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The Effect of Laying Head Temperature on the Structure and Formation of Scale in Special Alloy Steel Wire Rods during Hot Rolling

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ABSTRACT

In the present work,Influence of variability laying head temperature on the structure of scale in special alloy steel wire rods during hot rolling and form of oxide in scale were observed.The scale formed was analysed using optical metallography and SEM(Scanning Electron Microscope). It was observed the decreaces of laying head temperature showed reduction in scale.

Keywords: Scale, Special Alloy Steel, Hot rolling

INTRODUCTION

Oxide scales,which are created on the surface of steel wire rod during the wire rod rolling. In the present case scale have to remove before processing like wire drawing.Pickling process are preferring for de-scaling with HCl before wire rod rolling.[1].In that case cooling rates and laying head temperatures were optimizated for reducing scale oxide layer thickness and preparing to next step.It is known variability of cooling conditions effect to grain size of coil and oxide layer thickness[2].There are two kind of iron oxide ;one of them primary scale,another one is secondary scale.The primary oxide is created in re-heating furnace before wire rod rolling on the surface of steel billets and removed. However,together with wire rod rolling ,secondary oxide is mainly-but not only-formed after laying at the air cooling conveyor but also during the rolling itself.Iron forms with oxygen in all the 3 different oxides:wustite(FeO),magnetite(Fe3O4) and hematite (Fe2O3)[3].As expected,there is an increase in the oxide scale thickness with increasing time of exposure and oxidizing temperature.At ~1800 seconds exposure,the oxide thickening reaches a maximum rate at all temperatures except 650°C.After this point the oxidation rate slows and the thicknesss of the scale remains approximately constant or grows very slowly[4].In the present work,create receipt for adjust temperature which is the from laying head to reformer tub as 600 °C observing of reducing of scale thickness from laying head to reformer tub was aimed in those conditions.Conditions are changed for cooling rate as increase ,for laying head temperature decreasing. The oxide scale is predominantly two-layered, with an outer layer of magnetite and an inner layer of wustite. The wustite layer takes up about 2/3 of the oxide layer in thickness. [5].

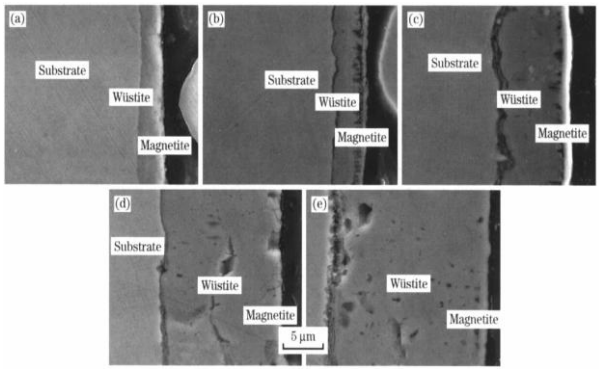

Fig1. *Oxide scales formed at different temperatures for 15 s.a)800 °C b)850 °C c)900 °C d)950 °C e)1000 ° [5].*

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MATERIAL AND METHOD

The material used for this study ,chemical composition is %C=0,21-0,22,%Si=0,11-0,12,%Mn=1,02-1,05 %B=0,0030-0,0033 and dimensions are 150 mm x 150 mm x9000 mm

The steel billets which are given chemical compositions and dimensions were re-heated 1100 °C-1150°C and rolled to 10 mm wire rod.Production laying head temperatures were changed(different laying head temperature) ,cooling rates was fixed for reach to 600°C. cooling rate was adjusted with to change conveyor speed, to change combination of fans which are under conveyor and laying head temperatures were adjusted to change pressure of waterboxes.The temperature was measured distance from when temperature reached 600 °C than cooling rates were calculated.

Waterboxes were defined as 'WB'' in Fig 2.layout of wire and rod mill was given Fig 2.

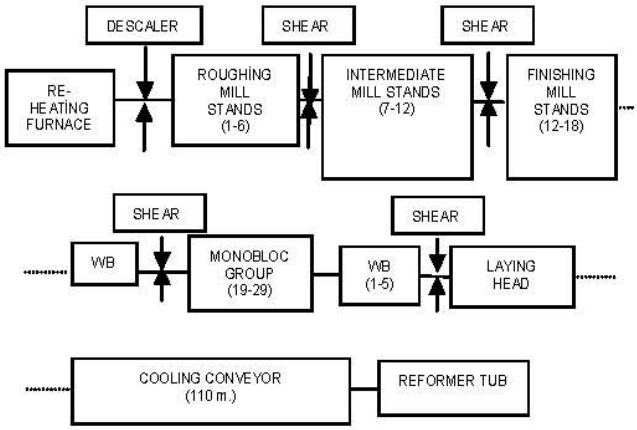

Fig2. *Layout of wire and rod mill*

EXPERIMENTAL PROCEDURES

Random samples were chosen for observe creating of scale on influence of changes of laying head temperature.Wire-rod was produced in conditions of variable laying head temperature and fixed cooling rate.Different laying head temperatures were adjusted with waterbox pressure and cooling rate was fixed with conveyor speed and fans.Scale thicknesses,cooling rate and laying head temperatures were shown Table 1.

Table1. *Production parameters of special quality steel of 10 mm wire rod and scale thicknesses*

Sample	Laying Head Temperature (°C)	Cooling Rate(°C/s)	Scale Thickness(µm)
1	850	0.50	10.59
2	820		8.20
3	790		5.16
4	760		4.40
5	730		4.20

According to results obtained graphic of influence of laying head temperature to scale thickness was shown in Fig 3. .

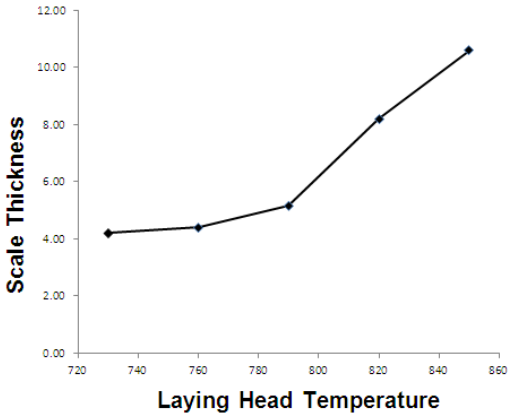

Fig3. *Graphics of laying head temperature and scale thickness*

Optical microscope was used for measuring of scale thickness and SEM(Scaninig Electron Microscope).Fig 4. shows the structure of scale of sample 1 which laying head temperature's 850°C.Fig 5. shows the structure of scale of sample 5 which laying head temperature's 730 °C.Measuring of optical microscope was performed with magnification x1000 and Fig 6. shows sample 5 scale thickness measuring of SEM was performed with magnification x1000.Measurements of optical microscope and SEM was in the same direction.In that case ,results of optical microscope were used in Table 1.

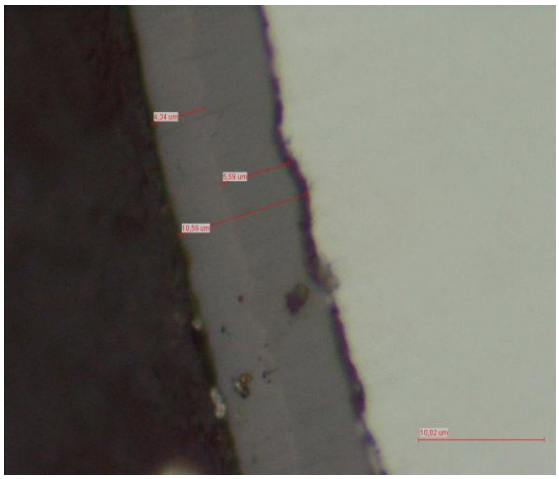

Fig4. *Scale thickness on sample 1 which laying head temperature is 850°C and cooling rate is 0.50 °C/s seen by light microscope with magnification (1000x)*

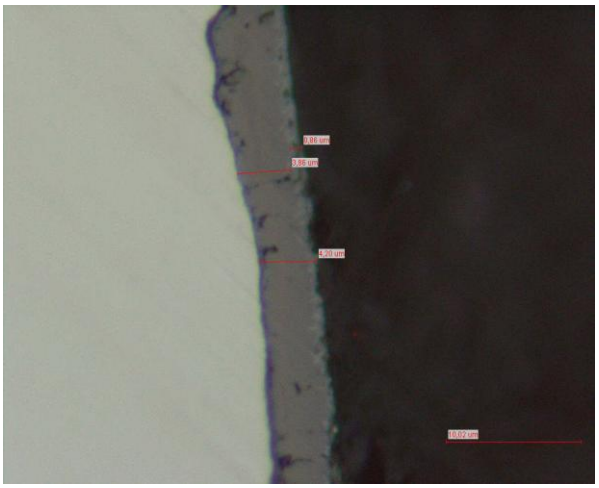

Fig5. *Scale thickness on sample 5 which laying head temperature is 730°C and cooling rate is 0.50 °C/s seen by light microscope with magnification (1000x)*

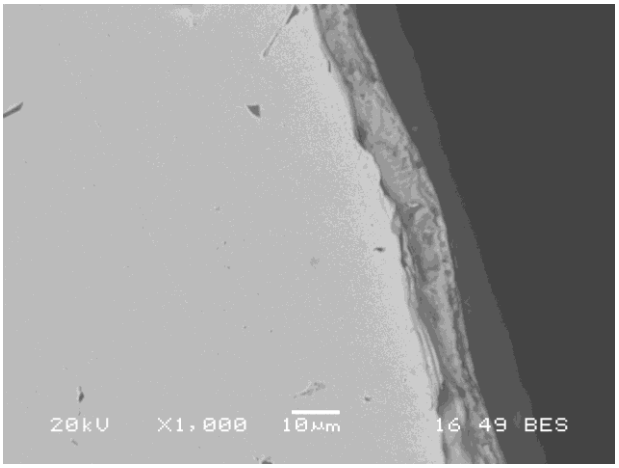

Fig6. *Scale thickness on sample 5 which laying head temperature is 730°C and cooling rate is 0.50 °C/s seen by SEM-BES with magnification (1000x)*

CONCLUSIONS

End of the examination;

1. Scale thickness was decreased in the conditions of fixed cooling rate and low laying head temperature
2. When observing to differences of between laying head temperature and scale thickness ,laying head temperature 760-730°C is optimum value for low scale thicknees
3. Scale thickness was reached maximum value at 850°C of laying head temperature.As is seen Table 1.,in differences of scale thickness between 850 °C and 760°C is 5.43 µm and differences of scale thickness between 760 °C and 730 °C is 0.60 µm and scale thickness was reached minimum thickness nearly at 760-730 °C.After this point the growth of scale thickness was slowed or constant.

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