Innovative HVAC Feats to Enhance the Performance of Existing Buildings

Jayesh Deshpande, Vice President, Applied Business
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Daikin became the world’s number 1 in HVAC industry in 2011.

Global revenues touch USD 19 Billion in FY13

The road to achievement was never easy: Diverse business landscapes. Economic volatilities. Discerning customers.

Yet. We dared to dream, strengthened the muscles to push through the odds. And emerged victorious.

(1 US$ = 80 JY as on 31st March 2014)
Daikin India turnover

(Rs. Crore)

FY09-10  FY10-11  FY11-12  FY12-13  FY13-14

440      850      1200     1800     2200

Ideas galore
Largest, widest and strongest product range
Challenges/ Aspects

- **Existing HVAC system**
  - (Window A/c, Splits, Scroll, Reciprocating, Screw, Fixed Speed Centrifugal, Variable Speed Centrifugal, etc)
  - Pumping system (Primary, Secondary with VFD, Secondary without VFD)

- **Proposed HVAC system**
  - Part Replacement/ Complete renovation
  - Air Cooled/ Water Cooled
  - Plant Room Space & Shafts
What is V.R.V.?

V.R.V. is

Variable Refrigerant Volume

- Independent control of each room and zone’s air conditioning according to thermal load.
- Energy conservation.
- Automatic control of each indoor unit.
VRV Concept-Individual Operation

Ideal for Random Occupancy and after office hours operation

Energy Conservation Opportunities

- System Type
  - A/c Scroll Chillers or Reciprocating Chillers 34 TR nominal capacity with R22 / R407C refrigerant x 3 Nos. (2 W + 1 S)
    - 1.2 kW/ TR app
  - Connected to 2 AHUs (16000 cfm, 50 mm SP) – 6 kW
  - Chilled Water Pumps -2.2 kW / pump
    - Auditoriums
    - G + 1 type installations
Scroll – Modules (17/18 TR)

High Efficiency Scroll Chillers/ Heat Pumps (R410A)
- 1kW/ TR Cooling at full load 1.1
- Cooling/ Heating both modes available
- Designed for space savings

Configuration (60 TR - Actual Load)
- Standard Scroll (34TR x 3Nos.)
- 2W+1S (Installed TR – 102 TR)

Configuration (60 TR - Actual Load)
- MODULAR Scroll (17TR x 5Nos.)
- 4W+1S (Installed TR – 85 TR)

Electrical Load Comparison

<table>
<thead>
<tr>
<th>Equipment R 407 C Scroll</th>
<th>kW</th>
<th>Qty</th>
<th>Total kW</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chillers</strong> 45 TR @ 1.2 kw/ TR</td>
<td>54</td>
<td>2</td>
<td>108</td>
</tr>
<tr>
<td>AHUs</td>
<td>6</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>Chilled Water Pumps</td>
<td>2.2</td>
<td>2</td>
<td>4.4</td>
</tr>
<tr>
<td><strong>SYSTEM kW</strong></td>
<td></td>
<td></td>
<td>124.4</td>
</tr>
<tr>
<td>Total TR</td>
<td>45</td>
<td>2</td>
<td>90</td>
</tr>
<tr>
<td>kW/ TR</td>
<td></td>
<td></td>
<td>1.382</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Equipment R 410 Scroll</th>
<th>kW</th>
<th>Qty</th>
<th>Total kW</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chillers</strong> 45 TR @ 1.1 kw/ TR</td>
<td>49.5</td>
<td>2</td>
<td>99</td>
</tr>
<tr>
<td>AHUs</td>
<td>6</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>Chilled Water Pumps</td>
<td>2.2</td>
<td>2</td>
<td>4.4</td>
</tr>
<tr>
<td><strong>SYSTEM kW</strong></td>
<td></td>
<td></td>
<td>115.4</td>
</tr>
<tr>
<td>Total TR</td>
<td>45</td>
<td>2</td>
<td>90</td>
</tr>
<tr>
<td>kW/ TR</td>
<td></td>
<td></td>
<td>1.282</td>
</tr>
<tr>
<td><strong>SAVINGS</strong></td>
<td></td>
<td></td>
<td>7.2 %</td>
</tr>
</tbody>
</table>
New product Inverter Modular Scroll heat pump MAC (UAL-V)

- Nominal Cooling Capacity 66 kW – 18.7 TR
- Nominal Heating Capacity 64 kW
- Modular Configuration

FEATURES
- New design DC modulation with Daikin compressor, more efficient
- Efficient heat exchanger
- High COP up to 3.38, IPLV 4.36
- R410A refrigerant
- Low starting current, reduce the impact on the power network
- 15%~100% stepless load control
- LWT control
- Low noise, lowest 58 dB(A)

Combinations
- Full inverter
  Inv(Master) + N* Inv (Slave)
- Mixed
  Inv(Master) + N* fixed speed (Slave)

Electrical Load Comparison – 24 Hrs operation

<table>
<thead>
<tr>
<th>System Types</th>
<th>R 407C Scroll &amp; HWG/Heaters</th>
<th>R 410A Heat Cool Scroll</th>
</tr>
</thead>
<tbody>
<tr>
<td>System TR</td>
<td>Cooling Mode</td>
<td>90</td>
</tr>
<tr>
<td>Average Running TR kW/ TR</td>
<td>63</td>
<td>63</td>
</tr>
<tr>
<td>Running Hours/day</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>Running days/Year</td>
<td>275</td>
<td>275</td>
</tr>
<tr>
<td>kWh Consumption</td>
<td>kWh Consumption</td>
<td>A</td>
</tr>
<tr>
<td>Output kW</td>
<td>Heating Mode</td>
<td>90</td>
</tr>
<tr>
<td>Average Output kW</td>
<td>63</td>
<td>63</td>
</tr>
<tr>
<td>Running Hours/day</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>Running days/Year</td>
<td>90</td>
<td>90</td>
</tr>
<tr>
<td>Energy Consumption for 1 kW Output kWh Consumption</td>
<td>B</td>
<td>160094</td>
</tr>
<tr>
<td>Energy Consumption kWh per annum</td>
<td>A+B</td>
<td>659054</td>
</tr>
<tr>
<td>Energy kWh Savings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimated Average Energy Cost INR / kWh (80% Utility @ INR 6.5/ kWh/ 20% DG @ INR 18/ kWh)</td>
<td></td>
<td>8.8</td>
</tr>
<tr>
<td>Energy Bill INR</td>
<td></td>
<td>5,799,676</td>
</tr>
<tr>
<td>Energy Savings INR</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Water Heaters

Environment Temperature -20 to 43 Deg C / Water Tank Water Temperature 25 to 55 Deg C

- Environmental friendly R410 refrigerant
- High efficiency design COP up to 4.59
- Intelligent control
- Modular design (1–16 units) for phased investment
- 30/40/80 kW option at 20 Deg C DBT ambient & 55 Deg C Hot Water Out Temperature
- Unique “Spray Liquid” Compressor Design

Can also be used for Fan coil units, Radiator, Floor heating and other hot water demands such as bathing, swimming pool heating, etc according to different customer requirements.

Calculation for a Hotel having 80 kW Boiler

**Flexibility**: Small investment; can be used with existing thermal storage tanks, gas and oil-fired boilers in combination.

**Whole year operation**: Running throughout the year; unaffected by changes of weather.

<table>
<thead>
<tr>
<th>System Types</th>
<th>Electric Boilers</th>
<th>MHA Water Heater</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output kW</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td>Running Hours/ day</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Running days/ Year</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>Energy Consumption for 1 kW Output</td>
<td>1.18</td>
<td>0.3</td>
</tr>
<tr>
<td>kWh Consumption</td>
<td>169920</td>
<td>43200</td>
</tr>
<tr>
<td>Energy kWh Savings</td>
<td></td>
<td>74.58%</td>
</tr>
<tr>
<td>Estimated Average Energy Cost INR / kWh</td>
<td>8.8</td>
<td>8.8</td>
</tr>
<tr>
<td>(80% Utility @ INR 6.5/ kWh/ 20% DG @ INR 18/ kWh)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy Bill INR</td>
<td>1,495,296</td>
<td>380,160</td>
</tr>
<tr>
<td>Energy Savings INR Per Year</td>
<td>1,115,136</td>
<td></td>
</tr>
</tbody>
</table>
**OPERATING MODES**
- COOLING MODE
- HEATING MODE
- HEAT RECOVERY MODE

- Modular Concept (Up to 16 modules in a set) for Design flexibility and inbuilt Redundancy (Module options – 30/ 40 TR Nominal Cooling Capacity)
- High COP for Energy Efficient operation
- Environment Friendly R 410A refrigerant (ODP = 0)
- IP 54 Water Proof Enclosure – Rain Proof Design
- Shell and Tube Heat Exchangers – Maintenance Friendly Design

Lowest CEWT can be 10°C at Cooling, 6°C at Heating

**Dual Mode – Cooling /Heating Switchover**

Switch over between water-cooled chilled water and water-source hot water modes can be achieved easily by the opening and closing of valves
Ultra High Efficiency Air Cooled Chiller

- Wide Range: 170 to 570 TR
- Inverter option available
- Heat Recovery (optional)

Less than 1 KW/TR including condenser fans

WSC 250 – 1500 TR
WDC 320 – 2600 TR
WCC 1200 – 2700 TR

Centrifugal Chillers

- Green Refrigerant R134a
- Entire Range LEED Compliant
- Positive Pressure Design
- No Purge Unit: No contamination to environment
- Unique Surge Guard feature
- Unique 3 Tier Control Architecture
- Quiet Operation, Quieter at part loads
- Close Control: ± 0.1 °C
- Unique Power Loss Damage Protection
Frictionless Centrifugal Chiller

- Magnetic Bearings: 40% more efficiency than conventional chiller
- Frictionless: Infinite life
- Frictionless: Ultra Quiet Operation
- Oil free: Sustainable performance
- Oil free technology: Lower maintenance, less moving components
- Green refrigerant R134a
- Entire range LEED Compliant
## Industry-Leading Performance

<table>
<thead>
<tr>
<th>Model</th>
<th>Capacity tons</th>
<th>Full load, kW/ton</th>
<th>IPLV</th>
</tr>
</thead>
<tbody>
<tr>
<td>WME1500D</td>
<td>1500</td>
<td>0.531</td>
<td>0.293</td>
</tr>
<tr>
<td>WME1450D</td>
<td>1400</td>
<td>0.520</td>
<td>0.310</td>
</tr>
<tr>
<td>WME1300D</td>
<td>1200</td>
<td>0.509</td>
<td>0.302</td>
</tr>
<tr>
<td>WME1000D</td>
<td>1000</td>
<td>0.531</td>
<td>0.309</td>
</tr>
<tr>
<td>WME700S</td>
<td>700</td>
<td>0.532</td>
<td>0.306</td>
</tr>
<tr>
<td>WME500S</td>
<td>570</td>
<td>0.570</td>
<td>0.335</td>
</tr>
<tr>
<td>WME500S</td>
<td>500</td>
<td>0.532</td>
<td>0.312</td>
</tr>
<tr>
<td>WMC400D</td>
<td>390</td>
<td>0.604</td>
<td>0.329</td>
</tr>
<tr>
<td>WMC400D</td>
<td>360</td>
<td>0.571</td>
<td>0.327</td>
</tr>
<tr>
<td>WMC290D</td>
<td>290</td>
<td>0.545</td>
<td>0.326</td>
</tr>
<tr>
<td>WMC250D</td>
<td>250</td>
<td>0.614</td>
<td>0.350</td>
</tr>
<tr>
<td>WMC150D</td>
<td>150</td>
<td>0.611</td>
<td>0.355</td>
</tr>
<tr>
<td>WMC145D</td>
<td>145</td>
<td>0.629</td>
<td>0.367</td>
</tr>
<tr>
<td>WMC145S</td>
<td>145</td>
<td>0.661</td>
<td>0.360</td>
</tr>
</tbody>
</table>

14% Energy Savings Over Comparable Standard Centrifugal Chiller w/ VFD
Fifteen percent of retrofit applications require partial or complete disassembly of the chiller Type A Knockdown, “Bolt-Together Construction”

Chillers are built and shipped completely assembled with bolt-together construction

Innovation
Two stage advantage

Industry leading COP - exceeding 6.7
Two Stage centrifugal chiller

Two-stage compressor

1° compression stage

2° compression stage

Discharge

Motor

Motor terminals

Suction

Motor driven inlet guide vanes (IGV)

Interstage suction
(piping connection to the economizer)

Motor driven variable diffuser (DDC)

Two Stage centrifugal chiller

Unique innovative 'back-to-back' impeller design, resulting in:

• thrust load reduction by 67%
• improved reliability
• longer bearing life

Industry leading COP - exceeding 6.7

Conventional 2-stage impeller

New back-to-back 2-stage impeller
Centrifugal Chillers

- Magnetic Centrifugal: WMC: 100 – 400 TR
- Magnetic Centrifugal: WME: 400 – 1500 TR
- Two stage Centrifugal: WTC: 600 – 1500 TR
  • COP 6.7
- Two stage Centrifugal: WCT: 3000 – 6200 TR

The Journey to excel continues

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