

Salinity Gradient – Source of Energy in the Coastal Zone of Ocean

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ABSTRACT

The paper treats a new source of energy – salinity gradient (at equilibrium mixing of solutions this energy can be transformed into useful forms of energy); estimates salinity gradient energy sources by the example of Primorye rivers, and treats several methods of salinity gradient energy transformation.

KEY WORDS: Osmosis; solutions; salinity; electro dialysis; energy.

INTRODUCTION

The areas with a drop of salinity of natural waters and solutions can be used as sources of energy, called Localization of Salinity Gradients Energy (SGE) Sources. These sources are mainly:

- Mouths of rivers flowing into the sea;
- Strongly saline reservoirs in arid zones
- a) Hypersaline lakes with inflowing rivers
- b) Lagoons, salt pans at sea coasts.
- Subterranean deposits of salt and brines, salt domes at the seacoast and under the seabed.
- Artificial output of solutions concentration difference using evaporation ponds, stratified solar ponds, freezing of solutions.
- Dump solutions of chemical production, desalination plants.
- Energy storage by solutions of different concentration from other sources, in particular the atomic power station.

So, major SGE sources are located on the shores and coastal regions of oceans and seas.

SGE can be illustrated by the example of osmosis water transfer through semipermeable membrane (it lets only water molecules diffuse and hinders from solutes) from a tank with diluted solution into a more concentrated solution tank. This process lasts till pressure drops between the tanks equal osmosis pressures differences. At sea water salinity 35‰ and temperature of 10 °C the drop comprises 245 m.

Salinity gradients have advantages before many other alternative energy sources in size of energy potential and energy density. In contrast to the majority of other energy sources SGE generation is stable and can be easily controlled as the sources of solutions vary insignificantly.

SGE conversion and usage have minimum environmental influence compared to other energy sources. Additional pollutants disposals into environment using salinity gradient sources are not discharged, solutions from the stations for the majority of SGE sources are natural as it happens during river and sea water mixing. While using concentrated solutions diluted solutions can return into strongly salted reservoir where concentration rises at vaporization or they can be pumped underground and dissolve solid salt beds.

Solutions of different concentration have different chemical potentials; at equilibrium mixing of solutions a useful energy can be received. Processes of equilibrium mixing of solutions are opposite to the processes of solution desalination and freshening. So, most methods of SGE transformation are opposite to the solution desalination methods. Solvent or dissolved solution molecular exchange between solutions can occur through membranes, intermediate body surface or different phase state solutions.

Salinity Gradients Energy Sources

SGE resources of several Primorye (Russia) rivers are evaluated on the basis of received equation for calculation of power accessible at mouths of rivers flowing into the sea:

$$W = 0.2757 TS \rho_1 \Phi \quad (1)$$

where U - fresh water consumption, m³/s, T - water temperature, S – sea water salinity, ‰, Φ - osmotic coefficient, ρ_1 - fresh water density, kg/m³.

SGE potential changes for rivers Samarga and Maximovka on the eastern shore of Primorye (consumption data on 1977) are represented in Figure 1. SGE potential changes in different water content years on the river Maximovka mouth are shown in Figure 2.