Munters

White paper

Managing humidity in cold storage

Executive summary

Cold storage facilities throughout the world struggle with a common and relentless challenge – frost. Water and ice create hazardous conditions in loading docks, accumulate around entrances, and even infiltrate critical components like evaporator coils, necessitating constant defrosts and straining equipment while consuming substantial energy. Defrosting costs time and energy, and your evaporator won't operate efficiently if ice has formed on it, further driving up operating costs.

When fog covers entrances, it's hard to see, and this can be dangerous for safety. It also puts the safety of stored goods at risk. While ice and condensation cause slippery floors, and ice deposits can even fall on personnel from overhead. Reduced visibility from fog further extends loading times, all while the loss of cooling capacity remains a costly concern.

But there is a cost-effective solution that addresses the root causes of frost formation. That solution is dehumidification. By shifting the focus from addressing symptoms to tackling underlying causes, cold storage facilities can enhance operational efficiency, product quality, and safety, all while reducing overall costs. Cold storage conditions can be improved by utilizing a tailored dehumidification solution, which will secure healthy, operationally efficient, and cost-optimized working conditions.

Addressing symptoms or root causes?

Many cold storage facilities have become adept at addressing the visible symptoms of their frost-related challenges. They invest in quick fixes to tackle ice formation on fixtures, water and ice accumulation, which disrupt operations and damage stored goods.

However, it's important to recognize that these solutions are primarily dealing with the symptoms, not with the root causes. They provide temporary relief but do not offer a lasting remedy, resulting in a continuous cycle of patching rather than preventing.

Optimized dehumidification solutions can address the fundamental physics behind condensation and ice build-up. It is possible to have complete control over cold storage facility conditions, safeguarding goods from spoilage and damage during storage.

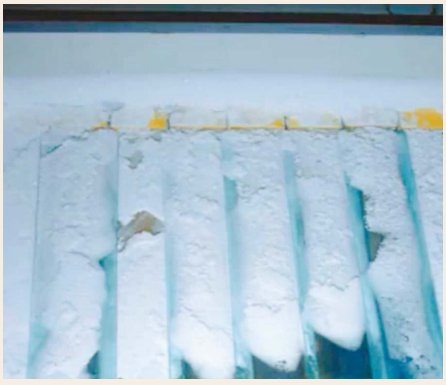
Humidity symptoms

Extreme icing on the ceiling.

Ice forms on fixtures and equipment.

Water damage to stored goods.

Icing impacts bar code scanner functionality.



Ice build-up in the loading dock.

Icing and fog obscure the floor.

Without dehumidification

Humidity is an invisible enemy, but its effects are visible:

- **Ice forms on fixtures and equipment:** This hampers functionality and safety.
- **Ice on the evaporator forms an insulated layer on the coil:** This reduces efficiency and increases energy consumption.
- **Water and ice build up:** This disrupts operations and can cause workers to slip and fall.
- **Stored goods get wet and damaged:** This results in spoilage.

These problems must be dealt with because they:

- Lead to additional costs
- Damage valuable goods
- Create work environment issues and potential dangers for workers

Understanding the scale of the problem

Ice and condensation can form in cold storages without dehumidification systems, if not managed they can impact operations.

- **Operating costs:** Ice and condensation lead to increased operational costs since defrosting and maintenance consume time and energy.
- **Lost revenue:** Frost and ice make product unsellable.
- **Work safety record:** Safety is paramount, and frost-related hazards can result in accidents and injuries.

Identifying the sources of humidity

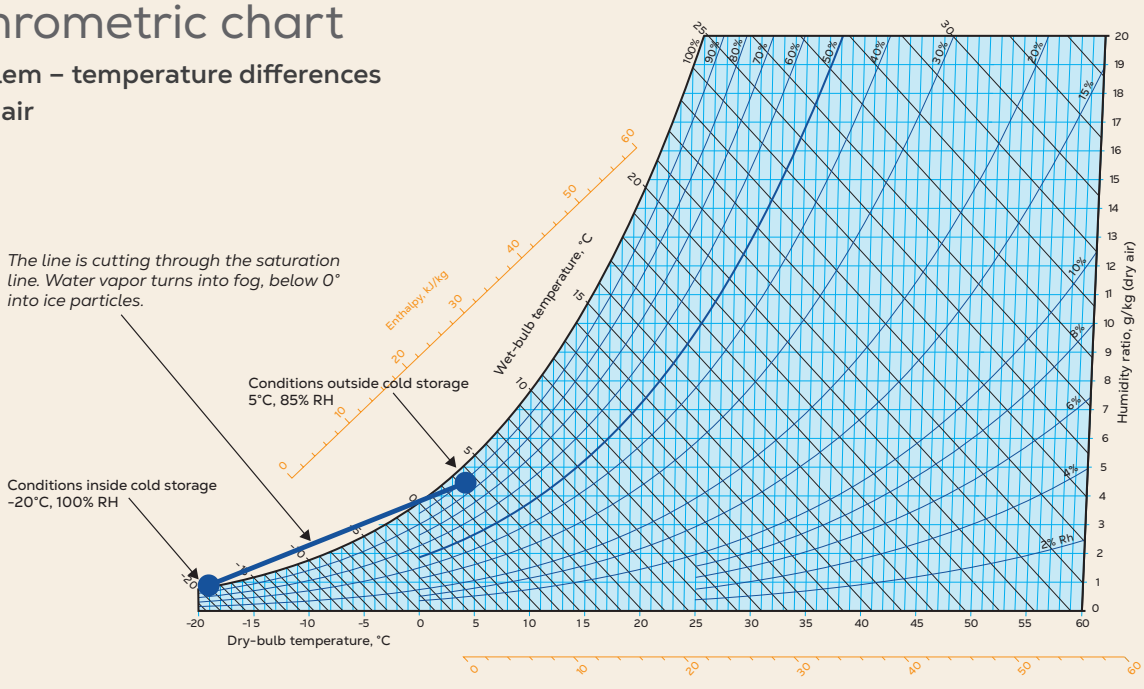
Understanding where humidity originates within a cold storage facility is vital in addressing the root causes of frost formation.

The most common sources of moisture-laden air include:

- **Points of entry:** When doors are open for extended periods or close too slowly, moist external air infiltrates the facility.
- **Ventilation:** Poor ventilation causes moisture buildup in the air. Water droplets form when this moist air meets cold surfaces in cold storage.
- **Improperly sealed doors:** Gaps or inefficiencies in door sealing can allow moisture-laden air to seep inside.
- **The goods themselves:** Certain products may release moisture, contributing to humidity levels.
- **People and vehicles:** Personnel and vehicles operating within the facility can introduce humidity.

Psychrometric chart

The problem – temperature differences in mixing air



Practical problems

Unwanted ice and condensation in cold storage facilities pose significant challenges, affecting operational efficiency and product quality.

Reduced product quality

The negative impact on stored goods includes increased waste and reduced profits. Undesirable moisture can lead to both physical damage and contamination, posing health risks and further diminishing profits. Moisture on strip curtains raises the risk of cross-contamination, while cleaning above 0°C jeopardizes the freeze chain, impacting product quality and customer trust.

Safety issues

Ice and condensation create hazardous safety conditions within cold storage facilities. Slippery floors become a breeding ground for accidents, posing risks to staff. These accidents not only cause injuries but also damage goods, equipment, and fixtures.

Poor working environment

Formation of ice not only affects the storage itself but also impacts the working environment. It makes it challenging to close doors and other openings properly, leading to more moisture-laden air entering the cold storage. Additionally, staff members experience a cold working environment with high humidity levels, making it feel even colder and more uncomfortable than an environment with the same temperatures but low humidity. This situation leads to lower staff morale and higher absenteeism statistics.

Cold storages without dehumidification

Slippery floors and reduced visibility caused:

The Safety Triangle

Common cold storage issues

Reduced product handling efficiency

The presence of ice and condensation hampers effective product handling, transport, stacking, and logistics. This results in reduced product handling efficiency and higher operational costs. Ice can even form on product barcodes, affecting product identification and causing labels to fall off or become unreadable. Data entry errors can also occur, numbers and codes that are entered incorrectly can impact operations. These issues result in unproductive time, workflow inefficiencies, and further harm to customer relations.

Wasted effort and reduced productivity

Once ice forms, it requires personnel for removal, and condensation needs to be addressed before it freezes into ice. This constant need for operator intervention diverts resources from productive purposes, resulting in wasted work hours. Furthermore, ice and condensation can lead to slower movement and an increase in accidents, thereby reducing overall productivity. This, in turn, raises personnel costs for treatment, compensation, insurance, and other associated expenses.

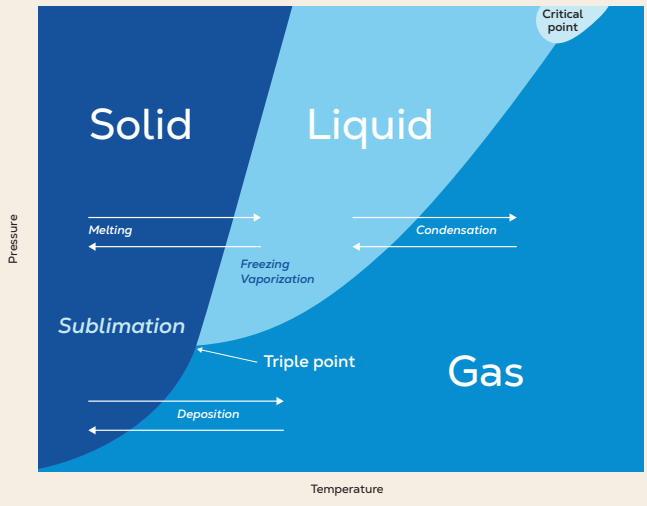
Higher energy bills

Managing ice and condensation in cold storages entails additional energy consumption.

Defrosting fixtures, fittings, and refrigeration equipment requires extra energy. Iced-up evaporators operate inefficiently, leading to even more energy consumption. In some cold storages, floors are heated to prevent icing, incurring additional energy costs for heating and cooling systems.

Condensation on electronics:

- Increases the risk of short-circuiting, corrosion, and device failure
- Buttons and keys on electronic devices can become sticky, resulting in higher error rates
- Reduce the lifespan of batteries
- May fail to meet environmental safety requirements



Triple point

What is sublimation?

Sublimation occurs when ice turns directly into water vapor without first transitioning into a liquid. In cold storages and freezers sublimation occurs when ice is surrounded by very dry air. In dry enough conditions water vapor molecules leave ice because of a lower vapor pressure and become airborne and are then removed by a dehumidifier.

Custom cold storage solutions

There are cold storage facilities throughout the world, but no two are alike. Whether it's due to specific operating profiles, commercial parameters, equipment and structure, or the climate and weather conditions in a region, each cold storage setup is unique.

Not all cold storages encounter serious problems with ice formation and condensation, and even when they do, the challenges and solutions can be markedly different.

In the complex world of humidity management, there are no one-size-fits-all solutions. Different climates and varying seasons of the year introduce dramatically different sets of conditions in various parts of the world, which leads to the countless challenges that cold storage operators face.

The dehumidification solution: addressing the root cause

When dealing with the persistent issue of ice formation and condensation within cold storage facilities, it becomes clear that root causes must be addressed. Traditional methods have often focused on mitigating the symptoms rather than dealing with the underlying problem.

Optimized dehumidification solutions tackle the root science behind ice and condensation, providing a range of benefits beyond surface-level fixes.

Dehumidify incoming air: Dehumidification solutions manage the moisture content of incoming air. By removing high moisture levels that contribute to condensation, dehumidification curtails the formation of frost and ice within the facility.

Preventing unexpected production interruptions

An optimized cold storage climate control system is a robust defense against unplanned production stoppages, securing continuous operations, reducing downtime and preventing revenue loss.

Saving energy

Time-consuming and energy-intensive defrosting can be avoided with customized dehumidification designed to meet a cold storage's specific requirements.

Enhancing product quality

Improved environmental conditions leads to sustained product quality. Inventory is safeguarded by mitigating the risk of product damage from ice or condensation.

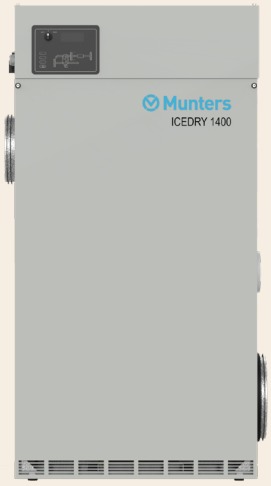
Boosting output

Optimal environmental control not only safeguards stored products but also boosts output. Operational efficiency and productivity increase when moisture issues are eliminated.

Customized dehumidification

A dehumidification system tailored to a facility's specific needs is highly effective in combating ice and condensation. The dehumidification system can be placed inside or outside the facility, depending on the overall storage layout and various temperature zone needs.

Custom climate control systems remove moisture from the air, creating dry air with a low dew point, which prevents condensation and ice formation.



Munters IceDry

Dehumidification benefits

Safety:

- Prevent slipping and falling by preventing snow and condensation

Maintenance:

- Less moisture-related problems
- Less maintenance costs
- Longer equipment lifetime

Clear visibility:

- Less/no fog outside cold storage
- Less/no ice on flap door

Hygiene

Less/no fog and condensation:

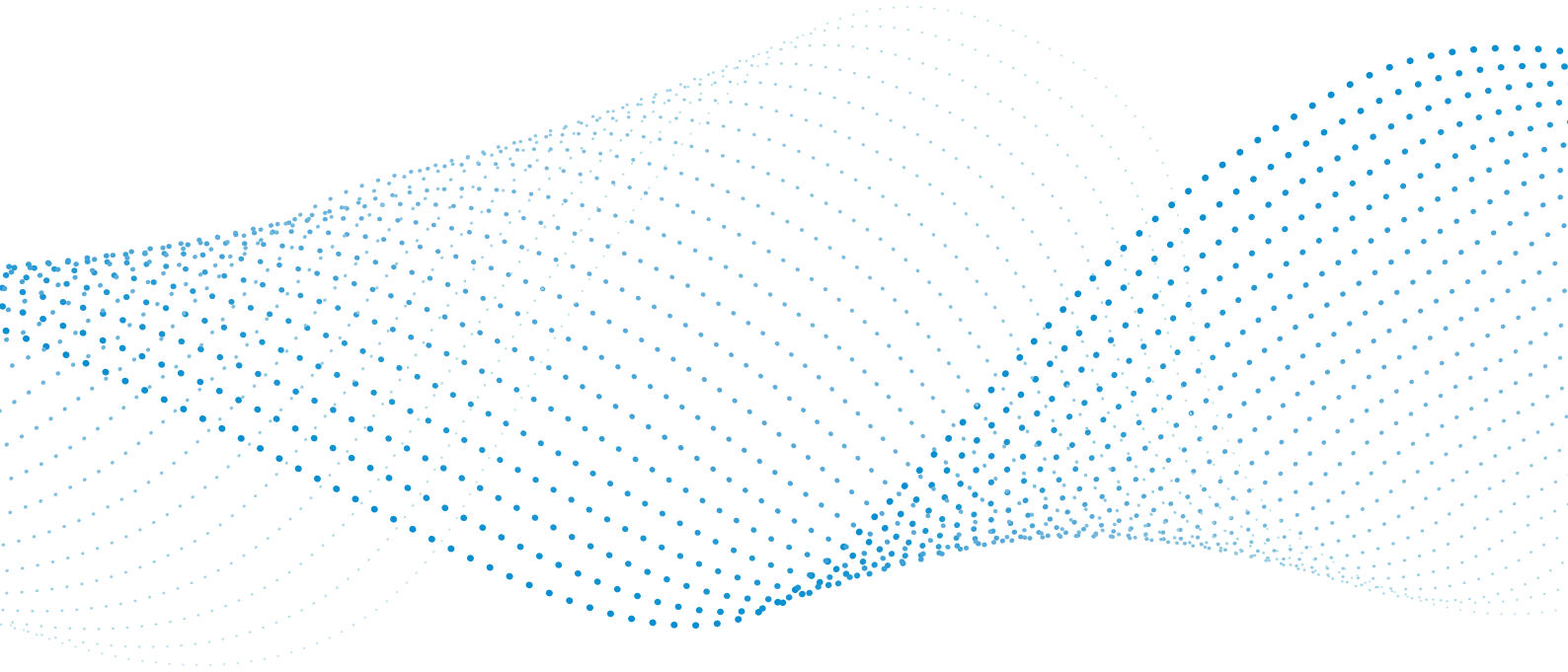
- Reduces cleaning time
- Less contamination risk

Production efficiency:

- Better visibility
- No slippery floors
- Optimal bar code reading
- Improved picking rates

Evaporator coil benefits:

- Higher efficiency of the evaporator
- Less water vapor = less latent load
- More economical
- Improves cooling performance
- Time between defrosts lengthens
- No floor heating needed near doors
- Reduced energy loss during defrost, which can account for up to 15% of total energy consumption, can be lowered to 3% in certain cases



Munters is a global leader in energy-efficient air treatment and climate solutions. Using innovative technologies, Munters creates the perfect climate for customers in a wide range of industries.

Munters has been defining the future of air treatment since 1955. Today, around 4,000 employees carry out manufacturing and sales in more than 30 countries.

For more information, please visit www.munters.com

Cold storage-WP-EN-202402