Practical use of local energy　地域エネルギーの活用

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Abstract

I illustrate the example of practical use of local energy. The methane generated in the process of sludge disposal produced electricity. We built the system which melts the snow on a road using the heat of the groundwater discharged from a hospital. The road was cooled by the heat pump which was not used in summer.

1. Local energy which attracts attention

Local energy is defined as follows.

- It is underdeveloped energy.
- It is the energy expected to be utilized regionally.
- It is small-scale and is the energy currently distributed.

They are waste heat, sunlight, wind force, the biomass and so on for example.

We have burned the fossil fuel for many years since the Industrial Revolution. Therefore, it is said that the balance of the carbon on the earth is losing. Local energy attracts attention against such a background.

Since I've experienced some work which utilizes local energy, I report it.

2. Practical use in sewage sludge disposal

Although the sewage sludge disposal system in Tsuruoka city consisted of anaerobic sludge digestion, drying, and composting, since sludge increased in recent years, it added the carbonization furnace.

Since biogas (most of it is methane) is generated in anaerobic digestion, the electric power generated by this biogas is supplied to the carbonization furnace.

Moreover, a part of biogas is used also as fuel for a carbonization furnace. A micro gas turbine is used

Micro gas turbine

for power generation. A micro gas turbine is the technology developed in recent years. A gas turbine makes a turbine rotate with the gas which burned fuel. For example a jet engine is one of them. Generally, the power generation using a gas turbine is large, and the diesel engine has been used for small power generation. The strong points of a micro gas turbine are that it is small compared with a diesel engine, that there are few part mark, that there are little noise and vibration, that there is little exhaust gas, and that it can be maintained easily. However, demerits are that the efficiency of power generation is low and that qualification is required to deal with it. In power generation with biogas, the uniformity of the methane composition in biogas is called for. A storage tank is needed in order to use the biogas effectively whose amount of generation is not fixed.

Adsorption type gasholder

There is an adsorption storage tank of biogas as technology to introduce. It is the technology which is filled up with activated carbon in a tank, and it can keep 20 times as much gas as before.

3. Snow melting system which utilized waste heat

The snow melting function was given to the road with improvement of the general hospital secondary road which is a base of community medicine. The design condition is as follows.

・Area: 2,800m2
・The depth of the snow to melt: 34cm/day
・Required quantity of heat: 137w/m2

As a result of examination, we used the heat of the groundwater drainage used in a hospital, and we decided to warm insufficient heat by heat pump. Heat pump produces heat by compressing gas, and has the cycle of taking heat by opening pressure. We can make a compressor be small if we use waste heat here. Although the heat rise was carried out from -5 by the conventional heat pump, cost was reduced by using 8.5 waste heat. We could reduce the construction cost by 10% in comparison with former times.

Moreover, we could reduce the operation cost by 21%.

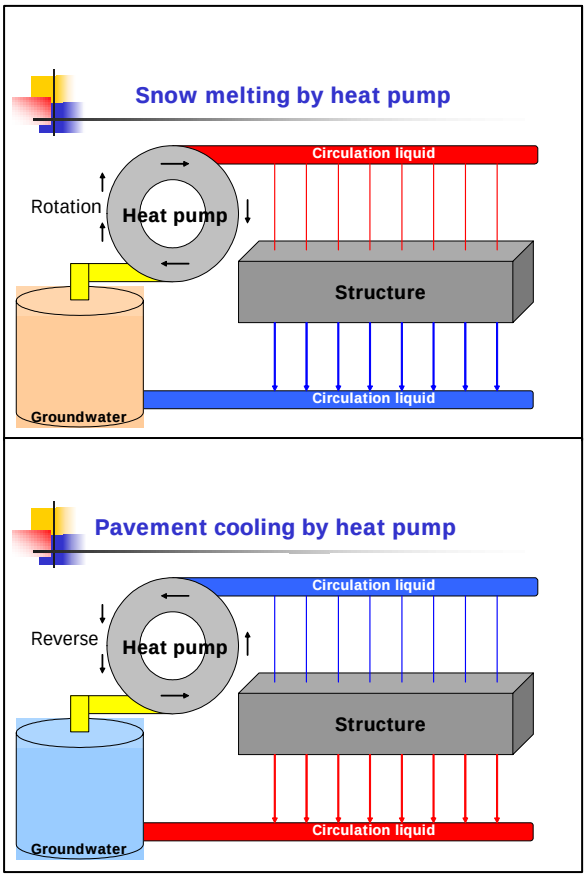
After this business, I thought of using the reverse cycle of heat pump and supplying coldness from an evaporator to a road.

In summer, there are many people who suffer from heatstroke on roads in city towns. If coldness is supplied to roads in summer, people will walk more comfortable and they will prevent damage from a heat island, I thought. We started the research.

4. Pavement cooling technology using snow melting system

Here is the snow melting system. It supplies the circulation liquid further heated by heat pump to a road. It also takes heat from groundwater.

If this heat pump and the circulation water are reverse-rotated, it will become the system which takes heat from a road and throws away into groundwater.



reverse-rotated

There are three problems with this system.

・How much does the temperature on a road surface fall?

・Is there any difference which can be felt?

・Can a heat island be prevented?

We investigated the basic research in the 03 fiscal year, and we could make sure that the temperature of a road fell by about 10 degrees. In the 04 fiscal year, we did the social experiment that we have a citizen experience the cooled road. We understood following things.

Under sunlight.

Circulation liquid : 0~5 ℃

Contrast road surface : max 50℃ min24℃

Cooling road surface : max 40℃ min14℃

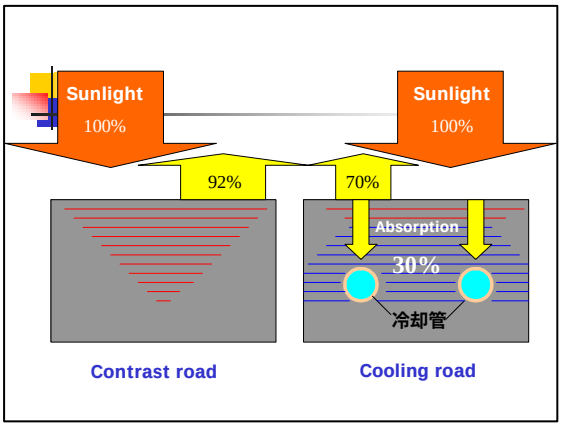
In the shade.

Circulation liquid : 0~5 ℃
Contrast road surface : max 34℃　min22℃
Cooling road surface　: max 25℃　min14℃

Since the temperature of the cooled road was lower than the dew point, it dewed. The evaporation latent heat of dew condensation was also contributing to cooling.

The result of survey of 170 samples from questionnaire, 60% answered that the cooled road under sunlight was effective, and 90% answered that a shady cooled road was effective.

When we saw thermostat graph, the cooled road had become the same temperature as grass. From the analytical result the balance of heat, 92% of solar heat remains on a road. On the cooled road by contrast, it decreases to 70%. A road absorbs 30% of the heat which sunlight gives, and circulation liquid conveys the heat, and it threw away into groundwater. If all city roads are cooled, 5% of heat can be thrown away out of a system.



Heat island prevention

5. Conclusion

I introduced the practical use of local energy that I was engaged so far, and the technical development related to it. The importance of local energy will raise further from now on. I want to advance the practical use of local energy in the future.

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