Cooling Channel Analysis to Enhance The Efficiency of Photovoltaic Panels

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Motivation

**Efficiency Vs. Temperature**


**Goal:**
- To study different cooling arrangements (geometries)
- Evaluate their impact on PV net power output

Passive cooling

See our team poster by
J.D. Osorio, A. Rivera and J.C. Ordonez
### SOLARA SM 200 S

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Brand</strong></td>
<td>SOLARA</td>
</tr>
<tr>
<td><strong>Model</strong></td>
<td>SM 200 S</td>
</tr>
<tr>
<td><strong>Origin</strong></td>
<td>Germany</td>
</tr>
<tr>
<td><strong>Performance</strong></td>
<td>200 Wh/d</td>
</tr>
<tr>
<td><strong>Power (P_{mpp})</strong></td>
<td>50 Wp +/- 10%</td>
</tr>
<tr>
<td><strong>System Voltage</strong></td>
<td>12 V</td>
</tr>
<tr>
<td><strong>Voltage (V_{mpp})</strong></td>
<td>17.8 V</td>
</tr>
<tr>
<td><strong>Open circuit voltage (V_{OC})</strong></td>
<td>21.7 V</td>
</tr>
<tr>
<td><strong>Current (I_{mpp})</strong></td>
<td>2.8 A</td>
</tr>
<tr>
<td><strong>Short circuit current (I_{OC})</strong></td>
<td>2.98 A</td>
</tr>
<tr>
<td><strong>Estimated Albedo Factor (a)</strong></td>
<td>0.30</td>
</tr>
<tr>
<td><strong>Area</strong></td>
<td>0.449 m²</td>
</tr>
</tbody>
</table>
Convergence Analysis

Calculation

\[ \dot{W}_{total} = \dot{W}_{pv} - \dot{W}_{fan} \]

\[ \dot{W}_{pv} = \eta_{pv} I_{solar} A \]

\[ \eta_{pv} = 0.147 - 0.0008 T_{panel} \]

\[ \dot{W}_{fan} = \frac{\Delta P A_{channels} U}{\eta_{fan}} \]

\[ \frac{\Delta P}{\frac{1}{2} \rho U^2} = 13.74 \left( x_+ \right)^{1/2} + \frac{1.25 + 64 x_+ - 13.74 \left( x_+ \right)^{1/2}}{1 + 0.00021 \left( x_+ \right)^{-2}} \]

\[ x_+ = \frac{x/D}{Re_D} \]
Results

Future Work:
- Construct physical apparatus
- Apply to PEMFC
- Perform experimental validation

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