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Distribution of Hot Water Resources and Potentials of İzmir Province

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ABSTRACT

Izmir, located in the western part of Anatolia, is the third major city of Turkey. Izmir is very important because of geothermal reresources. The geothermal areas of Izmir can be listed as Balçova-Narlidere, Kariyaka-Menemen, Seferihisar, Alaçati-Çesme, Dikili-Bergama, Aliaga and Bayindir. In Balçova district heating and thermal tourism, in Çesme thermal tourism, in Dikili-Bergama district heating and greenhouse heating is of importance in using geothermal energy Apparent potential of geothermal energy in Izmir province, considering the lowest consumption temperature as 400C, is 440 000 000 kcal/h. Depending on the greatness of the geothermal areas, reservoir temperature and possible number of wellhole locations of the future, expected total potential is 2325 MWt.

1. INTRODUCTION

İzmir, located in the western part of Turkey (Fig.1), exist on a very important geography from the point of geothermal. Geothermal energy occurs on specific belts on earth such as And Volcanoes, Alpen Himalayas, East African Rift System, Caribbean Islands, Middle America Volcanites Belt (Fig.2).

Italy, Yugoslavia, Greece, Hungary, Turkey, Iran, Pakistan, India, Tibet and China are on the Alpen Himalayas Belt. As it can be considered from above explanations, Turkey is located on the Alpen Himayala Belt (Fig.3).

Geothermal areas of İzmir province constitute the most important areas in West Anatolia (Fig.3). High reservoir temperatures of Seferihisar, Balçova, Dikili-Bergama located on the active tectonic lines, is distinctive. There are no surficial boundaries regarding these areas since the number of research and production drills are insufficient. This points an increase in the expected potential in the future. From this point of view, testing, re-injection studies should be carried out ceasless in addition to the duly drilled production wells and multidisciplinar area operation should be updated and applied.

2. HOT WATER RESOURCES OF İZMİR PROVINCE

İzmir is a very important Eagean geothermal city with its' hot water reresources and hot water usage. The major geothermal reresources located around İzmir are; Dikili-Bergama, Aliağa, Karşıyaka-Çiğli-Menemen, Balçova, Gülbahçe, Alaçatı-Çeşme, Bayındır and Seferihisar-Cumalı, Karakoç, Doğanbey Cape and Salt Mine. These reresources are used in direct applications as spas, district heating, greenhouse heating, thermal tourism and balneology.

2.1 Seferihisar-Cumalı, Karakoç, Doğanbey Geothermal Systems

Seferihisar spas are located in the southern part of Seferihisar (Fig.3). Many hot water reresources of varried sizes take place in this area. The highest temperatured resource is seen in the area formed by Doğanbey-Cumalı-Karakoç spas.

The apparent thermal potentials of the hot water resources of Seferihisar has been calculated and the minimum temperature is accepted as 40^0C. The considered resources are, Doğanbey, Doğanbey Salt Mine, Karakoç, Cumalı, Karakoç Spas and 2 wells around, a well in Doğanbey and a well drilled by MTA around Cumalı Spas. The total apparent potential of the mentioned resources is: 120 000 000 kcal/h. The expected geothermal potential in this area is minimum 500 000 000 kcal/h. The management of the calculated energy of 120 000 000 kcal/h for Seferihisar-Cumalı, Doğanbey and Karakoç Spas is very important. The required studies to use this apparent potential geothermal energy in especially thermalism, greenhouse heating and district heating should be initiated.

The waters of Seferihisar-Cumalı, Karakoç and Doğanbey Spas are generally sodium-chlorided, sodium-bicarbonated and sulfated. They have a charateristic of scaling. These resources are; Doğanbey Salt Mine (93^0C), Doğanbey Cape Resource (64^0), Doğanbey Resource ($64\text{-}95^0$C) and Karakoç Resource ($56\text{-}62^0$C). The highest temperature evaluated from the drills is indicated as 153^0C.

2.2. Balçova-Narlıdere Geothermal System

In Balçova geothermal area (Fig.3), studies continue ceasless since 1962, when heat production has been started via downhole heat exchangers. Totally 26 production wells including wells with downhole heat exchangers, deep and shallow wells, have been operated after initially drilled 10 gradian wells. The highest reservoir temperature measured from the wells is 140^0C.

The very first heat production via downhole heat exchanger is applied in Balçova. After the development of the chemicals to prevent scaling, production has been done by circulation pumps

As a result; the apparent usable total heat from the wells drilled by the governorship, university and local people, is around 145 000 000 (Aug-2004) kcal/h. The Dokuz Eylül University Medical Hospital, governorship facilites, a greenhouse area of 100 acre, aproximately 14 000 residence equivalent house is being heated with this amount of energy. Balçova Geothermal Area is being exploited from a realistic point of view in operating and usage. Here; thermal tourism, greenhouse and district heating is integratively carried out. By fallowing the required preventions regarding re-injection and drilling new wells, heating areas can be increased. The mimimum energy expected from the

Balçova-Narlıdere Geothermal System is 500 000 000 kcal/h.

Hot waters of Balçova is sodium-bicarbonated and chlorided.

2.3. Karşıyaka-Menemen Geothermal System

Apart from İzmir-Narlıdere geothermal system in İzmir, Karşıyaka-Menemen is another important potential geothermal area. (Fig.3). In some places of this area a number geothermal researches done by MTA in the name of the Governorship of İzmir. At Çiğli-Ulukent, where is in the geothermal area of Karşıyaka-Menemen, a hot water research well has been drilled with a depth of 800 m and 55^0C of downhole temperature with a 10 lt/sec flow. The usable potential of this well is approximately 500 000 kcal/h. The salinity of the waters around this area is low. The present potential can be consumed in district heating, greenhouse heating and thermalism as well.

The geothermal potential expected in Karşıyaka-Menemen Area is minimum 75 000 000 kcal/h.

2.4.Alaçatı-Çeşme Geothermal System

The initial studies regarding hot water research in Çeşme, Çeşme Spas, Şifne and Alaçatı has been started by MTA as in other geothermal areas (Fig.3). Çeşme hot water resources are placed around Çeşme Ilıca, Şifne and central parts of Çeşme. The known resources in this area are appeared to be related with fracture lines. The waters of Çeşme has a very high salinity besides being sea-feeded. MTA has drilled the well of Ilıca-1 at a depth of 282 m with a temperature of 56^0C, having a 42 lt/sec flow rate in Çeşme-Ilıca. In 1994 at Mamurbaba province FY-1 well at a depth of 364 m drilled and the temperature evaluated from this well was indicated as $61,5^0$C. Here, including the latest well drilled by governorship, the apparent usable potential is approximately 15 000 000 kcal/h.

The calculated heat energy of 15 000 000 kcal/h for Çeşme, Ilıca and Şifne should be used to proceed firstly thermal tourism, and balneolgical usage, fallowed by district heating and greenhouse heating. The expected energy in Çeşme is minimum 75 000 000 kcal/h.

The waters of this area is sea-feeded, resulting a high rate of sodium chloride and sulfate and also corrosive. As the temperatures of the wells drilled in Alaçatı is low, this is not considered at this stage.

2.5.Urla-Gülbahçe Geothermal System

There are some outflows of hot water resources around Urla- Gülbahçe village but there is no research regarding geothermal energy except geological studies done by MTA. The wells drilled by university could not result as expected but by making the required researches, the resource area would be developed.

Urla- İçmeler, again in this area, has a flow-rate of 10 lt/sec with a temperature of 19^0C. Chemically the waters of Urla-İçmeler is sodium-chloride sulfate waters. Also thermal water of Gülbahçe has a temperature of 32^0C, 10 lt/sec flow-rate and it is sea-feeded being sodium-chloride type.

2.6.Aliağa Geothermal System

There are hot water resources in İzmir Aliağa province as well (Fig.3). In some parts of this province, MTA has completed the studies regarding geology, geophysics and gradian drills. Aliağa-Samurlu Village geothermal anomaly has been defined depending on the results of these studies. MTA has drilled 3 wells in Samurlu geothermal area at depths of 625 m., 1136 m., 1145,5 m. with a total flow-rate of 80lt/sec (with pump) and with an average temperature of $97\text{-}98^0$C. According to this; including Ilıca Cape, Tavşan Island and the drilled wells, apparent potential geothermal energy is minimum 25 000 000 kcal/h.

With this potential of energy, the district heating of Aliağa can be started out. Also thermalism and green house heating should be revived. In Aliağa province, including the geothermal areas where no drilling studies done presently, expected geothermal potential is minimum 100 000 000 kcal/h.

2.7.Bayındır Ergenli Geothermal System

Ergenli Spas is located approximately 8 km northeast part of İzmir-Bayındır county (Fig.3). There are no detailed studies done by MTA focused on geothermal energy in this area. Only some research around the resource is done. In this area, static level starts with hot water and the temperature of the present wells varies depending on the mixing-rate of surficial waters with deep waters. With the help of the shallow drilled wells, hot water with a temperature of 45^0C hot water is obtained and 100 rooms of spa facilities is being operated. The present spas are The Headman of Ergene Village, Fatma Hanım and Vardar Spas.

Ergene Spas can be developed with the addition of modern spa facilities and become more attractive. By heating the spa rooms with geothermal water, the thermal tourism will be spread out to four seasons. The apparent heat potential of Ergenli hot water resources is approximately 1 200 000 kcal/h. The expected potential is around 5 000 000 kcal/h.

The waters of Ergenli Village hot water resources is sodium bicarbonated and total mineralisation is low with a distinctive amount of sulfur.

2.8.Dikili Bergama Geothermal Systems

It is better to explain the hot water resources of Dikili-Bergama under two titles as Dikili Province and Bergama Province(Fig.3). In this region with such a great geothermal potential, unfortunately the assesment of geothermal energy is very poor and restricted. Except some primitive spa facilities and 180 acre of greenhouse heating area, hot water is not being evaluated. With this great geothermal potential, aheading district heating of Dikili, greenhouse heating and thermalism is possible. By this means, though there are several attemptions, no serious studies.

Expected geothermal energy from Dikili Province is minimum 400 000 000 kcal/h. Chemically, the waters of this province is sodium-bicarbonate type waters and presents 3gr/lt salinity. Bademli Province is sea-feeded and the water is sodium-chloride type water. Nebiler Resource is sodium-bisulfated having a low rate of salinity.

The most important resources of Bergama Province, considering the flow-rate and temperature, are Paşa Spas and Bergama Dibek Mevkii well. The total apparent heat potential of these resources is approximately 6 000 000 kcal/h. Apart from this, in 2003, two hot water wells have been drilled by Bergama Municipality in the area, where Dibek and Güzellik Spa are located. So; the total apparent usable geothermal heat potential has become 16 000 000 kcal/h.

Heading greenhouse heating and thermal tourism, district heating should be developed with the present and forthcoming geothermal resources. The expected energy in this area is minimum 200 000 000 kcal/h. The waters of Bergama Province is generally sodium-bicarbonate-sulfate type waters and overall salinity is not very high. The resource of Güzellik spa is dry presently, water can be supplied from subsurface via drills. Paşa Spas will stay inside the dam-lake area in the future.

3.Result and Recommendations:

The total apparent usable geothermal potential of hot water resources, located in the boundary of İzmir depending on the drills done by MTA and local people, is 440 000 000 kcal/h. Today, this energy cannot be evaulated in a realistic way. Approximately 15 000 residence equivalence of district heating and 300 acre of greenhouse heating is being provided by geothermal engery. So, only the 25% of the present apparent usable energy is consumed.

The total expected energy from the known geothermal areas inside İzmir County boundary is minimum 1 850 000 000 kcal/h. Except this, there are Torbalı and Güzelbahçe geothermal areas in İzmir, as well. No technical studies has been done regarding these mentioned areas. The expected geothermal energy from these areas will be minimum around 200 000 000 kcal/h.

Including the expected geothermal potentials of the new areas, the total geothermal energy potential of İzmir is minimum 2 000 000 000 kcal/h.

Here, by using the expected total potential energy in district heating, minimum 400 000 house can be heated by geothermal energy. If the above mentioned potential is used in greenhouse heating, minimum 20 000 acre of greenhouse will be heated by geothermal energy.

A multidisciplinar field operating model should be developed and re-injection should be done in İzmir.

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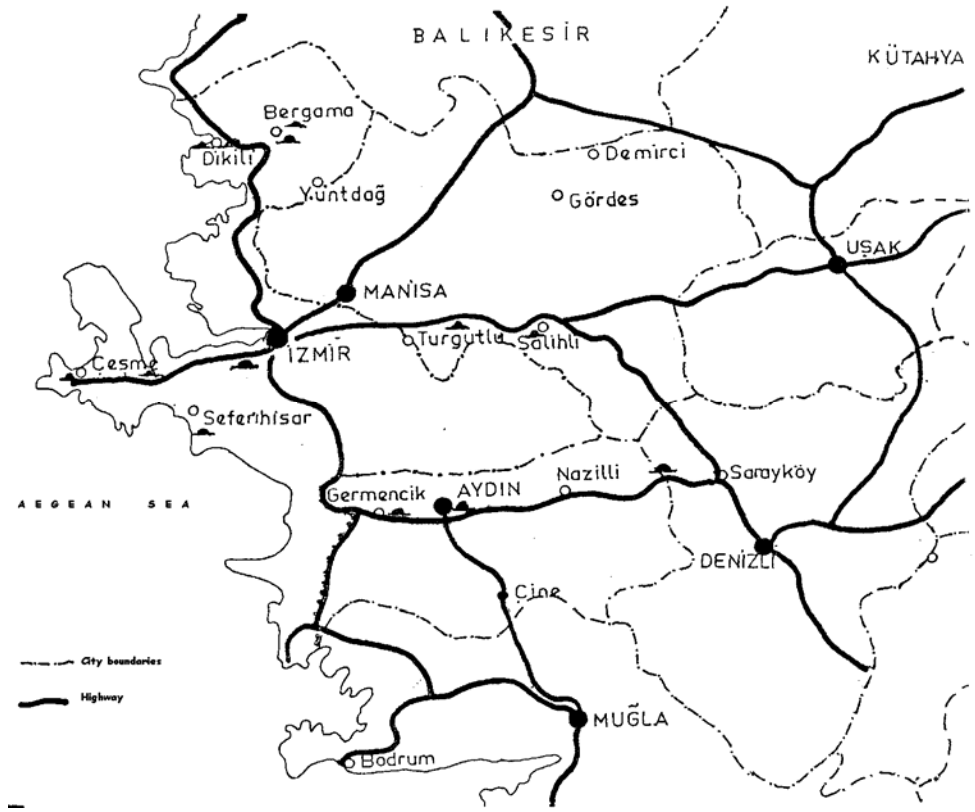

Figure 1: Location map

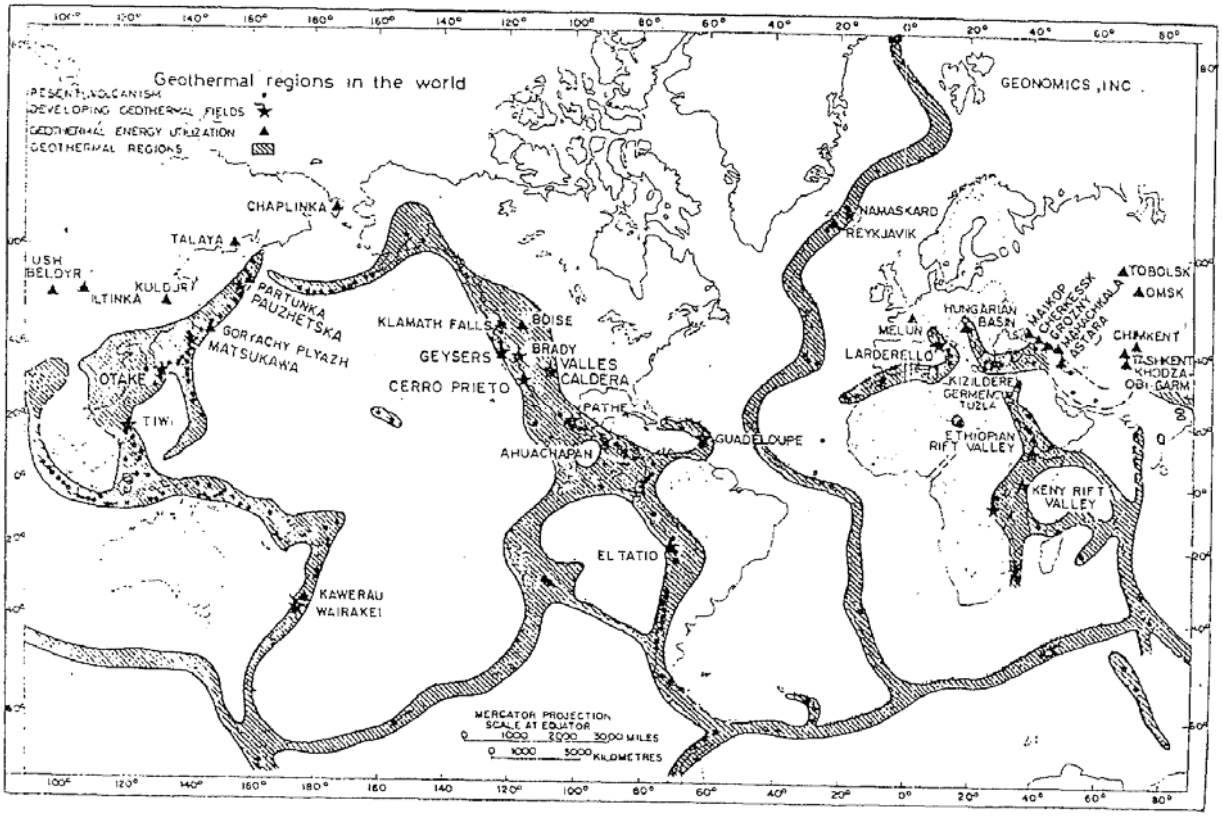

Figure 2 : Geothermal regions in the world.

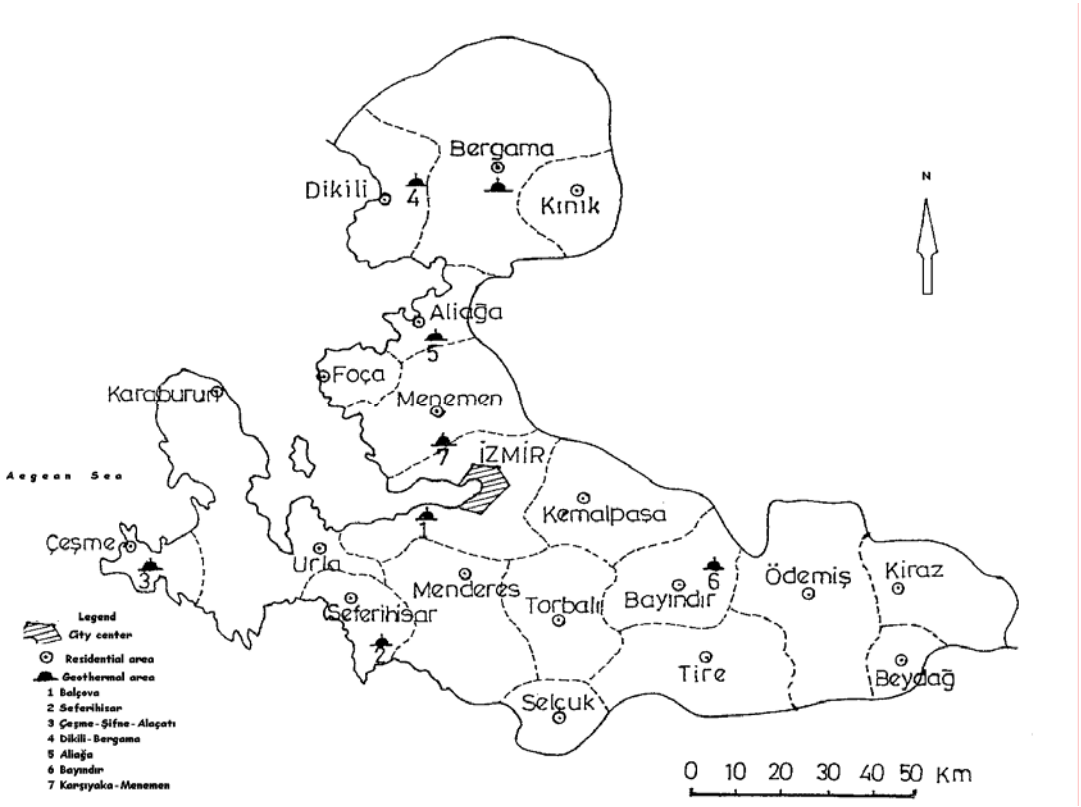

Figure 3 : Geothermal areas of İzmir Province