Solar Desalination as a Means to Provide Potable Water in Rural Iran

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Basin Type Solar Stills

- Solar radiation may be employed in almost all rural Iran with hot-dry environment to produce fresh water
- The simplest and least expensive method of fresh water production is via basin type solar still
  - Most useful in small-scale fresh water production from seawater and brackish water

Hormozgan

State in Southern Iran

- Demographics:
  - 60% of the population is rural
  - 2000+ villages
  - ~50 families per village
- Water supply
  - Rivers
  - Cisterns
  - Reservoirs
- Water quality
  - Saline
  - Untreated, unhygenic

Simple solar desalination can easily meet the needs of such families

Basin Type Solar Distillation Process

- Basin type solar distillation is the simplest desalination process and based on the Greenhouse Effect
- Glass and other transparent materials transmit incident short-wave solar radiation, but not infrared radiation
- Incident short-wave radiation passes through glass into the still, where its heat is trapped and evaporates water
- The water condenses on the glass surface and is collected as distillate
  - Equipment is of simple construction
  - Requires a large area of land

Basin Type Solar Still

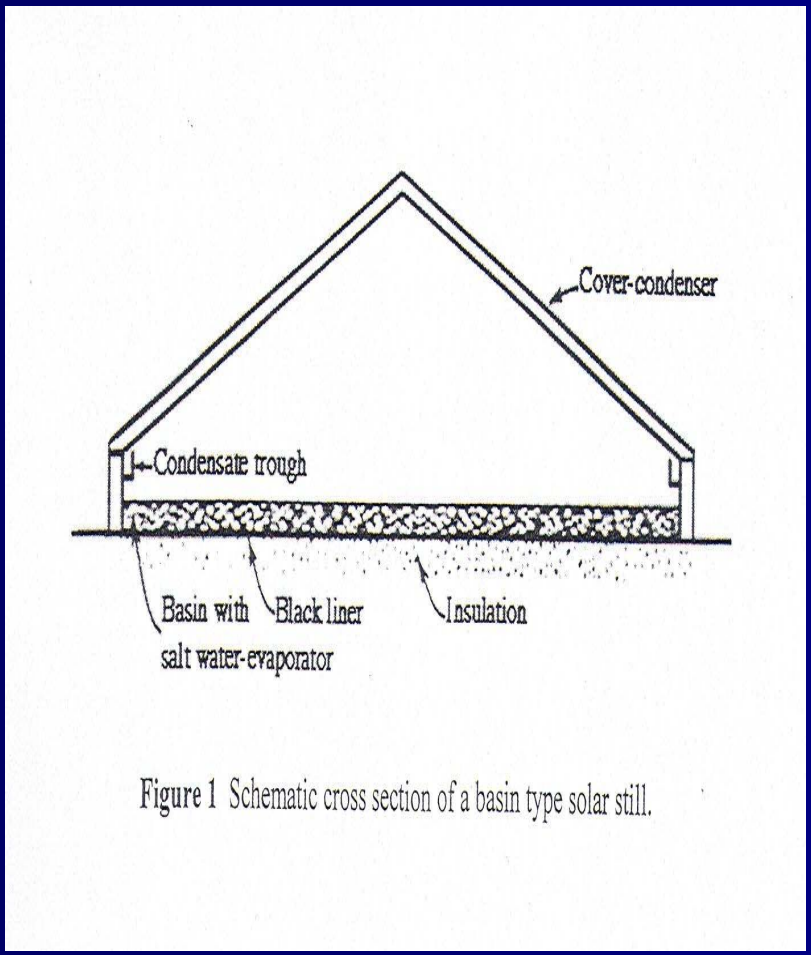

Figure 1 Schematic cross section of a basin type solar still.

A solar desalination plant may have many bays side by side, each of the type shown.

- Cover Materials
  - usually glass
  - air-supported plastic films
- Basin Dimensions
  - Shallow
    - 10-20mm deep
  - Deep
    - 100+mm
  - Width
    - 1-2m
  - Length
    - 50-100m

Energy Flow in Solar Still

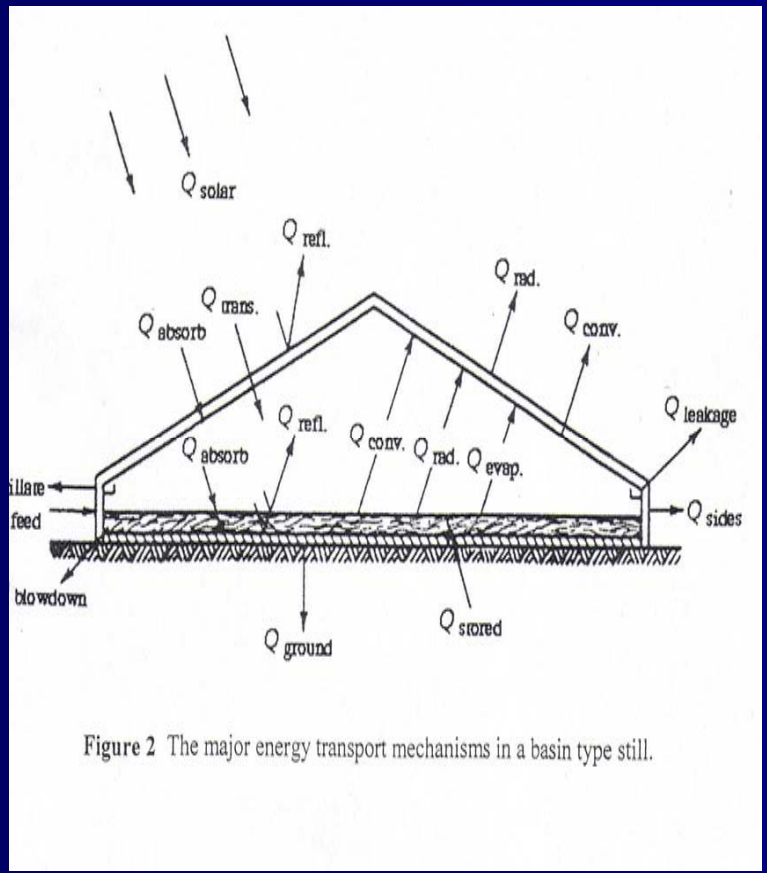

Figure 2 The major energy transport mechanisms in a basin type still.

- The objective of the still design is to maximize Q_{evap}, the transport of absorbed solar radiation to the cover-condenser by water vapor, as this is directly proportional to the still's productivity
- All other energy transfer from the basin to surroundings should be suppressed
- Most energy flow can be evaluated using basic principles, but "leakage" and "edge loss" is difficult to quantify

Modes of Energy Transfer from Basin to Cover

- Evaporation/condensation
- Convection
- Radiation

- The losses from the back of the still are to the ground
- The depth of the water in the still is usually such that its capacitance must be taken into account

Thermal Network

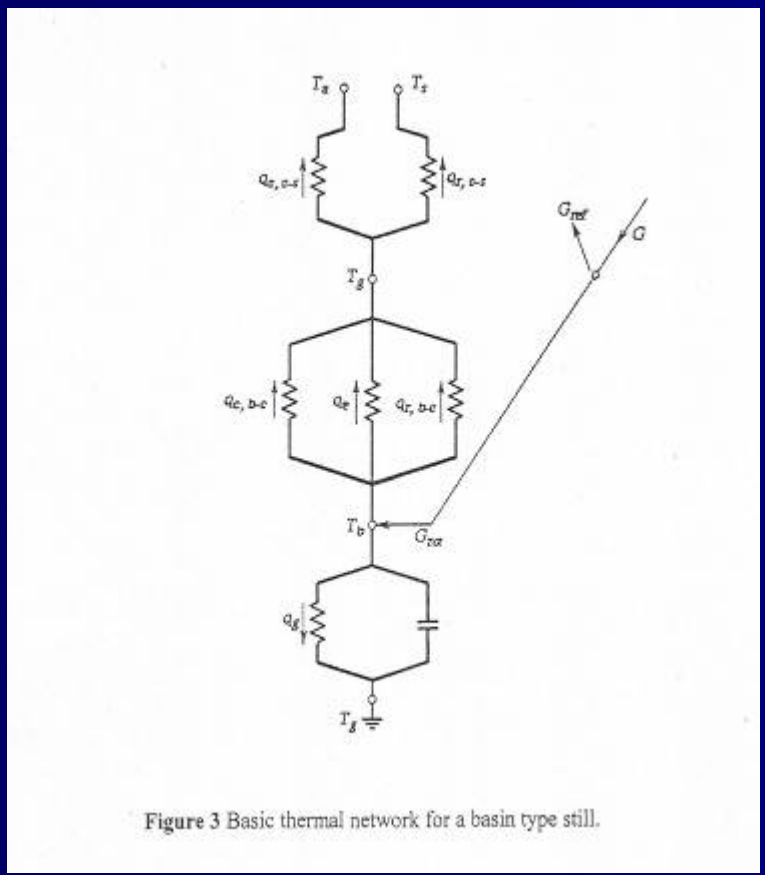

Figure 3 Basic thermal network for a basin type still.

- Resistance corresponds to energy flow in Figure 2
- Leakage, edge loss, entering feedwater, leaving brine, and product are not considered in this diagram

Materials

- Base materials should absorb as much radiation as possible
  - Black paint
    - Paint can be compromised when the still is left empty and the heat from the sun raises the temperature of the material enough to destroy it
  - Black pebbles
    - A thin layer of black pebbles can be placed at the bottom of the basin to ensure material integrity
    - This material also increases the water evaporation rate

Basin Type Solar Still Design Trends

- Large area deep basin still
  - Can be built using standard construction techniques
  - Durable
  - Relatively inexpensive
- Modular shallow basin stills
  - Lower thermal capacitance
  - Produce somewhat more water
  - More expensive to construct

Thank You