Dehumidifiers & dehumidification

- 4 brands
- 14 companies
- 700 employees
- €150 m turnover
- +300,000 products
Outline/Agenda

• What is humidity?
• What is dehumidification?
• How do they work?
• Technologies: Refrigerant vs Desiccant dehumidifiers
• Applications
What is humidity?

• Humidity is the moisture content of air. It varies with season, temperature, and weather.
• You'll be surprised how much humidity is in the air. Even in the winter!
• We will move on to define the way you measure the moisture content of air, i.e. Relative Humidity.
Where do we see humidity?
Side affects of excess humidity – damp
Side affects of excess humidity – mould
Quantify

• Moisture from your bodies
• 0.05l/h/person seated at rest at 22°C
• 30 people = 1.5l/h. e.g Bottle of water
• Moisture in this room
Humidity

- Air is only capable of entraining a small amount of moisture but this varies with air temperature
- holding **MORE** at high temperatures
- holding **LESS** at low temperatures

- This is why if a humidity condition is stated, we must also know at which temperature this is.
Humidity

• When the air has absorbed all the moisture it can hold it is said to be saturated, or stated another way – it has reached its dewpoint temperature

• If the temperature of this air is lowered (cooled) moisture will be released from the air – It rains!, or forms condensation on contact surfaces.

• If the temperature is raised (heated) it can potentially hold more moisture
Relative Humidity

• This is the ratio of the actual amount of moisture in the air and the maximum that it could hold at the same temperature

• It is expressed as a percentage

• It is RELATIVE to the maximum amount

• At the maximum i.e. saturated it is defined as 100%RH

• So at 50%RH the air is holding half of the maximum possible
Climates

We can’t see humidity but we can we feel it

• UK – London
  21°C & 80%RH = 12.5 g/kg

• Doha – Qatar
  43°C & 50%RH = 27.9 g/kg

• Colombo – Sri Lanka
  27°C & 80%RH = 18.1 g/kg
## Comfort RH

### Comfort Diagram

<table>
<thead>
<tr>
<th>Relative Humidity (%)</th>
<th>Room Temperature °C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>20</td>
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<tr>
<td>90</td>
<td>😞</td>
</tr>
<tr>
<td>100</td>
<td>😞</td>
</tr>
</tbody>
</table>

- Comfortable
- Semi-Comfortable
- Uncomfortable

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Humidity ranges

- Above 70%RH mould and mildew grows
- Above 60%RH the corrosion rate of steel and other metals accelerates
- Office comfort range is suggested to be 40-70%RH (CIBSE A1-9)
- Below 40%RH discomfort probable from dry lips, eyes and skin
- Below 40%RH static shocks can occur, below 20%RH they are certain
What is Dehumidification?

• Dehumidification is the process of removing water vapour from moist air

• All atmospheric air contains water vapour

• High quantities of moisture can lead to problems with human comfort and cause damage to buildings, products and industrial processes
Dehumidification

There are three main ways of reducing the relative humidity and moisture content of air within a space:

• Heating (only hiding not removing)
• Ventilation (only if outside air has equal/lower moisture content) than inside)
• Mechanical dehumidification
  • Utilising Refrigerant Dehumidification or Desiccant dehumidification
Heating, sometimes using A/C with reheat

What are the effects:

• Increases the Dry Bulb temperature
• Reduces the Relative Humidity
• No change in Moisture Content (heating)
• No change in Dew Point (Heating)
• Could only disguise/hide and does not cure problem
Ventilation

• Fresh air introduced from outside area
• Moist air exhausted from area
• Relies on ambient air being at a lower moisture content than air inside area
• In some situations ventilation can make a problem worse
• Ventilation will only assist during winter
Refrigerant and desiccant dehumidification

These devices physically remove moisture from a space.

**What are the effects:**

- Lowers the Moisture Content of the air
- Increases the Dry Bulb temperature
- Lowers the Dew Point
- Lowers the Relative Humidity
Refrigerant dehumidifier

The process of dehumidification involves moisture-laden air being drawn into a dehumidifier where the air passes across a refrigerated coil. The air is rapidly cooled below its dew point, condensing the water vapour and recovering its latent heat energy for re-use. The cooled air is then passed across the condenser where it is reheated and returned to the served area at the required lower relative humidity.

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Desiccant dehumidifier

Double fan motor
Advantages of Refrigerant type

- Low operating cost
- Minimal maintenance required
- High efficiency (COP 2.5-4 : 1)
- Easy installation
- Small diameter condensate drain
Advantages of Desiccant type

• Suitable for single pass situations common in tank drying applications

• Capable of large reduction in moisture content through the unit in each pass

• Can achieve very low RH levels and low absolute humidity
Disadvantages of a Desiccant type unit

• High energy usage, less efficient. Can consume four times more power than an equivalent refrigerant machine

• Heat gain from release of latent energy and carry over from regeneration section

• High rotor replacement costs

• Needs ducting to outside for wet air
Where are they used?

<table>
<thead>
<tr>
<th>Refrigerant</th>
<th>Desiccant</th>
</tr>
</thead>
<tbody>
<tr>
<td>– Recirculation. 40% - 100% RH</td>
<td>– Very low humidity required</td>
</tr>
<tr>
<td>– Dewpoint reduction in humid cooled spaces (supports A/C)*</td>
<td>– Total loss (single pass)</td>
</tr>
<tr>
<td>– process drying</td>
<td>– Confined spaces</td>
</tr>
<tr>
<td>– When connected to RCU’s for zero heat carry over to room</td>
<td>– Cold environments</td>
</tr>
</tbody>
</table>

* A/c often has a SHR in excess of 0.9. This means it does not remove much moisture. In humid spaces where the dewpoint is high, cooling will only reach the dewpoint temperature, resulting in inadequate room cooling.
Applications for refrigerant dehumidifiers

**Storage**
- Paper, Leather, Wood, Metals, Food, Vintage cars

**Control rooms**
- Data centres, telephone exchanges, switch gear rooms

**Museums**
- Artefacts, Manuscripts, Paintings

**General**
- Offices, Laundry, Kitchens, unoccupied rooms where RH remains important

**Condensation**
- Pumping stations, Basements

**Drying Rooms**
- Fire stations, Outdoor activities

**Process Drying**
- Timber, Ceramics, Confectionery, food

**Swimming Pools**
- Domestic, Commercial, Municipal
Storage

Storage condition 55%RH

- Finished products
- Raw materials
- Paper
- Cardboard
- Leather
- Textiles
- Wood
- Metals
Steel storage

- Corrosion will almost completely stop at humidity levels of 55%RH or less
Sensitive materials - Car storage, military

• Installations of various Calorex units in our customers garages and military storage facilities
Museums

- General storage 55%RH
- Photo archives 10°C & 40%RH
Electrical switchgear

- Reasons: Corrosion protection, arcing between electrical contacts
- Reasons: RH requires controlling, yet CRAC units are designed for 100% SHR. Therefore DH is required as a separate item
Swimming pools

- Large central duct systems with heat recovery for large commercial pools
- Standalone or ducted DH systems for private pools
Condensation (dew point control)

- Pumping stations
- Breweries, milk, juices
- Cold stores
- High humid air conditioned rooms
Condensation protection

Condensation can occur on

• Cold beams
• Cold voids
• Cold walls

Examples

• Sports hall
• Cold stores
• Can occur due to change in air condition before surface can warm up
Drying out

- Food industry
- Drying out after water damage/leakage
- Drying out after wash down
- Hygiene requirements
  - stainless steel cabinet
  - portable
- Size of unit dictated by:
  - amount of water remaining
  - time available for drying
Sizing

Formula

Moisture Load (l/h) = V x AC x (MC1/SV1 – MC2/SV2)/1000

V = Volume of space (m³)
AC = air change rate (per h)
MC1 = moisture content external (g/kg)
SV1 = specific volume external (m³/kg)
MC2 = moisture content required (g/kg)
SV2 = specific volume required (m³/kg)
Questions

• What is the problem?
• When does it occur?
• What are the internal/external humidities and temperatures?
• Does the client have a required temp/RH?
• Is the room exposed to outside air, or within a temperature controlled building?
Dehumidification drying

Advantages
• Reduce drying times
• Increase product quality
• Reduce rejection rates
• Increase energy efficiency
• Short payback period
• Less aggressive drying process
• Increase space for production
• Reduce energy costs
• Increase control of drying environment
Product drying

There are three important factors that affect the rate of drying

- Air temperature
- Air speed
- Moisture extraction
Wall mounted type
Floor mounted type
Ductable type
Ventilation/Dehumidification/Fresh air/Water heating

• DanX

• HRD
Mobile
Desiccant
What you need to know when comparing

- Capacity at a known air temp and RH
- Capacity at design conditions
- Power consumption
- Operating temperature range
- Suitability of construction for particular application
- Defrosting system used
- Control
- Fan available static
QUESTIONS?

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