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REMOVAL OF ANIONS FROM THERMALLY-WASTED GEOTHERMAL WATERS

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Abstract

The theme of this paper is one of large practical and present interest, dealing with a very important issue, i.e. the softening of geothermal worn-out thermic waters with the help of ion exchange resins.

One of the most important problems of nowadays society is the one of the pollution cleaning of the soil, the waterways and the atmosphere. The cleaning process of wasted geothermal waters is of real interest and topicality.

In the western part of Romania, the domestic heat energy is being obtained from geothermal waters, with the use of heat exchangers, where conversion takes place. The resulted wastewater is being disposed at temperatures varying between 35 and 40 degrees Celsius.

The embracement of some treatment technologies for the geothermal wastewater, having the ecological protection as the main objective, represents a way to reduce the outlet pollution as a consequence of the waste water release. The present study aims at monitoring the deanionization of geothermal water with the help of ion-exchange resins. The geothermal water used in this study comes from Drill 4795 of Transgex, Calea Aradului (Nursery), Oradea in 2012.

Key words: deanionization, thermally-wasted geothermal water, Resin Amberlite IRA 458 Cl

INTRODUCTION

The prospects of using the geothermal waters are determined by the quantity and quality of the economically-identified resources as well as by the efficiency of the embraced technologies to prevent the disturbing phenomena (antartare and corrosion) generated in the facility exploitation by the water and gas chemistry in their composition [Romocea and al 2012]. These aspects add to the potential risk of polluting the environment, the surface outlets, the soil and water with harmful substances contained in the geothermal fluids whose neutralisation, within permissible limits, is determined by the efficiency of the technologies applied to treat these resources [Ungur and al, 2008; Wachinski and Etzel, 1997].

The modern technologies of water treatment by using ion exchange resins in the processes of water softening and their usefulness has determined the choice of this method for geothermal water treatment. The elaboration of some water softening methods for thermal waters which are thermic worn-out and of water demineralization involves a very good knowledge of the types of ion exchange resins and of their properties .The choice of a resin in a practical application has to take into consideration the speed and the mechanism of the ion exchange process. For the geothermal waters it is necessary to consider the maximum operational temperature for these ion exchange resins.

This paper has as its main purpose the monitoring of the deanionization of the geothermal water with the help of ion exchange resins. The research has been done on the geothermal water which resulted from its use to get thermic energy [Ghergheles, 2009].

MATERIAL AND METHOD

The development of some methods to remove the cations from thermally-wasted geothermal waters requires a deep knowledge of the types of ion-exchange resins as well as of their properties. When choosing a resin in a practical application one must take into account the speed and the mechanism of the ion-exchange process. The maximum operating temperature for these ion-exchange resins must also be taken into consideration for geothermal waters [Iancu 2009, 2011].

This study aims to develop some methods of removing the cations from the thermally-wasted geothermal waters. To achieve the proposed aim, the behaviour in the specific working conditions of the following resins must be taken into account: Amberlite MB20 and the anionic column with the anionic resin (Amberlite IRA 458 Cl^-) [Helfferich, 1995, Liteanu 1985, Rohm and Haas, 1994].

The geothermal water from the Drill 4795 of Transgex, Calea Aradului (Nursery), Oradea has been studied to which the nitrite, nitrate, sulphate and sulphide anions have been monitored. This source water is characterized by a mineralization of 1 g/l, the chemical nature of water is sulphate-bicarbonate-calco-magnesian and with a pH ranging from 6 to 7. One can notice the absence of phenols .

For the deanionization of thermally-used geothermal water, an equipment produced by the company ARMFIELD from UK, called W9 has been used. Deanionization was achieved by passing downwards through the anion-exchanger [Ghergheleș, 2009, 2011].

The two ion-exchange resins are produced by the company ROHM&HAAS. The resin Amberlite MB20 is a mixed resin (a mixture of strongly acidic cationic resin with a strongly basic resin), and, to compare, we used anionic column with anionic resin (Amberlite IRA 458 Cl^-).

The determination of anions in the geothermal water before and after the passage through the ion-exchange resins has been performed using colorimetric methods, with a visual determination performed with the help of the device SPECTROQUANT Nova 60A.

RESULTS AND DISSCUSIONS

The following results have been achieved after the deanionization procedure for the resins used in this study:

Table 1

Concentrations of anions in the geothermal water treated with ion-exchange resins

Anion (mg/l)	**Anion concentration in geothermal water (mg/l)**	**Mixed resin Amberlite MB20 Anion concentration (mg/l)**	**Amberlite IRA 458 Cl- Anion concentration (mg/l)**
NO^{2-}	0,016	0,004	0,007
NO^{3-}	3,6	1,4	0,8
SO_4^{2-}	520	110	110
S^{2-}	0,14	0,03	0,07

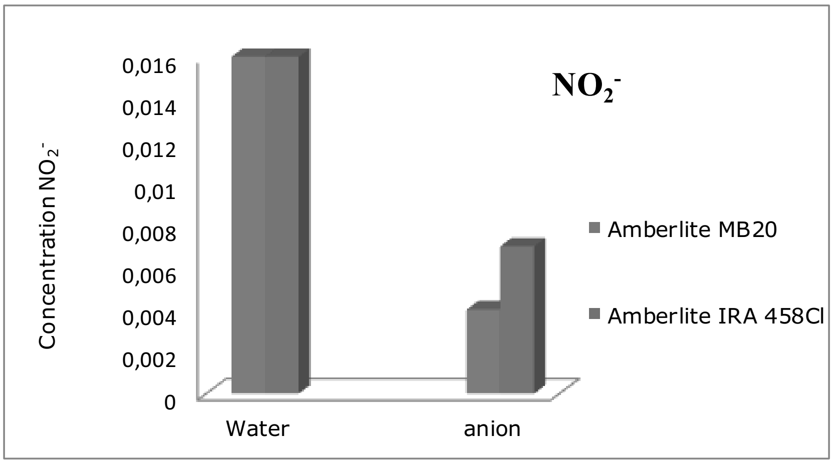

Figure 1. The variation of NO_2^- ion concentration during the treatment of thermally-wasted geothermal water

The variation of NO_2^- ion concentration during the treatment of thermally-waste geothermal water with ion-exchange resins is presented in Figure 1. From the experimental data, it is noticed that in the case of using the mixed resins Amberlite MB20, the concentration of NO_2^- ion decreased from 0, 0016 mg/l l to 0,004 mg/l.

In the case of treating the thermally-wasted geothermal waters with anionic resin Amberlite IRA 458Cl, the concentration of NO_2^- ion was initially 0, 0016 mg/l and in the end it reached 0,007 mg/l.

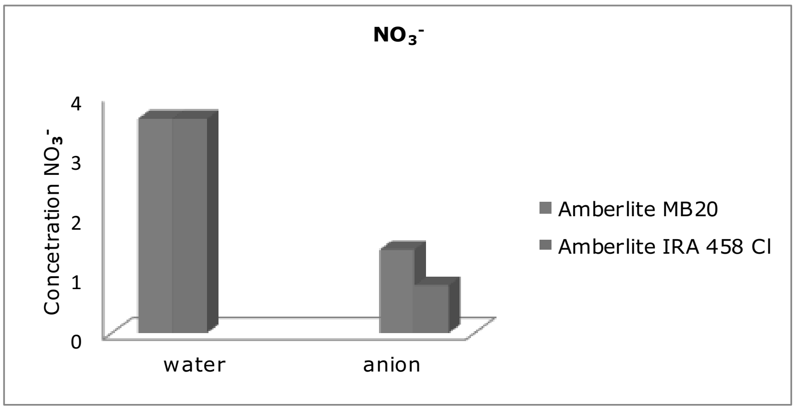

Figure 2. The variation of NO3- ion concentration during the treatment of thermally-wasted geothermal water with ion-exchange resins

The variation of NO_3^- ion concentration during the treatment of thermally-wasted geothermal water with ion-exchange resins is presented in Figure 2. From the experimental data, it is noticed that in the case of using the mixed resins Amberlite MB20, the concentration of NO_3^- ion decreased from the initial value of 3,6 mg/l l to a concentration of 1,4 mg/l in demineralised geothermal water.

When switching to the anionic resin column Amberlite IRA 458Cl, the concentration of NO_3^- ion decreased from the initial value of 3, 6 mg/l to 0, 8 mg/l.

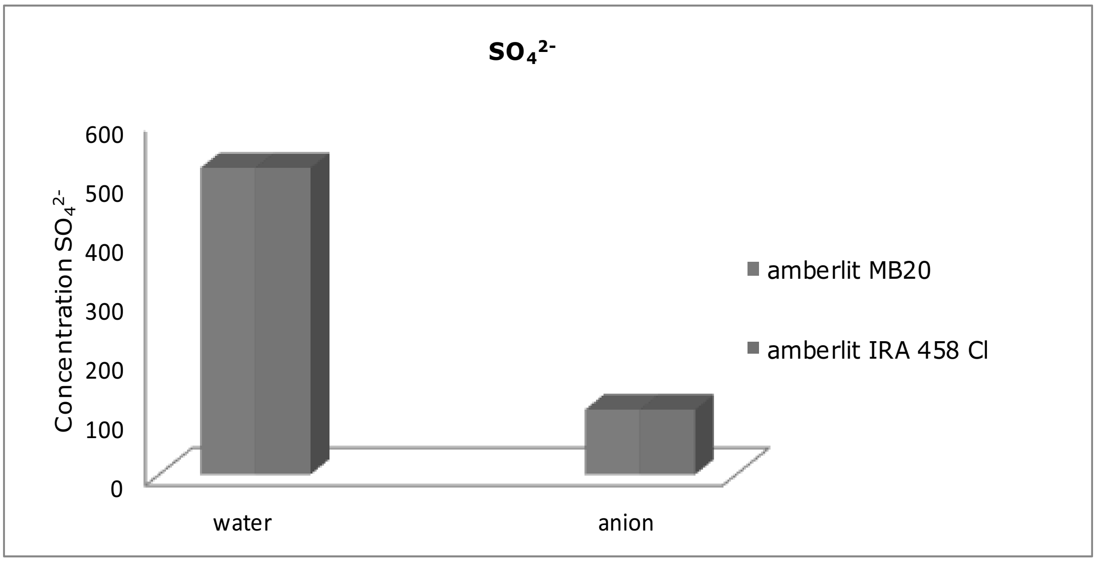

Figure 3. The variation of SO_4^{2-} ion concentration during the treatment of thermally-wasted geothermal water with ion-exchange resins

The variation of SO_4^{2-} ion concentration during the treatment of thermally-wasted geothermal water with ion-exchange resins is presented in Figure 3. From the experimental data, it is noticed that in the case of using the mixed resins Amberlite MB20, the concentration of SO_4^{2-} ion decreased from the initial value of 520 mg/l to 110 mg/l in demineralised geothermal water.

When switching to the anionic resin column Amberlite IRA 458Cl, the concentration of SO_4^{2-} ion decreased to the value of 110 mg/l.

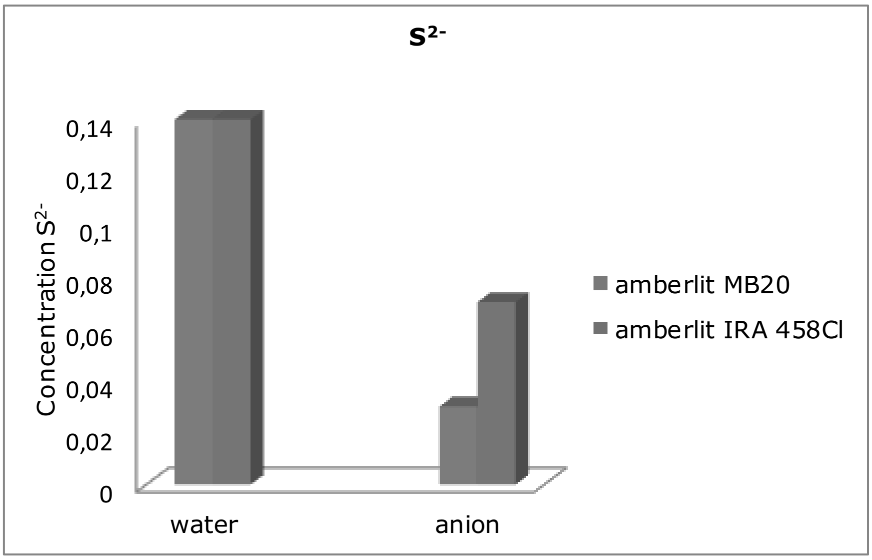

Figure 3. The variation of S^{2-} ion concentration during the treatment of thermally-waste geothermal water with ion-exchange resins

The variation of S^{2-} ion concentration during the treatment of thermally-wasted geothermal water with ion-exchange resins is presented in Figure 4. From the experimental data, it is noticed that in the case of using the mixed resins Amberlite MB20, the concentration of S^{2-} ion decreased from the initial value of 0, 14 mg/l to the concentration of 0, 03 mg/l in demineralised geothermal water.

When switching to the anionic resin column Amberlite IRA 458Cl, the concentration of S^{2-} ion was initially decreased from the value of 0,14 mg/l to 0,07 mg/l.

CONCLUSIONS

According to the parameters determined by the pattern of Langmuir isotherms, the switch of the geothermal water to the mixed resin Amberlite MB20, determines the processing of a greater quantity of thermally-wasted geothermal water in comparison to the processing of geothermal water on the column with anionic resin Amberlite IRA 458 Cl^-.

The experimental studies for the deanionization process of thermally-wasted geothermal water represented in diagrams 1-4 confirms the theoretical determinations. Thus, the deanionization of thermally-wasted geothermal water on the column of mixed resin Amberlite MB20 led to the decrease of anions concentrations in the thermally-wasted geothermal water.

The decrease of anion concentrations when thermally-wasted geothermal water passed on the changing columns, with anionic resin Amberlite IRA 458 Cl-, takes place in a lower proportion than in the case of mixed resin.

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