off the plating solution because of the different electrochemical efficiency in plating and dissolution. An increase of tin concentration in the plating solution is unavoidable with the use of tin anodes, and dilution of the solution generates overflow and discharge, with loss of expensive material and possible water pollution, unless adequately treated.

Other disadvantages in conventional lines are the fumes exiting the plating tanks, the labour requirements for handling the tin anodes and the low productivity. Additionally, market demand is towards tinplate with thinner coatings; indeed for some uses tin coatings down to 0.2 – 0.4 g/m² are required, causing production problems.

With conventional electroplating technology the homogeneity of tin coating thickness decreases as the coating weight decreases, due to the particular geometry of the tin anodes, which do not present a continuous surface. In fact, each anode is formed by a series of vertical bars drawn against each other so as to leave only a minimum space between the bars, which may produce a lower tin thickness.

The solution to these problems is to equip the entire tinning line with insoluble anodes. The main advantages of tinplating with insoluble anodes are:

- less tin consumption due to equal tin covering on the strip,
- better coating of the strip edges with a coating thickness less than 1 g/m²,
- reduced labour costs, higher productivity and flexibility, safer and better working environment due to obsolete handling of the anodes,
- no anode melting plant, resulting in further reduction of labour costs,
- less fumes due to covered tanks,
- lower electrolyte consumption and pollution, because electrolyte is always under control,
- less power consumption (anodes are closer to the strip).

Technology developed together with Ternium

Tenova has developed a new low-sludge tin dissolution process based on the technology of insoluble anodes. The process is based on the oxidation of metallic tin granules by the tinning electrolyte flowing in a dissolution reactor. The electrolyte is then saturated with pure oxygen to accelerate the oxidation reaction of metallic tin to ionic tin.

The tin dissolution process technology was developed by Tenova at the electrolytic tinning line of Ternium Siderar (Techint Group) over an extensive operational period. The campaigns confirmed that the developed tin dissolution process considerably reduces the quantity of generated sludge and consequently the loss of tin.

Since the plant was run continuously, it was possible to optimize the anode and edge mask design and confirm the efficiency and productivity of the dissolution plant. Inert titanium based anodes with an active precious metal coating were used for this application, as titanium is resistant to chemical attack in acid electrolyte, such as PSA, due to its inert and extremely strongly adhering surface oxide film.

The insoluble anodes were vertically positioned in a cell containing a plating solution, and spaced from the passing strip at a distance of less than 50 mm. The plating solution blows into the gap between the anode and the strip.

Due to the very high speed of the strip, the fluid dynamics of the cell tends to create a so-called Venturi effect in the region between the strip and the anode. This effect promoted contacts between the anodes and the strip, causing defects on the strip. With the aim of reducing this effect, anodes have been designed with a regular array of orifices. While reducing the level gap between the ascending and descending zone of the plating cell, the orifice

distribution has also been conceived to maintain evenness of current density distribution in the transverse direction.

Operational results

During operation no strip defects which could be related to the use of the insoluble anodes have occurred. Both the optimization of the anode design and the material selection have proved to fully satisfy the process and strip quality requirements.

Insoluble anodes are of a fixed width. In order to process strips of different widths, electrically insulating plates so-called edge masks are used to prevent "white border defects" due to tin overcoating at the edge.

The strip edges engage in U-shaped sections arranged at the end faces of the masks. The degree of edge galvanization depends on the insertion depth of the strip edges into the U-shaped sections. It is therefore essential that the U-shaped sections always follow the strip travel precisely, the expected accuracy being less than 1 mm.

At Ternium Siderar, the edge mask system was mounted on a plating cell and comprised two pairs of epoxy-glass edge masks held from the top and guided at the bottom by the anodes guides. Each pair was equipped with an internally developed inductive sensor for detection of strip penetration and driven by a servo-cylinder with a linear transducer.

The Tenova edge mask design guarantees easy inspection and access to the cell for maintenance and operational activities. Through a local PLC communicating with the line PLC, edge mask control also tracks the position of the weld and allows information about the strip width to be sent to the local PLC. Though redundant, the system was conceived with two edge sensors to improve system reliability in case of failure of any one of the sensors. The sensors and the control system have performed well and the overall system has proven very stable and accurate.

The electrolyte produced fully complies with the requirements of the tinning line and important operational and maintenance practices have been defined. The very low tin loss achieved in the sludge is both a commercial and environmental advantage.

According to Ternium Siderar the most promising aspects of the system of insoluble anodes are: improved strip quality due to the elimination of chronic defects, such as white edges and anode marks, elimination of anode handling, and more flexible campaigns in terms of strip width programming, since the edge masks can adapt to all strip widths. Moreover, the dissolution plant allows controlling the tin concentration in the electrolytic solution of the line.

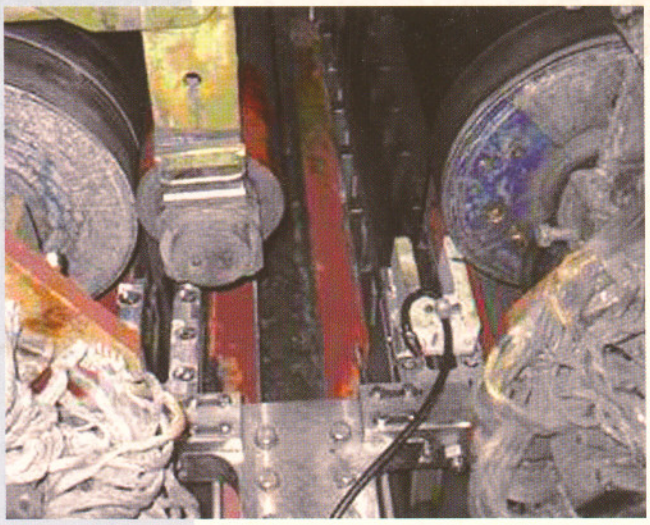

Figure 1. Insoluble anodes are vertically positioned in the plating cell

Figure 2. Looper of the tinning line at ArcelorMittal, Spain

Outlook

As explained above, there are many good reasons to definitively choose the technology of insoluble anodes in the tin dissolution process, both for new plants and upgrading of existing process sections. Tenova is currently supplying a complete new electrolytic tinning line to Dajiang Steel in China, with a capacity in excess of 250,000 t/year and with a process speed of 550 m/min, equipped with insoluble anodes and edge masks and an associated tin dissolution plant. The plant will start up at the beginning of 2009. In terms of capacity, performance and technology the new plant will be one of the most important plants in the world, further enhancing the experience and the technical solutions developed in the high-speed plants previously supplied to ArcelorMittal (Avilés facility) in Spain and to Erdemir (Eregli) in Turkey. ■