

NEW GALVANIZING LINE COUPLED WITH HIGH-SPEED PAINTING LINE AT MARCEGAGLIA'S RAVENNA PLANT, ITALY¹

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Abstract

This paper describes a state-of-the-art galvanizing and high-speed painting line for the production of galvanized and painted coils at Marcegaglia's Ravenna Plant in Italy. The substantial advantages of this combined line are the low investment costs, high production flexibility (producing either galvanized only, or galvanized and color coated), low operating costs (less coil handling, packaging, degreasing, manpower needs), installation cost reduction, and lower environmental impact. The innovative curing process guarantees high flexibility of the painting section, due to a fully automated control system that modulates the furnace power in accordance to the various line operating conditions. This curing process allows the steel strip to be painted (up to 180mpm) using much less space compared to the traditional curing ovens. The line has been designed with the Best Available Technology concept aiming at minimizing emissions and consequently reducing the environmental impact, in compliance with the latest European safety rules.

Key words: Galvanizing; High-speed painting line; Low investment cost; High production flexibility; Environmental impact; Curing process

NOVA LINHA DE GALVANIZAÇÃO ACOPLADA COM LINHA DE PINTURA DE ALTA VELOCIDADE NA PLANTA DA MARCEGAGLIA, RAVENNA, ITALIA

Resumo

Este trabalho descreve um estado de arte para galvanização e linha de pintura de alta velocidade para a produção de bobinas galvanizadas e pintadas para a planta da Marcegaglia Ravenna na Itália. As vantagens substanciais dessa linha combinada são o baixo custo de investimento, alta flexibilidade de produção (produzindo tanto apenas galvanizado, ou galvanizado e pintado), baixo custo de operação (menos manuseio de bobinas, empacotamento, desengraxamento, necessidade de mão de obra), redução do custo das instalações, e menor impacto ambiental. O processo de cura inovador garante alta flexibilidade da seção de pintura, devido a um sistema de controle completamente automatizado que regula a potência do forno de acordo com as várias condições de operação. Esse processo de cura permite à tira de aço ser pintada (até 180 mpm) utilizando muito menos espaço comparado aos fornos de cura tradicionais. Essa linha foi desenvolvida com a melhor tecnologia disponível visando minimizar emissão e conseqüentemente reduzir o impacto ambiental, de acordo com as últimas normas de segurança Européia.

Palavras-chave: Galvanização; Linha de pintura ultra-veloz; Baixo custo de investimento; Alta flexibilidade de produção; Impacto ambiental; Curing process.

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Introduction

Danieli & C. has recently been awarded the equipment supply order for the Marcegaglia Ravenna Works expansion project. It is a remarkable achievement, first of all because it is one of the largest orders awarded in the latest years to one single Supplier of flat products finishing plants in Europe.

Secondly, and what makes Danieli proud of the work done in the past during the previous contract for the hot dip galvanizing line Nr.2 of Ravenna works, it is a confirmation of the solid relationship existing between Danieli and Marcegaglia.

Recently Marcegaglia S.p.A. has taken the strategic decision of doubling the finished product output capacity of its Ravenna Works.

The Ravenna expansion project foresees an additional 65,000 square meter area of new buildings that will host a new two-stand four-high reversing mill, the combined galvanizing and painting line Nr.3, and the hot-dip galvanizing line Nr.4 for pickled coils and heavy-gauge cold rolled coils.

The new plants will gradually run into production during 2009 and 2010, starting from the heavy-gauge galvanizing line and ending with the painting section of the combined galvanize-painting line.

The capacity increase of the cold strip production was necessary in order to produce the starting material for the new equipment ordered from Danieli

Danieli will supply the mechanical, as well as the electrical and automation equipment for the new two-stand cold reversing mill and lines.

The two galvanizing lines will be built in two adjacent bays, and they will utilize as much as possible the same equipment, in order to minimize the spare parts and reduce the investment.

Both lines will be built according to the latest requirements of the European and Italian laws concerning safety and the environment, and will be designed in order to minimize manning and maintenance requirements.

Danieli Wean United hot-dip galvanizing lines with in-line painting sections respond to the rapid spread of pre-painted rolled steel and the ever expanding technology of coil coating.

The special layout guarantees a high quality product, checked at the origin and with a homogeneous color finishing having optimum aesthetics, duration and resistance characteristics.

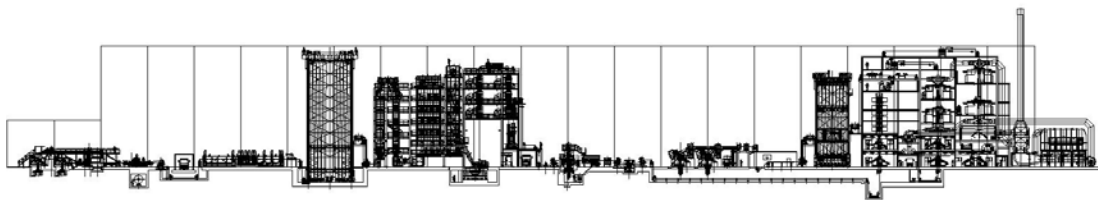


Figure 1. Galvanizing and color-coating line section view drawing.

Galvanize-painting line Nr. 3: Line and material data

Production output	350,000 tpy (150,000 tpy painted)
Incoming material	Cold rolled strip
Strip thickness	0.25 to 1.4 mm
Strip width	900 to 1550 mm
Coil weight	35 tons max

Final product	Galvanized and or color coated strip.
Coating weight	80 to 450 g/m ² total
Surface conditioning mill	1000 tons max. rolling force
Tension leveler	Elongation 2% max.
Passivation	Cr ³⁺ , Cr free, anti-finger print
Primer film	5 to 7 microns
Finisher film	17 to 23 microns
Back-coat film	5 to 7 microns
Oil	0.25 to 2 g/m ² per side

Main line features

The entry end must be designed to provide a continuous flow of strip into the processing section of the line because a stoppage in the curing ovens would spoil the coated material.

The entry section consists of two uncoilers, a welder and a notcher. Before passing through

the vertical entry accumulator, the strip is cleaned in the horizontal tanks cleaning section. The cleaning section includes an alkali cleaning tank followed by brush unit (6 brushes in operation) and a rinsing section. All the tanks are connected to the fume exhaust system for suction of the fumes generated in the cleaning section.

The steel strip is heated by a vertical furnace equipped with three heating zones (direct fire zone, radiant tube zone and soaking zone) prior to applying the zinc coating.

The annealing furnace is equipped with a heat recovery system that reduces significantly the amount of gas burnt in the radiant tubes.

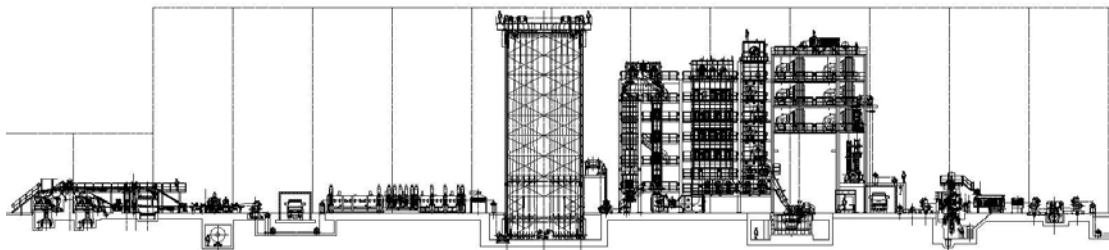


Figure 2. Galvanizing coating line section view drawing.



Figure 3. Overall view of the entry section.



Figure 4. Loooper tower.



Figure 5. Vertical process furnace.



Figure 6. Process section.

Zinc pot and air knives equipment

The zinc pot is single type and is used to keep the pure zinc at the proper temperature for the strip galvanizing process.

The wiping equipment shapes and directs a sharp and uniform air jet which measures the metal coating to produce the desired uniform coating weight. The streamlined design permits the most efficient performance in both low speed/heavy coat weight and high speed/light coat weight operations. Nozzle gap openings are easily adjusted to optimize performances.

After the zinc pot, the cooling tower and the spray-type water quench reduce the strip temperature to less than 40°C to allow elongation in the Danieli Wean United skin pass mill section.



Figure 7. Air knives system.



Figure 8. Zinc pot area.



Figure 9. Process control pulpit.

Surface conditioning mill and tension leveller

The introduction of surface conditioning mills has brought radical improvements in the quality of hot-dip coated products. The Danieli Wean United mill design produces uniform finishes for painted products and allows the use of two different work roll diameters. The surface conditioning mill is designed to work in dry and wet mode. The rolling detergent present on the strip surface is removed in the high-pressure cleaning tank located downstream the mill.

This part of the process section, which also includes a Danieli Wean United tension leveller, is designed to allow mill roll and leveller cassette changing during line operation.

A Danieli Wean United tension leveller produces flat products, by eliminating edge waves, center buckles, crossbow and coil off-set.

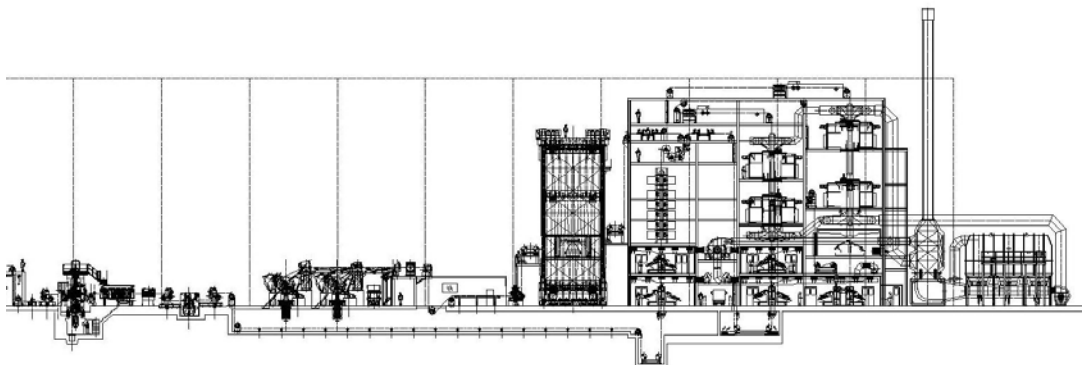


Figure 10. Galvanizing coating line section view drawing.



Figure 11. Surface conditioning mill.

Painting section

A by-pass system directs the strip either to the painting area or directly to the exit looper and exit section. The zinc coated steel strip is centered to the line axis by a two-roll steering unit located before each couple of roll coaters (for chemical and for painting). Chemical coaters are installed before the coating ovens to prepare the surface to be painted. There are two chemical roll coater systems, one used for passivation and the other for the application of antifingerprint solution. The chemical roll coaters are placed in a ventilated cabin in order to guarantee optimum conditions for the operators. The oven furnace is infrared type with PMT 120°C complete with fume exhaust system.

The painting area is equipped with two coaters for the “primer” and two coaters for the “finish”. All coaters are controlled through servomotors in order to guarantee the optimum control for the painting process also at high speed. A special IR furnace is used to cure the paint. The peculiarity of this furnace is the reduced space required compared to traditional ovens. This allows to design a vertical painting section capable to run up to 180 mpm. The new curing technology offers a high degree of operational flexibility. E.g heat up and shut down of the facility from cold to start take less than 1.5 min. Dynamic power response (within 2-3 s) allowing instantaneous power adaptation to actual coil geometry (thickness, width, materials). The temperature profile is homogeneous across coil width, so that curing temperature is kept within a tolerance closer than +/- 5 K also with transient coating operation. Thanks to high-performance RTO (regenerative thermal oxidizer) system the emissions are kept continuously under the European admissible levels and the gas consumption for the innovative painting section is kept to a minimum.

With this configuration different colors can be applied to the strip surface. The coater configuration allows quick color changes from one coil to the next without line stoppages and dummy coils.

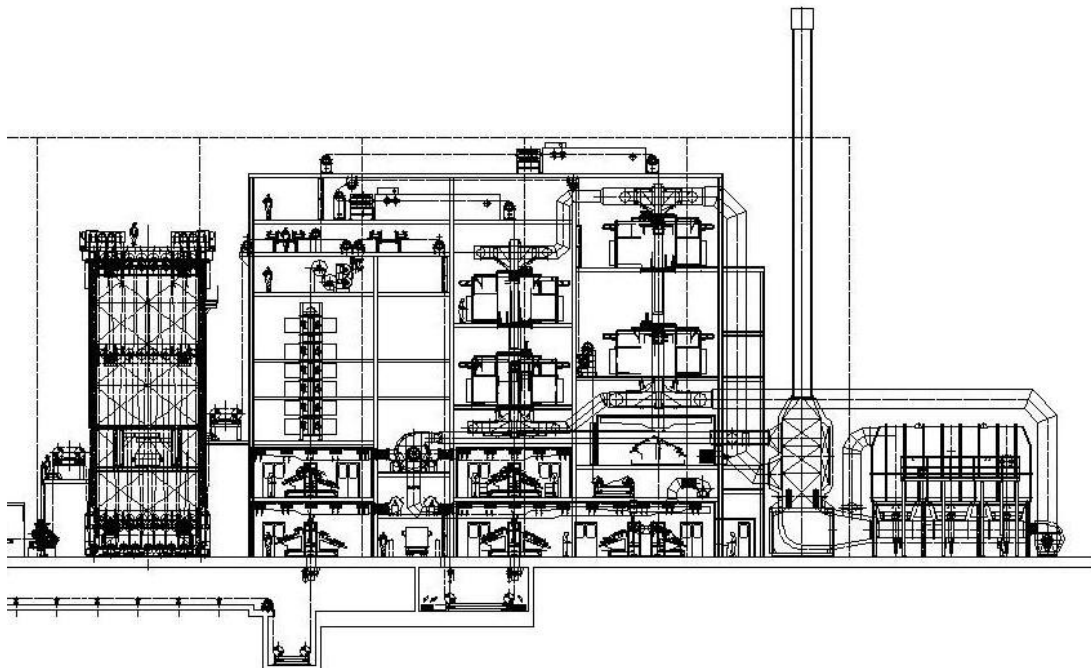


Figure 12. Painting line section view drawing.



Figure 13. Painted strip



Figure 14. Exit strip looper

Exit section

The exit end includes a vertical looper with associated bridles, an inspection station, the electrostatic oiler, the exit shear with scrap and sample handling equipment, the recoiler and the coil car. An exit walking beam conveyor transfers the coils to the weighing area and to the automatic banding machine, in order to apply radial and circumferential strap banding to the coil.

Conclusions

A Hot Dip Galvanizing line combined with a color section offers the following advantages:

- Reduction of over all investment in terms of building, civil works and line equipment
- reduction in line operators (8 operators for the combined line, 13 operators for the stand alone lines)
- reduction in operating costs for intermediate storage and handling
- reduction in coil process time from one week to one hour
- plant flexibility to produce either galvanized or painted material
- usually in a stand-alone color coating line, it is necessary to use a dummy coil to prepare the new process set up when changing color or strip dimension; in this line everything becomes easier and faster
- lower environmental impact, because oiling of the strip, which is normally used in stand alone galvanizing line, and consequent cleaning at the entry of the painting line, are not needed

Thanks to the new curing technology it is possible:

- to obtain high flexibility for processing different strip dimensions and coating composition in painting process
- quicker restart after line stop: less than 1.5 min

- fuel and power savings during line operation compared to conventional technology
 - enhanced environmental solutions
- This innovative Galva painting line is the answer to customers' requests: flexible line with high throughput, capable to reduce production costs and complying with safety and environmental regulations



Figure 15. Painted Coils

References

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