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The Reinjection of Kizildere Geothermal Area, Reinjection Works and Doing Necessity

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ABSTRACT

As of January 2009 the geothermal field Kızıldere had 25 deep wells and 108 gradient wells. Some of them cannot be used. A portion are observation wells, and one is used for re-injection. Nine production wells feed the power plant. In the case of the R-3 well, test work has been completed after making a connection to participate in production. In previous years, production was done from the KD-20 well, and waste water was injected in the KD-7 well. This study was of less than 1 month. Other wells were abandoned for affecting the other wells quickly and for other reasons. In 2002, the KD14, 15,16 and 20 were connected at a separator, output water was collected in a main line, and a 405 t/h flow rate re-injection was accomplished. Over a long period the re-injection flow rate was 230-250 t / h, and 30 kg tracer have been used and monitored for 6 months in the other wells. In this study, re-injection at Kizildere field work, and do the work that needs to be done by re-injection, and then started reinjection in 2002 began to change in the field observations are given.

1. INTRODUCTION

In 1965 the MTA (General Directorate of Mineral Research and Exploration) initiated work on the field. KD-1 (540m, 203°C) drilled in 1968, was the first well to discover high temperatures. Then a new well field was developed. Installed capacity of the power plant is 20.4MWe. The power plant in Kizildere Geothermal Field commenced in 1984 and the average in the electricity produced is in the range of 9-11 MWe. After scale cleaning production of 15MWe is possible, but in time decreases back to under 10MWe. Increasing the production again requires mechanical scale cleaning.

Until 2002 approximately 1000t/h geothermal water was produced and 800-900t/h waste water was discharged to the Menderes River. Since 2002, approximately 200t/h water has been reinjected in well R-2.

2. REINJECTION STUDIES OF THE FIELD BEFORE

The first reinjection study in the field was made in 1965. In this study, the water was at 147 ^{o}C with separator output pressure directly forwarded to the KD-7 from the KD-20 well separator output. But because the KD-7 well started to be produced in a short period of time, the re-injection was not continued.

In order to continue the test, the KD-,7 KD-20 separator was moved and the silencer was separated, but after five days the flow rate had to be reduced, and injection was stopped 20 days after injection was started.

Then the KD-20 separator output was moved to the KD-7 well and also the silencer was separated. Then injection continued, but after 5 days the injection flow rate was reduced, and then after 20 days the reinjection could not be performed.

The 98 t/h injection experiment was started again in February 1999 on the KD-7 well. The KD-20 separator output water was at 147 ^{o}C and flowed at 86t/h, and the cooling tower was at 40 ^{o}C with 20t/h water stirred and reinjected with gravity. Here the silica concentration was kept at 300ppm in order to not pollute the reservoir. The reinjection was continued until February 1999.

During this study the KD-20 well was observed. At the beginning production flow rate was 122t/h. 7 days later production flow rate reduced to 86t/h, and 10 days later 72t/h. Injection to KD-7 affected KD-20 quickly. After the re-injection experiments in this study, it was decided to also do KD-1A, KD-8 and KD-9.

For waste water reinjection the TH-2 well(2000m) situated south of field had been drilled but the injectivity index was very low. For the same purpose the R-1 well was drilled to 2261m. Also R-1 well injectivity index was low. Tghe reservoir temperature was 142°C and production was good, and it is used for production. Finally, the R-2 well was completed in 1371 m and has a temperature of 204°C. It's injectivity is very promising.

3. R-2 REINJECTION STUDIES

It was decided to do reinjection on R-2, due to the emergence of high injectivity index (approx. 30t/h) / bar) (Figure 1). From 2001-2002, KD14, KD15, KD16 and KD20 made a connection to their separator output until R-2 well up to a 350mm diameter main reinjection line (Figure 2).

After 18-04-2002 reinjection has been continued consistently at various flow rates.

Starting from the moment the KD-6 number reinjection well began, dynamic measurements over the 7-year process have shown a reduction in the reservoir temperature of 4°C (Figure 3).

From 2002 until 29 May 2009, injected waste water amounted to approximately 5,228,852 tons(Figure 4).

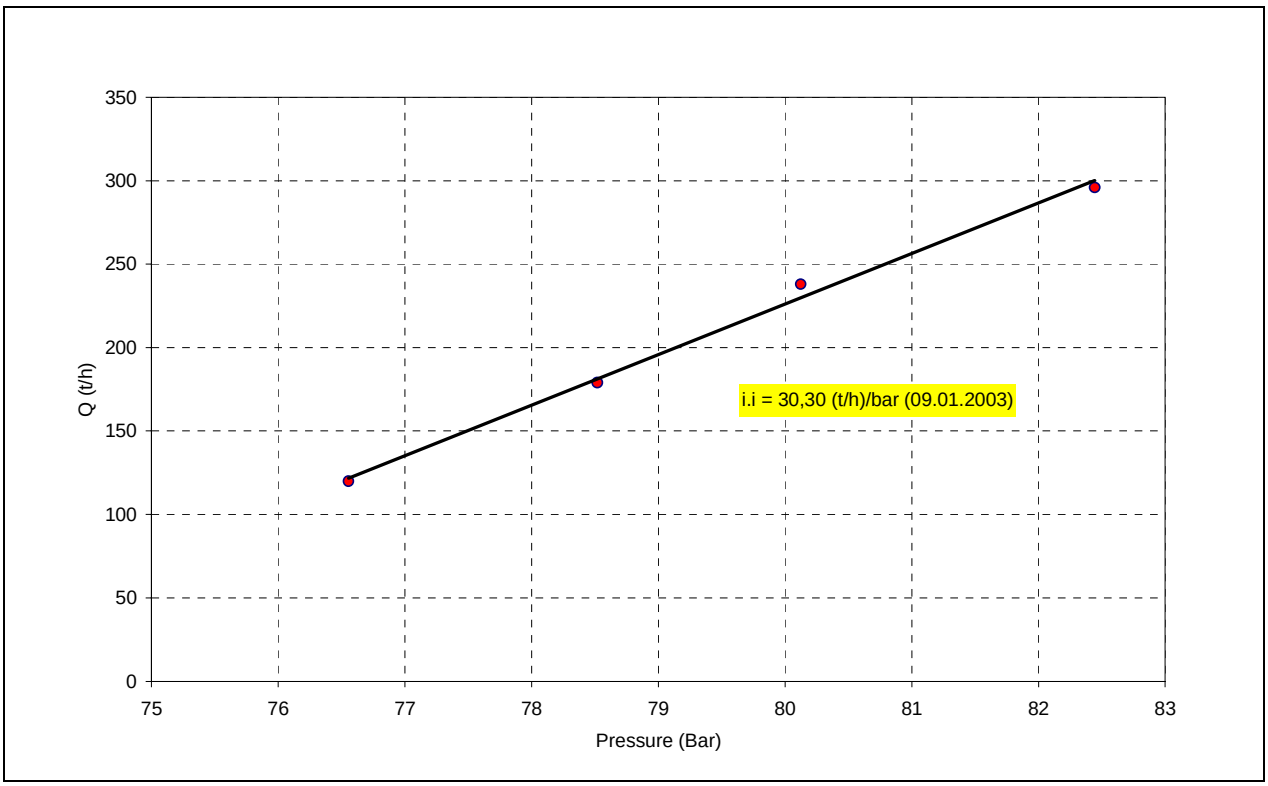

Figure 1: Injectivity index of R-2 well

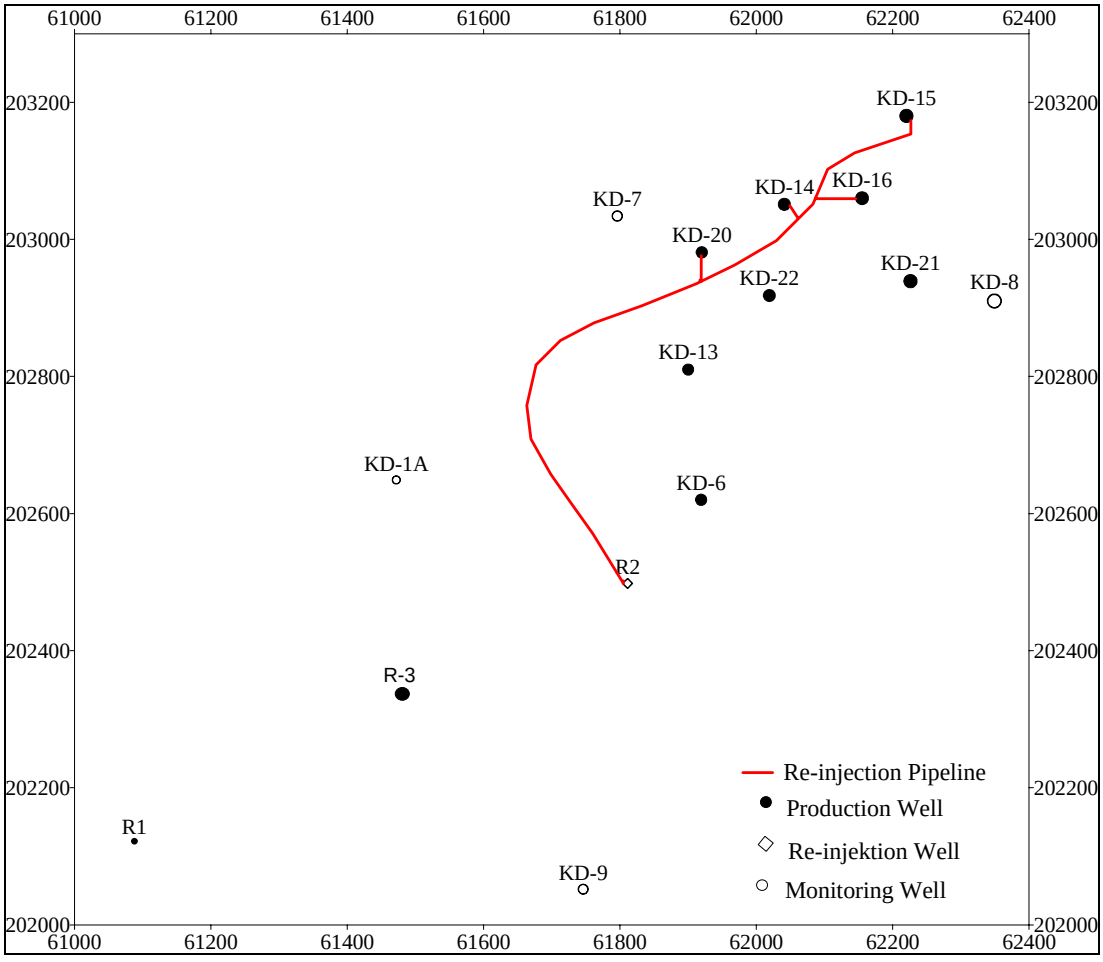

Figure 2: The wells in field and locations of reinjection line

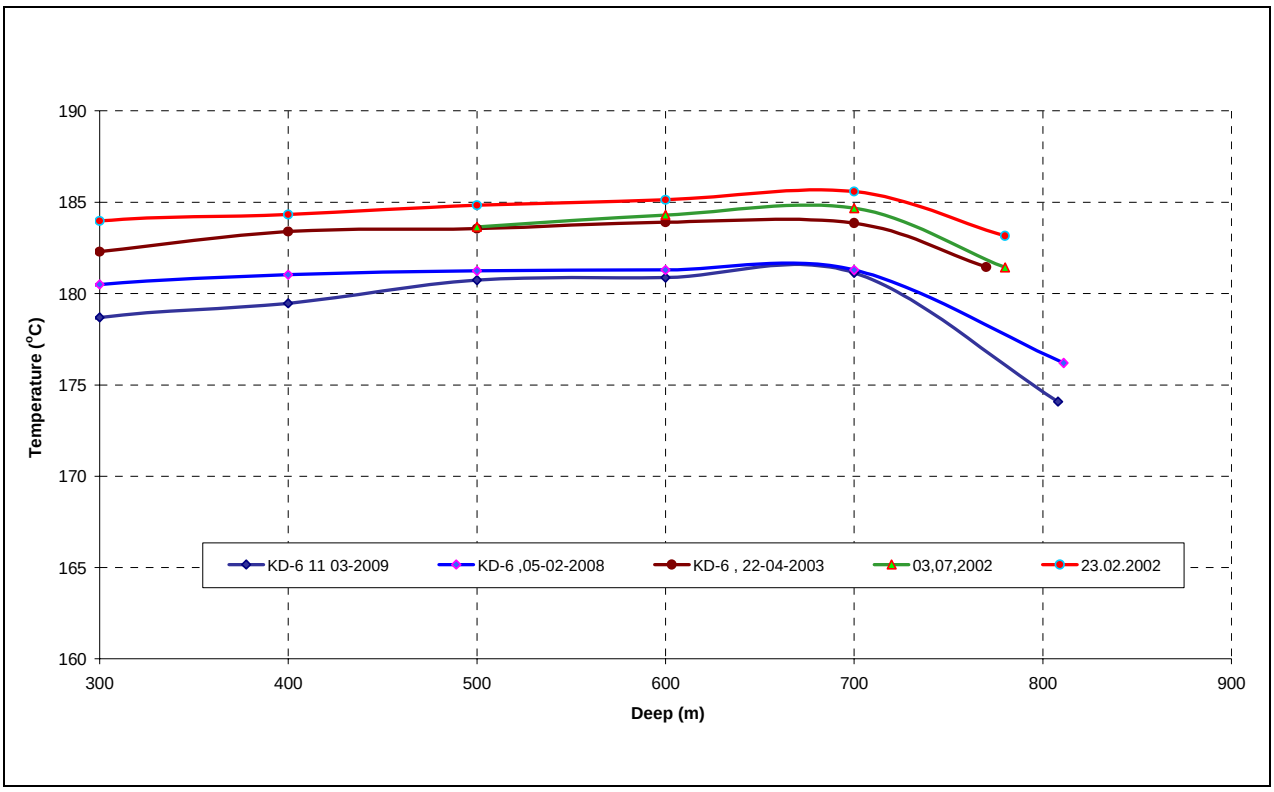

Figure 3 : The variations of dynamic temperature in KD-6 well in 2002-2009

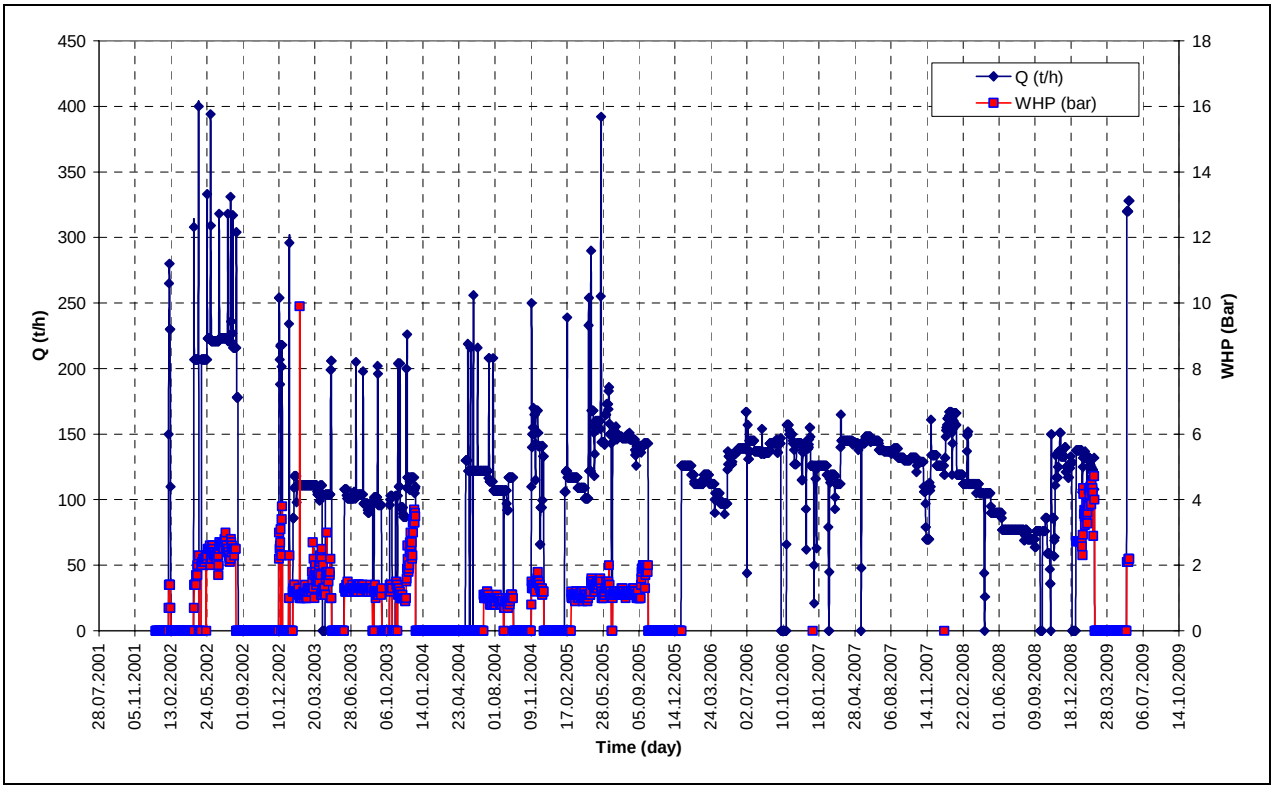

Figure 4: By years of reinjection flow rate and variation of WHP pressure

Today injection flow rate is at 3.7 bar and 130 t/h.

After acidizing the well, reinjection flow rate has been increased with a 2.1 bar WHP and flow rate 328t/h. (Figure 5). Reinjection in R2 prevents decreasing water level in KD-1A and KD-8 (Figure 6).

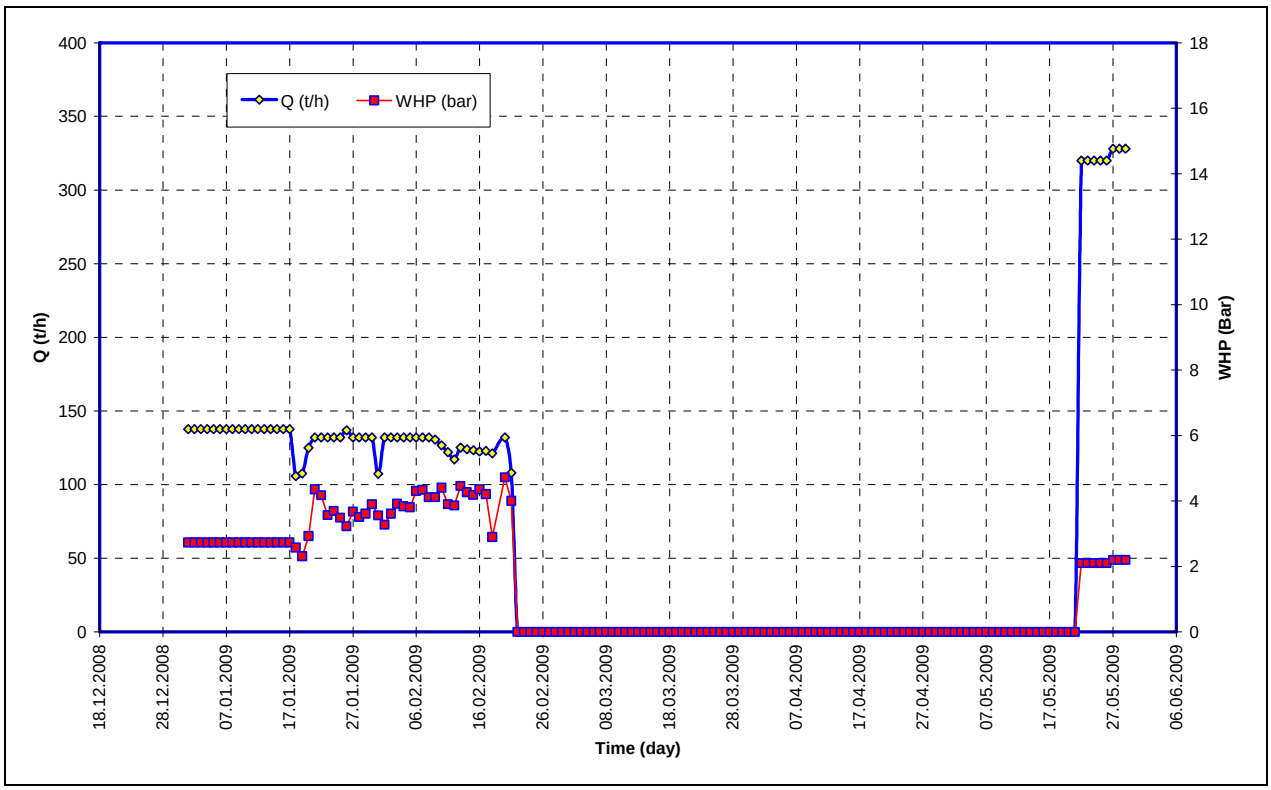

Figure 5: The relation between injection flow rate and WHP before and after acidification at R2 well

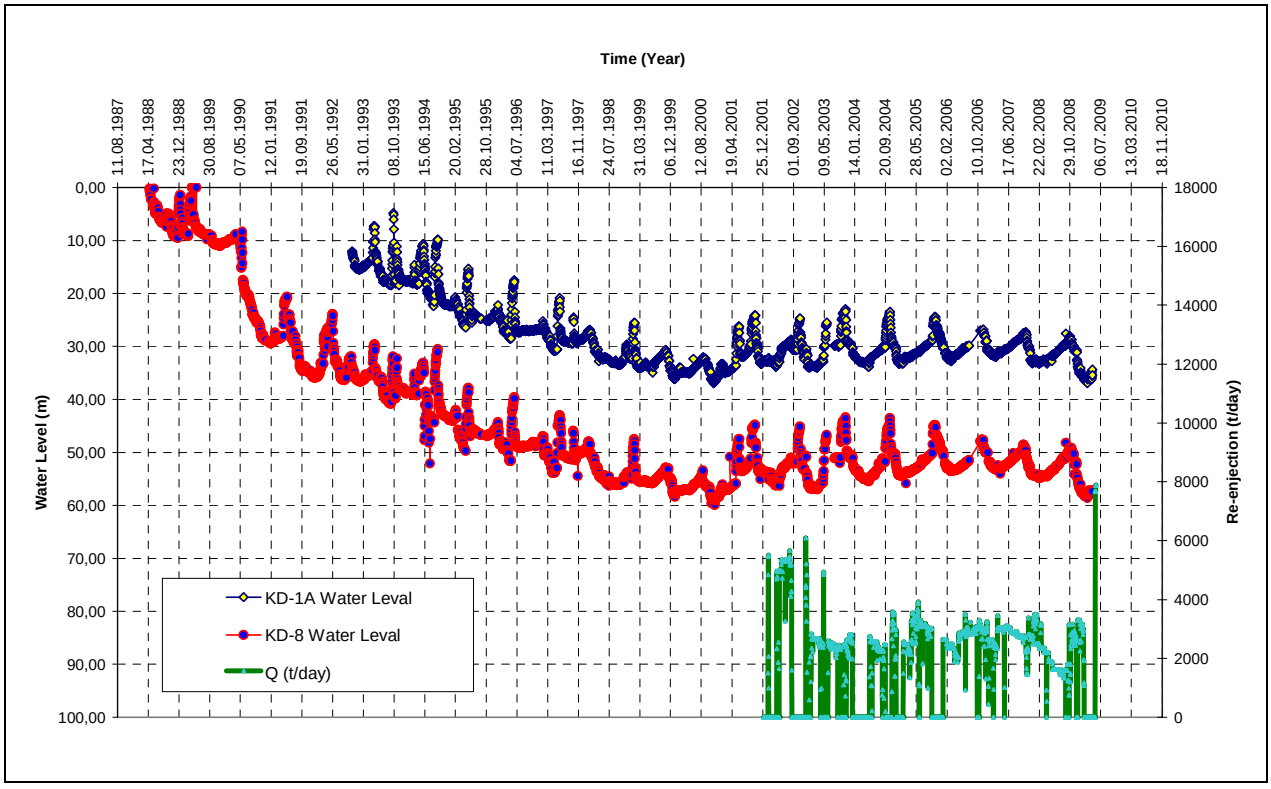

Figure 6: Reinjected to R2 well and the relation water level between KD-1A and KD-8

On average water levels between the years 1988-2001 decreased 4.5 m/year. The rapid decline in water levels has slowed with reinjection.

4. OTHER REINJECTION FACILITY

Though the R-2 well is good for reinjection, it is located within the field

Reinjection can be done on the old wells on the edges of the field (KD-9, KD-2, KD-1A, etc..) by doing maintenance work. KT-1 is situated approximately 4 km east of field and has good permeability. It is a big advantage to be away from the field and to be able to accept reinjection. A decision will be made to place new reinjection wells in this area. Moreover, a deeper area to the south side of the field be used for reinjection if possible.

5. RESULTS

Only 25% of water produced from Kizildere geothermal field can be injected into the R-2 well.

Using pump this flow rate can be increased 2-3 times. After acidification in 2009 of the R-2 well, its injectivity index was calculated as 128(t/h)/bar. This value is fairly high. As much produced fluid as possible should be injected.

The dynamic temperature measurements in KD-6 are well structured, and are the nearest to R-2 (163m), and over 7-years about 4°C cooling was observed.

The new reinjection wells must be drilled just a little bit away to be reinjection wells and deeper. In contrast, R-2 is located in the middle of the field.

From 1988 to 2009 water level decreased 57 m at KD-1A.

In order to slow the rapid decrease in water level, full reinjection of produced fluid is needed.

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