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3. CORROSION IN THE PODHALE GEOTHERMAL SYSTEM

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ABSTRACT

Geothermal system of Banska – Bialy Dunajec (Podhale region) supplies geothermal heat to the town of Zakopane and several surrounding villages. The chemical components of the thermal waters used in the system cause the corrosion of steel elements. Consequently the corrosion is the source of many troubles in functioning of the whole system especially in heating the houses. The investigations were conducted to understand the process of corrosion, to find the way of reducing the corrosive effects as well as to select the best non-corrosive material for system.

1. INTRODUCTION

Geothermal system of Banska – Bialy Dunajec has been working efficiently for the last several years but the corrosion has affected the pipes and valves, causing serious damage to the system. The phenomenon of corrosion leads to the reduction of filtration of filters; besides it introduces iron in the form of iron oxides into the geothermal basin, built of the Middle Eocene and Middle Triassic limestones and dolomites at the depths of about 2 – 3.5 km (Sokolowski 1992; Pawlikowski et al. 1997, 2000a, 2000b; Kepinska 2000). As a result, the system fails to function, causing a great problem during winter time.

Investigation of the mentioned phenomenon was con-ducted in two ways: (i) monitoring of corrosion processes by the means of a system constructed especially for this purpose, (ii) mineralogical investigation of corrosion's products coating internal walls of pipes and valves.

2. RESULTS

2.1. Monitoring of corrosion

The corrosion was monitored with the use of an elec-tronic system designed and constructed especially for this purpose. Electrodes composed of various types of material were coupled with a computer system of corrosion control. Electrodes were mounted on pipes conducting thermal waters. The effect of corrosion was measured as a change of the electric parameters of electrodes.

All the obtained data were controlled using a special computer programme and collected on a hard disc. Moni-toring of corrosion was preceded by monitoring of chemical parameters of geothermal water (Pawlikowski et al. 1997, 2000 a, 2000b).

The data obtained up to now showed that thermal wa-ters were highly aggressive. They contain O_2, CO_2, and me-thane which react with steel. Products of chemical reactions were tested using mineralogical methods.

2.1. Mineralogy corrosion's products

Products of corrosion were tested using SEM, XRD, IR, ASA, PLM (polarizing light microscopy) and other. Obtained results showed to the presence of the following minerals – products of interaction between thermal waters and steel elements of the system: calcite, siderite, goethite, lepidocrokite, manganite and other (photos 1, 2, 3). Toge-ther with the newly formed minerals, grains of minerals and rocks washed out from the reservoir rock

formation and transported up to the surface were discovered,. These grains are represented by grains of quartz, gneisses, metamorphic schists, various limestones, etc. Moreover, the investigation proved that newly formed sulphides and oxides are formed as product of corrosion. The sulphides, however, become quickly oxidated into oxides because of contact with air. This means that it is extremely important to perform mineralogical investigation of vacuumed samples.

Corrosion processes lead not only to the reduction of thickness of the wall of pipes (creation of centres of da-mage) but they also cause the formation of undulation on pipes' walls. These undulations are the source of distur-bances of laminar flow of thermal waters, resulting in faster corrosion, e.g. removal of plates of corrosion products from internal walls of pipes.

3. SUMMARY

Preliminary results of investigation help understand corrosion processes of the system and select the best ma-terials for reconstruction of its elements, leading to a noticeable reduction of corrosion.

Proposed solutions are as follows: first of all selection of the best quality steel (Banas et al. 1991) will reduce the costs of exploitation of the system and its damage. This is specially important at the time when the system is used for heating of houses, i.e. in winter time. On the other side, reduction of corrosion will limit secondary introduction of corrosion products into thermal basin of clean waters, i.e. reduce the pollution of natural environment (Pawlikowski et al. 1997).

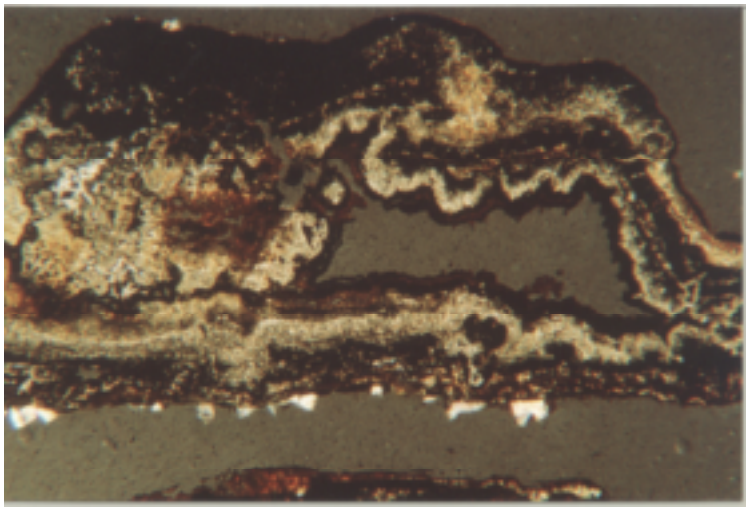

Photo. 1. Fragment of a corrosion plate composed of brownish iron oxides (goethite), intercalated with yellow secondary formed calcite and siderite. Polarizing light microscope, polaroides in part X, magnification 60 x.

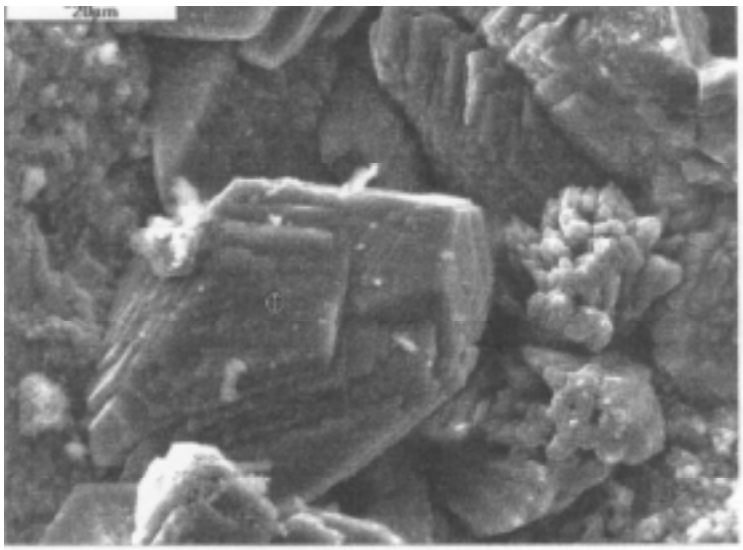

Photo. 2. Crystals of carbonates growing just under corroded plate composed of iron oxides. SEM

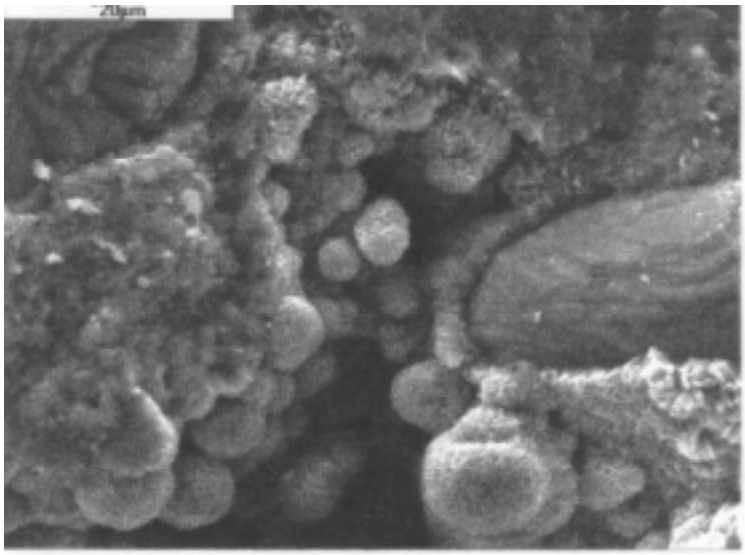

Photo. 3. Secondary crystals of carbonates coating hydrated oxides of iron. SEM.

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