



Martin Ginty – DCVMN Webinar 13th March 2018

Munters Group

Key facts

- Munters began trading in 1946 and incorporated in 1955
- 3,000+ employees
- 16 major Manufacturing Plants
- 5 Logistics and Assembly Hubs
- 53 sales and service centres serving customers in more than 30 countries
- Headquarters in Stockholm, Sweden
- Over 300,000 air treatment systems installed





Munters Group





> Agriculture

> Automotive





> Chemical Processing



> Commercial & Public Buildings



> Construction



> Data Center & Telecom Coolina



> Defense & Aerospace



> Education



> Electronics



> Food & beverage



> General Industry/Production



> Greenhouse



> Healthcare



> Oil, Gas & Petroleum



> Pharmaceutical



> Power Generation & Distribution



> Pulp, Paper & Printing



> Recreation & Leisure



> Retail & Supermarkets



> Shipbuilding & Marine



> Steel Industry



> Storage, Preservation & Archives



> Temporary Structures



> Water & Waste Water







Global Manufacturing & Logistics Support





Logistic & assembly hubs

16 Manufacturing Plants5 Logistic & Assembly Hubs53 Sales & Service Centres

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Munters Core Competencies

- Dehumidification
- Humidification
- Evaporative cooling
- Refrigeration

- Heating
- Energy recovery
- Mechanical separation liquid from gas





Pharma – Air Treatment for Tablet Manufacturing





Pharma - Air Treatment for Effervescent Tablet Packaging





Pharma - Air Treatment for Gelatine Capsule Manufacturing



- Drying of gelatine
- Production of capsule shape
- Capsule content
- Packaging



Pharma - Air Treatment After freeze-drying





Pharma - Air Treatment for Cleanrooms





Design Considerations



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GMP requirements for air treatment - Product Protection

- Contamination (product & staff)
 - Ensure air flows are not mixed between production areas unless the proper precautions have been taken
 - Risk assessment carried with the customer
 - Filtration
- Protect from product cross-contamination
 - -Ensure air flows are not mixed
- Correct temperature and humidity
 - Based on customer's specifications for the product being made and comfort conditions



GMP requirements for air treatment - Personnel Protection

• Prevent contact with dust

-Very low probability in clean areas

Prevent contact with fumes

Ensure that fume extraction is working as specified and alarms are properly configured

Acceptable comfort conditions

 Based on customer's specifications – and will be influenced by the product's temperature and humidity requirements



GMP requirements for air treatment - Environment Protection

Avoid dust discharge

- -Use dust collectors and filters
- -Ensure correct disposal of used filters
- Avoid fume discharge
 - -Assess the content of fumes, are they harmful to the environment? If so, consider adding a treatment system to the exhaust airflow



Air Treatment in Pharmaceutical Applications

- Control of airflow between different areas
- Specific ventilation requirements to avoid cross contamination
- Different demands on temperature and humidity
- Reliable projects that meet the requirements for control and air quality
- Operational cost



Pharmaceutical - Clean Zones Criteria (GMP HVAC)

Finishing and building structure

- Infiltration of air
- Air exchanges
- Room pressure
- Airflow
- Temperature
- Moisture
- Material flow

- Flow of people
- Procedures
- Outdoor conditions
- State occupation
- Type of products
- Cleaning procedures





Humidity



The Composition Of Air



Earth Surface



How To Quantify Humidity

- Absolute Humidity (or "Humidity Ratio")
 - The amount of (kilo)grams of water vapour per kilograms of (dry) air (g/kg)
- Relative Humidity
 - The ratio (in %) between the actual quantity of water vapour in the air and the maximum quantity of water vapour that the air can contain at a certain temperature



Humidity And Temperature

- Warm air can contain more water vapour than cold air
- Air at a certain temperature will have a corresponding maximum content of water vapour
- When too much water vapour is in the air (at a certain temperature), the air is "saturated" and the excess moisture will condense out
- This can happen when the temperature falls



Outdoor Relative Humidity





Psychrometrics

Which is the driest condition?

30 ° C and 50%R.H.

or

24 ° C and 70%R.H.



Psychrometrics



Psychrometric Chart or Mollier diagram is one method for showing the thermodynamic qualities of humidity and water vapour



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Psychrometrics – Calculated values

- 30°C Dry Bulb Temperature
- 50% Relative Humidity
- 22°C Wet Bulb Temperature
- 18.4°C Dewpoint Temperature
- 13.3g/kg Absolute Humidity













Psychrometrics – Calculated values for driest condition

- 30°C Dry Bulb Temperature
- 50% Relative Humidity
- 22°C Wet Bulb Temperature
- 18.4°C Dewpoint Temperature
- 13.3g/kg Absolute Humidity

- 24°C Dry Bulb Temperature
- 70% Relative Humidity
- 20°C Wet Bulb Temperature
- 18.2°C Dewpoint Temperature
- 13.1g/kg Absolute Humidity



Psychrometrics – Reference values

	Dry temp °C	Absolute Humidity g/kg
Stockholm	19.8	12.2
Riyad	22.9	13.0
Sydney	24.8	16.4
New York	26.8	17.8
Tokyo	28.0	20.4
Rio	30.1	21.5
Singapore	28.9	21.7
Shanghai	31.0	23.0



Sources Of Humidity In a "Closed" Environment





Sources Of Humidity In a "Closed" Environment

Humidity emitted depending on activity, clothing and room temperature

Average value at 20 - 25 °C and normal clothing:

- High activity
- Medium activity 125 g/h
- Low activity
- 200 g/h
- - 40 g/h





Does Humidity Cause Problems?

We will quickly walk through a list of humidity related processes that cause damages, quality loss and/or cost increases.

- Condensation (water) and frost formation (ice i.e. condensation below 0°C)
- Corrosion of metals
- Influence of moisture on resistance values (electronic malfunctions)
- Mould affecting hygiene in ducts, systems, buildings and manufacturing processes
- Property and quality change of materials and substances
 - Storage and production processes that require a stable, optimal climate
 - Product drying (deliberate moisture reduction, avoiding too high temperatures)
- Chemical reactions with moisture in the air
- Special cases of humidity impact
 - Comfort impact
 - Energy impact



Visible Humidity - Condensation on cold surfaces or in cold air







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Visible Humidity - Condensation on cold surfaces or in cold air





Source: www.teachingengineering.org

Source: www.myallergo.de



Source: www.szelloztetes.hu



Source: www.bontott-tetoablak.hu



High Humidity Causes Corrosion





Influence of Moisture on Resistance Values



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High Humidity Speeds Up Mould Growth





High Humidity Speeds Up Mould Growth – Hanoi Example

Hanoi, Hoàn Kiếm, Hanoi, Vietnam Wednesday 8:00 AM Mostly Cloudy



Precipitation: 8% Humidity: 74% Wind: 16 km/h

Relative Humidity by month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave.
68	70	76	75	69	71	72	75	73	69	68	67	71.1



Property and Quality Change of Materials and Substances



Materials and substances will have changing properties at different humidities

Storage and production in the right, constant climate will optimise quality of the product and the production process and reduce cost



Property and Quality Change of Materials and Substances





Relative Humidity and Comfort Feeling



Human comfort feeling depends on a combination of room temperature, air speed, wall temperature and RELATIVE HUMIDITY

At lower RH less cooling is required to maintain a comfortable climate

Other benefits are no condensation and mould growth is the duct system.... much healthier!





Moisture Removal Cost Comparison

Typical Energy Cost to Remove 120 Pounds of Water Per Hour

Floduce/Daily Cases	φ <u>9.13</u>			
Meat/Deli Cases	\$10.62			
Frozen Food Cases	\$14.83			
Ice Cream Cases	\$16.72			
Courses Tider Defrigeration Advance Development				

Source: Tyler Refrigeration Advance Development

Desiccant dehumidification can save a lot of energy

Depending on the temperature and initial humidity level, moisture removal through condensation can be costly and ineffective

If applied properly, it is much more cost effective to dehumidify than to heat objects and buildings

Dehumidification can be combined with cooling to reach the desired climate at optimal energy efficiency





Humidity Control



The Benefits of Humidity Control

- Condensation prevention
- Corrosion prevention
- Electrical resistance optimisation
- Mould prevention
- Property change optimisation, incl. drying
- Chemical reaction prevention
- Comfort optimisation
- Energy optimisation
- Other reasons (damping, ionisation prevention, etc.) Mostly, the benefits are found in a <u>combination of above reasons</u>



Desiccant vs Cooling - Dehumidification Capacities at 50% RH



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Sorption Dehumidifier - Munters Rotor Principle





Silica Gel

• A non-crystalline (amorphous) silicon dioxide based material which has water molecules in its composition. Adsorption takes place in cavities and pores.





In closing

- Humidity is present in all environments
- Humidity control and proper HVAC techniques maintain correct GMP conditions
- Dehumidification can deliver the following benefits
 - Eliminate Condensation (water) and frost formation (ice i.e. condensation below 0°C)
 - Prevent corrosion of metals
 - Prevent influence of moisture on resistance values (electronic malfunctions)
 - Stop mould formation and improve hygiene
 - Prevent property and quality change of materials and substances





Thank you for your attention Martin Ginty – <u>martin.ginty@munters.de</u> www.munters.com

