

Tenova's new generation of electrolytic tinning lines

Tenova's high productivity tin plating lines with insoluble anode technology respond to the increasing demand for high quality products with an environmental friendly process in growing markets such as India.

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With improving living standards in India, the population has rising expectations for better quality products and facilities. The demand for beverage and food cans and for various other containers is growing so fast that producers are struggling to keep up with supply. As a result, the demand for coated steel products is rising at an extraordinary pace.

Indian steel producers, recognising the demand for tinplated products of international standard, are focusing on up-to-date production, based on the advanced technology of electrolytic tinning lines. The necessity for safety and an eco-friendly environment demands highly automatised solutions to enable the highest standard in product quality and productivity performances.

In this situation, steel suppliers are measured not only on price, but also on their most advanced technology, in terms of ease of handling on lines, eg, operation and maintenance, safety requirements for operator and maintenance personnel and environmental issues, which are important to the communities living near the plant.

Tenova's low tin sludge technology is proving a commercial success. For example, five of the new lines contracted for in China in the past two years have been assigned to Tenova – a total of 11 in the past 10 years. By gathering the developments and experience of this research into new technology, which is either installed or under installation in many plants, we get an idea of its progress.

The parameters for a typical line are shown in *Table 1*.

DESIGN ASPECTS

Entry section A double pay-off reel configuration is used with automated coil loading and strip threading using electromagnetic threading conveyors to eliminate operator contact with the strip. Pup coil removal and sleeve handling systems are provided. A laser welder is generally used to join the head of the incoming coil to the tail of the one in the line for continuous operation.

The side trimmer has rotating turret heads to enable knife changes and set-up to be done on the outboard set of knives while the inboard knives are in operation. This reduces set-up time and so increases productivity. The

Parameter	Value
Production capacity (kt/yr)	350
Strip thickness (mm)	0.10-0.60
Strip width (mm)	up to -1,400
Entry/exit line speed (m/min)	up to 750
Process speed (m/min)	up to 600
Coating weight (g/m ²)	1.0-11.2

Table 1 Main operating data for Tenova's high productivity tin lines

quality of the cut edges is guaranteed via accurate control of the knife gaps (horizontal and vertical). All movements are made by advanced servomotors to guarantee high performance.

Double-entry loop towers are provided with storage for up to 48 lengths of strip to allow continuous process operation during coil loading, notching and side trimmer adjustments during strip width changes. These double-loop towers include entry, exit and intermediate strip steering, as well as auxiliary drives to reduce tension build-up in the strip as it wraps around the accumulator rolls.

Process section A tension leveller is provided at the entrance to the process section to flatten the strip prior to plating. The tension leveller incorporates two pairs of flexing units and a multi-roll unit in order to level double reduced (DR) material which is of higher strength and lighter gauge than single reduced strip. The tension leveller is located after the electrolytic cleaning section and before the electrolytic pickling units. This reduces the risk of leveller contamination and so extends roll life.

Work rolls and back-up rolls are made of a special hard steel to guarantee longer roll life. The tension leveller is equipped with two tensiometer rolls, one in the entry and one in the exit section, to control actual strip tension inside the machine.

The most significant innovation in modern electrolytic tinning lines (ETLs) is our insoluble anode tin plating system. The vast majority of older ETLs around the world use consumable tin anodes of conventional segmented design as the source of tin to plate onto the strip. There are ▶

Parameter	Benefit
Constant tin covering on strip	Less tin consumed
Better edges	Better strip quality (particularly important for thin coatings)
No anode casting and handling	Reduced labour costs, higher productivity and flexibility, and a safer and better working environment
No anode melting plant	Reduced labour costs
Covering on tanks	Fewer fumes in the environment
Electrolyte always under control	Lower electrolyte discharge, consumption and pollution
Anodes closer to strip	Reduced electricity consumption

Table 2 Advantages of insoluble anodes

many disadvantages and inconveniences associated with these consumable anodes. The operator must load new anodes and remove spent anodes from all of the plating cells while working above the hot electrolyte solution in an unfriendly environment.

Also, strip width changes require the operator to manually shift the end anodes to accommodate the new strip width in order not to over plate the edges. And due to the varying thickness of the anodes as they are consumed and the irregularities between the segmented tin anodes, the coating weight tolerance is influenced by the anode's physical condition and location relative to the strip.

Although there have been insoluble anode tin plating systems in operation in the past, the problem is that these generated large quantities of tin sludge (10-12% of the tin dissolved). The heart of the Tenova insoluble anode tin plating system is the tin dissolution reactor. This 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.

Tenova developed and patented this low tin sludge dissolution process for replenishing the tin in the electrolyte. The dissolution reactor incorporates a proprietary oxygen injector and a control which precisely manages the oxygen injection rate, the electrolyte flow rate and pressure, the level of the fluidised bed and the rate of tin pellet addition.

The other component of the insoluble anode tin plating system are the edge masks that accommodate different widths of strip with high precision. These are designed to eliminate the centre supports that restrict access to the plating cells. The edge mask supports and positioning mechanism are cantilevered from outside the plating cells and the mechanism located below removable access plates under the walkway.

The main advantages of tin plating with insoluble anodes are summarised in *Table 2*.

Reflow section This incorporates a combination of conduction and induction to heat the strip to above 240°C to melt the tin. The initial heating is by conduction and an induction coil provides the final heating to rapidly bring the tin coating to its melting point, thereby eliminating 'wood grain' defects visible on the lighter coating weights.

Exit section This includes a surface inspection cell that views the top and bottom surfaces of the strip as it passes vertically through the inspection unit. This is followed by a pinhole detector using either a photo or laser sensor. A rotary drum shear is provided to enable samples to be taken from the line without halting the exit section, so increasing productivity.

CHINESE COATING LINES

Details of two of the recent coating lines are given below.

Yi Chang Three Gorges Quan Tong Colored and Galvanized Plate Co Ltd, has ordered two high-speed electrolytic tinning lines equipped with insoluble anodes and two high-speed electrolytic chromium coating lines (tin-free steel lines).

All four lines will process thin strip for the packaging market. The lines are designed for 1,250mm wide strip at thicknesses of 0.14-0.55mm. The annual capacity of each of the four lines is 250kt.

The chromium coating lines employ state-of-the-art two-step plating technology which enables more precise and independent control of both the metallic chrome layer as well as the chrome oxide layer of the coating.

The plants are to be constructed in record time with the first coils scheduled for production in 2011.

In 2007, **Jiangsu Dajiang Metal (Sunshine Group, China)** awarded an electrolytic tinning line to Tenova, based on the advanced insoluble anodes process. This line is one of the fastest in the world at 700m/min at the entry/exit and 550m/min in the process section. Annual production is 250kt. The strip is 700-1,250mm wide and 0.15-0.55mm thick and the line can process all the main grades of steel.

Besides the tinning line, Tenova also supplied a complete cold mill plant for tinplate, consisting of:

- 1 CRM Cold rolling reversing mill (single stand 4-Hi) by Tenova i2s
- 1 DCR Double cold rolling and skin pass mill (double stand no-reversing 4-Hi) by Tenova i2s
- 1 BAF Set of batch annealing furnaces by LOI-Italimpianti Tenova
- 1 Roll shop Including grinders by Tenova Pomini
- 1 ETL Electrolytic tinning line by Tenova Strip Processing. **MS**

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