DIE BIBLIOTHEK DER TECHNIK 233

Aluminium Rolling Mill Technology

Future concepts in thin-strip and foil rolling

VERLAG
MODERNE
INDUSTRIE

Achenbach Buschhütten

Contents

Basics of aluminium rolling mill technology

Flat-rolled aluminium from slab to foil

The production of aluminium flat-rolled products can schematically be divided into four major steps as shown in Figure 9.

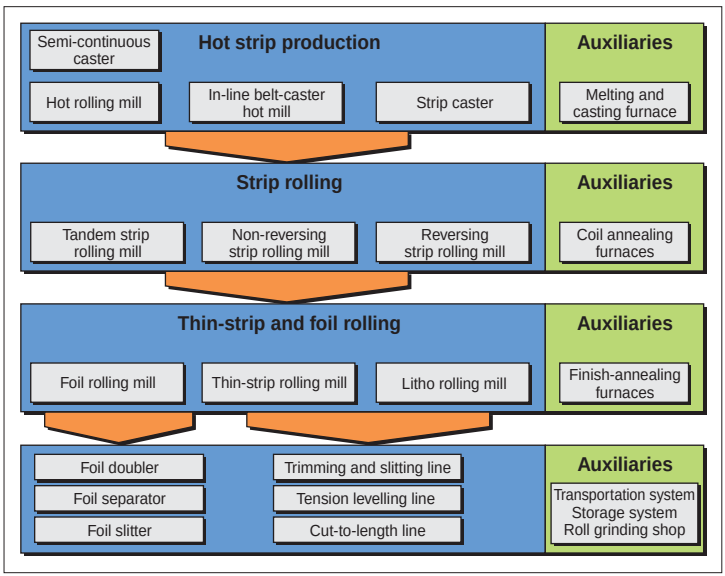

Fig. 9:
Major steps in the production of flat-rolled aluminium

In step 1 – the *hot strip production process* – traditionally the molten metal is cast after refining and alloying processes into 10 to 25-ton slabs in semi-continuous casters, then preannealed, hot-rolled in single-stand or tandem hot rolling mills and, at a strip thickness of 6 to 2.5 mm, coiled at a temperature of approx. 300°C (Fig. 10).

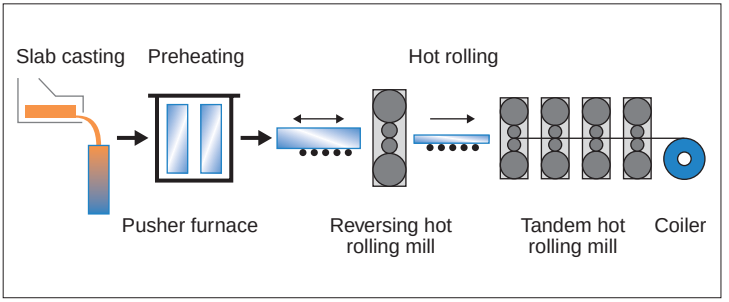

Fig. 10: Conventional hot strip production

More economical in terms of energy saving is the direct casting process into strips of 12 to 20 mm thickness in twin-belt casters with a continuing hot rolling process in a tandem hot rolling line at an hourly production rate of 25 kg per mm width. The suitability of this process is restricted to a limited number of alloys allowing a quick cooling without segregation.

Hot strip production

The third and most economic way is hot strip casting between two rolls in a so-called twin-roll caster with an exit thickness between 6 and 3 mm at low speed (Fig. 11). This casting method can also only be used for pure aluminium or material with a low alloy content for the production of foil.

All three different hot strip production methods have advantages and limitations in terms of material quality, productivity, en-

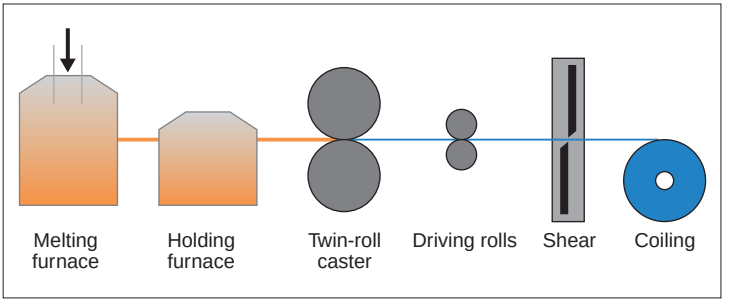

Fig. 11: Twin-roll caster for hot strip production

ergy and labour intensity. The investment and operational costs are also key factors for the final decision about the optimum solution.

Cold strip rolling

After the hot strip production in step 2, the *cold strip rolling* starts. Even though this deformation process is called "cold" rolling, the strip is heated up to approx. 100°C during each pass and large quantities of coolant have to be poured over the rolls to keep a thermal equilibrium. After each of the three to four

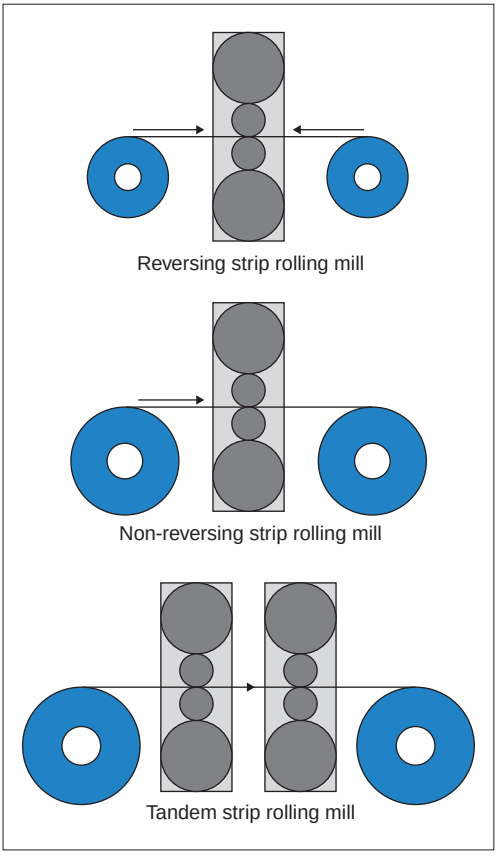

Fig. 12: Different types of strip rolling mills

passes, the coils have to be cooled down to room temperature for several hours.

Material hardening

During each cold rolling pass, a material hardening is effected by the deformation process of the strip. Depending on the grain structure mainly influenced by the alloy composition, one or two annealing sessions for recrystallisation have to be integrated into the production programme to permit a continuation of the rolling passes and to fulfil the final requirements of the product specification.

The strip rolling process itself can be done with different types of rolling mills (Fig. 12). For small coil weights up to 5 tons, reversing rolling mills are still used. For normal coil weights between 10 and 15 tons, non-reversing single-stand rolling mills are common. For high coil weights up to 25 tons, and large production volumes, multi-stand tandem rolling mills are used.

Thin-strip and foil rolling

Step 3 – *thin-strip and foil rolling* – is the finishing operation for nearly all flat-rolled products on non-reversing single-stand rolling mills. Either universal rolling mills or groups or lines of two to five rolling mills are used.

The thin-strip rolling mills used for the production of can stock provide extremely narrow strip gauge and flatness tolerances. Lithogra-

Fig. 13: Foil rolling mill with double decoiler

phic sheet rolling mills, in particular, fulfil high demands on the strip surface. Foil rolling mills are the most accurate in gauge and tension controls. All rolling mills used for these different purposes are equipped with specific components to ensure the quality requirements. The last pass of foil rolling is done with a double web (Fig. 13). This requires a doubling operation of foils after the penultimate pass and a separating operation after the last pass. The finished foil typically consists of a shiny and a matt side. Both sides are used for different printing images in a later stage.

Foil rolling: an aluminium-specific process

Foil rolling is an aluminium-specific process. No other material can be rolled down to a thickness of 5 or 6 µm. Taking into consideration that a human hair has a diameter of about 12 µm, finished converter foil has about half of this (Fig. 14). Foil rolling mills manage to be twice

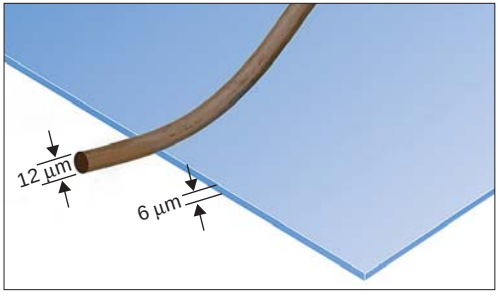

Fig. 14: Thickness of light-gauge foil

as accurate in their controls as a wristwatch and use deformation forces of several hundred tons.

Slitting operation

Step 4, the last step of the production line of flat-rolled products, is the *slitting operation* of wide-rolled thin strips and foil. Aluminium strip and foil has to be supplied on spools specifically tailored to the downstream production processes. High-speed slitting and winding machines with very accurate slitting geometries have been developed for these purposes.