Optiguide ltd.

Cooling System For Gas Turbine
Established in 1997 in the Technology Incubator of the Technion – Israel Institute of Technology.

Founded by Igor Zlochin, R&D Director. Haim Kizman, General Manager.

Company shares are held by founders, employees and investors.

Initial sales in 1998.

Main Applications: Gas Turbines, Post Harvest, Clean Rooms.
Post Harvest Applications

- Controlled humidity for cold storage for fruits and vegetables.
- Adding humidity by dry fog without wetting the produce.
- Increasing produce quality and shelf life.
- Reducing weight losses during storage period.
Optiguide Atomizer

- Low pressure air assist nozzle
- Micro-Droplets provide “dry fog”
- Up to 98% RH without wetness
- Large orifice prevents clogging
- Very low maintenance
- Complete automatic operation
- Operates at – 0º C
- Simple piping and fittings
The water outlet orifice 1.38 mm
Water is drawn by means of a Venturi principle
Very small droplet size
Working air pressure 6 bars

<table>
<thead>
<tr>
<th>Distance from the nozzle (mm)</th>
<th>Water Pressure (bar)</th>
<th>Air Pressure (bar)</th>
<th>D10 (microns)</th>
<th>D32 (microns)</th>
<th>D90 (microns)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>0</td>
<td>6</td>
<td>2.72</td>
<td>5.16</td>
<td>28.65</td>
</tr>
<tr>
<td>100</td>
<td>-0.1</td>
<td>7</td>
<td>2.13</td>
<td>4.19</td>
<td>21.4</td>
</tr>
</tbody>
</table>

The droplet size distribution has been measured using a laser diffraction system
Optiguide’s RH Sensor

- Reliable control up to 98% RH.
- Operates where other RH meters become saturated and fail.
- Unique optic technology insures accuracy.
- Self-cleaning and self-calibrating daily.
- Full remote computer capability for operation and data logging.
Full Data Logging on PC as Graph of Chart
Optiguide’s Wetness Sensor

- Direct measurement and control of state of wetness at various stations within the air inlet duct.
- The possibility of compressor blades damage by relatively large water droplets (greater than 20 microns) is prevented.
- Operating conditions: -5°C…125°C.
GT Pre-Cooling

- GT performance is strongly affected by ambient temperature. High temperature decreases power output, due to reduce of inlet air mass flow rate.
- 1°C rise in ambient air temperature decreases the GT output by 0.5%…0.9%.
- One of the cheapest and effective way to recover the GT output loss is evaporative air-cooling of GT inlet.
- GT power output can be increased by more than 10% by inlet air-cooling.
Ambient Temperature Effects - Typical Heavy-Duty GT Output

GT Output (MW)

Ambient Temperature °C
# Cooling System Performance Chart

<table>
<thead>
<tr>
<th>Month</th>
<th>January</th>
<th>February</th>
<th>March</th>
<th>April</th>
<th>May</th>
<th>June</th>
</tr>
</thead>
<tbody>
<tr>
<td>RH, % at</td>
<td></td>
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<tr>
<td>Ta, °C at</td>
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<tr>
<td>$T_{\text{wet}} = f(Ta, RH)$, °C at</td>
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<tr>
<td>Evaporative Cooling Potential, °C (T - daily avr)</td>
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<tr>
<td>Daily Cooling Capacity, °C</td>
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<tr>
<td>Daily Fogg Operating Time, hours</td>
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<tr>
<td>Max Available Daily Energy Increase, MWh</td>
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<tr>
<td>Max Available Monthly Energy Increase, MWh</td>
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<tr>
<td>Capacity Factor / =</td>
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<tr>
<td>Available Annual Energy Increase, MWh</td>
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<tr>
<td>Max Accumulated Daily Water Massflow, ton</td>
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<tr>
<td>Max Accumulated Monthly Water Massflow, ton</td>
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<tr>
<td>Annual Fogging Water Massflow, ton</td>
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</tbody>
</table>
Cooling System Performance Chart

- **JANUARY**: 
  \[ y = -a x + bx - c \]

- **FEBRUARY**: 
  \[ y = -a x + bx - c \]

- **MARCH**: 
  \[ y = -a x + bx - c \]

- **APRIL**: 
  \[ y = -a x + bx - c \]

- **MAY**: 
  \[ y = -a x + bx - c \]

- **JUNE**: 
  \[ y = -a x + bx - c \]
Optiguide Advantages in GT Power Augmentation

- Small droplet size. Cost effective power increase, heat rate improve and NOx emission reduce.
- On-line wetness control at compressor inlet. Closed loop control.
- Low pressure water system.
- Fine tuning flexibility.
- No skids required. Installation time 1-2 days.
- Low investment and O&M costs.
- Payback period is less then 1 year.
- Field tested by IEC.
Optiguide Air Cooling System Typical Layout Scheme

- Optiguide Atomizer
- PLC Outputs
- PLC Controller
- PLC Inputs
- Meteorological Station
- Wetness Sensor
- Turbine
- Generator
- Water Supply
- Water Pipe
- Air Pipe
- Compressor
System Layout
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System Layout
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System Layout
Inlet Section
Inlet Section
Inlet Section
Inlet Section
Filter Section
Filter Section
Filter Section