Vicot Solar Intermediate Temperature Applications Introduction

Vicot Air Conditioning Co., Ltd., Dezhou, Shandong
Chinese Solar Cooling Conference, Shanghai, March 27th 2015
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Chapter 1 About us

VICOT----Global Leading Solar Energy Collection System
Vicot Group is a high-tech corporation specialized in R & D, production, sales and service of renewable energy products. Vicot locates in the ‘solar city’ Dezhou Shandong, China.

Solar energy products of Vicot include Solar Air Conditioning System and Solar Industrial Boiler System. Vicot has more than 20 sales branches in China and has successfully built more than 200 projects through 5 years’ efforts.
Chapter 1 About us

Registered capital : USD5 million
Total assets : USD100 million
Factory Area : 150,000m²
Workshop : 80,000m²
Nos. of Employee : 2000
Designed annual yield : USD500 million

Products :
Solar Air Conditioning System
Solar Absorption Chiller & Heating System
Solar Heat Pump System
Solar Industrial Boiler System
Solar Thermal Oil Boiler
Solar Steam Boiler
Solar Hot Water Boiler
Electric HVAC

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VICOT AIR CONDITIONING CO., LTD.
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Vicot parabolic trough solar collectors are completely developed by our company independently.
Chapter 2 Product introduction

- Theoretical efficiency

Parabolic Trough Solar Collector
### Chapter 2 Product introduction

#### Straight-through solar collector vacuum tube

![Parabolic Trough Solar Collector](image)

<table>
<thead>
<tr>
<th>Size</th>
<th>Length</th>
<th>2035mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glass tube</td>
<td></td>
<td>High borosilicate glass3.3 ；Φ102*2.8mm</td>
</tr>
<tr>
<td>Metal absorbers</td>
<td></td>
<td>Φ42*2mm</td>
</tr>
<tr>
<td>Weight</td>
<td></td>
<td>8.8kg</td>
</tr>
<tr>
<td>Operating pressure</td>
<td></td>
<td>≤3MPa</td>
</tr>
<tr>
<td>Absorber coating</td>
<td>Absorptance</td>
<td>α&gt;93% ；</td>
</tr>
<tr>
<td></td>
<td>Emittance</td>
<td>ε&lt;10% ( 200℃ )</td>
</tr>
<tr>
<td>Vacuum</td>
<td></td>
<td>( 1-3 ) ×10-2Pa</td>
</tr>
<tr>
<td>Tmax</td>
<td></td>
<td>280℃</td>
</tr>
<tr>
<td>Work temperature</td>
<td></td>
<td>-40℃-55℃</td>
</tr>
<tr>
<td>Impact resistance</td>
<td></td>
<td>No damage to the vacuum tube, impacted by Φ30mm solid steel ball free fall from 0.5m height.</td>
</tr>
</tbody>
</table>
Chapter 2 Product introduction

- Vicot Accumulator:
- Phase change enthalpy 290J/kg
- Phase change temperature ranges 190°C-200°C
- High energy accumulation density, and small size.
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◆ Solar Air Conditioning System
  ◆ Solar Absorption Chiller & Heating System
  ◆ Solar Heat Pump System

◆ Solar Industrial Boiler System
  ◆ Solar Thermal Oil Boiler
  ◆ Solar Steam Boiler
  ◆ Solar Hot Water Boiler
Solar Absorption Chiller & Heating System: Vicot Solar Absorption Chiller System is a renewable energy system that uses solar energy instead of conventional energy. It is an energy saving and eco-friendly product that has good energy saving effect and high economic benefit without any emission and pollution. It consists of solar collector, absorption chiller and accumulator.
Chapter 3 Solar intermediate temperature applications

- Solar Air Conditioning System

- **Solar Heat Pump System:** Vicot Solar Heat Pump System provides heating by air sourced absorption heat pump directly driven by the energy collected by trough solar collector, it combines the utilization of solar with air source energy perfectly and naturally, which is the latest global technology in the field of clean energy.
Chapter 3 Solar intermediate temperature applications

- **Solar Thermal Oil Boiler**
  - Vicot Solar Thermal Oil Boiler System is a boiler system which uses solar energy for heating oil, and to stabilize the output, mainly by solar collectors, accumulators, oil boiler and other components.
  - Main applications: food processing, chemical, rubber, electronic components, wood processing and other needs of high-temperature thermal oil as the heat source of the industry, the maximum output temperature of 300 ℃.
Chapter 3 Solar intermediate temperature applications

**Solar Steam Boiler**

- Vicot solar steam boiler system is a boiler system which uses solar energy to heat water to produce high pressure steam, mainly by solar collectors, thermal oil boiler, steam generator and other components.
- Main applications: pharmaceuticals, chemicals, printing and dying textile, food and beverage industry needs to steam heat with the steam pressure not higher than 0.8MPa system.
Chapter 3 Solar intermediate temperature applications

- **Solar Hot Water Boiler**
  - Vicot solar hot water boiler system is a boiler system which uses solar energy to get hot water, mainly by solar collectors, exchanger, hot water boiler and other components.
  - Main applications: heating, printing, food processing and other industries requiring hot water of no higher than 100 ℃.
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- Vicot Solar AC Demonstration Base
Chapter 4 Demonstration projects

- Project Introduction

  - The project is located in Dezhou Economic Development Zone, Shandong Province, north of the Hongdu Road, 1000 m to the west of Jinghua Avenue. Office building is of five layers, with a total construction area of 2970m².

  - This project uses solar absorption chiller system which is mainly composed of parabolic trough solar collectors, accumulator, absorption chiller heating unit, power center, centralized controller and other components. Collector aperture area 360m², installed capacity 200kW。

  - This system provides cooling in summer (8:00-17:00) and heating in winter for office building.
Chapter 4 Demonstration projects

- Performance Testing

  - In October 2013, assessed by National Center for Quality Supervision and Testing of Solar Heating Systems (Beijing), solar guaranteed rate 67.6% and collector system efficiency 55.2% have all reached 1 level.

  - Test standards reference to Evaluation standard for application of renewable energy in buildings.

  - Vicot solar air conditioning system is stable, energy saving effect is remarkable, after actually running experiments and authority assessment.
Chapter 4 Demonstration projects

Test Equipment

- Parabolic trough solar collector arrangement drawing
- Data logger for recording the ambient temperature, radiation and wind speed
- Pyranometer for recording the solar radiation
- Anemometer for recording the wind around collectors.

Vicot Solar AC Demonstration Base
Chapter 4 Demonstration projects

- Test Data

Vicot Solar AC Demonstration Base
Chapter 4 Demonstration projects

Test Reports

Vicot Solar AC Demonstration Base
Chapter 4 Demonstration projects

- Actual Operating Conditions

![Graph showing solar air conditioning system operating conditions](image-url)
Chapter 4 Demonstration projects

- Actual Operating Costs

**Solar air conditioning running costs composition**

- Electricity costs 40%
- Gas costs 60%

**Operating cost comparison**

- Solar air conditioning costs: around 80,000 RMB
- Gas air conditioning costs: around 140,000 RMB

Vicot Solar AC Demonstration Base
Chapter 4 Demonstration projects

Conclusions

- The project has been stably running for 4 years, since 2011. It runs four months in summer for cooling, four months in winter for heating.

- The annual operating cost is RMB 84,800, compared to traditional gas air conditioning and gas fired boiler which cost RMB 150,000 annually, energy-saving effect is remarkable.

<table>
<thead>
<tr>
<th></th>
<th>Building load</th>
<th>Building load per unit area</th>
<th>Cooling/Heating capacity</th>
<th>Operating costs</th>
<th>Operating costs per unit area</th>
<th>Energy price</th>
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<tbody>
<tr>
<td></td>
<td>kW</td>
<td>W/m²</td>
<td>kWh</td>
<td>RMB</td>
<td>RMB/m²</td>
<td>RMB/kWh</td>
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<tr>
<td>Cooling</td>
<td>217.7</td>
<td>73</td>
<td>194,000</td>
<td>39,800</td>
<td>13.4</td>
<td>0.21</td>
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<tr>
<td>Heating</td>
<td>180</td>
<td>60</td>
<td>162,000</td>
<td>45,000</td>
<td>15.2</td>
<td>0.28</td>
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<tr>
<td>Annual</td>
<td>199</td>
<td>66.5</td>
<td>356,000</td>
<td>84,800</td>
<td>28.6</td>
<td>0.24</td>
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Vicot Solar AC Demonstration Base
Dezhou College School Solar Heating Project
The end
Thank you