



Plant and equipment for colour coating aluminium

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Aluminium is a perfect substrate for colour coating, given its flat matt finish and high corrosion resistance. There are several types of aluminium coating from lithographic for printing through to lacquering for can stock. However, for colour coating of aluminium we will focus on applications for the construction industry. Aluminium consumption in this area is growing due to its weight differential compared to steel making it suitable for long span roofing sheets, sandwich panels, composite panels and many other construction applications.

Methods of coating aluminium for construction applications are typically similar to that of steel, however the sensitive surface, soft alloys, different micro structure and conductivity means some subtle differences must be considered when designing equipment for coating aluminium. The points below are aimed at highlighting these requirements.

Stitching/slivers and Roll Cleaning

As with all continuous process lines it is necessary to join the aluminium coils. To do this a mechanical stitcher is used (see Fig 1), however unlike Steel, aluminium is prone to creating slivers during the stitching process. Air blowing systems can reduce these and the level of carry over. It is however preferable that roll cleaning is also included throughout the line to reduce any further carryover along the line. Scraper blades applied to each roll on the entry accumulator tower provides a significant reduction in line contamination, however individual roll cleaners on the covered bridge rolls optimises line cleanliness and performance on highest quality coatings (see Fig 2). Both of these items can be retrofitted to existing lines where cleanliness is an issue.



Fig 1 – Mechanical Stitcher

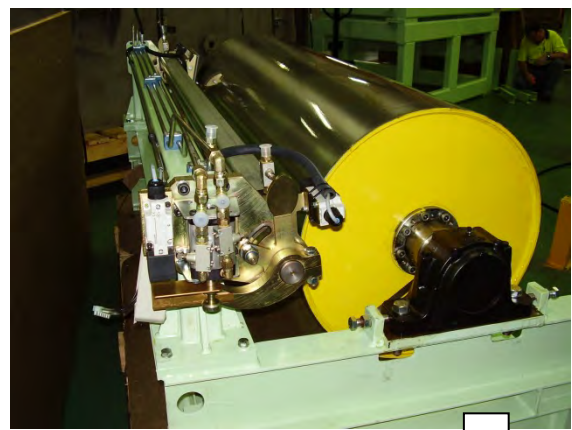


Fig 2 – Roll Cleaning

Tension Levelling – 6 high (Bronx UK)

As aluminium is supplied cold rolled, (unlike steel which is often levelled in the galvanising line before colour coating), it is regularly supplied unlevelled. It is therefore common to see tension levelling in the continuous process sections of an aluminium coating lines. This avoids marking due to stopping/starting of the strip in the levelling machine and ensures optimum surface flatness and condition prior to coating (see fig 3). Once again due to aluminium's surface sensitivity and the soft alloys a 6 high levelling roll cassette is required.

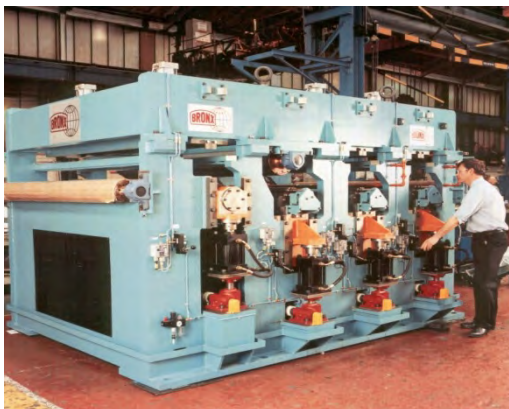


Fig 3 – Tension Leveller

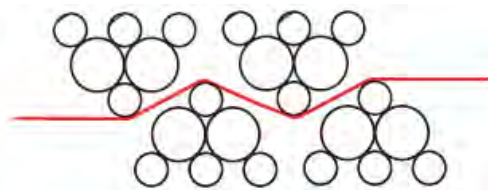


Fig 4 6 High Roll Configuration

This design avoids any 'tram-lining', a marking problem that can be seen on the strip (and potentially through the colour coated product) created by back up rolls contacting the works rolls, which is eliminated by use of the 6 high machine design (see Fig 4) by the addition of intermediate rolls.

Strip Cleaning (Cleaning Sections) and Pre-treatment

In general, cleaning sections (see Fig 5) for steel and aluminium are similar if not the same in construction. Aluminium is usually supplied oiled but often this is dry and easily removable with alkali



Fig 5 - Cleaning Section

based cleaner. Many older aluminium lines were set up with only one cleaning tank, however an additional tank combined with hot rinses and a well-designed cascade system can both limit water consumption and volume of effluent requiring water treatment prior to disposal. The major difference in an aluminium cleaning section is the absence of a brush scrubber that is more typically required for cleaning steel.

Today, many pre-treatment chemicals are universal for both steel and aluminium and a move to chrome free products is being driven by environmental legislation. The use of roll coaters (Fig 6) can allow for improved chemical application, reducing chemical consumption and provides a more accurate coating. With both roll coating and spray/squeegee systems dry-in place



chemicals are preferred today. This avoids any post rinsing again reducing effluent levels from the line and environmental impact.

Coating – (3 roll heads, PVDF's)

Generally coating heads are the same for colour coating of aluminium or steel. However the high quality demands of the architectural aluminium products, which often request PVDF coatings dictates that 3 roll coating heads (with metering, pick up and applicator) are included (Fig 7). Flexibility in head design allows versatility in coating applications, ensuring forward coating/reverse coating, tray feeding and nip feeding to suit paint and required surface finish.



Fig 7. 3 Roll Coating Head



Fig 8. Pattern Coated Aluminium

In recent times coated aluminium has become a choice material for decorative construction products, especially in curtain walling/cladding around new modern buildings. This has led to an increase in demand for patterns. Application of patterns using inks or paints with a protective clear coat can both differentiate the product and increase its use as a substitute for other materials. Wood grain is the most common pattern (Fig 8) but increasingly the market is demanding other effects as producers' look to create a niche product when compared with their competitors.

Pattern Coating can be achieved by several different production techniques. Rotary screen print is one that offers flexibility of patterns but has a high investment cost requiring a high volume line/demand to justify this investment. Bronx uses a rotogravure process, as this can be readily integrated into new lines or retrofitted to existing coating technology at much lower costs than alternative processes, but still providing equivalent products.

Curing Ovens

Aluminium colour coating lines can use gas convections, floatation and electric infra red ovens. As aluminium has a higher conductivity than steel it reaches the desired PMT (Peak Metal Temperature) quicker. This means that for a dedicated line, smaller burners or electrical power can be used than that required for steel, however the desired dwell



and thus length of the oven will be determined predominantly by the coating not the substrate.

Care must be taken using infra-red curing ovens, as an uncoated surface (common on the reverse side of coated aluminium products) can reflect the IR wavelength and reduce the ovens effective heating capability, resulting in under cure of the coating.

In high speed aluminium lines, air flotation may be preferred due to its shorter oven lengths when compared with convection ovens. This is especially beneficial on high speed light gauge applications where risk of strip breakage in the oven is increased.

Cooling and Quenching

Cooling of aluminium strip prior to quenching with water is a critical part of the line design. In aluminium coating lines this is typically done with ambient air being applied to the strip at either the exit zone of the oven or in a separate air cooler located after the oven and prior to the quench. This is necessary to avoid thermal shock created by too rapid cooling of the strip resulting in a metallurgical change that induces strip shape. Air cooling is used to reduce the strips PMT (Peak Metal Temperature) to around 150-170 deg C. The added benefit of this is seen when incorporating hot film laminating, typically requiring a strip temperature around 180 deg C.



Water quenching ensures that the colour coated strip is not recoiled at too high a temperature. This can lead to coil collapse, blocking and marring, common defects associated with poor temperature control. Water quenches are similar for both steel and aluminium, however aluminium will cool quicker and it is imperative to have even cooling by water, as hot spots can create defect patches on some coatings, especially PVDF's which are commonly used in aluminium colour coating.

Line Tensions

Tension control in the strip is a critical aspect of any process line, however aluminium requires a high degree of control, especially for lighter gauges. Aluminium colour coated product can be as light as 0.18mm (equivalent to 0.06mm steel). Strip tear offs/breaks will occur unless excellent tension control is applied. This is done by the lines bridles using rubber covered rolls. However, in some applications the use of tungsten coated rolls may provide increased coefficient of friction, improving performance, reducing slip and improved strip tension control.

It is important when considering any process line design to be realistic about the gauge range to be processed, however this becomes more critical for aluminium, as roll sizes and motors power need to be optimised to provide satisfactory performance throughout the gauge range.

Metal Embossing & Lamination

Colour coated aluminium offers a multitude of different finishes by variation of coatings applied. These can be further enhanced with the introduction of metal embossing that presses a pattern in to the surface of the coated aluminium. Whilst this can be used for aesthetic purposes, it also offers the

advantage of increasing the materials rigidity. In certain applications, like roofing, this can increase the coated sheets load bearing capacity, allowing a lighter gauge embossed material to do the same job as a heavier gauge non-embossed product. It also covers minor surface defects that would be apparent on a flat sheet and result in a reject for visual reasons, therefore reducing line yield.



Lamination is often used as an alternative to colour coating/patterning, as it allows PVC, Polyester and PET films to be glued to the surface of the strip. These pre-printed laminates come in varying thickness and patterns. They can offer a greater scope of designs to that produced by pattern coating but for large volumes costs can be higher than a standard pattern coating process.

Combinations of laminates with subsequent embossing can again produce varied and interesting effects that stimulate an architect's imagination and it is these niche products that are gaining in popularity for both steel and aluminium coated products globally.

In Summary

Colour coated Aluminium offers a versatile product for the construction industry. Equipment designs and supplier selection needs to be carefully considered, as this is a high value product being coated with expensive coatings and finishes. Incorrect line design can result in much lower production yields than predicted by creating high scrap levels or inability to process full product range. Lines can operate effectively, subject to market conditions, from 5,000 tonnes/annum up to 60,000 tpa. End users product demands are constantly changing, quality levels are being raised and therefore selection of the right plant and equipment will ensure aluminium coatings lines sustainability in to the future.