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Development of Direct Use Application by BPPT

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Beside for generating electricity, geothermal energy can also be utilized directly in such processes as heating, drying, sterilization, pasteurization, heated swimming pool and hot springs; also known as direct use applications of the geothermal energy. Direct use application in Indonesia commonly uses geothermal resources with low to medium enthalpy (<150ºC) which usually not economical if used for electricity generation. Utilization of geothermal energy in Indonesia is primarily for generating electricity, while the lower enthalpy is used for direct use (non-electricity) applications, which had began more than ten years ago.

Several years ago, a group of researchers from the national research and technology agency (BPPT) began to investigate methods for applying geothermal energy in agricultural sectors, particularly to sterilize the growing agent used in mushroom cultivation as a pilot project. This technology is used in Kamojang-field, West Jawa, which places geothermal energy as substitute for kerosene to fuel boilers. Furthermore, BPPT has also developed the direct use application in Way Ratai – Lampung, South Sumatera for drying process of coconut and cocoa. The energy resource in this area uses natural geothermal wells with surface temperature around 92-95ºC.

1. INTRODUCTION

Indonesia is a country with tremendous geothermal energy potential. It is marked by the manifestation of geothermal energy applications in 256 locations, spread around Sumatera, Jawa, Nusa Tenggara, Sulawesi, Maluku and Papua. Some of them are for generating electricity, while others are direct use applications.

In areas of developed geothermal fields such those in Kamojang, Dieng, Darajat, Gunung Salak, and so forth, there are abandoned geothermal wells which are unused due to their lack of pressure, temperature, and production flow rate, therefore can not supply energy for electricity.

The distinguishing trait of geothermal resources in Indonesia is their locations, which are generally around the mountainous areas surrounded by agricultural, plantation, forestry and breeding fields, as well as fisheries and tourism sites. Therefore, many forms of direct use geothermal energy applications are automatic match in these areas, namely for drying and preservation processes of agricultural products (tea, coffee, cocoa, coconut, etc), growing agent sterilization, breeding products pasteurization (milk, etc), heating room, hot spring bathing, and other utilizations including leather tanning industry, metal, etc.

Drying, heating, sterilization, pasteurization processes and so forth generally use oil fuels in large quantity. As the primary energy source in this case, oil can be substituted by geothermal energy. A device of utmost necessity for the substitution is heat exchanger, as shown in figure 1.

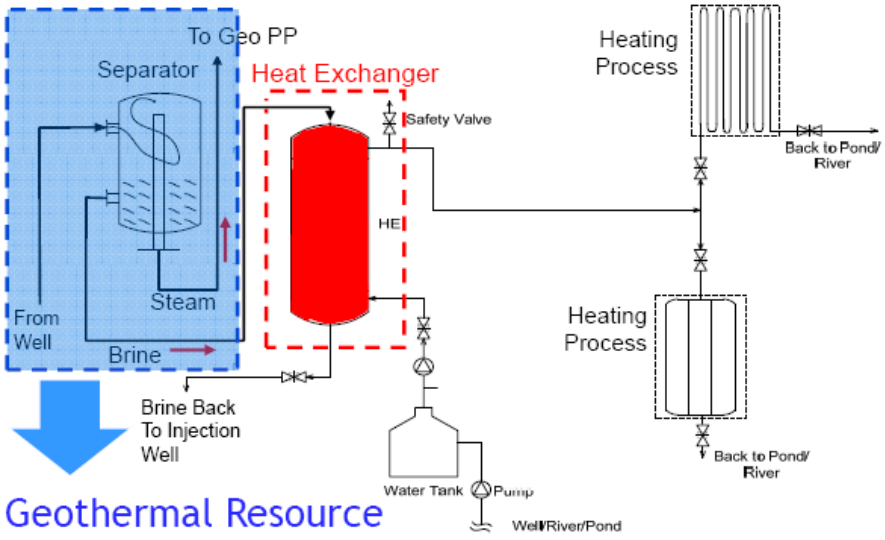

Figure 1: General Process of Direct Use Application

Heat exchangers are always present in processes of agricultural products that involve thermal energy. From 1999 to 2000 BPPT has pioneered researches on utilization of direct-use geothermal energy for non-electricity application, especially in processes for agricultural products. Experiments to develop the diect-use technologies have given satisfying results, as well as gathered interests from communities—where farms and geothermal resources are available—to apply results of the technology development at their facilities.

BPPT has developed various types of direct-use geothermal energy applications. For instance, geothermal fluid is utilized to sterilize growing agents at a mushroom cultivation facility in Kamojang geothermal field, West Jawa. Another direct-use geothermal application developed by BPPT is a coconut drying system in Way Ratai, South Lampung. Geothermal manifestations such as hot spring, caldera and hot mud were found in this area, also the energy source employed for the drying system comes from a natural geothermal well. This type of source with surface temperature around 92-95ºC can be used for agricultural applications or others.

2. MUSHROOM GROWING PROJECT AT KAMOJANG, WEST JAWA

Figure 2 shows a mushroom growing project at the Kamojang Geothermal Field. In the mushroom growing system, steam from a geothermal well with 150ºC temperature and pressure of 2 bar is supplied to a steam generator (heat exchanger) to evaporate fresh water. The steam generator as shown in figure 3 has a thermal capacity of 57,33 kW, which just reqiures steam of 92,5 kg/hr, and fresh water of 78,5 kg/hr. This steam generator can sterilize growing agents of 1200 baglog that 1 baglog equals to 1.5 kg. 1 baglog can grow mushroom from 600 to 800 gram. The steam generator is a shell and tube heat exchanger, which is a BEM type. This heat exchanger has a global deminison of 3.576 meter height , 1.8 meter length and 1.5 meter width.

The steam from the evaporation process is then used to sterilize growing agents of mushroom in sterilization chamber called autoclave, which is shown in figure 4. This process requires temperature of 100ºC at a pressure of 1.2 bar. The sterilization process in the autoclave takes about 6 hours. This autoclave has a capacity of 600 baglog, and also has a length of 2 meter, a diameter of 0.61 meter.

Besides sterilizing the mushroom growing agents, this steam is also used for heating the mushroom incubation room. The incubation process takes between 5 until 10 days at a temperature of 28ºC. Figure 5 shows the growing mushroom.

1. Seeding and Refrigeration Room

- Dimension : 3.5 x 10 meters
- Foundation : river stone
- Wall Material
  - Back side : brick plastered and concrete framework
  - Side and front side : 1 meter brick plastered and plaited bamboo
  - Seeding room : inside wall and plafond are layered by plywood
- Floor : plastered
- Door : plywood
- Window : glass with wood frame
- Roof : phase roofing

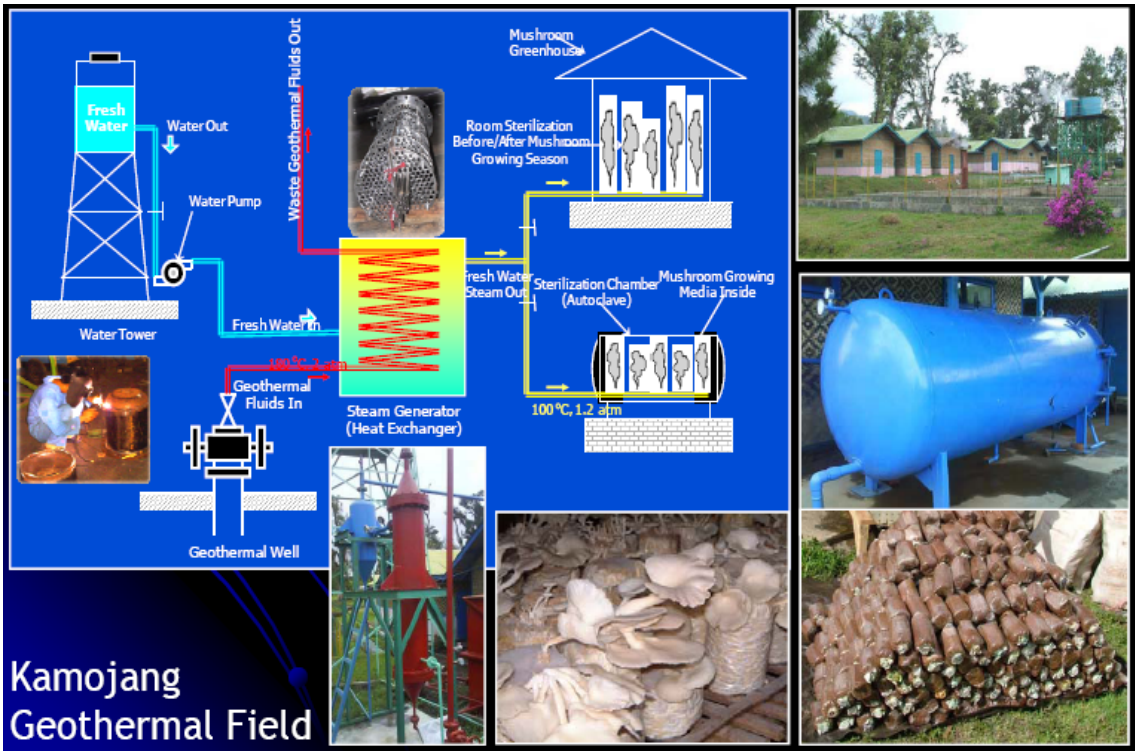

Figure 2: Mushroom Growing System

2. Seed Preparation Room and Incubator

- Dimension:
  - Seeding preparation room : 8.5 x 6.5 meters
  - Incubator : 6 x 3 meters
- Foundation : brick
- Wall Material : plaited bamboo
- Floor : plastered
- Door : plywood
- Window : glass with wood frame
- Roof : phase roofing

Figure 3: Steam Generator (Red Heat Exchanger)

Figure 4: Sterilization Chamber (Autoclave)

Figure 5: Mushroom Building Specification of Mushroom Growing Project at Kamojang, West Jawa

3. COCONUT DRYING PROJECT AT WAY RATAI, SOUTH LAMPUNG

The coconut drying project at Way Ratai, South Lampung is a pilot project for drying coconut with a capacity of 100 kg copra. One of natural geothermal resources found in Way Ratai, is applied for this project. The figure 6 shows the natural geothermal resource at Way Ratai.

Figure 6: a natural geothermal at Way Ratai

The project is started with surveys and determining the experiment objectives, which then continued with engineering design for application of the direct-use technology. These result in the blue print of a Down Hole Heat Exchanger Technology. This Heat Exchanger is used to extract heat from the geothermal fluid.

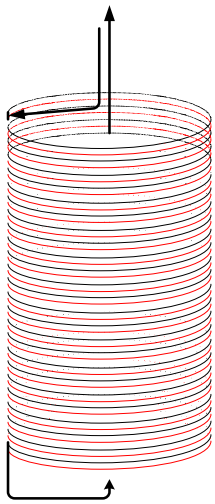

Figure 7: Geothermal Down Hole Heat Exchanger

Figure 7 above describes Geothermal Down Hole Heat Exchanger which is applied at the coconut drying facility in Way Ratai, Lampung. This heat exchanger has dimension as listed below:

Main Pipe Diameter : ½ inch
Number of Circle : 17 x 2 pipes
Material Stainless steel : 304

Inlet/Outlet Pipe : ¾ inch
Material Galvanise

Figure 8 below illustrates the Geothermal Down Hole Heat Exchanger system with connection to dryer room.

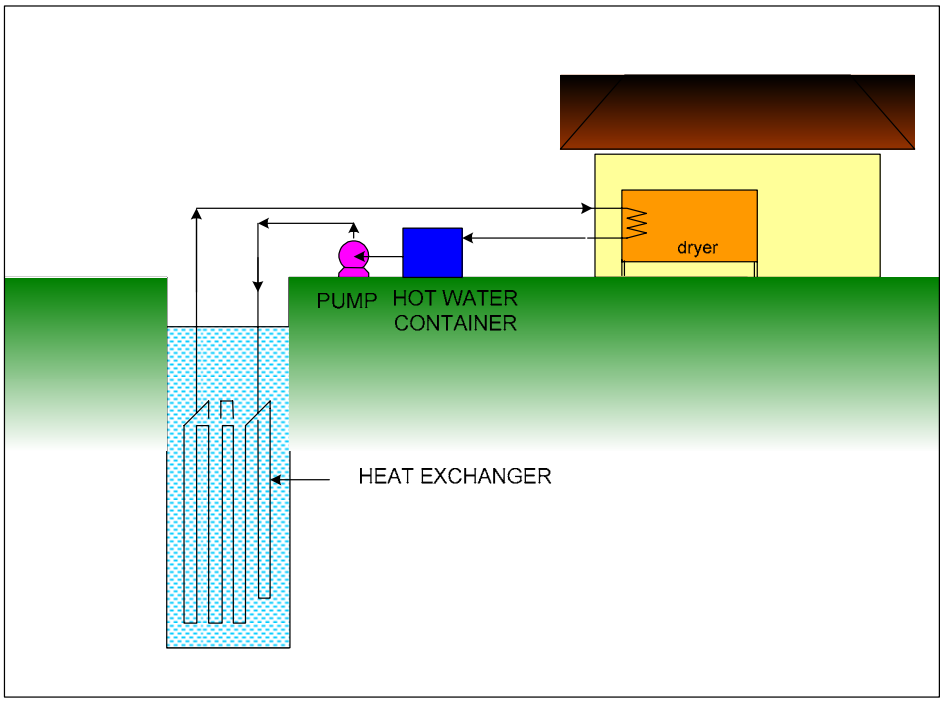

Figure 8: Geothermal Down Hole Heat Exchanger System

(a) (b) (c)

Figure 9: (a) Down Hole Heat Exchanger; (b) Coconut Dryer; (c) Dried Coconut (Copra)

The geothermal Down Hole Heat Exchanger transfers heat from geothermal fluid to fresh water in the pipe. The hot water in the pipe, as the result, is then sent to the drying room. The heat from hot water is transferred to the drying room, heats up the room and therefore drying the coconut. Dried coconut is also called copra. Figure 8 shows the main components and the result of the coconut drying project.

The temperature of a natural geothermal at Way Ratai varies from 92°C to 95°C, with 92°C being the temperature during rainy season.

The drying time depends on the drying temperature. The experiment of coconut drying at Way Ratai, Lampung was done in 2 steps. The first step is done at 57.29°C, which takes 16 hours to dry the coconut. The second is done at 84.75°C and it takes 11 hours. Figure 10 and 11 below show the general scheme of experiment for drying agricultural products.

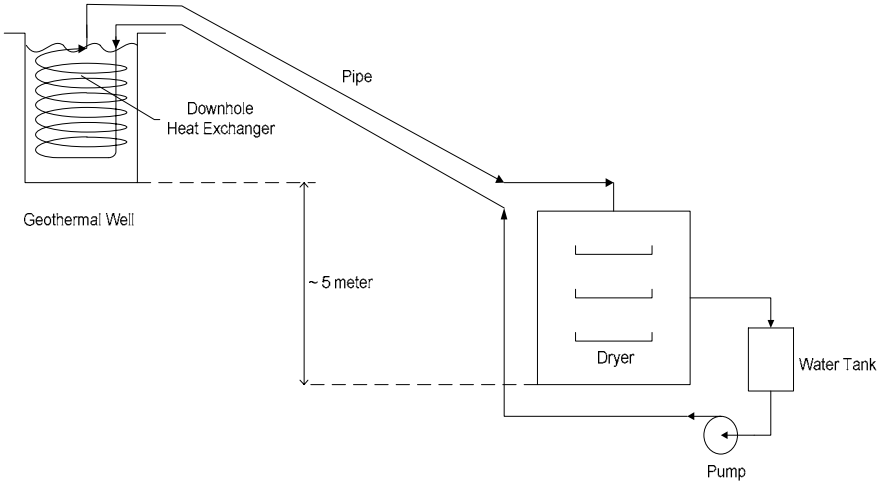

Figure 10: Experiment of Agricultural Product Drying Step I

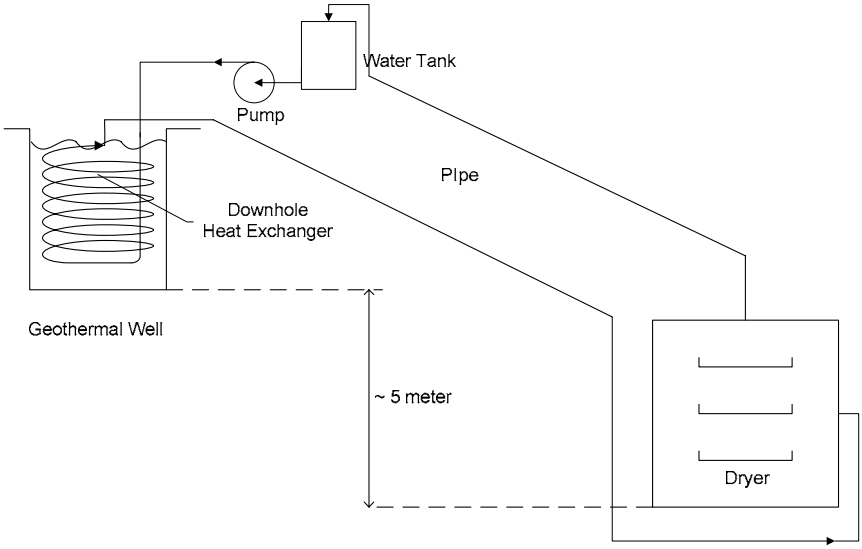

Figure 11: Experiment of Agricultural Product Drying Step II

CONCLUSIONS

Direct use application of geothermal energy refers to the immediate use of energy rather than the conversion of this energy to other form such as electrical energy. In Indonesia direct use application is generally applied to the abandoned and unused wells.

The direct use utilization of geothermal energy that has been applied by BPPT are mushroom growing project at Kamojang, West Jawa and coconut drying project at Way Ratai, South Lampung.

The mushroom cultivation at Kamojang, West Jawa is successfully developed by cooperation between BPPT, Pertamina and the government of West Jawa province. It used non-commercial geothermal well for community development program. Whereas coconut drying (copra) at Way Ratai, South Lampung is developed by BPPT to exploit natural geothermal well.

Geothermal direct use application is suitable non cash and income generating community development program. To accelerate the geothermal utilization in direct use application, support from government like a good policy is expected in this matter.

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