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Case study

Electrolytic corrosion of water pipeline system in the remote distance from stray currents—Case study

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ABSTRACT

Case study of corrosion failure of urban water supply system caused by the harmful effects of stray currents was presented. The failure occurred at a site distant from the sources of these currents namely the tramway and railway traction systems. Diagnosis revealed the stray currents flow to pipeline over a remote distance of 800/1000 m from the point of failure. At the point of failure stray currents flowed from the pipeline to the ground through external insulation defects, causing the process of electrolytic corrosion of the metal. Long distance between the affected section of the pipeline and the sources of stray currents excludes the typical protection against stray currents in the form of electrical polarized drainage. Corrosion protection at this point can be achieved by using the earthing electrodes made of magnesium, which will also provide cathodic current protection as galvanic anode.

1. Introduction

Corrosion processes occurring on the outer surface of underground pipelines in the cities is not only a general corrosion process, where corrosion microcells equally covers the surface of corroding metal. On the surface of the pipeline may also arise corrosion macrocells [1–4] in which cathodic and anodic areas on the metal surface can be spaced apart by several tens or even hundreds of meters. Galvanic corrosion (bi-metal corrosion) [5] is an example of corrosion macrocells (created by electrical contact between two different metals, for instance: pipeline and fittings of another metal), differential oxygen corrosion [6] (produced by varying the diffusion of oxygen to the adjacent pipeline sections, for example: in the transition under way and beside the road), concentration cells (differential concentration corrosion) [7] (the transition pipeline by soil with varying levels of dissolved salts or by different types of soil).

The impact of stray currents on pipelines is extremely dangerous, the source of such are tram and rail tractions powered by direct current (DC) [8,9]. The stray currents are one of the most common causes of pipeline corrosion failure in the cities [10]. This result in leaks of media flow (DHW, heating water, gas, oil), outages of media to customers and high costs of repair [11,12]. Since the cathodic and anodic zones on the pipeline are arising as a result of mentioned above interactions, the damage can be spaced

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Fig. 1. View of pipeline corrosion failure.

Fig. 2. Zoom on the defect site.

apart up to several hundred meters or even several kilometers, so it is sometimes difficult to make the diagnosis of corrosion damage.

The paper presents a case of corrosion of DN 300 underground water pipeline made of steel belonging to the water supply system of the city of Krakow and describes the methodology of undertaken corrosion diagnosis. Corrosion damage was caused by the effects of stray currents. The failure occurred despite a considerable distance (nearly a kilometer) from the crossing the tram and train with pipeline.

Table 1
Criteria of soil aggressiveness.

Indicator	Soil aggressiveness:		
	low	average	high
Soil resistivity [Ω m]	More than 100	30/100	Less than 30
pH	7	6 or 8	Less than 6 or more than 9
Chloride content [mg/kg]	Less than 100	100/200	More than 200
Sulphate content [mg/kg]	Less than 200	200/1000	More than 1000
the content of hydrogen sulphide and sulphides by qualitative analysis (indicator of the presence of sulphate-reducing bacteria)	Lack of H_2S	Lack of H_2S	Presence of H_2S