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TECHNICAL INFORMATION

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TITLE: DEHUMIDIFICATION - GENERAL

What is Dehumidification

Dehumidification is the removal of water from the air. Dehumidification equipment will take the ambient air and will "treat" it before it is exhausted into the enclosure. The addition of heat to the air will merely reduce the relative humidity - it will not remove water from the air. Therefore, a heater is not a dehumidifier.

Types of Dehumidification

There are currently four industry accepted types of dehumidification.

They are:

Compression of the air. This will reduce the absolute moisture content of the air but will generally produce a saturated condition at the elevated pressure. Expansion of this high pressure air will result in a lower dew point at the lower pressure because of the increase in actual volume. This is similar to what one experiences with an air compressor. The removal of the condensed water is accomplished by use of water traps and after coolers. However, the amount of air treated does not make this a viable alternative for dehumidification within the industrial marketplace.

Liquid sorption. The air is passed through sprays of liquid sorbent, such as lithium chloride or glycol solution. The sorbent in its active state has a vapor pressure below that of the air being dehumidified and thus absorbs moisture from the air stream. The sorbent must be continually regenerated by using heat to drive off the absorbed moisture.

Solid sorption (desiccant). This method utilizes either granular beds or fixed desiccant structures that are employed in automatic machines through which the air is passed. This desiccant also needs to be reactivated by heat to release the previously sorbed moisture to an outdoor stream.

Condensation-based (Refrigerant). This type unit, chills the air below its dew point, causing moisture to form as condensation on the cold surface of the cooling coil and thus removes water from the air.

In practicality, from the standpoint of the corrosion control and product protection industries, only the condensation based (refrigerant) and the solid sorption/desiccant types are applicable.

The desiccant based dehumidification system uses a chemical to directly absorb moisture from the air while it is a vapor. Specifically, the moist air stream is passed over a desiccant, typically lithium chloride or silica gel, that in its active state has a vapor pressure below that of the air to be dehumidified. Moisture is absorbed from the air stream. The desiccant is then heated which forces it to give up the absorbed moisture, regenerating the desiccant for continuous use. The heat of regeneration causes the temperature of the air entering the enclosure to be substantially higher than the ambient air. Due to this heat of regeneration requirement, the power requirements to operate this type of unit are generally quite high. Ultimately the desiccant will have to be completely replaced to maintain its performance level.

The condensation based (refrigerant) dehumidification system has the incoming air cross over the evaporator coils to reduce the absolute amount of moisture in the air via condensation. The air exits the cooling coil section of the dehumidifier at a reduced temperature, dew point, and absolute humidity. It then passes over both the condenser coils and a series of reheat coils to (a) increase the temperature of the air and (b) reduce the relative humidity of this air.

This system is advantageous when the ambient external air is comparatively warm with a high moisture content and the dew point is greater than 0 degrees C (32 degrees F). It has low power consumption requirements - approximately half that of a desiccant unit with an equal air flow rating.

Why you should use Dehumidification

During Abrasive Blasting

It is generally accepted that for corrosion to occur all four of the following components must be present:

1. Anode - A metal, in contact with the electrolyte, which corrodes (gives up energy)
2. Cathode - A metal, in contact with the electrolyte, which does not corrode (gives up energy)
3. Conductor - A metal which connects the anode and the cathode to complete the circuit for current flow
4. Electrolyte - Conducts current

During Coating Application

Due to the U.S. Clean Air Act Amendment of 1990 and air quality regulations enacted by other governmental agencies, the majority of the coating/lining manufacturers are reducing the volatile organic compounds (VOC's) in their products. However, as long as there are solvents in the formulation, the following scenario can occur during the application of the lining material.

The lining material is atomized as it passes through the spray gun nozzle. This is the beginning of the solvent evaporation process. However, once the material has reached the surface and has become a "wetted" film, the solvent continues to evaporate. At this point in time two potential problems can occur:

The air flow through the enclosure may have to be adjusted since it now must be capable of exhausting this evaporating solvent. This is discussed in more detail in the "During Curing of the Coating" Section.

Solvent evaporation is a cooling process. Therefore, as the solvent evaporates from the "wetted" film, the coated surface has a tendency to cool and its temperature will actually be less than either the air within the enclosure or the surface to which it has been applied. Because of this phenomenon, most specifications include the phrase "...the surface temperature must be at least 3° C (5° F) above the dew point..."

However, if this surface temperature can not be met due to external ambient conditions, one can either:

Raise the temperature of the steel surface. It is not practical, logical, or cost effective to raise the surface temperature of the entire steel tank - especially if it is not insulated, which is generally the case.

Reduce the dew point of the air within the enclosure. This is the obvious choice. This can be done only by dehumidification procedures. Heating of the air does not reduce the dew point - it merely reduces the relative humidity.

During the Curing of the Coating

As previously stated, water vapor is present at all times in the air. Also, at a given temperature and atmospheric pressure this air can hold only a fixed amount of liquid in the vapor state. Or, to put it another way, each cubic foot of air can hold only a fixed amount of evaporated liquids.

After a lining has been applied, the solvent release ideally continues until the lining has cured. If it can not be totally released and exhausted from the film, solvent will be retained in the film and premature lining failure will occur. There are two directions a contractor can go to resolve the above problem. Since a given cubic foot of air with a given relative humidity (a function of the amount of water in the vapor state that is found in the air) and temperature can retain only a fixed amount of solvent, the air flow can be increased so that more air passes through the enclosure and thus all the solvent can be removed. However, this could become prohibitive due to the required size and cost of the equipment plus the additional cost of power to run the equipment - especially if the exterior ambient air is almost saturated due to either (a) rain or high humidity or (b) low temperatures.

The second, and the most practical and cost effective solution, would be to utilize dehumidification equipment. Under the scenario above, the amount of water vapor in the air within the enclosure would be substantially reduced which in turn allows each cubic foot of air to retain additional solvent. This is true regardless of the exterior ambient air conditions. Typically a specification will call for 85% Relative Humidity, or less, during this operation. If this Relative humidity figure were to be reduced, the curing rate could be accelerated and the tank could be returned to service even more quickly.

Applications

A wide range of applications are available to the users of these Airblast multi-functional refrigerant based dehumidifiers. Typical uses include, but are not limited to the following:

Aviation

1. To facilitate the preservation of aircraft during periods of either long or short term inactivity.
2. To facilitate the storage of sophisticated electronic equipment by minimizing the formation of minute layers of corrosion build up on the circuit surfaces.

3. To facilitate the painting of aircraft that have been placed within an enclosure.

Food

1. To facilitate the drying of grain products.
2. To minimize the formation and growth of detrimental algae, mold, and fungus.
3. To assist in the shipping of perishable food items.
4. To maintain dry areas to assist in packaging applications
5. To protect hygroscopic materials.
6. To assist in the material handling of hygroscopic materials

Marine

1. To reduce the amount of time required for degassing of tanks.
2. To reduce the time required to dry a tank after steam cleaning, hydro blasting, or washing operations.
3. To minimize the formation of "flash rusting" in abrasive blasting operations that are required for the application of protective linings required for a good corrosion control program.
4. To reduce the time required for the curing (drying) of the protective lining.
5. To provide and safer, more productive work environment for personnel working within a tank.

Off Shore

1. To protect operational electronic and computer equipment against corrosion caused by the severe off shore environment.
2. To reduce the time required to create a "workable" environment for personnel as they enter closed storage areas.
3. To maintain the enclosed work areas in a safe condition for working personnel.
4. To assist in the prevention of corrosion by the application of protective coatings and linings.

Petroleum

1. To minimize the formation of flash rust during the abrasive blasting portion of a lining project - even if it is raining.
2. To facilitate the application and cure of the protective coating/lining material.
3. To provide a more ideal environmental condition for the lining to cure and thus lengthen the service life of the coating.
4. To provide a more comfortable, and thus a safer and more productive environment for the working personnel.

Petrochemical

1. To minimize the formation of flash rust during the abrasive blasting portion of a lining project - even if it is raining
2. To facilitate the application and cure of the protective coating/lining material.

3. To provide a more ideal environmental condition for the lining to cure and thus lengthen the service life of the coating.

4. To provide a more comfortable, and thus a safer and more productive, environment, for the working personnel.

Power

1. To facilitate in the storage of production units that have been shut down due to low power demand.

2. To facilitate in the preservation of storage tanks in a manner similar to that found in the above Petroleum section.

Restoration

1. To dry buildings and their contents after catastrophes such as floods, hurricanes, fires, broken water pipes, etc.

2. To dry books, papers and other similar items that have been severely wetted.

Shipyards

1. To assist and speed up the degassing of tanks to allow faster personnel entry

2. To provide a safer and more productive working environment for personnel

3. To provide an environment that will assist in the abrasive blasting and lining applications due to a lower Relative Humidity within the tank.