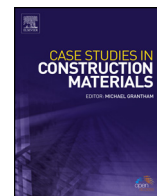




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Case study

Research on causes of corrosion in the municipal water supply system



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ABSTRACT

This paper presents results of failure analysis study to characterize the corrosion damage that occurred in the water supply system in Krakow. This analysis includes: electrochemical noise, linear polarization and resistometric measurements. Water aggressiveness of four water intakes was defined using Langelier and Ryznar indices. Results from this indices did not reveal the causes of considerable corrosion losses in water systems. The corrosion rate measurements revealed that water from the one of water intakes is characterized by considerable corrosive aggression. In all studied water subsystems formation of protective layers limiting the corrosion rate was found. Overall analysis reveal the need to implement a on-line corrosion rate monitoring in the water supply system of the city of Krakow.

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1. Introduction

Detailed research on the operation of the water supply system in the city of Krakow has shown that the losses amount to 13.41% at the end of 2014 with 55 348 thousand m³ having been pumped into the system over the whole year. In accordance with the register, failures caused by corrosion account for approx. 20% of the overall number of water supply failures. Failures of water main networks above ϕ 300 mm account for approx. 7%. A considerable number of failures of main networks are subject to local corrosion, which leads to perforation of pipe walls (Fig. 1).

Considerable costs connected with water losses and costs of removing failures have become grounds for research to explain the causes of corrosion processes. A significant problem in the analysis is the fact that water sent to the water supply system from the Water Treatment Plant (Zakłady Uzdatniania Wody) has various physicochemical properties and is characterized by varying values of the corrosivity index.

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Fig. 1. Local corrosion of a DN300 pipeline.

2. Experimental

Samples of water collected from four water intakes for the city of Krakow were selected for tests:

- Bielany
- Rudawa
- Dłubnia
- Raba

Analytical tests were performed using a Palintest 5000 spectrophotometer.

Tests of the corrosion rate were conducted on the basis of the following measurement techniques:

- linear polarisation measurement,
- resistometric measurement,
- measurements of electrochemical noise.

Table 1

Results of analytical tests of the tested samples of water.

Tested parameter	Unit	Bielany	Rudawa	Dłubnia	Raba
Measurement temperature	°C	25.6	25.4	24.8	25.5
pH	pH-meter CP-551	7.30	7.23	7.67	7.87
Hardness	mg/dm ³ CaCO ₃	70	56	56	52
Total alkalinity	mg/dm ³ CaCO ₃	188	183	233	103
Sulphides	mg/dm ³	0.03	0.02	0.02	0.02
Silica	mg/dm ³ SiO ₂	0.02	0.82	0.08	0.06
Dry residue	mg/dm ³	300	290	370	60
Conductivity	μS/cm	0.64	0.55	0.58	0.31
Calcium	mg/dm ³	86	57.2	80	38.4
Magnesium	mg/dm ³	6.4	6.0	4.8	5.7
Nitrogen	mg/dm ³	1.3	1.8	0.58	0.80
Total copper	mg/dm ³	0.20	0.13	0.20	0.10
Potassium	mg/dm ³	5.3	3.9	2.4	6.0
Nitrates	mg/dm ³	5.72	7.92	2.55	3.52
Chlorides	mg/dm ³	46	42	45	32
Sulphates	mg/dm ³	83	57	27	22
Phosphates	mg/dm ³	14	16	11	16
Iron	mg/dm ³	0.03	0.00	0.01	0.00
Zinc	mg/dm ³	0.12	0.06	0.05	0.10
Bicarbonates	mg/dm ³	229.36	223.26	284.26	125.66

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