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The Effect of Well Elevation on Production in Lumut Balai Field

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ABSTRACT

This paper presents the effect of well elevation on production in Lumut Balai field. In this paper, the authors analyzed the effect of different elevations on the production especially for the well with significant contour difference. To date, many scientists just focus on several main parameters for determining high-low production such as pressure, temperature and permeability. However, one parameter couldn't be forgotten is the existence of elevation for each well location obviously determining production. This is because for most geothermal fields, the difference of elevation for each cluster is insignificant.

In this paper, authors did case study of Lumut Balai field. Moreover, well discharge data of many wells were presented and the processing of this study employed existing wellbore simulation software. Results showed that higher production is obtained at lower elevations. Thus, the authors conclude that the parameter of elevation needs to be considered in developing geothermal field especially for the fields have significant elevation differences for each cluster.

1. INTRODUCTION

The geothermal industry is unique when compared to the oil and gas industries. The goethermal industry has its own challenges when one wants to explore and develop it because it cannot be moved easily and cannot be packed like oil and gas. It needs to be firstly converted into electrical energy and then distributed. It is interesting because it just relies on the natural ability of the reservoir. Consequently, it should be handled to obtain optimal production. In addition, the high temperature makes it difficult to implement "artificial lift" as common in the oil and gas.

Due to the limitation of natural ability, the geothermal wells targetting strategy needs to consider the pressure drop that occurs along the wellbore and important factors that have to be considered both geoscience and reservoir. It is also supported by the type of reservoir that is water-dominated which has pressure drop greater than the steam-dominated. To this end, the authors assume that the elevation of the well is quite instrumental in getting the wellhead pressure high or low even the well has no high enthalpy.

2. DELIVERABILITY CURVE

In this paper the authors present several examples of data from wells in Lumut Balai field. Data was obtained from the production test and was then processed to obtain the output curve using Wellsim software.

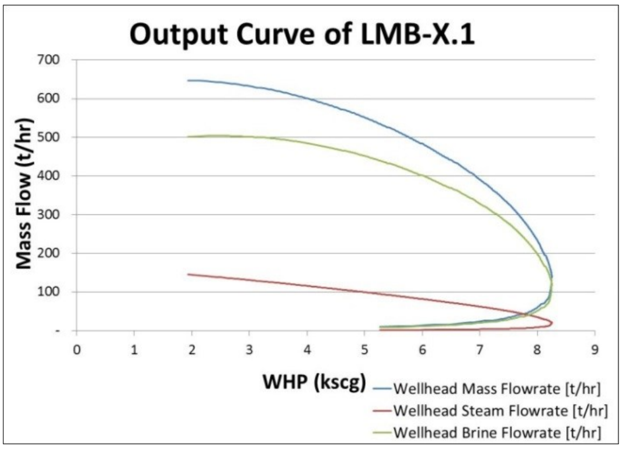

Figure 1: Output curve of LMB-X.1.

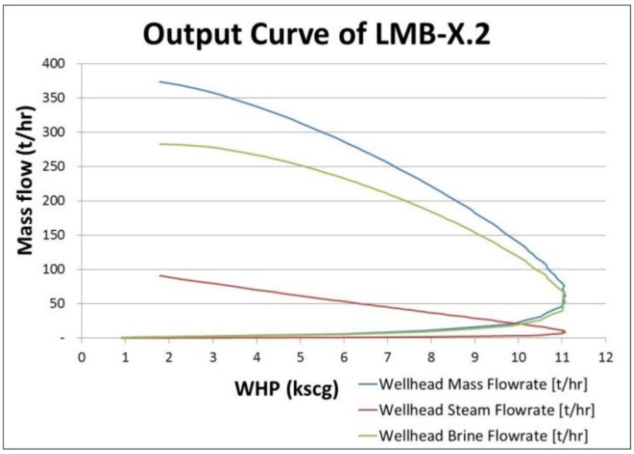

Figure 2: Output curve of LMB-X.2.

In the well of LMB-X1, the wellhead pressure (WHP) is normalized by 6 kscg. In this well, the value of enthalpy is 1045 kj/kg, dryness is 0.17, injectivity index is 3155 lpm/ksc and the power is 9 MW. This well is located at the elevation of 1300 meters.

The well of LMB-X2 is located at same cluster as LMB-X.1 and the elevation is 1300 meters. This well has enthalpy of 1081 kj/kg, dryness of 0.19, injectivity index of 465 lpm/ksc and the power of 6 MW.

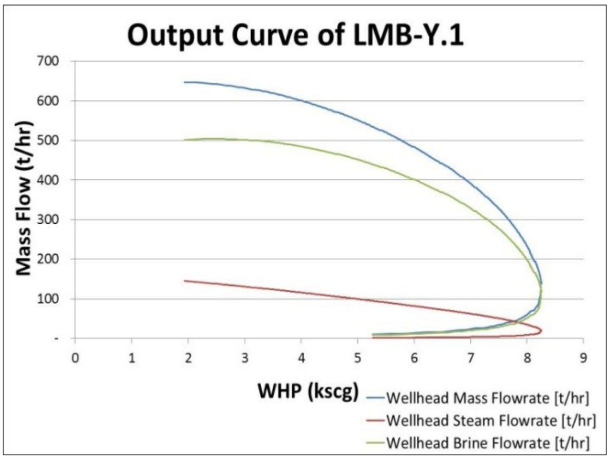

Figure 3: Output curve of LMB-Y.1.

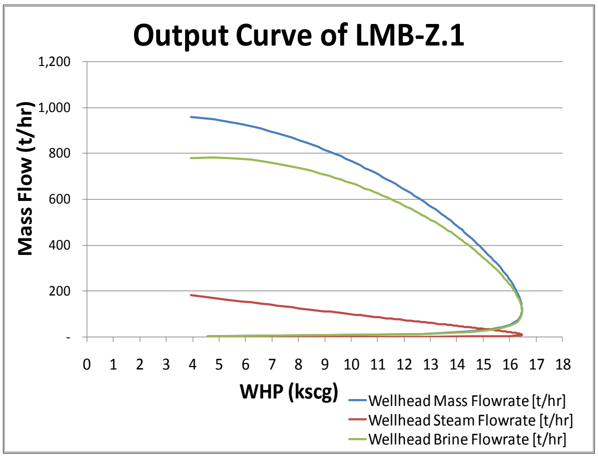

Figure 4: Output curve of LMB-Z.1.

The well of LMB-Y.1 is located at different cluster with LMB-X.1 and LMB-X.2. This well is located at the elevation of 1250 meters with enthalpy of 1006 kJ/kg, dryness of 0.15, injectivity index of 1304 lpm/ksc and the power of 4 MW at 6 kscg.

The well of LMB-Z.1 is located at cluster Z with elevation of 1000 meters. This well has enthalpy of 1035 kJ/kg, dryness of 0.15, injectivity index of 3000 lpm/ksc and the power of 18 MW at 6 kscg.

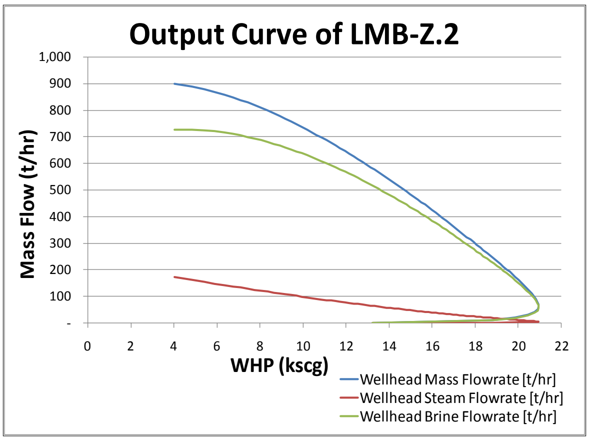

Figure 5: Output curve of LMB-Z.2.

The well of LMB-Z.2 is located at the same cluster as LMB-Z.1 and the elevation is 1000 meters. This well has enthalpy of 1042 kj/kg, dryness of 0.16, injectivity index of 2726 lpm/ksc and the power of 17 MW at 6 kscg.

3. DISCUSSION

The above cases show that the well LMB-X.1 has the power of 9 MW which is lower than that of LMB-Z.1 and LMB-Z.2 with the power of 18 MW and 17 MW respectively. The values of enthalpy and dryness of the three wells are similar. The injectivity index that represents the value of the permeability has insignificant difference with the range 2700-3200 lpm/ksc. The power of LMB-Z.2 is slightly smaller than that of LMB-Z.1 because LMB-Z.2 has injectivity smaller than LMB-Z.1 (even though the enthalpy of LMB-Z.2 is higher than LMB-Z.1). The well of LMB-X.2 has higher enthalpy of 1081 kj/kg than the other wells. However, due to the injectivity index of 456 lpm/ksc, the power of the well is only 6 MW. The injectivity may affect the value of the well power. LMB-Y.1 well has power of only 4 MW because among all the wells, the well of LMB-Y.1 has the smallest enthalpy of about 1006 kj/kg.

Referring to the injectivity and enthalpy values which are quite different between the wells LMB-X.2, LMB-Y.1 and LMB-X.1, LMB-Z.1, LMB Z.2, it is difficult to compare the two wells (LMB-X.2 and LMB-Y.1) with the wells LMB-X.1, LMB-Z.1 and LMB-Z.2. In other words, the wells LMB-X.1, LMB-Z.1, and LMB-Z.2 can be compared in terms of the elevation parameter due to the similar injectivity index (2700-3200 lpm/ksc) and also similar enthalpy which is in the range of 1035-1045 kJ/kg at the temperature of about 240°C and the reservoir pressure of about 50 ksc. Assuming that the injectivity index and enthalpy are similar to the three wells and thus the wells at lower elevations have higher power. In other words, the wells of LMB Z.1 and LMB-Z.2 located at the elevation of 1000 meters have greater power. The well LMB-X.1 is at 1300 meters. The power of wells LMB-Z.1 and LMB-Z.2 is in the range 17-18 MW while LMB-X.1 is only 9 MW with the altitude difference of 300 meters. There is a significant power difference of 8-9 MW. This happens because the pressure drop in the well of LMB-X.1 is larger than that in the other well due to the fluid that is raised with higher elevation starting from feedzone of about 0 meter to 1300 meters. LMB-Z.1 and LMB- Z.2 only pump the fluid 1000 meters high to reach the surface.

4. CONCLUSION

In some wells like LMB-X.1, LMB-Z.1 and LMB-Z.2, the pressure, temperature and injectivity index values (representative of permeability) are similar. It is clear that elevation difference significantly affects the wells power with 8-9 MW for 300 m elevation difference. Wells LMB-X.2 and LMB-Y.1 are difficult to compare “apple to apple” in terms of the elevation parameter due to the significant difference in injectivity index and enthalpy (temperature) between those wells.

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