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Influence of Production Sequence of Aluminum Alloy Hot Rolling on Strip Surface Quality

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Abstract: With the intensification of market competition in the aluminum alloy strip processing industry, it is difficult to control the mass production of the same specifications, which is bound to affect the hot rolling production. This paper studied the effect of the hot rolling order of aluminum alloy on the surface quality of strip, such as roll printing, color difference, anodic oxidation, etc., reasonable discharge sequence and corresponding optimization measures were formulated.

Keywords: hot rolling; production sequence; surface quality; aluminum alloy; chromate treatment

Introduction

At present, the domestic aluminum alloy hot rolling production technology is relatively mature, and the number of aluminum alloy hot rolling lines is increasing year by year. After 2010, as many as 27 new hot rolling production lines have been built, the competition for domestic aluminum hot rolling products is becoming increasingly fierce. In order to better adapt to the market and compete for output, the production and processing of hot rolling can no longer meet the mass and specialized production mode [1]. Therefore, it is necessary to cope with the fast production rhythm of alloy and specification changes, which in turn has a significant impact on the utilization of hot rolling capacity. This is because from the perspective of ensuring surface quality, it is necessary to frequently replace the rough and finish work rolls, clean the roller table of the rolling line, and adjust the lotion concentration [2], which leads to the production process is not smooth, thus increasing production costs and losing competitive advantage. This article studies the impact of hot rolling production sequence on the surface quality of different alloy strips, optimizes the hot rolling production sequence, and prevents it in advance to create relatively batch and specific conditions for hot rolling production, in order to maximize productivity and have a profound impact on the production capacity of hot rolling.

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1 The influence of alloy sequence on surface quality

The rolling sequence of alloys has an impact on the surface quality of hot-rolled products, mainly manifested in the cleanliness of the coil surface after hot rolling and the quality of anodizing after hot rolling. When rolling 1 series soft alloys, relatively less aluminum powder is produced during the rolling process, while when rolling 5 series hard alloys, especially aluminum alloys with magnesium content>3.0% such as 5182 and 5083, more aluminum powder is produced. A part of the aluminum powder produced is taken away by the lotion during rolling and returned to the lotion system; The other part remains on the surface of the strip, resulting in an increase in the ash content of the lotion, a dirty lotion, more aluminum powder on the surface of the strip, and a decline in the surface cleanliness of the coil after hot rolling. This can be seen from the comparison of lotion ash content and strip gray scale of different alloys after rolling 60 pieces, as shown in Table 1.

The main reason for this phenomenon is that when rolling 5 series hard alloys, compared to 1 series alloys, there is more surface magnesium oxide during the rolling process, and there is a certain roughness on the surface of the rolling rolls, which scrapes away and peels off the surface metal of the strip; In addition, when rolling 5 series alloys, the deforma-

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Table 1 Comparison of ash content and grayscale of 60 rolled blocks of different alloys

alloy	Ash content of lotion/ppm	Aluminum alloy strip gray/ level
1050	655	2
5005	722	3
5052	750	3
5182	998	5

tion heat is relatively high, and the surface temperature of aluminum alloy strips increases sharply in the rolling deformation zone, exacerbating the production of alumina and magnesium oxide. These phenomena are manifested in the rolling process of 5083 alloy, where there is yellowing on the surface of the intermediate billet of the strip.

In addition, during the rolling process, as the amount of aluminum powder increases, the probability of producing black stripes will greatly increase, and the anodizing effect of the coil will deteriorate. Therefore, if the production of the 1-series alloy is arranged after the 5-series alloy, the anodizing quality of the 1-series alloy cannot be guaranteed, and it cannot be used for products with high anodizing quality requirements, such as CTP.

Therefore, when arranging the hot rolling production sequence, the rolling sequence from soft alloy to hard alloy should be followed. When switching from hard alloy to soft alloy, oil shall be skimmed in time to ensure the cleanness of lotion, and roll shall be replaced properly to ensure high surface quality.

2 The influence of ingot width sequence on surface quality

The rolling sequence of ingot width has an impact on the surface quality of hot rolling, mainly manifested as the color difference on the surface of the coil after hot rolling and the impact on the quality of anodizing after hot rolling.

Generally speaking, like cold rolling, the width of the ingot should be rolled from wide to narrow specifications. This is mainly because during the rolling of narrow specifications, the edges of the strip will produce imprints on the rolling rolls. If switched to wide specifications, it will affect its surface quality.

However, the width variation of hot rolling has a much greater impact than that of cold rolling. During the hot rolling process, the temperature of the strip can reach over 400 ℃ [3], but the temperature drop at the edges is greater than in the middle, and the temperature at the edges is relatively lower. In addition, in the process of casting production control, there are relatively more edge quality defects and more hard spots, which further exacerbate the damage to the rolling mill caused by the edge of the strip. The damage to the rolling mill will further deteriorate the edge quality. Under normal circumstances, the edge areas of hot rolling will be cut off during the edge cutting process, which will not have a significant impact on the quality of the hot rolled strip. When rolling narrow specification ingots and then rolling wide width ingots, this effect will be amplified: the edge imprints will be inherited to the wide specification, causing color difference on the surface of the strip and poor quality of anodizing. Therefore, such phenomena should be avoided during hot rolling production scheduling.

3 Other optimization measures

To ensure good surface quality of hot-rolled aluminum alloy strips, the production sequence must follow the above principles to ensure the stability of product quality. However, as mentioned earlier, due to other factors such as product specifications, customer demands, and delivery times, hot rolling production scheduling sometimes cannot fully adhere to the above principles. This requires other preventive measures to improve and optimize production conditions, in order to minimize quality risks.

3.1 Use of rolling rolls

When it is inevitable to roll 1 series alloy after rolling 5 series alloy, the precision rolling work roll can be replaced and a new roll can be used for rolling. After replacement, the surface quality of the new roller is good, and the aluminum powder on the roller surface is almost zero, which can ensure that a large amount of aluminum powder will not be pressed into the surface of the strip during the rolling process. Of course, if the rough rolling work roll is replaced, the effect will be better, but it will affect production efficiency.

3.2 Use of roller brushes

When it is inevitable to roll narrow specification ingots before rolling wide width ingots, the roller brush can be inserted before production to wash the roller surface, reduce aluminum powder on the roller surface, and reduce edge imprints. During the brushing process, the lotion lubrication of the work roll and the lotion lubrication of the roll brush will also impact the aluminum powder on the roll surface, enhancing the brushing effect [4].

3.3 Use of chrome plated rollers

By replacing the rollers, the impact on the product during the rolling process can be reduced, but it can also affect the production efficiency of hot rolling and increase the frequency of roller replacement; However, the use of roller brushes before rolling has limited relief. By using work rolls for chrome plating, the problems of the above two measures can be effectively solved. Chromium, due to its high hardness, wear resistance, lubrication, conductivity, oil and water repellency, and corrosion resistance, is used on the surface of rolling rolls to change the surface hardness and wear resistance of the rolls. In particular, it delays the decrease in surface roughness of the rolls, improves the uniformity of surface roughness of aluminum alloy hot-rolled coils during the rolling cycle, enables free rolling, and reduces the number of roll changes caused by product specifications, thereby increasing the roll throughput and reducing the number of roll changes, And improve the surface quality of the

product [5].

The surface roughness of a typical rolling mill decreases the fastest when the throughput reaches 60 pieces, and has dropped to 1.0 when the throughput reaches 120μ M; When the chrome plating work roll reaches a throughput of 300 pieces, its roughness is still greater than 1.0μ M. After chrome plating, when the rolling process changes from narrow to wide, there are no obvious roller marks, imprints, color differences, etc. in the edge area of the original narrow specification on the roller surface, which can better ensure the surface quality requirements.

4 Conclusion

(1) The production sequence of aluminum alloy hot rolling has a great impact on its surface quality, especially for products with high requirements for anodizing and surface color difference control. Therefore, in the process of production scheduling, the principle of alloys from soft to hard and specifications from wide to narrow should be followed. (2) When production cannot be scheduled according to the above principles due to practical needs, corresponding measures must be taken to improve surface quality. The main measures are roll replacement, roll brush use and roll surface lotion cleaning. (3) By using chrome plated work rolls to improve the surface quality of the rolls, not only can the throughput of the rolls be increased, but also the impact on the surface of the strip can be effectively reduced when switching rolling specifications.

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