A business model of hot spring power generation and its current progress in Japan

Hirofumi Muraoka[1], Seiichiro Ioka[1], Norio Yanagisawa[2], Munetake Sasaki[2], Hajime Sugita[2], Masatake Sato[3], Kazumi Osato[3]

[1]North Japan Research Institute for Sustainable Energy (NJRISE), Hirosaki University, Japan, [2]Institute for Geo-Resources and Environment (GREEN), AIST, Japan, [3]Geothermal Energy and Development Co., Ltd. (GERD), Japan

E-mail: hiro@cc.hirosaki-u.ac.jp

A business model of hot spring power generation was proposed by Muraoka (2007) and Osato and Muraoka (2008) to efficiently utilize low-temperature hydrothermal resources such as the numerous hot springs in Japan. About 28,000 hot spring sources are distributed all over Japan and their pre-existence is one of the serious barriers to develop new geothermal power plants in Japan. However, current binary cycle technology enables power generation by hot spring water even less than 100℃. Most of high-temperature hot springs are mainly used for bathing in Japan until the present where they have to be cooled down to the adequate bath temperature 42℃ without any serious dilution of balneological constituents. It means that high-temperature hot springs need more works in terms of the bath use compared to the moderate-temperature hot springs. Then, we proposed to introduce a very small binary cycle in the upper reach of high-temperature hot springs. If we do that, we could make power generation with the high-temperature range above the bath-use temperature and we could make the cooling down to the adequate bath use temperature without any serious dilution of balneological constituents at the same time. This is our business model of hot spring power generation. This business model gives a further merit, that is, if hot spring owners adopt the business model of hot spring power generation, the conflict between hot spring owners and geothermal power development will be gradually reduced, because the hot spring power generation itself is some sort of geothermal power development. At the time of the proposal, we did not have any small binary cycle power generation systems suitable for the small discharge rate of hot springs and therefore we made our efforts to develop a 50 kW class Kalina cycle hot spring power generation system. This system was almost completed and is now under the operation experiment in the Matsunoyama hot spring field, Niigata Prefecture. In addition to this, many makers recently manufactured small-scale binary cycle power generation systems such as 70 kW, 50 kW, 20 kW and 3 kW classes in Japan. The feasibility studies of hot spring power generation are recently made in Niigata, Shizuoka, Nagasaki, Oita, Nagano, Toyama and Aomori Prefectures. The profitability of hot spring power generation is still marginal even by the new Feed-in Tariff system at 42 Yen/kWh introduced in July 2012, but the hot spring power generation market will be established within the coming ten years.

References: Muraoka, H. (2007) Current withering and possible future revival of geothermal energy development in Japan. Journal of the Japan Institute of Energy, 86, 153-160 (in Japanese with English abstract). Osato, K. and Muraoka, H. (2008) Hot spring binary cycle power generation. Journal of the Japan Institute of Energy, 87, 812-818 (in Japanese with English abstract).