Report of a Solar Panel Recycling Facility

2024/6/17

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During the Kyoto Training last month, I had the chance to visit the solar panels recycling facility of Hamada Co., Ltd.

Solar power generation is the number one renewable energy source in Japan (reference link). As the use of solar panels increases, the importance of their disposal and recycling also increases. The spread of solar power generation is a pillar of sustainable energy, but its waste disposal must also be done in an environmentally friendly manner.

However, the current situation is that there is no recycling system in place, and many discarded panels are not properly disposed of. A four-year research project is underway using subsidies from the New Energy and Industrial Technology Development Organization (NEDO), a national research and development agency, but the spread of this facility has not progressed due to the small number of companies participating. Landfill disposal is cheap, but there is a risk of soil contamination; therefore, it is urgent to establish an environmentally friendly recycling method.

According to NEDO, it is expected that approximately 170,000 to 280,000 tons (reference link) of panels will be discarded annually from 2035 to 2037, which is equivalent to 1.7% to 2.7% of the final disposal volume of industrial waste. In order to properly process this large amount of discarded panels, recycling technology and infrastructure must be developed.

Currently, there is a lack of facilities and regulations for recycling solar panels in Japan, and many panels are not properly recycled.

There are several possible challenges and necessary solutions.

First of all, there is the issue of capacity of recycling facilities. According to JPEA (Japan Photovoltaic Energy Association), there are 35 industrial waste intermediate treatment companies nationwide that can recycle solar panels (reference link). Furthermore, considering the amount of panels to be discarded, both existing facilities and capacity are insufficient. In order to efficiently process large amounts of panels, it is necessary to expand and improve recycling facilities.

There are also technical challenges. Recycling solar panels requires technology to efficiently separate and reuse them from their complex structures. In particular, it is difficult to remove adhesives and sealing materials, and it is also difficult to reuse silicon cells. In order to solve this technical challenge, it is necessary to develop new recycling technologies and improve existing technologies.

Awareness and dissemination are also essential. There is a lack of awareness of the importance and potential of recycling, and many businesses are unaware of the option of recycling, so it has not become widely known. Sharing information and education is important and necessary to widely communicate the benefits of recycling.

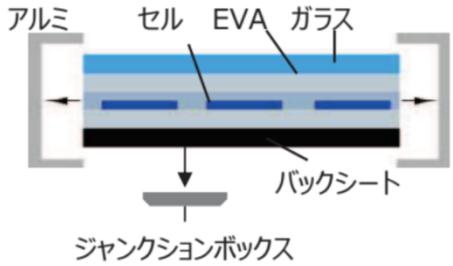
Finally, recycling may not be economically viable with high recycling costs and falling prices of new panels. In order to make recycling economically viable, cost efficiency must be improved. Support from the government and companies, and the introduction of incentives and subsidy systems to promote recycling are considered essential. However, recycling will not progress purely on economic rationality alone, so legal development is necessary. Currently, in Japan, the choice of recycling has not progressed due to the lack of clear legal regulations regarding the recycling of solar panels and the low cost of landfill processing. Therefore, the introduction of recycling obligations, provision of incentives, and strengthening of disposal regulations are required. It is important to promote recycling and build a sustainable energy system by promoting legal development.

Hamada Co., Ltd., where we visited, established the Solar Panel Recycling Association and has a network throughout Japan. In addition, as an environmental solutions business, it collects industrial waste and purchases iron, and also develops metal recycling and waste consulting businesses.

Let’s take a look at the recycling procedure for solar panels as seen at the factory.

First, from a normal unbroken panel,

1. Aluminum frame removal



- The panel is placed on an aluminum frame removal device. This device can quickly and efficiently remove the frame from the junction box (the box that connects the solar panel to the wiring). The processing time is about 60 seconds per panel, and this process allows the components of the panel to be separated.

2. Separation of glass and cells

- Next, the process moves to the separation of the glass and the cells (the solar cell part). In this process, a hot knife at about 300 degrees is used to separate the glass from the cells. This also takes about 60 seconds per panel. After separation, the components of the glass are analyzed and those that can be reused are separated from those that cannot.

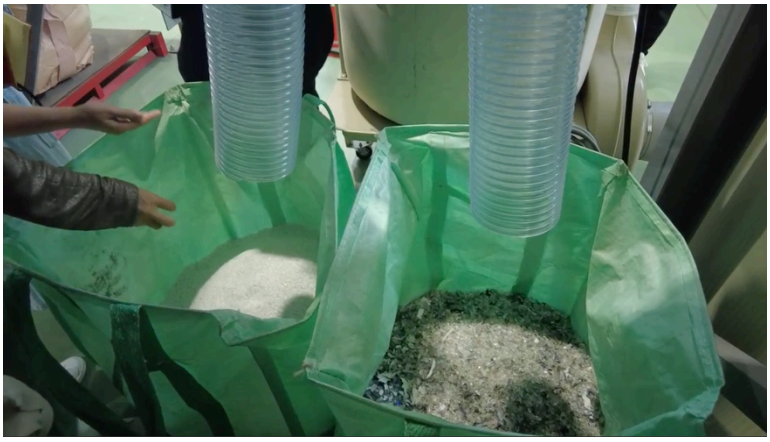
3. Crushing

- The crushed powder is separated into two types by particle size using a vibrating sieve. The finer particles with a higher content of valuable materials are sold to a refining manufacturer, and silver, copper, etc. are recovered. By crushing and sorting by particle size, the value can be increased and transportation efficiency is also improved.

The process is different for cracked panels, as the aluminum frame cannot be removed.

Although the PV recycling hammer is a generic recycling equipment, it solves the problems of the equipment of earlier manufacturers, such as "high cost, complex equipment structure, difficulty in processing broken panels, insufficient peeling. This technology has a processing capacity of more than 50,000 panels per year, and can also process broken panels. Glass is recovered as cullet (crushed glass) and is ideal for "aggregation" (reuse as construction material). Currently, 22 PV recycling hammers have been delivered or ordered nationwide.

1. Crushing process:
   The PV recycling hammer is a machine for crushing solar panels into small pieces. It separates the glass, silicon, metal frame, and other materials that make up the panel. The hammer rotates at high speed and applies physical force to crush the panel.
2. Material sorting



After crushing, a process continues to efficiently separate different materials. Technologies such as magnetic sorting, flotation, and eddy current separation are used to individually recover reusable materials such as metal, glass, and silicon.

Used panels are also bought, but the falling unit price of new panels is disadvantageous to the reuse business. Panels less than 10 years old can be reused, but repair is difficult. In addition, there is a dilemma that the demand for reused panels decreases when new panels are available at low cost. Furthermore, many corporations such as power generation companies, installers, and insurance companies (disaster) do not know that panels can be reused.

Through the tour, I learned that recycling solar panels is extremely important in building a sustainable society. As the spread of solar power generation, a clean energy source, progresses, its disposal must also be done in an environmentally friendly manner. In addition, recycling will not progress in a situation where there are no regulations and selection is based only on cost, so I strongly felt that legislation is necessary. By addressing these issues, it will be possible to build a sustainable energy system. I would like to continue learning and sharing this knowledge with my fellow interns as well as the newly reformed Action Group!