Energy from the Ocean

Even Mehlum, Björn Qvale*

1. Identification (Definition) of Topics

(1) Ocean thermal energy conversion.

(2) Electricity generated by differences in salinity.

(3) Electricity produced by wave energy.

(4) Production of raw materials and fresh water from sea water by electrolysis driven by wave energy.

2. Technical Description and Background

Wave energy represents solar energy in highly concentrated and refined form, namely as kinetic energy. Compared to other forms of energy we have:

Biomass cultivation 0.002 kW/m^2
Wind mill 0.2 kW/m^2
Wave energy 40 kW/m (10–90) of coast line.

This power is available 50 to 90 percent of the time (as compared to 20 percent for wind).

The salinity differences between fresh and salt water that occur at estuaries in the polar regions where melting ice lowers the salinity, may give rise to high osmotic pressures.

Highly valued materials are dissolved in the seawater ($MgCl_2$). Electrolysis of seawater may be used to produce Mg, H_2, Cl_2, or fresh water.

Moving seawater may be considered as a moving conductor. If this moves in a magnetic field, electric phenomena will take place that may be utilized to precipitate the aforementioned chemicals or to charge a battery.

Successful realization of topics (1) and (2) depends on the development of high-performance non-fouling heat exchangers. The development of these should/could best be left to other areas where the gains are more immediately apparent and where therefore, it could be expected that considerable effort would be invested in their development (heat recovery, heat pumps).

Björn Qvale: Born 1937 in Oslo, Norway. After receiving his B.S. and M.S. degrees (1963) and his Ph.D. (1967) from Massachusetts Institute of Technology, he taught in the School of Mechanical Engineering at Purdue University. Since 1971 Professor of Energetics at the Technical University of Denmark in Lyngby. Research mainly directed towards mathematical models of power and refrigeration machinery, energy systems and cogeneration, and seasonal thermal energy storage.

Electricity produced from wave energy (topic 3) is today close to commercial realization, and is commercial already today on selected sites.

3. Wave-Driven Electrolysis (WADE)

The production of various substances by on-site electrolysis, based on the harnessing of wave energy, is subject for further

* For correspondence address, see List of Participants, p. 242.

considerations:

Seawater is an electric conductor, but a conductor with considerable internal resistance. Therefore, the generation of electricity by using the motion of seawater in a magnetic field will be inherently inefficient. However, this low efficiency is a result of the need to make heavy ions move towards the electrodes. This, however, is the effect that is desired in electrolysis. Therefore the harnessing of the energy of the waves by the motion of seawater in a magnetic field may open the possibility of separating on site the various chemical components contained in seawater such as Mg, H_2, C_2, and fresh water.

4. Recommended R&D Action

- Institute a program to develop cheap, high-efficiency, easily-cleanable heat exchangers. This could possibly be established in co-operation with other research efforts in heat recovery, bottoming cycles, or heat pumps.
- Institute a program in order to identify, investigate, and develop various ways of converting wave motion into material separation on site by using the electric/electrolytic properties of seawater.
- Systematic scanning of the leisure or small consumer market, and organization of brain-stormings in order to identify needs or uses for various of the topics under discussion and, thereby, to establish a commercial base on which further development could be envisaged (as has been the case for photovoltaics, wind mills, and wave-driven pumps).

WADE-specific considerations:

- The combination of WADE with membrane technology and inverse osmosis may lead to wave-driven desalination.
- Many facts and elements from physics and chemistry are thrown into one basket. A small group of carefully selected persons with different kinds of knowledge must work together to find the right combination(s) of magnetic circuits, electrode materials, product mix, etc. (time frame: 2 years).
- Embark on a long-term research program based on promising combinations, but be (mentally) prepared to stop after 2 years (see above).
- The individual combination of sciences, knowledge, experience, and people increases in itself the probability of success.

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