LIQUID DESICCANT AIR CONDITIONING
Saves energy, Controls humidity, Cleans air

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Humidity: *The Hidden Cost Driver*

Start with a typical building’s design load:
- 60-80% *sensible* load
- 20-40% *latent* load

Temperature reduction (sensible) is dealt with **directly** and efficiently by thermally absorbing heat into the refrigerant.

Humidity reduction (latent) is dealt with **indirectly** by significantly overcooling the air to force the moisture to condense, and then draining or pumping the water out of the system.

Resulting breakdown for a typical building’s HVAC:
- **30-50% of energy cost** is for humidity removal
- **40-60% of up-front cost** is for humidity removal

For some buildings – drier conditions or higher ventilation rates – the humidity portion could be **80-90%**
## Standard approaches to dealing with humidity:

<table>
<thead>
<tr>
<th>Approach</th>
<th>Description</th>
<th>Often used by</th>
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</table>
| 1. Off-the-Shelf | • Attempts to extract humidity by **overcooling** the air using traditional vapor-compression equipment  
• Design limits effective operation to mostly temperature reduction applications | • General Commercial  
• Older buildings  
• Schools  
• Hospitals  
• Restaurants |
| 2. Dedicated Systems / DOAS | • Same **overcooling** as above, but significantly increases coil size and refrigeration capacity  
• Often incorporates reheat to achieve lower SHR | • Newer schools  
• Hospitals in humid climates  
• Energy-conscious buildings (e.g. LEED) |
| 3. Solid Desiccant | • Directly treats humidity by using chemical absorption to **dry and heat** the air simultaneously  
• Requires extra refrigeration to post-cool the overheated air | • Humidity-sensitive industrial plants  
• Supermarkets  
• Ice Rinks |
Approach 1: Off-the-Shelf Systems have many, all-too-common problems

- Mold & bacteria
- Clogged coils & drain lines
- Dripping ceilings & pipes
- Poor air quality
- High maintenance costs
- Fogging and frosting

Limited capability to remove moisture due to coil design
Approach 2: Dedicated Systems / DOAS are effective but have their own significant drawbacks

- High first costs
- High energy consumption
- Complex, costly maintenance
- Performance degrades substantially over time
Approach 3: Solid Desiccants have their own limitations.

- High energy consumption
- Desiccant and substrate disintegration - wheel needs replacement every 3-6 years
- High maintenance costs
- Slow reaction makes it difficult to achieve precise humidity control
Liquid desiccant presents an alternative approach

- Avoids excessive energy use and expense from overcooling
- Avoid heating the air while drying it
- Controls humidity precisely with rapid response
- Manufactured from simple, low-cost components
- Easy to install & maintain
Liquid Desiccant Air Conditioning
What is liquid desiccant?
Liquid Desiccant Air Conditioning: *the most efficient solution*
Equipment Example
Liquid Desiccant Air Conditioning: the most efficient solution

The thermodynamic shortcut takes you directly to the Comfort Zone, cutting air conditioning workloads by half or more.

- Avoids “rework” of conventional and solid desiccant systems
- Eliminates maintenance-intensive components (air filters, evaporator coil, pans, condensate removal systems)
The thermal energy to drive the process can be derived from many sources

- Internal vapor-compression
- Condenser waste heat
- Electricity only

- Chiller
- Chiller waste heat
- Electricity and external hot/cold water

- Evaporative (cooling tower)
- Industrial waste heat
- Electricity and renewable power

- Ground source/geothermal
- Hot water loop
- Renewable sources, even if intermittent (e.g. solar)

- Internal vapor compression
- Condenser waste heat
- Electricity and renewable power

- Renewable sources, even intermittent
- Condenser waste heat
- Renewable sources, even if intermittent (e.g. solar)
Conditioner section “close-up”

Liquid desiccant in @ 60°F

Desiccant
$\Delta T = 15°F$

Corrugated Material

Latent heat absorbed

Sensible heat absorbed

Supply air out @ 72°F, 43% RH

Supply air in @ 83°F, 78% RH

Liquid desiccant out @ 75°F

Desiccant
$\Delta T = 15°F$

Air
$\Delta T = -11°F$
$\Delta W = -84 \text{ gr/lb}$

Note: incoming air conditions based on ASHRAE humidity load design point for Washington DC
## Performance benefits of liquid desiccant systems

<table>
<thead>
<tr>
<th></th>
<th>Liquid Desiccant A/C</th>
<th>Standard A/C</th>
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</thead>
<tbody>
<tr>
<td><strong>Controls</strong></td>
<td>Temperature &amp; humidity</td>
<td>Temperature</td>
</tr>
<tr>
<td><strong>Power sources</strong></td>
<td>Electric power</td>
<td>Electric power</td>
</tr>
<tr>
<td></td>
<td>Renewable energy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Waste heat</td>
<td></td>
</tr>
<tr>
<td><strong>Indoor Air Quality</strong></td>
<td>Salt solution naturally disinfects air of microorganisms</td>
<td>Air forced through a wet coil coated with mold and algae</td>
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<td>Eliminates all condensation points</td>
<td>Condensation points promote bacteria growth (e.g., legionella, e-coli)</td>
</tr>
<tr>
<td></td>
<td>Solution scrubs particulates and odors from the air</td>
<td>Sensitive to airborne particulates</td>
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<tr>
<td></td>
<td>No odor reduction</td>
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## Maintenance Requirements

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<tr>
<td></td>
<td>Rinse 2 liquid strainers (approx. 3 months)</td>
<td>Replace air filters (monthly)</td>
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<tr>
<td></td>
<td>Pump liquid from unit, wash sump, return liquid (approx. 5 years)</td>
<td>Clean coils, drip pans (3-6 months)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check and clear condensate drain lines (ongoing)</td>
</tr>
</tbody>
</table>
Case Study: Regents Park Nursing Home, Miami

- Nursing home in South Florida cares for over 200 patients in 80,000 square foot facility.

- The facility searched for a solution that would eliminate condensation problems, deliver clean, odor-free air and reduce energy costs in their cafeterias.

**Solution**
- Installed 2 DT 800 units

**Impact**
- Removed humidity/condensation problems
- Eliminated odors
- Dried floors quickly after mopping
- Reduced load on existing system for energy savings
Case Study: Duty Free Americas

- Warehouse in Miami stores perfumes, chocolates, and other goods for the airport’s Duty Free operations. To keep products well-preserved in the 10,000 sq ft space, air must remain at 73°F, 45% RH.

- As overhead doors opened throughout the day, the summer’s heat and humidity poured into the space. Feeling sticky and uncomfortable, workers moved thermostat to far left but conditions did not improve (typically around 80°F, 70% RH).

- Conditions worsened: condensation dripped from ceiling and vents, drip pans overflowed, products were damaged and the electric bill skyrocketed.

**Solution**

- Installed two DuTreat 800 CFM units

**Impact**

- 35% reduction in energy consumption
- Maintains conditions at 73°F and 45% RH
- Eliminates all humidity & condensation issues
Case Study: Huawei

- Huawei, an industry leader in communication networks, has a clean room production facility in Shanghai, China. Due to the need to control higher pressure in the clean room as well as to maintain high quality air for the employees, the facility required 100% fresh air and 68°F, 50% RH.

- Huawei installed a Dedicated Outside Air System to treat the air in this hot, humid region.

- While the system proved satisfactory, the associated water and electricity expenses were so excessive that upper management demanded a more economical solution.

**Solution**  
- 2 DuCool DT 3400 units

**Impact**  
- Energy cost savings of 40%
Case Study: Pines Ice Arena, FL

- Ice arena experienced high energy costs from cooling and dehumidifying its 80,000 sq ft facility through conventional means (chillers, cooling towers, desiccant wheel dehumidifiers).

- System consumed inordinate amounts of electricity, gas and water in South Florida’s hot, humid climate.

**Solution**
- Installed 6 DuHandling units (no compressors)
- Units powered by waste heat from cogeneration and geothermal well with Zamboni’s ice shavings

**Impact**
- Electricity consumption dropped by over 35% (expected up to 50% in upcoming year)
- Natural gas consumption reduced by 35%
- Water consumption lowered by 25%
- Pre-tax deduction of $144,000 and $50,400 less in federal income tax
Case Study: Lilavati Hospital, India

- Extremely high energy costs to maintain required hospital conditions in harsh climate

- Operation Theater requires:
  - 6,000 CFM of treated air
  - 25% fresh air
  - 64 - 78° F
  - 50 ± 5% RH

- Ambient Conditions:
  - 86° F
  - 90% RH, 172 gr/lb

**Solution**
- Installed DT 2400 unit

**Impact**
- Energy cost savings of 60%
- Provided 12.5 tons of additional capacity
Advantix Systems Company Overview

- More than **750 installations** deployed commercially worldwide with proven performance of 5 years+
- Pioneered liquid desiccant technology in early 1980’s for cooling and dehumidification with broad patented portfolio
- Rebranded in 2010 to Advantix Systems and moved headquarters to Miami
- Winner of AHR’s *Most innovative Cooling Product Award*, 2011
- ACHR News *Product of the Week* award, 2010
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Thank you.

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Advantix systems
Makers of DuC sool Dehumidification and Cooling