2.500 Desalination and Water Purification

Spring 2009

Clean Water for Haiti

May 14, 2009

Overview

- Background
- Desalination Technologies
  - Misc. Technologies
  - Humidification-Dehumidification (HDH)
  - Reverse Osmosis (RO)
- Improved Rainwater Collection
- Recommendations

Background

- Working with Mercy and Sharing to provide clean water to Phaeton and Paulette, Haiti
- Combined Pop: 4200 (~930 families)
- Daily Water Consumption: 4650 5 gal buckets (~90 m^3)
- Average Family Income ~$2/day

Desalination Technologies

Technology	Driving Force	Notes
Nanofiltration	Pressure	Does not remove mono-valent ions
Electrodialysis	Electricity	Electricity not available
Multi-Effect Distillation (MED)	Steam	Too costly at small scales
Multi-Stage Flash (MSF)	Steam, Vacuum	Too costly at small scales
Vapor Compression	Pressure, Heat	Vacuum/compression systems expensive
Forward Osmosis (FO)	Pressure, Heat	Unproven technology
Humidification-Dehumidification (HDH)	Heat	Possible
Reverse Osmosis (RO)	Pressure	Possible

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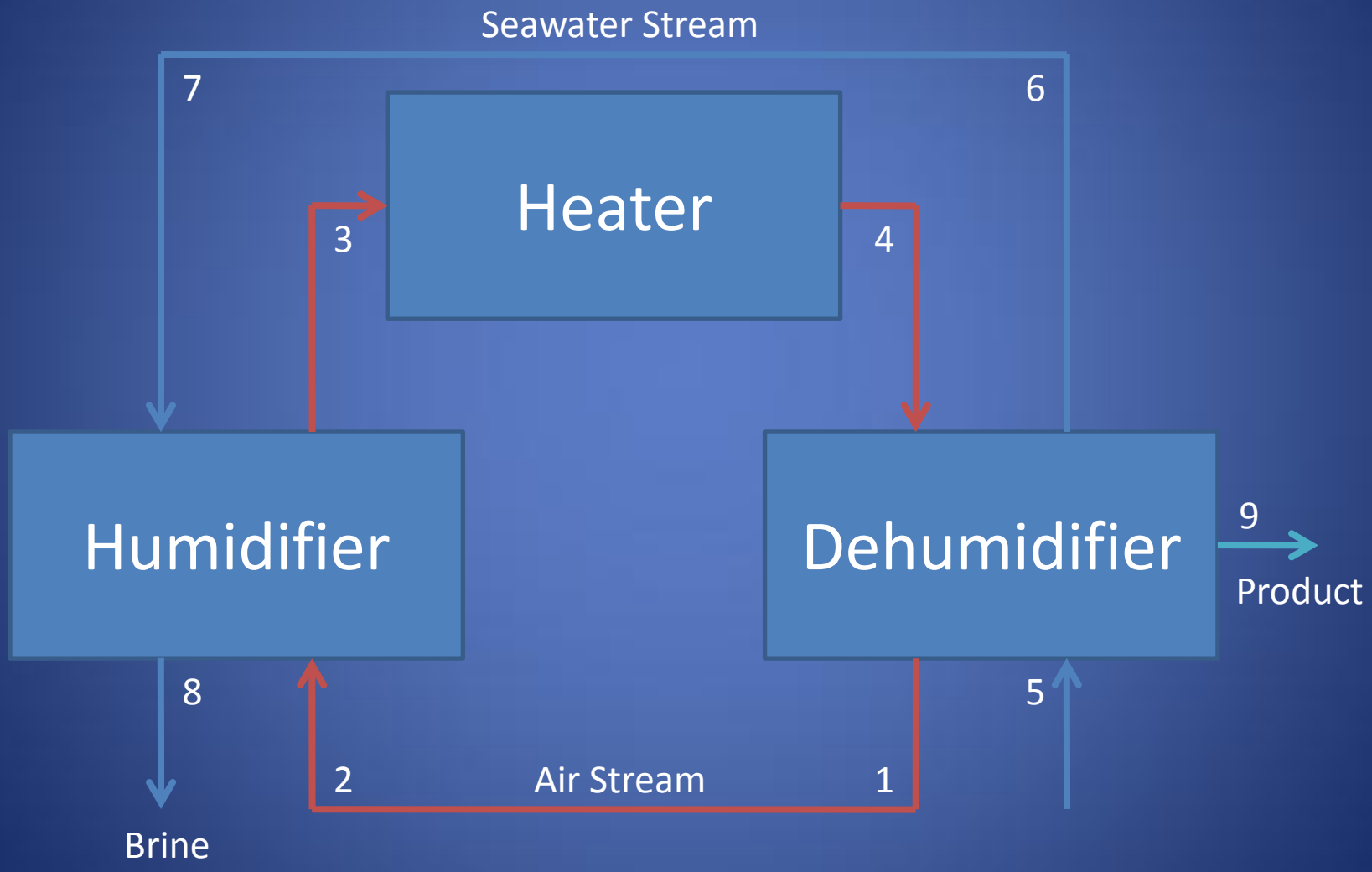
Reverse Osmosis (RO)	Pressure	Possible

Project Approach

- Modular design
  - Desalination system to produce ~30m^3
- Improve situation
  - Improvement of rainwater collection

Humidification-Dehumidification



Humidification-Dehumidification

- GOR = 3.4
- Heat Input = 163 kW
- Components
  - Diesel Combustor
  - Shell and Tube HX
  - Locally built Humidifier

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Humidification-Dehumidification

Item	Type	Cost	Cost/bucket
Components	Fixed	<$7500 ($4.94/day)	$0.003
Fuel	Daily	$321/day	$0.20
Labor	Daily	$1/day	$0.0006

- Without locally available fuel, HDH is prohibitively expensive.

Reverse Osmosis

- GOR equivalent ~ 200
- Driven by high pressure and mechanical work
- Built by many companies as skid-mounted plants

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http://www.tsgwater.com/ro_plants.htm

Reverse Osmosis

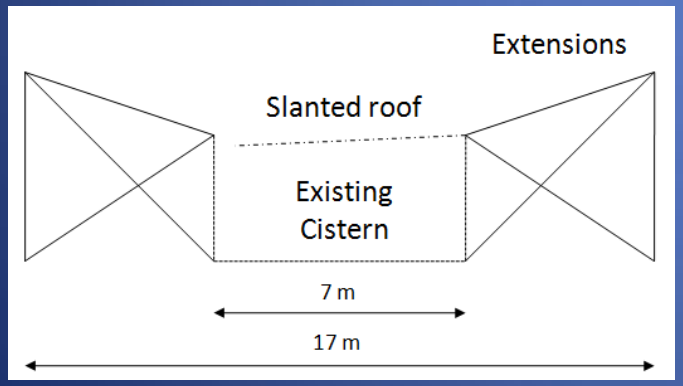
- Seawater intake to avoid drying of wells
- 4.5 HP (3.35 kW) diesel pump: 60 bar inlet
- Total water cost: 1.7 ¢ per 5 gal bucket
  - diluted 2 to 1 with well water
- Risks
  - Complex technology easily susceptible to sabotage
  - High capital cost (~$15k) require consistent revenue to pay off

Rainwater Collection

- North Central Haiti: 1.6 m/year rainfall
  - Takes advantage of natural distillation process
- Repair existing cistern to hold ~100 m^3 of rainwater
- Total Cost: $1740 + local materials

Rainwater Collection

- Expand cistern collection area to 290 m^2
- Filter and Chlorinate water
- 0.3 L of drinking water per person per day



Cistern/Collector Diagram

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http://www.a1poolparts.com/stores/a/A1PoolParts/catalog/s244t_chart2.JPG

Recommendations

- HDH too expensive with current heat sources
- RO meets large need cost effectively
- Rainwater Collection is effective supplement for drinking use only

Thank you.

Questions?