Chapter 11

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IGNORAL OF WORKING CONDITION AS REASON OF PIPELINE DAMAGE

Abstract: The ignoral of working condition is very frequent reason of equipment damage. The authors in this work states the reasons of pipeline damage; uneven aeration was reason for the starting of corrosion degradation mechanisms, creating of holes and finally pipeline putting out of service.

Key words: pipeline, damage, reasons, uneven aeration.

11.1. Introduction

The degradation of structural materials during service life and fracture of components are for the practice very actual. With regard on this fact is important to the know the properties of materials and to study the degradation mechanisms and threshold state of components (HAZLINGER M. 2010, PUŠKÁR A. 2000). The degradation of materials is gradual, non-reversible process of deterioration material properties what can decrease the safety and reliability of components. In many cases the degradation of materials reach the critical values, threshold states of components are achieve (HAZLINGER M. 2010, PUŠKÁR A. 2000). This reality is also connected with economical and ecological losses (BORKOWSKI S. 2007, BORKOWSKI S. 2011).

The pipelines used for the liquid transport are subject to corrosion processes of different type and intensity (BOKŮVKA O. 1981). The non-qualified appraisal of working condition can lead to threshold state,

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to damage of pipeline. In this work authors states experimentally obtained reasons of damage pipeline used in the construction of hot-water piping.

11.2. Experimental investigation of damage reason

The pipeline damage is shown on the Figure 1.1. For the verification of basic materials properties including damage reasons were used the visual examination and metallography analyse by light microscopy.

Fig. 11.1. Pipeline damage.

Source: own study

The visual examination by naked eye and at magnitude 25 times indicated that corrosion mechanisms attack the pipeline locally and only on the upper side with final results – holes (see Figure 11.1). Three spec-

imens were removed for the metallography analyse, one from the bottom side of pipeline (non-damage part), two specimens from the upper side, from damage place in longitudinal and transversal direction. The specimens were prepared by grinding, polishing and etching by 1 % Nital and observed on the NEOPHOT II microscope at magnitude 20, 100 and 500 times. The results are on the Figures 11.2, 11.3 and 11.4.

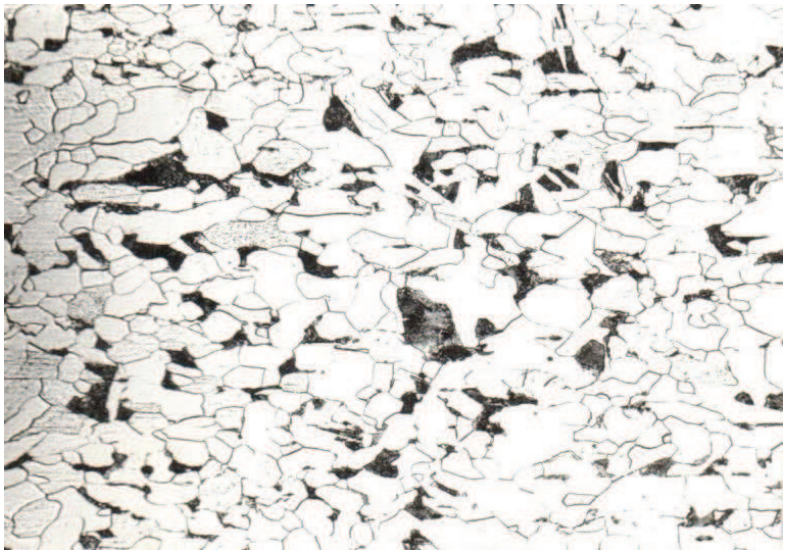

Fig. 11.2. Pipeline microstructure, basic material, mag. 500x, etch. 1 % Nital.

Source: own study

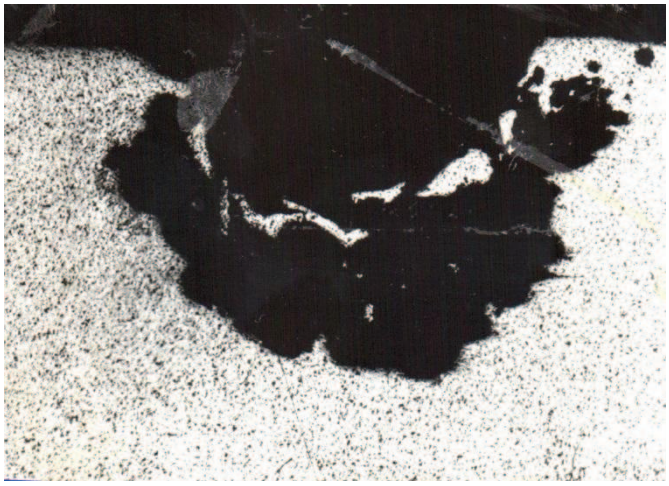

Fig. 11.3. Pipeline, local corrosion damage, mag. 20x, etch. 1 % Nital.

Source: own study

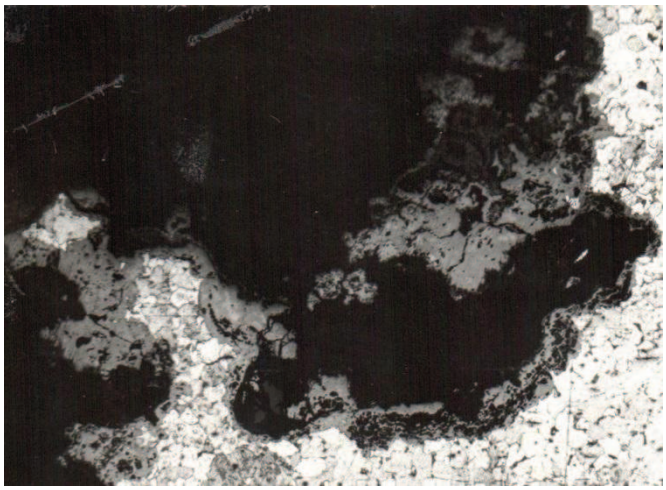

Fig. 11.4. Pipeline, surface of corrosion pits, detail, mag. 100x, etch. 1 % Nital.

Source: own study

The microstructure of pipeline (see Figure 11.2) is in the non-damage and damage places the same, is created by mixture of ferrite and pearlite with high portion of ferrite (steel with low content of carbon). The microstructure is fine-grained with grain size No. 7. There was not observed interchange of material, was not observed damage caused by mechanical or thermal effects (SKOČOVSKÝ P. 2000, SKOČOVSKÝ P. 2013). The typical local corrosion damages are on the Figure 1.3 and Figure 1.4. The surface of pits and holes are cover by non-uniform, discontinuous oxid layers. The damage has not cavitations origin but the damage is caused by uneven aeration, abnormal aeration (BARTONÍČEK R. 1996, LIPTÁKOVÁ T. 1997). This type of corrosion origin in certain distance from working liquid surface where is the supply of oxygen smaller as direct at surface. There is created the galvanic cell as a result of different aeration – uneven aeration. The pipeline diameter (89 mm) was not suggested correctly; the liquid passage was only 50 ÷ 60 %.

11.3. Conclusions

The qualified analyses of service condition are assumption of fail-safe function. On the contrary the unqualified access has results in degradation of materials and finally in the threshold states of components. The mentioned example, the pipeline damage, is example non-respect of working conditions at service of hot-water piping. The pipeline diameter was not suggested correctly, the pipeline was overdesign.

Acknowledgements

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