Slurry Pipe Wear detection by Infrared Thermography: Case of Cyclone Underflow Pipe in Kinsevere Process Copper Plant in Democratic Republic of Congo

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Abstract: ***This article present the slurry pipes wear detection by using infrared image thermography analysis. By determining via the software the temperature difference on one of pipe area, it's possible to determine the wear while the fluid is moving into the pipe. The difference of temperature found on the pipe area makes easily to estimate the wear and suggest the corrective maintenance action. As part of condition monitoring technics, this is helpful to contribute to pipes thickness monitoring*.**

Keywords: Pipe, wear, infrared, thermography

1. Introduction

In the industrial companies, the pipes are useful to transport solution. Due to solution speed, this creates friction witch causes wear and then pipe failure. The ultrasonic thickness is the one of method used around the world to measure the thickness and determine the wear. Therefore, this practice present some disadvantage especially collecting the thickness on single point, only being in contact with the object, the instrument calibration, the surface condition, the part geometry, the couplant and the transducer characteristics. **[1]** So, Infrared thermography is a proactive troubleshooting and predictive maintenance tool. **[2].** The wear on pipe could be detected via gradient of temperature variation This article present the way wear can be identified on pipes by using infrared inspection via analysis. In the context of scientific research as result of this study, the purpose is to identify wear by using thermography as one of condition monitoring technic and prevent prevent the pipe failure, such that remedial action may be planned in cost effective manner to maintain reliability.

This study has been done one cyclone underflow pipe in MMG Kinsevere SX-EW copper plant in Democratic Republic of Congo into Haut Katanga province

The pipe is coming from Cyclone underflow distribution box to mill. This pipe has been exposed many times to wear and using the ultrasonic thickness test is some time difficult as it required having scaffold. The rest of this paper is organised as follows:

In section 2 the materials and method used for this study are presented, the section 3 gives the results and discussion. Finally the conclusion is summarised in section 4

2. Literature Survey

The part of this line number 15-0402-PSL-400-SR1J [3] is shown on below figure. This fugure is showing 3 spools connected to the mill feed chute.

Figure 1: Cyclone under flow line

Repetitive failures have been experienced on this cyclone under flow line pipe.

3. Materials and Method

3.1 Materials

To perform our No Destructive Test inspection via infrared thermography we used the infrared camera FLIR T420, the software FLIR QuickReport1.2 SP2

3.2. Method

Infrared thermography is the process of acquisition and analysis of thermal information from non-contact thermal imagingdevices**[2]**

It is a way to measure body thermic energy. It's allow also to observe the temperature gradients variation [4] To realise our thermography, we've done on MMG Kinsevere copper process plant in Democratic Republic of Congo on the cyclone underflow line. This pipe is coming from distribution box to Mill. Thermograms have been collected and analysed through FLIR Software and conclude with diagnosis and recommendations.

The figure 2 is showing the Piping and Instrumentation Diagram of the under flow pipe in the circuit [3]

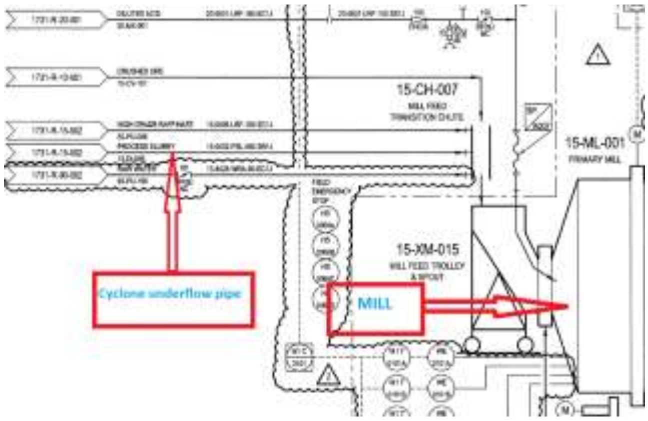
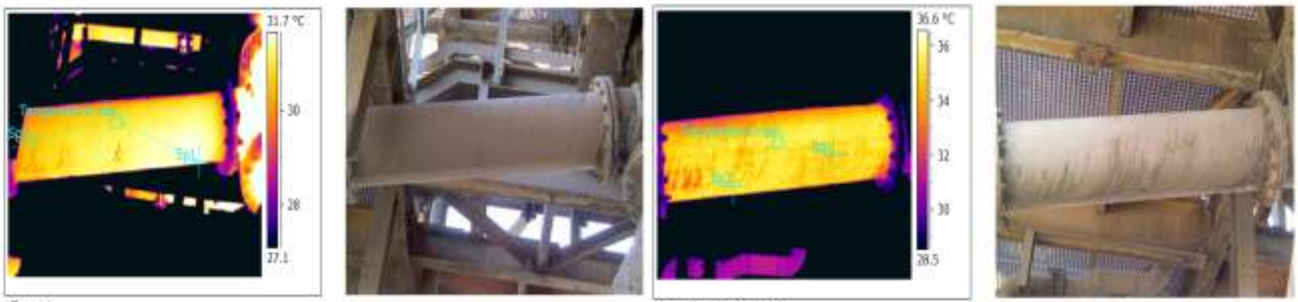


Figure 2: Piping and Instrumentation Diagram extracted and showing the pipe in the circuit [3]

In total, the pipe contain 6 spools where infrared images have been collected with infrared camera as shown on below figures



1st spool

Sp1 Temperature	31.6 °C
Sp2 Temperature	30.5 °C
Temperature rise Value	1.1 °C

Image File Name: Spool 2

Sp1 Temperature	35.9 °C
Sp2 Temperature	35.8 °C
Temperature rise Value	0.1 °C

Figure 3: infrared image of spool 1 and 2

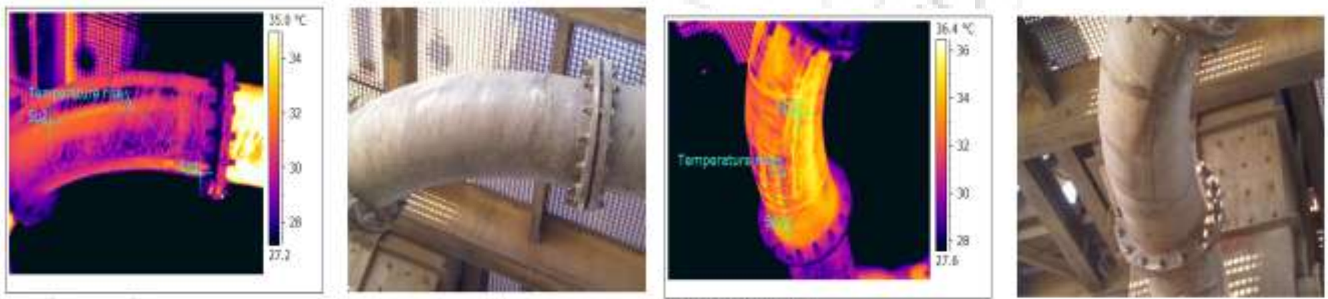


Image File Name: spool 3

Sp1 Temperature	35.2 °C
Sp2 Temperature	31.9 °C
Temperature rise Value	3.3 °C

Image File Name: spool 4

Sp1 Temperature	35.7 °C
Sp2 Temperature	34.4 °C
Temperature rise Value	1.3 °C

Figure 4: Infrared image of spool 3 and 4

Sp1 Temperature	31.9 °C
Sp2 Temperature	29.8 °C
Temperature rise Value	2.1 °C

Sp1 Temperature	34.0 °C
Sp2 Temperature	29.8 °C
Temperature rise Value	4.2 °C

Figure 5: Infrared image of spool 5 and 6

4. Results and Discussion

4.1 Temperatures Results

The results are summarising by measuring 2 temperatures on the area, the highest and the lowest. We have calculated the temperatures rise value which is equal the to the difference between the both temperatures measured via the software as shown on below table

Table 1: Temperatures results summary

Spools	*Spot1 Temperature*	*Spot 2 Temperature*	*Temperature Rise*
1st spool	31.6 °C	30.5 °C	1.1 °C
2nd Spool	35.9 °C	35.8 °C	0.1 °C
3rd Spool	35.2 °C	31.9 °C	3.3 °C
4th Spool	35.7 °C	34.4 °C	1.3 °C
5th Spool	31.9 °C	29.8 °C	2.1 °C
6th spool	34.0 °C	29.8 °C	4.2 °C

4.2 Discussion

4.2.1Spool 1, 2 ,4

The temperature rise comes from the difference in emissivity as some dried solution covers some part of the spool, that why the gradient path is like a fluid flowing over a surface. The condition is good and no action is required

4.2.2Spool 5

The condition is less critical and regular monitoring is needed

4.2.3Spool 3 and 6

The condition will required a closed monitoring, a future repair is necessary, and the confirmation from ultrasonic thickness measure is important.

5. Conclusion

The results can be summarised as follows:

The difference of temperature measured on a surface is the most important tool, which could determine the way the pipe is worn.

By examine the above measurements, we can conclude with the below values based on differential temperature

1) Up to 2°C, it is non critical condition, in term of maintenance, no action is required
2) Between 2°C to 4°C,we have less critical condition and regular monitoring is required
3) Between 4°C to 9°C, this range is related to semi-critical condition and in term of maintenance activity, a close monitoring needed and should be repaired in the next opportunity.
4) Above 9°C, the condition is critical and an immediate repair is required

So, by implementing this technic in industrials areas, this will prevent a lot breakdown and contribute to production and minimise loss of production

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Author Profile

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