DEVELOPMENT OF IN-LINE ISO-THERMAL COOLING TECHNOLOGY IN WIRE ROD MILL*

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Abstract
Softening heat treatment of CHQ alloy steel (Cr-Mo Steel) is a bottleneck process that requires 90% or more of the entire manufacturing process. In order to reduce the property deviation between edge and center and remove the low-temperature structure problems, CHQ products is heat treated by customers. This technology comes from the idea to solve the problem by applying the concept of “In-line isothermal transformation through initial quenching + heat source addition. Consider the stability of field operations, durability from high ambient temperature and fall of scale, Instantaneous heating and cooling control was required for the conversion of slow cooling and rapid cooling products. An electric heating system was applied to the underside of Stelmor air-cooling nozzle. Using the Scan Pyrometer, the feedback control was performed and fine temperature control was performed through the thermocouple by zone. Through the this technology, it is possible to develop and expand products that can be shortened or omitted by the heat treatment process of customers.
Keywords: Wire Rod; Cooling; Stelmor; Heat treatment

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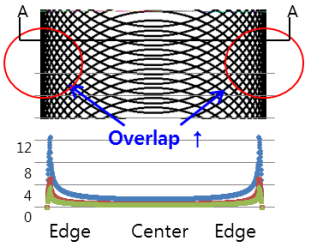
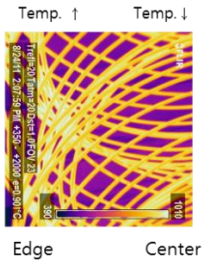
1. INTRODUCTION

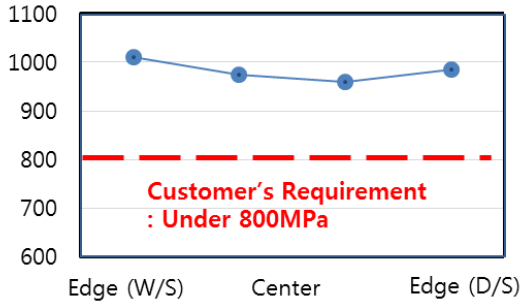
In the cooling process of wire rod, slow cooling material exceeded the strength required by the customer due to overcooling, and the material property has deviation. This material deviation was caused by the difference in cooling rate due to the difference in degree of overlap between the coil edge and the center. In order to overcome the problem of overstrength and material property deviation, the customer has been subjected to additional heat treatment.



[Overlap of Wire Rod]



[Temperature of wire]



[Tensile Strength, MPa]

2. RESEARCH CONTENTS

In order to reduce the overstrength and the temperature variation of wire rod, POSCO's own slow cooling facility was developed.

This is to install the heating system at the bottom of the wire rod so that the heat treatment process of the customer can be omitted or shortened.

The progress of facility development is as follows.

First, the optimal position and length of the heating system were calculated.

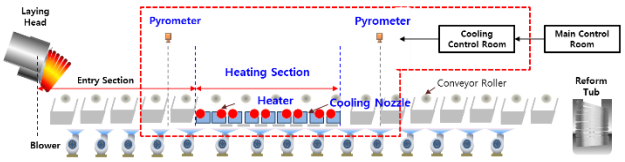
The conditions for the iso-thermal transformation in the in-line are derives. That is temperature, time and moving speed of wire rod. The length of the facility was also determined.

The second, to heat the lower part of the coil center directly, an electric heater was installed. The maximum heating temperature was determined.

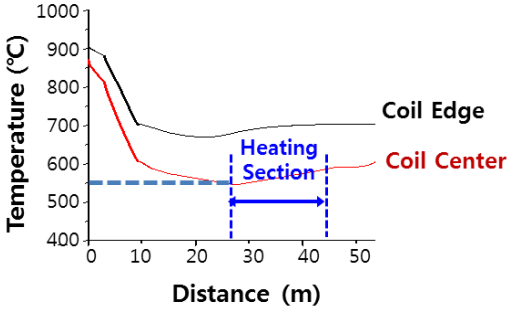
This makes it possible to reduce the deviation of coil width direction and upper and lower direction, and instantaneous heating for the conversion of slow cooling material into the rapid cooling material is possible.

Third, the cooling nozzles were optimized. It was possible to minimize the heat loss from the lower part by changing the existing cooling plate material from steel plate to refractory brick material.

Finally, a scanning temperature measuring system was installed to measure the temperature of full width of wire coil and the special measurement algorithm was developed. This algorithm is to measure edge and center part of wire coil temperature and void space temperature separately. Using the Scan Pyrometer, the feedback control was performed and fine temperature control was performed through the thermocouple by zone.



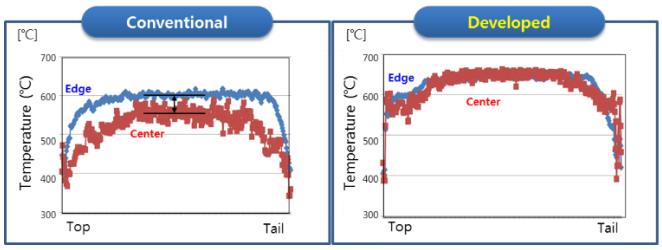
[Layout of in-line heat treatment process]



[Cooling Curve]

3. RESULTS AND CONCLUSION

As a result of the production test for the equipment capability verification, the temperature deviation between the coil edge part and the center part was reduced than the conventional.



[Coil Temperature distribution]

In addition, Tensile Strength has also met customer requirements and has significantly improved variability (Table 1).

Table 1. Material Properties

Steel Grade	Conventional (TS/Dev.[MPa])	Developed (TS/Dev.[MPa])	Customer's Requirement (TS[MPa])
SCM435	987 / 62.3	676 / 16.5	Under 800