Innovators of Technologies to Harness the Potential Of Water for the Advancement of Human Welfare
Salinity Power Generation

Texas-Mexico Border Energy Forum

By

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Life Supporting Phenomena

Photosynthesis:

It is the foremost important Chemical Phenomenon in biology.

Plants and some microorganisms use water, carbon dioxide and the energy from sunlight to produce food and livable atmosphere.

Water + Carbon Dioxide $\iff$ Sugar + Oxygen

$6\text{H}_2\text{O} + 6\text{CO}_2 \iff \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$

Osmosis:

It is the foremost important Physical Phenomenon in biology. Without it no living cell can exist.
Renewable Energy

- Energy produced from virtually inexhaustible resources.
- Energy that can be replenished at the same rate as it is used

Natural surface renewable energy includes:

- Wind
- Organic carbon
- Waves
- Solar evaporation
- Hydropower
- Photovoltaic
- Ocean thermal gradient
- Salinity Osmotic Power

All surface renewable energy are derivatives of the solar energy
Process Characteristics

Spontaneity:

- A spontaneous process is the time-evolution of a system in which it releases free energy and moves to a lower, more thermodynamically stable, energy state.
- The process that can proceed without any outside intervention.

Thermodynamic Reversibility:

- The process can be "reversed" by means of infinitesimal changes in some property of the system without loss or dissipation of energy (Sears & Salinger 1986). All the processes occurring in nature are irreversible processes.
- The process that can be reversed and causes no change in either the system or its surroundings.
Osmosis Phenomenon

**FIG 1A**
Initial Fluids Status
@ time = 0

1 Water
2 Brine
W W + S
P₁ = P₂

**FIG 1B**
Osmosis in Progress
@ time > 0

1 Water
2 Brine
W W + S
P₂ > P₁

**FIG 1C**
Final Fluids Status
@ Equilibrium

1 Water
2 Brine
W W + S
P₁ = P₂

Δπ > ΔP

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Internal energy

\[ dU = TdS - pdV + \mu dN + \varphi dQ + \nu dp + \psi dm + ldA + \ldots \]

Heat    Work  Chemical  Electrical  Momentum  Gravitational  Surface Tension

[temperature \( T \), entropy \( S \)], [pressure \( p \), volume \( V \)], [chemical potential \( \mu \), amount of substance \( N \)], [electrical potential \( \varphi \), electric power \( Q \)], [mass \( m \), momentum \( p \)], [gravitational potential \( \psi \), mass \( m \)], [surface tension \( l \), area \( A \)], etc.

Gibbs free energy

\[ dG = Vdp - SdT + \Sigma_i \mu_i dN_i \]

Osmotic Pressure

\[ \pi = \Phi icRT \]

\( \pi \) = Osmotic pressure, bars

\( \Phi \) = Reflection Coefficient

\( i \) = Ions concentration (\( \text{Na}^+ \) and \( \text{Cl}^- \) ions = 2),

\( c \) = Molar concentration of the salt ions,

\( R \) = Gas constant (0.08314472 liter·bar / (k·mol)),

\( T \) = Ambient temperature in absolute Kelvin degree

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\[\pi = P\]

\[\Delta \pi > \Delta P\]

\[t = 0 \& P > \pi\]

\[t = \infty\]

\[t = 0 \& P > \pi\]

\[t = \infty\]

\[\Delta \pi > \Delta P\]

\[\pi = P\]

\[t = 0 \& P > \pi\]

\[t = \infty\]
<table>
<thead>
<tr>
<th>Energy Estimation</th>
<th>FIG 3A</th>
<th>FIG 3B</th>
<th>FIG 3C</th>
<th>PATENT</th>
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</thead>
<tbody>
<tr>
<td>Potential energy generation (E) @85%</td>
<td>2.34 MJ</td>
<td>4.61 MJ</td>
<td>15.81 MJ</td>
<td>32.73 MJ</td>
</tr>
<tr>
<td>Total pumping energy (PE) @75%</td>
<td>-2.44 MJ</td>
<td>-4.41 MJ</td>
<td>-9.144 MJ</td>
<td>-15.97 MJ</td>
</tr>
<tr>
<td>Membrane LMCD</td>
<td>2.53</td>
<td>5.1</td>
<td>12.98</td>
<td>4.32</td>
</tr>
<tr>
<td>Net energy generation (NE)</td>
<td>-0.1 MJ</td>
<td>0.2 MJ</td>
<td>6.66 MJ</td>
<td>16.77 MJ</td>
</tr>
<tr>
<td>System Efficiency NE/E</td>
<td>0</td>
<td>4.3%</td>
<td>42.1%</td>
<td>51%</td>
</tr>
<tr>
<td>NE/m³ of brine feed</td>
<td>0 MJ</td>
<td>0.2 MJ</td>
<td>6.66 MJ</td>
<td>16.77 MJ</td>
</tr>
</tbody>
</table>

Drain ~0.01%  SW: 1 m³/s @ 3.5%  Drain ~0.01%  RO Brine: 1 m³/s @ 7%  Drain ~0.01% salt 1 m³/s @ 24% Salt

FW: 1 m³/s  2 m³/s @ 1.75%  FW: 1 m³/s  2 m³/s @ 3.5%  FW: 3 m³/s  4 m³/s @ 6%

Gunnison Bay/Freshwater

Potential energy generation (E) @85%
Total pumping energy (PE) @75%
Membrane LMCD
Net energy generation (NE)
System Efficiency NE/E
NE/m³ of brine feed

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FIG 4: The Great Salt lake, USA

4,400 Square kilometer, 400 MW Osmotic Power

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FIG 5: Laguna Salada, Mexico

1,000 Square kilometer, 500 MW Osmotic Power

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FIG 6: Southwest USA & Northwest Mexico Precipitation
FIG 7: Closed Osmotic Power Generation Unit

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FIG 8: Atmospheric Saline water Desalination
- MIK technology has developed a new concept for using osmosis to generate clean power from natural and manmade high salinity water domains.

- Global osmotic power potential exceeds 50 Gigawatts, the equivalent of 25 Hoover dams. The Great Salt Lake can generate 400 MW enough to power 350,000 homes. Laguna Salada, Mexico can generate 500 MW.

- Our patent pending concept functions like a reversible process, resulting in power generation efficiency higher than 50%.

- The technology can provide electricity to 120 million people, recover seawater minerals in billions of tons, and generate jobs for hundreds of thousands of people. All without emission or radiation.

- Project development requires a salinity lab and a 10KW osmotic power station for water salinity research, process optimization and training personnel.

- We are seeking funds for $10 million to construct this facility and initiate commercial development.

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World-Class Development in Osmotic Power, Desalination and Ion Exchange for Commercial and Industrial Applications