

The Analysis of the Causes of Cartridge Igniter in Industrial Boiler Water Cooling Wall

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Abstract—In accordance with the large area cartridge igniter of the heating boiler, through the analysis of the vapor sample in the running, and the analysis of the scale components and the metallography of the model test sample of cartridge igniter, the causes of the boiler cartridge igniter from chemistry and the metallography study of the material are discussed, and put forward the effective processing methods.

Index Terms— Water Cooling Wall, Cartridge Igniter, Chemistry, Metallography

I. INTRODUCTION

It is one of the usual accident in boiler that cartridge igniter of the pipe of the boiler water cooling wall, it can straight result in the calling off of the boiler, increasing the overhaul cost of the boiler, and also endanger the security running of the boiler production[1-3]. However, there are a great many complication arose the cartridge igniter of the pipe of the boiler water cooling wall, and one of the most important reasons is the high temperature eroding, but it is always unnoticed owing to the gradually change course of the eroded. So in order to improve the regarding of the related people, analysis is essential.

II. BASIC PHENOMENON OF THE BOILER ERODED

The area of the high temperature eroding of the water cooling wall generally takes place near the centre-line of the burning container, and both slagging and no-slagging boiler are likely to erode, and the speed of the point eroding is the fastest which usually happens on the pipe of the side of the face-fire[4]. The building rate of the exterior oxidize safeguard of the pipe of the water cooling wall is quite inferior to the rate of the high temperature eroding. Currently there are two extrinsic characteristics of the high temperature eroding of the pipe of the water cooling wall: One is the light eroded format that there are many thick deposits in the ectexine of the pipe, which the appearance color is hoar and the within configuration is storied which black sediments inside is more close-grained than hoar outer. The fragile and magnetize outer takes on granule or powder state which united quite unfastness with the black sediments as mechanical flaking off, and presents small pieces state when aparting. There are many hardness black sediment which ply is 0.5mm in the ectexine of the pipe is the other eroding

format which flaking off by itself, and still exists thin black sediment on the pipe face which combined fastness with the pipe after deviated. Both the two sediments all have a high sulfur content which much sulfide and a little sulfate after analyzing. The pipe bed which seems fleck state becomes thinner when eroding mangled [5]. All that illuminated that water cooling wall is eroded in high temperature due to sulfur and other harmful impurities in the boiler running. Moreover, the ash from the burning coal makes the actual reduction of the ply, it fiercely strikes the water cooling wall which forms fearful cutting of the working face of the water cooling wall to many small flats of different extent in the dynamic complicated course of the boiler intestine burning.

III. METHOD AND RESULT OF THE TEST

A. Macroscopically Examine, Analysis of the Chemical Ingredient and Metallographic

Choosing to research the two representative test samples of the disabled samples: A: It crazes through the pipe lengthways and takes on window state near the seam of the water cooling wall. The maximal hatch degree of the lengthways and transverse are 102.36mm and 22.52mm. There is no obviously plastic distortion near the piping, which edge coarseness and fracture brittleness, and there is a clearly reduction of the pipe wall. The picture 1 is the appearance of the sample and the inner surface state is according to the picture 2. B: There is also no obviously plastic distortion near the piping, it crazes through the pipe length ways or transverse that takes on flaw state near the elbow. Within the sample piping elliptic eroded offspring which extrusive inner face and relax texture is in existence. There are many pits on the pipe surface which the distinct phenomenon such as eroded diminution and scale eroded are in existence seems utensil state after wiping off the eroded offspring. The picture 3 is the appearance of the sample, the state of the nearly piping inner surface is as picture 4 showed and the configurations of the metallic floor pipe sample after mechanical elimination the eroded offspring are regarded as picture 5.

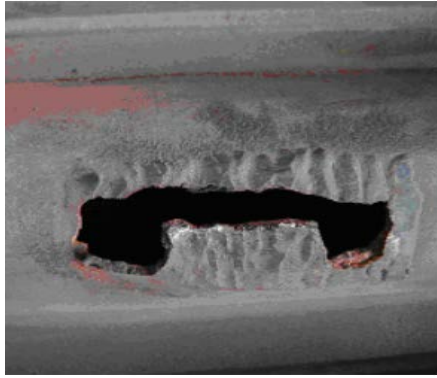


Figure 1. The appearance of window state samples



Figure 2. The inner surface of the nearby piping of window state samples



Figure 3. The appearance of flaw state samples



Figure 4. The inner surface of the nearby piping of flaw state samples



Figure 5. The configurations of the metallic floor pipe sample after mechanical elimination the eroded offspring

B. Scale Examine

1) Macroscopical State of the Scale

We can see the symmetrical and loosen folium of rufous deposit nearby the piping surface of A, and the sediment of the face-fire pipe wall is more than the back against, and we also can see the un-sizable pits which utensil state after scouring off the sediment. There are many dense heaves which diameter among 1-5mm nearby the piping surface of B. The face of heaves is rufous, and the hypo-face is black powder, Peeling part of the eroded sediment off is a kind of salt condensate. There are many different bulk discontinuous pits of utensil state after washing the eroded sediment off by acid. The elliptic eroded offspring which texture relaxed has a 3-23.65mm length and ply of 1-7mm, what is protrude the inner face of the samples near the piping in-wall, and the flaw is in the middle of the eroded pits. There are silvery white metal body, rufous eroded offspring, black Fe₃O₄ and white salt beds of small flaws in the bottom of the eroded pits by mechanical method eliminating the agglomerate eroded offspring, and the maximum depth of eroded pit is 3.1mm.

2) Ingredient of the Scale

The result that analysis the chemical ingredient of the two typical samples deposit within the surface is as table 1 showed:

TABLE I. RESULT OF THE INGREDIENT ANALYSIS IN ERODING AND DEPOSIT

NO.	Na ₂ O +K ₂ O	CaO	MgO	Fe ₂ O ₃	CuO	S qu.
A	0.11 %	2.00 %	0.65 %	87.25 %	6.12 %	226
B	0.96 %	2.22 %	1.89 %	90.29 %	0.46 %	

C. Result of Metallographic Analysis

The result of the metallographic analysis of A and B as follows:

Picture 6 shows the metallography round sample A, the metallography of A are ferrite and farthing pearlite, we can see a mass of flaw which the pearlite nearby seriously decarburization through the crystal.

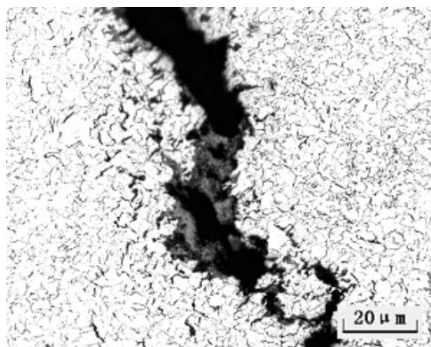


Figure 6. The metallography round sample A

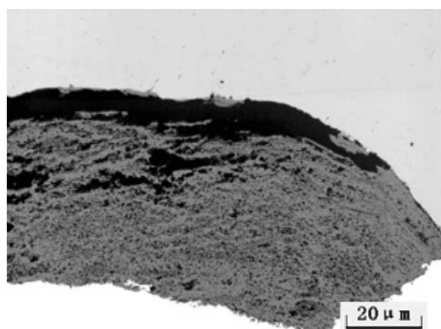


Figure 7. The metallography round sample B (the gray bottom is scale layer, the black middle is the interspace and the top is metallic style)

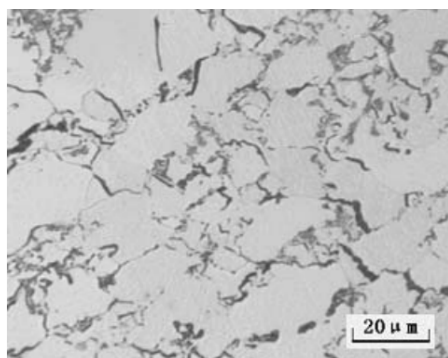


Figure 8. The 600 times (dip in 4% nitric acid alcohol) metallography of sample B

There are large numbers of black strip micro-flaws which distributing through crystal or indwelling the point of pearlite and ferrite in the metal style of the water cooling inner wall round the sample B as picture 7 showed, and there is no eroded offspring in the inner flaw. Mostly of the scale layers are separated from the body, little joints the body. It is clearly that the hydrogenous eroded flaw in the 600 times (dip in 4% nitric acid alcohol) metallography of the picture 8.

IV. DISCUSSING AND ANALYZING

A. Disabled Characteristic of the Pipe Sample

Basing on the analysis results of the experiment above, the basis characteristics of the cartridge igniter of water cooling wall are concluded as follows:

1) The scathe character belongs to the fragile craze, because there is no wriggle and obviously plastic distortion round the sample.

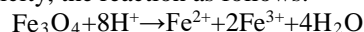
2) The layer configurations of the scale in pipe sample inner surface are consist of the eroded offspring of iron, oxide and kinds of salt. There is an obviously cavum between the scale layer and metal body which exists pits of utensil state after eliminating the scale layer.

3) There are a great number of crystal flaws in the metal body below the scale layer, and the decarburization is existed.

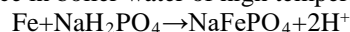
B. Analysis of Causes of the Cartridge Igniter

Summarize the analysis of macroscopical, chemical and metallographic of the pipe sample, the acid eroded brings the hydrogenous eroded scathe is the course of cartridge igniter. There are two aspects that the source of the acid in vapor system: The back-water of over temperature enters the ionic exchange system results in the colophony falling to pieces and heating fission, and the powders of colophony enter into vapor system, with that the sulfon of cation exchange colophony comes into being high acid; Another part is the organic acid which fissiles as minim chemical products entering into vapor system through desalting system. Furthermore, deducing the pH of the boiler water by eroded offspring of high iron content is the other way leads to acid eroded.

Acidic boiler water which dissolving the original Fe₃O₄ protection of water cooling wall possesses high causticity, the reaction as follows:

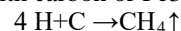


It is quite easily eroded once exposure of the steel surface in boiler water of high temperature.



The erosive boiler water which erodes the deposit enters into the pipe inner wall where the sediment of lacunaris and the interspace of metal body concentrating enrichment. Such as the salt kinds of CaO, MgO, Na₂O and K₂O of boiler water concentrated in the interspace form the eroded offsprings mostly Fe₂O₃.

It is unable diffuses in time that the atomic hydrogen which the metal pipe wall is eroded by acidic medium to vapor mixture. So the hydrogen is accumulated between metal pipe wall and eroded scale, the hydrogen atom diffuses into the metal body and the metal crystal, and then reacts with carbon or Fe₃C as follows:



Therefore the pearlite is decarburization. We can see a mass of crystal flaws round the sample because the power what the low diffused coefficient brings and stress effects. The rapidly reducing of the capability of the metal intensity, tenacity, plasticity and so on owing to the existence of crystal flaw, then the cartridge igniter of hydrogen eroded occurs under the stress effects of boiler medium.

V. IMPROVING AND CONCLUSION

The attain format of above 30-50% of water cooling wall pipes are mostly hydrogen eroded samples as acid eroding, because of the dissolving safeguard. The activated metal owing to the membrane dissolved has to resume passivity after disposal. However, the pipe of water cooling wall which acid eroded ought to examine

macroscopically of the appearance and measure the ply in the period of examining and repairing, and resect the insecure piping. We should check the same part of the other pipes using mensurative apparatus after ensure the reasons of cartridge igniter. Above all, we conclude consistently that the causes of the boiler invalidation from chemistry and the metallography study of the material, and put forward a new way of the metal material of boiler in invalidation.

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