

The Role of Mg in the Circular Economy and its Potential as an Energy Carrier

-Agriculture (Forestry), Fishery and Modern Industry-

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ABSTRACT: The biggest challenge we face today is to sustainably produce and consume energy to sustain society. For example, it is an urgent issue to find a way to develop the use of magnesium (Mg) as a new energy carrier. Mg has the potential to achieve true material circulation by smelting Mg using renewable energy or surplus energy, using it as an electrode in batteries, and smelting it again from the used compound. It is thought that Mg can be regarded as a truly circulatable energy carrier, and by building it as a sustainable energy circulation system and making it a technology that can be used equitably anywhere in the world, it will contribute to the preservation of the global environment. It can be said that our efforts have a high affinity with the concept of the circular economy, which is a global trend.

KEY WORDS: Magnesium, Energy Carrier, Circular Economy, Local Production and Local Consumption, Green Materials

1. INTRODUCTION

We are working on the development of technology to circularize Mg raw materials extracted from seawater by smelting them using renewable energy to produce alloys, using them as lightweight structural materials, using them as batteries, and recycling the spent Mg.

2. ABOUT MG AS A MARINE RESOURCE

The main sources of Mg are the huge amount contained in seawater and carbonate rocks in the surface layer of the earth's crust. This is extremely fortunate as the accumulation of the valuable element Mg coincides

with the area near the earth's surface, where humans live. Atmospheric CO₂ is in an equilibrium relationship with seawater, and the process in which it is fixed and removed as carbonate through biological activity together with Mg dissolved in seawater is greatly related to the balance among the atmosphere, ocean, and earth's crust. It is irreplaceable and important for human survival. Mg is an element that makes us realize that it may be possible to talk about and weave energy and materials through activities that are in harmony with this exquisite balance without disrupting it.

3. A CIRCULATING SOCIETY THAT USES RENEWABLE ENERGY

In the 21st century, there has been a call for the use of renewable energy and surplus energy. Looking at the amount of electricity generated in Japan (2015) ¹⁾, the total amount of electricity generated is 1.04 billion kWh, of which renewable energy including hydroelectric power generation is 85.57 million kWh, which is only about 8% of the total. There are many power generation facilities using renewable energy in rural areas and remote islands, and the number of business establishments is increasing, but there are disadvantages related to power transmission as it is transmitted to large power consumption areas through transmission lines. Furthermore, there are few industries that use renewable energy in the areas where renewable energy is generated (producing areas), and electricity is transmitted to areas with high electricity consumption over the distance traveled by Shinkansen. It can

be seen that activities and technologies that bring energy production closer to local production and local consumption are consistent with sustainability. Just as power consumption sites were located near hydroelectric power plants, which are said to be the most environmentally friendly, the use of renewable energy requires the promotion of local production and local consumption.

We are currently considering Kumejima as a model as a suitable location for these technology demonstrations and are proceeding with technological development and social implementation in close collaboration with local governments. Kumejima is a remote island, and while it is our earnest desire to be self-sufficient in terms of energy, we also believe that it is extremely important that there is a basis for social acceptance of such activities. We are moving forward with the following goals while envisioning future business development in Japan, which is surrounded by the sea.

Circular/Independent model in remote islands with Combined use of Deep Ocean Water

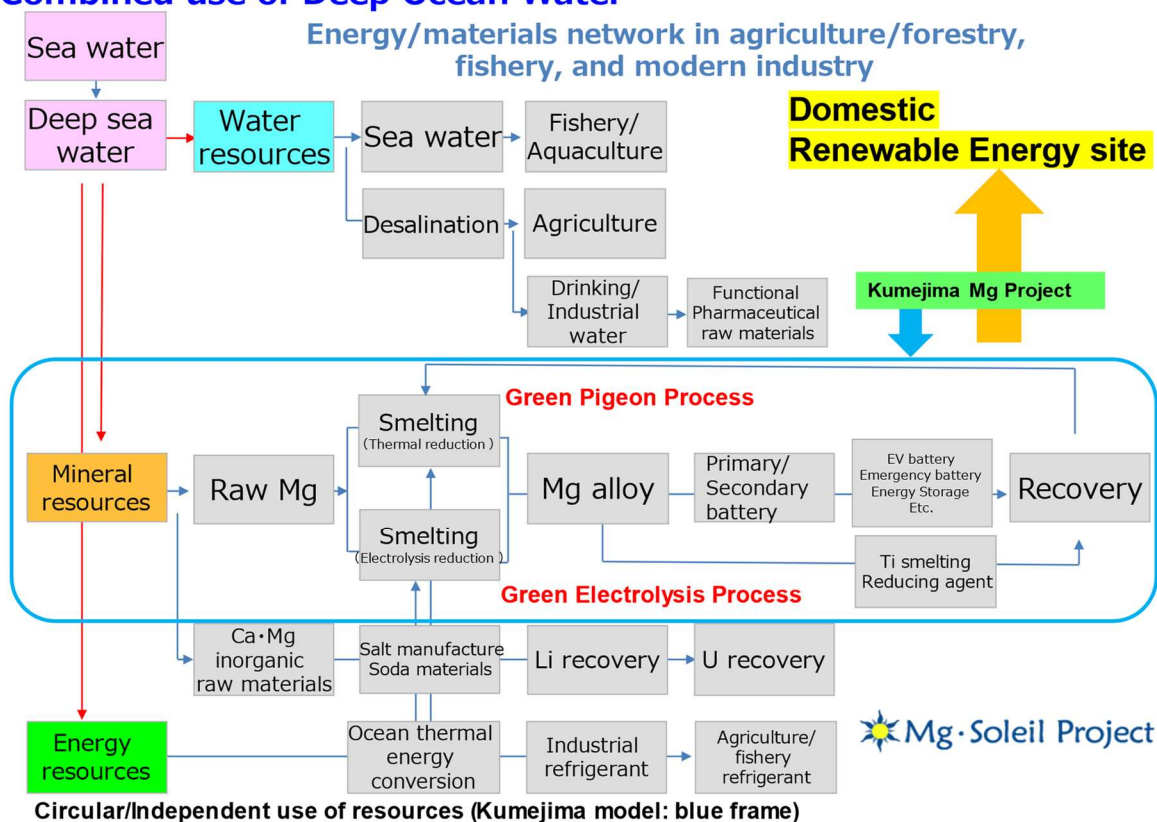


Fig.1 Circular/independent model in remote islands with combined use of deep ocean water ^{2,3,4)}.

- ① Using bittern, which is a by-product of deep sea water plants, as a raw material for Mg smelting (pigeon method or molten salt electrolysis method)
- ② Implementation of green smelting of Mg using electricity from ocean temperature difference power generation and renewable energy.

Additionally, used battery residue can be recycled by returning it to the smelting process.

- ③ Local production and local use of Mg air batteries, such as charging EVs for remote islands and realizing power generation infrastructure.
- ④ Enable the expansion of companies and research institutions belonging to the Mg industry and play a role in regional development.



Fig.2 Establishment of Mg production base in Japan.

4. CONCLUSIONS

Smelting and recycling Mg is nothing less than storing energy. If Mg alloys can be used as energy carriers, the diversity of ways to utilize renewable energy will certainly expand. In our project, we will find not only Mg but also energy carriers that can be truly recycled,

and by building a sustainable energy circulation system, we will establish it as a technology that can be used fairly anywhere in the world and contribute to the sustainable development of industry. We aim to support development and contribute to the preservation of the global

environment into the future. It is the development of "Green Materials", and new scenery can be seen in many places.

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