REMOVAL OF CATIONS FROM THERMALLY-WASTED GEOTHERMAL WATERS

Ghergheleş Carmen*, Ghergheleş Viorel*, Pantea Emilia*

*University of Oradea, Faculty of Environmental Protection, 26 Gen. Magheru St., 410048 Oradea, Romania, e-mail: i_carmen_g@yahoo.com

Abstract

The embracement of some treatment technologies for the geothermal waste water, having as the main objective the ecologic protection, represents a way to diminish the emissary's pollution as a consequence of the waste water release. The present study has as objective the monitoring of decationization of geothermal water with the help of ion-changing resins. The geothermal water used in this study comes from Drill 4795 Calea Aradului (Nursery)

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

INTRODUCTION

The perspectives 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 for preventing the disturbing phenomena (corrosion) generated in the exploitation of installations by the component water and gas chemism. To these aspects we can add the potential risk of polluting the environment, surface emissaries, soil and water, with harmful substances contained in the geothermal fluids whose neutralization within the admitted limits is determined by the efficiency of the technologies applied for the treatment of these resources.

MATERIAL AND METHOD

The elaboration of some methods to remove the cations from the thermally-used geothermal waters needs a deep knowledge of the types of ion-changing resins as well as of their properties. The choice of a resin in a practical application must take into account the speed and mechanism of the ion-changing process. For the geothermal waters, the maximum operational temperature for these ion-changing resins must be also taken into account.

The study has in view the elaboration of some methods of removing the cations from the geothermal waters that are thermally used. To achieve the proposed aim, the behavior in the specific working conditions of the following resins must be taken into account: Amberlite MB20 and Amberlite IR 120Na.

The geothermal water from the drill 4795 of Transgex, Calea Aradului (Nursery), Oradea in 2009, has been studied, monitoring the level of ammonium, calcium, magnesium, natrium, potassium and iron cations. This water at the source is characterized by a mineralization of 1 g/l, the chemical character of water is sulphato-bicarbonato-calco-magnesian and with a pH ranging from 6 to 7. The absence of phenols was noted.

For the decationization of thermally-used geothermal water, equipment produced by the company ARMFIELD in UK, called W9, has been used. Decationization was achieved by descending passage through the cation-changer.

The two ion-changing resins are produced by the company ROHM&HAAS. The resin Amberlite MB20 is a mixed resin (a mixture of strongly-acid cationic resin with a strongly basic resin), and comparatively a cationic resins Amberlite IR 120 Na has been used.

The determination of cations from the geothermal water before and after the passage of the ion-changing resins have been performed through colorimetric methods, with a visual determination performed with the help of SPECTROQUANT Nova 60A.

RESULTS AND DISSCUSIONS

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

Table 1

Concentrations of cations from the geothermal water treated with ion-changing resins

Cation (mg/l)	Cation concentration in geothermal water (mg/l)	Mixed resin Amberlite MB20 Cation concentration (mg/l)	Amberlite IR 120 Na Cation concentration (mg/l)
Mg^{2+}	31.4	17.3	24
Ca^{2+}	196	52	89
Fe^{2+}	0.33	0.12	0.24
Fe^{3+}	0.47	0.18	0.19

The variation of Mg^{2+} ion concentration during the treatment of thermally-wasted geothermal water with ion-changing resins is presented in Figure 1. From the experimental data, it is noticed that in the case of using mixed Amberlite MB20, the concentration of Mg^{2+} ion decreased from 31.4 mg/l to 17.3 mg/l.

In the case of treating the thermally-wasted geothermal water with cationic resin Amberlite IR 120Na, the concentration of Mg^{2+} ion was initially 31.4 mg/l and in the end 24 mg/l.

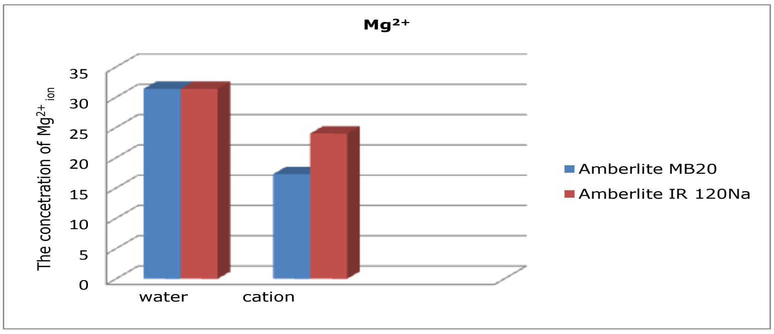

Fig. 1. Variation of Mg^{2+} ion concentration when treating the geothermal water

The variation of Ca^{2+} ion concentration during the treatment of thermally-wasted geothermal water with ion-changing resins is presented in Figure 2. From the experimental data it is noticed that in the case of the mixed resin Amberlite MB20, the concentration of Ca^{2+} ion decreased from 196 mg/l to 52 mg/l.

In the case of treating the thermally-wasted geothermal water with cationic resin Amberlite IR 120Na, the concentration of Ca^{2+} ion was initially 196 mg/l and in the end 89 mg/l.

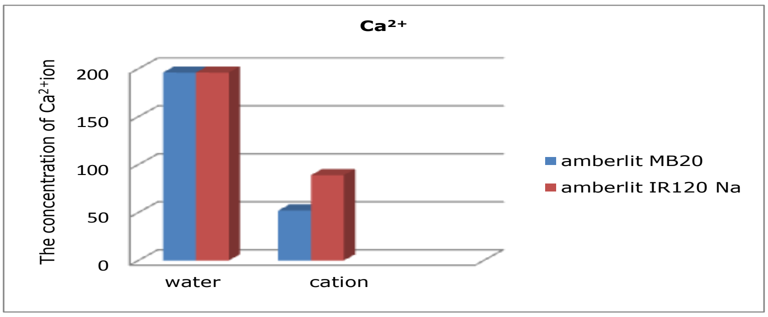

Fig. 2. Variation of Ca^{2+} ion concentration when treating the geothermal water

The variation of Fe^{2+} ion concentration during the treatment of thermally-waste geothermal water with ion-changing 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 Fe^{2+} ion decreased from 0.33 mg/l to 0.12 mg/l.

In the case of treating the thermally-wasted geothermal waters with cationic resin Amberlite IR 120Na, the concentration of Fe^{2+} ion was initially 0.33 mg/l and in the end 0.24 mg/l.

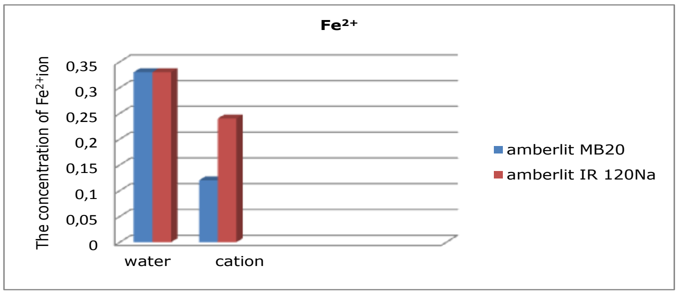

Fig. 3. Variation of Fe^{2+} ion concentration when treating the geothermal water

The variation of Fe^{3+} ion concentration during the treatment of the thermally wasted geothermal water with ion-changing resins is presented in Figure 4. From the experimental data, it is noticed that in the case of using mixed resins Amberlite MB20, the concentration of Fe^{3+} ion decreased from 0.47 mg/l to 0.18 mg/l.

In the case of treating the thermally-wasted geothermal water with cationic resin Amberlite IR 120Na, the concentration of Fe^{2+} ion was initially 0.47 mg/l and in the end 0.19 mg/l.

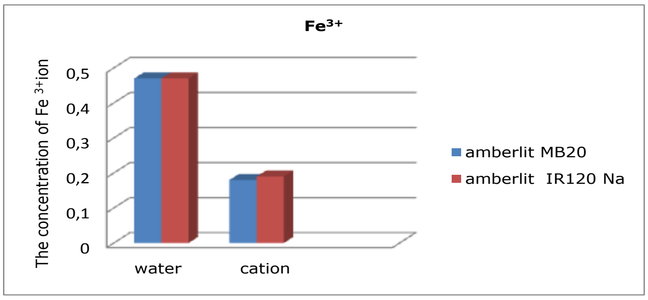

Fig. 4. Variation of Fe^{3+} when treating the geothermal water

CONCLUSIONS

According to the parameters determined by the model of Langmuir isotherms, the passage of geothermal water on the mixed resin Amberlite MB20, determines the processing of a great quantity of thermally-wasted geothermal water with respect to the processing of geothermal water on the column with cationic resin Amberlite IR 120Na.

The experimental studies for the decationization process of thermally-wasted geothermal water represented in diagrams 1-4 confirms the theoretical determinations. Thus, the decationization of thermally-wasted geothermal water on the column of mixed resin Amberlite MB20 led to the decrease of cation concentrations existent in the thermally-wasted geothermal water. The diminution of cation concentrations, once with the passage of thermally-wasted geothermal water in the changing columns, with cationic resin Amberlite IR 120Na, takes place in a lower proportion than in the case of mixed resin.

REFERENCES

1. Ghergheles Carmen: Contribuţii la studiul procesului de tratare a apelor geotermale uzate termic prin metoda schimbului ionic, Editura Politehnica, 2009.
2. Gherghele₣, C., Gherghele₣, V., Romocea, T., Roman, M.A, Pantea, E., Mirel, I., Iovi, A.: Softeners waste heat geothermal water using ion exchange resins, with the objective protection and improvement of the environment, Proceedings of the International U.A.B. – B.En.A Conference Management and Sustainable Protection of Environment, Alba Iulia, 6-7 May, published in the J.E.P.E, 2009.
3. Gherghele₣ V., Gherghele₣ C., Romocea T., Pantea E.: Treatment and use of Geothermal Water with Low Entalpy, University of Oradea, Faculty of Environmental Protection, International Symposia „Risk Factors for Environment and Food Safety" & „Natural Resources and Sustainable Developmnet", November 6-7, 2009.
4. Gherghele₣ C., Gherghele₣ V., Romocea T., Pantea E.: Softeners geothermal worn-out thermic water using cationic resins Amberlite IR 120Na with the objective protection and improvment of the environment, University of Oradea, Faculty of Environmental Protection, International Symposia „Risk Factors for Environment and Food Safety" & „Natural Resources and Sustainable Developmnet", November 6-7, 2009.
5. Iancu Carmen, Chioreanu N, Vasile Bogdan, Dan Craciun, Converting into electro-mechanic energy the thermic energy from the thermal water and solar energy, The 14th International Conference on Nonconventional Technologies, ICNCT 2009, pp. 31-34, ISSN 1454-30-87, Oradea 2009.
6. Helfferich, F.G.: Ion Exchange, Dover Publications, New York, 1995, 250-322.
7. Liteanu, C.: Chimia analitică cantitativă, Editura Didactică şi Pedagogică, Bucureşti, 1985.
8. Rohm and Haas: Amberlite resin product description, Philadelphia, Rohm and Haas Co., 1994.
9. Romocea, T., Gherghele₣, C., Pantea, E.: The Study of Carbon Steels Corrosion in Geothermal, Chemisty Magazine, volume Vol. 63, no. 6, June, 2012, p. 636-640.
10. Ungur P., Pop A.P., Vereş M.E., Iancu Carmen, Gordan M., Crăciun D., Thermal register with core for heated installtions with geothermal and heat Water, 12th International Research Expert Conference "Trends in the Development of Machinery and Associated Technology" TMT 2008, 26-30 Aug. 2008, pag 601-604, Istanbul Turkey. 2008.
11. Wachinski, A.M., Etzel, J.E.: Environmental Ion Exchange Principles and Design, Boca Raton, Fla., Lewis Publishers, 1997.