The Study of Heat Convection Flow Around AUM Geothermal Area of South Sumatra, Indonesia

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Research Paper

The Study of Heat Convection Flow Around AUM Geothermal Area of South Sumatra, Indonesia

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ABSTRACT : *The heat convection flow study has been conducted around the Airklinsar-Ulu Musi (AUM) geothermal area, Empat Lawang Regency, South Sumatra, Indonesia. A study was carried out by measuring the heat flow dimension of the hot springs, the temperature of the hot springs and its environment, and then the travel time of styrofoam moving on the flow. Furthermore, the heat flow discharge will be calculated. The objective is determining the value of the loss energy of heat convection naturally. The study showed that the amount of heat energy by convection was 1165.22 KJ/s or 1165.22 KW_t.*

Keywords – *Convection, discharge, geothermal, heat flow, temperature.*

I. INTRODUCTION

The Airklinsar geothermal area is located in Ulu Musi, Empat Lawang Regency, South Sumatra, Indonesia. In this area there are four points of hot springs. The area is prospected to be developed into the power plants. It is demonstrated by hot springs temperature ranging up to 65°C, type of fluid is cloride (pH=7), and reservoir temperature estimate higher than 320°C [1]. In accordance with the reservoir temperature is above of 225°C, which is classified as high-temperature geothermal systems [2]. However, the estimated potential of geothermal reserves can be used as a power plant still unexposed. Meanwhile, one the important parameters in the estimation of potential geothermal reserves is about the value of the natural heat loss either by conduction or convection [3].

Based on the reason above, the study of heat convection has been done. The goal is to expose the value of the loss energy of heat convection naturally. The result can be combined with the value of the loss energy of heat conduction in the calculation of the total natural heat loss to estimate the potential reserves of geothermal energy.

II. THEORY

In the fluid, the heat transfer occurs through a combination of molecular conduction and energy transfer resulting from the motion of fluid particles. A heat transfer like this is known as convection. The heat loss by convection can be calculated by the following equation [4]:

$$Q = m\, C_{water}(T_{water} - T_{air}) \qquad (2.1)$$

$$m = \rho_{water}\ x\ V \qquad (2.2)$$

Where m is the mass transfer, C_{water} is the thermal conductivity of water (4.2 $KJkg^{-1}$), ρ_{water} is the density of water (990 kgm^{-3}), V is the discharge of fluid at the hot springs flow (m^3detik^{-1}), T_{water} is hot water temperature measured (°C), and T_{air} is normal air temperature around the hot springs (°C).

III. METHOD

The equipment is used in this study as follows; stopwatch is used as a timer measurement, the GPS is used to determine the position of the measurement, thermometer is used to measure the temperature of the air (environment) and hot springs, the roller meter is used to measure the dimensions of the heat flow of the hot

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springs, then the styrofoam are used to measure the travel time of the Styrofoam movement on the flow. Furthermore, the time is used in the calculation of discharge of heat flow.

The method is expressed by the following steps; first, the measured average of length, width and height were conducted to obtain the dimensions of heat flow of the hot springs. Second, sebagai analogi dimensi aliran panas dibuat balok kayu dengan ukuran sesuai yang sesuai dengan hasil pengukuran rata-rata dimensi aliran (200 x 30 x 30 cm^3). Third, the styrofoam puts on the flow, the travel time of its movement from the initial position to the final position was measured. Then, the travel time is used to calculate the discharge of heat flow. Finally, by using Equation (2.1) and (2.2), the value of the heat loss by convection will be obtained.

a. The styrofoam velocity measurement on the flow of the hot springs-1.

b. The styrofoam velocity measurement on the flow of the hot springs-2.

c. The styrofoam velocity measurement on the flow of the hot springs-3.

d. The styrofoam velocity measurement on the flow of the hot springs-4.

Fig. 3.1: The styrofoam velocity measurement on the flow of the hot springs.

IV. RESULTS AND DISCUSSION

Discharge measurements made on a three points of different hot springs. To get good result, the temperature of air and hot springs, the height of heat flow, and the styrofoam travel time, were measured three times respectively. The results of discharge measurements can be seen in Tabel 4.1.

Tabel 4.1. The result of discharge calculations

Hot	Position (m)			T_{hs}(°C)			Average	T_{air} (°C)	Dimension of Flow (cm)						Travel Time (s)			Average	Volume	Volume	Discharge	Mass	$Q_{convection}$
Springs	X	Y	Elev.	T_1	T_2	T_3	T_{hs}(°C)		Height			Average	Lenght	Width	t_1	t_2	t_3	Trav. Time (s)	(cm^3)	(m^3)	(m^3/s)	Transfer	(KJ/s)
									1	2	3	Height											
1	244242	9580092	312	62,70	63,00	63,20	62,97	29,50	2,10	2,00	1,90	2	200	30	3,61	3,99	3,42	3,67	12000	0,012	0,003267	3,23412	454,59
2	244257	9580069	314	60,40	60,90	61,40	60,90	29,50	1,80	1,81	1,79	1,8	200	30	4,23	4,23	4,34	4,27	10800	0,0108	0,002531	2,50594	330,48
3	244260	9580065	309	62,00	62,10	62,10	62,07	29,50	1,61	1,63	1,62	1,62	200	30	6,1	5,28	6,82	6,07	9720	0,00972	0,001602	1,58618	216,96
4	244259	9580138	303	56,64	56,61	56,62	56,62	29,50	1,40	1,42	1,41	1,41	200	30	6,78	5,25	5,51	5,85	8460	0,00846	0,001447	1,43251	163,19
																						TOTAL=	1165,22

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From Tabel 4.1, the total value of natural heat loss by convection in AUM geothermal area was ± 1165.22 KJ/s, or equivalent to ± 1165.22 KW_t (kilo watts thermal). If combined with the results of geochemical research that has been done [1] which states that the geothermal potential in this area is the prospect to be developed into a power plant. Thus, it can be interpreted that the small amount of fluid flow of heat reaching the surface can not be linked directly to the amount of the potential for geothermal energy is produced. In contrast, little or the least amount of fluid flow of heat rising the surface can be interpreted that the potential heat energy stored below the surface likely still relatively large.

V. CONCLUSION

The value of loss energy by convection which flows to the surface around the AUM geothermal area was ± 1165.22 KJ/s, or equivalent to ± 1165.22 KW_t.

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REFERENCES

[1]. Virgo F., Karyanto, Ady M., Agus S., Wahyudi, Suharno, and Wiwit S., Water Geochemical Analysis Within Penantian Geothermal Area in Pasema Air Keruh, Empat Lawang District, South Sumatra. Proceeding, The 12th Annual Indonesian Geothermal Association Meeting & Conference, Bandung, Indonesia, 2012.

[2]. Anonymous, Angka Parameter Dalam Estimasi Potensi Energi Panas Bumi. SNI 13-6482-2000, ICS 07.060, BSN, Jakarta, 2000. Retrieved from ITB website: http://geothermal.itb.ac.id/sites/default/files/public/Angka_parameter_energi_geothermal.pdf.

[3]. Mwawongo, G. M., 2007. Geothermal Mapping Using Temperatur Measurements, Short Course II on Surface Exploration for Geothermal Resources, UNU-GTP and KenGen, Lake Naivasha, Kenya, 2007.

[4]. Hochstein, M.P., Owen, S.A., and Bromley C., Thermal Springs at Hot Water Beach, Proceeding of The 18th NZ Geothermal Workshop, New Zeland, 1995.

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