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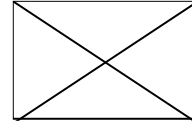
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What are moisture related problems?

Rust, mold, mildew, rot, decay and decomposition are all common enough problems encountered in our daily life. It is interesting to note that the root cause of all these problems is the presence of moisture or humidity in the air.



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The manufacturing, processing, storage of material often takes place in a humid environment which is not suited to the moisture sensitivity of the material, leading to deterioration of material, machinery, equipment and reduced product appeal.

What is Corrosion?

Corrosion is the deterioration of a material, usually a metal that results from a reaction with its environment. Over a period of time the components of a material may deteriorate to the extent that the material is no longer safe.

The individual electrode process could be shown as:

At anode : $4 \text{ Fe} \rightarrow 4 \text{ Fe}^{++} + 8 \text{ e}^-$

At cathode: $4 \text{ H}_2\text{O} + 2 \text{ O}_2 + 8 \text{ e}^- \rightarrow 8 \text{ OH}^-$

The initial product of oxidation is thus ferrous hydroxide

$4 \text{ Fe}^{++} + 8 \text{ OH}^- \rightarrow 4 \text{ Fe}(\text{OH})_2$

In the presence of excess oxygen the ferrous hydroxide is oxidized to hydrated ferric oxide which is rust.

Though corrosion is a complex function of many factors, the three most important are-

- a electrochemical difference between pure and impure areas
- physical conditions of temperature and humidity
- and oxygen in the air.

Higher humidity's may lead to higher condensation of water on the metal surfaces. The concentration of molecules of water vapor increases with increasing RH. This molecular thickness of the layers of water eventually permits ionic conduction, which accelerates the rate of corrosion.

With iron or steel, the ferrous ion may react with hydroxyl ion in water to form ferrous hydroxide and with oxygen to produce ferric hydroxide (rust).

The rate of corrosion is faster where surfaces are exposed to polluted air in combination with high relative humidity. Industrial pollutants like sulphur dioxide enhance the corrosion rate. Corrosion or rusting of stored material can be seen in every Industry

How Humidity Effects Industry?

The damage, which can be caused by excessive relative humidity, is:

- corrosion of steel and metals
- deteriorated characteristics of hygroscopic material
- increased harmful activity of micro - organisms.

What is Relative Humidity ?

Atmospheric air is a mixture of various gases and water vapour. The invisible water vapour in the air is called humidity.

The amount of water that can be contained in a pound of air depends upon ...

- . Temperature of the air
- . Pressure of the air

At a constant pressure, the warmer the air the more water vapour it can retain. If air at a certain temperature has absorbed all the moisture it can hold at that temperature, it is said to be saturated.

The amount of water present or the degree of saturation is evaluated in terms of Relative Humidity or Saturation ratio.

Hence, Relative Humidity is the actual water content in % of that of a saturated volume.

When air is 50% saturated, it contains only one half the amount of water than it can contain at the same temperature and pressure. As the relative humidity approaches 100%, the air can take on less and less moisture and at 100% relative humidity, that air cannot hold more water.

If air is saturated with water vapour at a given temperature, a drop in the temperature will lead to condensation of water in the form of droplets. The temperature at which moisture condenses out is the dew-point temperature.

How do you measure Relative Humidity?

Relative Humidity is determined by means of wet bulb and dry bulb thermometers. The dry bulb temperature is the temperature of air as determined by a standard thermometer. The wet bulb temperature is determined by tying a wet wick over the bulb dipped in a reservoir containing distilled water. Airflow around the wick causes the evaporation of moisture thus lowering the temperature and producing a reading lower than that on the dry bulb thermometer.

The comparison between the two readings gives us the measurement of water vapour in the air.

1. The lesser the difference - the wetter the air.
2. The greater the difference - The dryer the air.

The readings can be plotted on a chart known as the psychometric chart from where the properties of air vapour mixture like relative humidity, absolute humidity, dew-point can be directly determined.

What conditions to be mentioned in surface preparation and coating applications?

As per the research conducted by various technical bodies like NACE, EIL, SSPC etc. " In order to prevent metal surface from rusting, the metal surface temperature should be 5deg. F above the dew point of air around the surface. Moreover Relative humidity of air should be 55%-60%.

Why and how such conditions are to be maintained?

A typical example is when a large tank is blasted clean and then sealed at the end of the workday. The following morning the blasted surface may show corrosion even though the relative humidity in side the tank is below 50%. The corrosion occurs because the relative humidity at the metal surface (not in the air) can reach 100% because the metal cools at night, chilling the air in immediate contact with the surface to below the dew point and causing moisture to condense on the surface.

Dehumidification is used 24 per day until all blasting and lining application is complete. Dehumidifiers are applied to blasting operation in the following uncomplicated means. Air is (1) taken from the outside environment, (2) dried and , (3) fed to the interior of the tank where plastic and lining application takes place. The dry air performs 3 primary functions. First prevents condensation and high relative humidity at the interior walls. Second prevents build up of hazard vapors and particles inside the tanks. Third provides ventilation air for personal to perform cleaning and coating. Dehumidified air can also be used to supply air compressor thus avoiding problem caused by humid blast air.

How to install the Dehumidifier?

In all practical cases Dehumidifier is installed outside in open area with temporary shed over it so as to prevent the unit from rain. It takes the fresh outside air, dehumidifies it and sends to area where it is required through flexible ducts. The dry, fresh air continuously purges the tank and is exhausted to the atmosphere. Except under unusual circumstances, air is usually purged and not recirculated in the tank because fresh air is needed for ventilation. Also, if the air is returned to the dehumidifier from the tank, the heavy particulate loading could quickly clog dehumidification equipment regardless of the filtration precautions.

How to dehumidify external surface for blasting and coating application?

In order to prevent external surface from rusting during blasting and coating application, dehumidified air can be applied. For this purpose, Plastic sheets can be used as vapor barrier with suitable scaffoldings to hold the plastic sheet.

How to size Dehumidifier?

The capacity of the dehumidifier can be calculated using the following formula:

$$(V_i) (RAC) / 60 = m^3 / \text{min.}$$

Where:

- V_i is the internal volume of the tank minus the volume of any obstructions measured in m^3 . RAC is the required air changes rate per hour.
- 60 is the number of minutes per hour and
- m^3 / min is the airflow rate in cubic meters per minute required to meet the specified air change rate.

How Humidity Effects Industry ?

Humidity is a constant threat to production efficiency and product quality. The damage which can be caused by excessive relative humidity are principally:-
- corrosion of steel and metals
- deteriorated characteristics of hygroscopic material
- increased harmful activity of micro organisms.

What are the typical methods of dehumidification?

Principally there are three methods of dehumidification:-
... Over compression
... Refrigeration Dehumidification
... Sorption Dehumidification

How does a Dehumidifier work?

The new ranges of Bry-Air Dehumidifiers are fluted media based and remove moisture through a process of continuous "physical adsorption".

The moisture is adsorbed in the dehumidification sector by the fluted, metal silicate desiccant synthesized rotor and is exhausted in the reactivation sector by a stream of hot air in the counter flow. Following the reactivation process, the adsorption sector is again ready to adsorb the moisture. Thus, the two processes of "moisture adsorption" and "reactivation" are taking place with separate airflows continuously

and simultaneously. Positive sealing between chambers prevents mixing of the process and reactivation air streams.

What is the range and capability of Desiccant Dehumidifiers and to what level can relative humidity (RH) be controlled by us?

A. Bry-Air dehumidifiers incorporating desiccant synthesized rotor are available in a range of 170 cmh (100 cfm) to 40,000 cmh (24,000 cfm) as standard and engineered/package systems

B. As the dehumidifiers use desiccants, they work independent of apparatus dew point (ADP), and can continuously maintain relative humidity as low as 1%, even at subzero temperatures.

How can Refrigeration be used to Dry Air?

Another method most commonly employed is the reduction of moisture in the air by means of reducing the temperature. By examination of the dew point alone or saturation curve on the psychometric chart. It can readily be seen that as the temperature of the air is lowered, the amount of moisture it can hold is reduced considerably. Thus by cooling the air below the dew point, the moisture contained in that air can be condensed out and some of the moisture vapour removed in liquid form, but cooling to very low temperature makes the refrigeration process impractical, as it requires a great deal of subsequent re-heating. The reduction in air temperature is also limited by the freezing point of water condensing on the cooling coil, which in some designs is offset by complicated brine spray and liquid lithium chloride type systems available using a combination of refrigeration and adsorbent liquid. These are very bulky and involve complicated control systems for the proper maintenance of solution density.

Are the humidity levels, being specified, not easily achievable with regular air conditioning or refrigeration?

Two items are significant in deciding the choice of the final equipment :

- i) The amount of latent (moisture) load in relation to the total load.
- ii) The relative humidity specified to be maintained

a) Generally, if the relative humidity is to be maintained between 50-60%, it is more economical and preferred to employ standard air conditioning. However, if the latent load, even at this RH levels, is predominant or significant, e.g. Supermarkets, large fresh air equipments, it is recommended and preferred to divide the sensible load on the refrigeration equipment and latent load on desiccant dehumidification equipment.

b) For relative humidity to be maintained below 45 to 50%, desiccant dehumidifiers offer the most economical, efficient and simplest method of humidity control.

c) Often humidity levels are not correctly specified as the user is not aware as to what RH levels and moisture will have ill effect on its products and processes.

What are the limitations in controlling RH with central air-conditioning plants/window air conditioners?

In tropical areas like India, with normal central air conditioning plants, lowest relative humidity of 50%-60%, at best, are attainable economically, at room temperatures between 20°C to 24°C. This again is only possible with special design of the cooling coil and appropriate selection of the apparatus dew point and provision of sufficient reheat.

With window air-conditioners or split A/c units, in the absence of specially designed cooling coils and reheat provision, typical relative humidity of 60-70% are commonly experienced at times of high outside moisture ambient conditions like monsoon.

Removal of large water vapour/moisture through cooling requires after cooling to apparatus dew point close to freezing and substantial subsequent reheating, thus requiring both over sizing of the cooling equipment, as also increasing the operating cost with higher BHP per ton consumed, and reheat energy.

How is the dehumidification equipment sized?

To size the equipment, it is first necessary to correctly estimate the moisture load. At low humidity, water vapour will permeate at very significant rate and large quantity based on vapour pressure difference. As ASHRAE has not laid out moisture estimation procedures for low humidity requirements, most air conditioning engineers are not fully equipped to correctly estimate the moisture load. Estimation of the moisture load procedure is explained in a very easy to understand manner in the [Bry-Air design and engineering data manual](#).

Once the moisture load has been correctly estimated the sizing of the dehumidifier is a relatively simpler task. Please see Bry-Air engineering data manual or call our nearest office for support.

Will the relative humidity being maintained inside an environment, with the help of dehumidifier, vary from season to season, depending upon the ambient temperature?

OR

What are the controls used to maintain the desired RH, when there is a wide variation in ambient temperatures and RH?

Like any refrigeration plant the load on the dehumidifier system varies due to ambient conditions. The temperature control is maintained by a thermostat. This RH control is achieved with the help of humidistat or a proportionate RH controller. There are several control option for optimizing dehumidifier equipment energy/performance by one or more of many methods like proportionate reactivation energy, switching on and off the reactivation energy, switching off the dehumidifier, switching off the rotary bed and the reactivation energy and keeping the air flows on, etc.

Are there any references/commendations from users regarding the satisfactory usage of dehumidifiers?

Yes, [references](#) from various users of Bry-Air dehumidifiers are available.

The fact that we have tens of thousands of Bry-Air Dehumidifiers operating around the world and we are producing this product in India and Malaysia in addition to USA and Brazil. The export of the same to Middle East, various countries in American continent and Europe, South East Asia, including Taiwan, Hong Kong, Thailand, Indonesia, Singapore etc., China, African continent including South Africa and West Asia, serves as an adequate testimony of both the quality and capability of Bry-Air Dehumidifiers.

For Surface Preparation and Coating Application in India, We have many **references/commendations** from users regarding the satisfactory usage of dehumidifiers:

- INDIAN OIL CORPORATION LTD. BARODA
- INDIAN OIL CORPORATION LTD. VADINAR
- HPCL WIZAG
- BHEL MUMBAI
- ONGC (OFFSHORE APPLICATION)
- L&T HAZIRA
- L&T POWAI
- ENRON (DHABOL PLANT)
- PAHARPUR COOLING TOWERS

What are the common maintenance problems with dehumidifier? Are the spares and consumables available easily?

Bry-Air dehumidifiers are easy to maintain and do not require special skills either to operate or to maintain them. Elaborate maintenance manuals provide easy to follow instructions for installation, start-up and also a comprehensive trouble shooting guide.

Consumables and spares are easily available through any of the Representative, Regional or Branch offices located in all major cities in India and abroad.

Bry-Air also offers training programs for service technicians, maintenance staff of user organisations, from time to time, to familiarise them with the operation and maintenance of the dehumidifier.

Where all our offices are available?

At the moment we are offering machines on rental from Gurgaon (Haryana) and by April-2003 we will have our offices at Mumbai and Chennai.

For how long Dehumidifier should run in a day?

In order to get proper result, machines should run 24 hours a day continuously. It is being designed to run nonstop without any problem.

What RH is preferred in Surface Preparation and Coating application?

In most of the cases it is between 55%-60%. According to customer requirement. it can be changed accordingly by using suitable size of machines.

When the machine should be called in a project?

As soon blasting operation is started, Dehumidifier should run till the coating is complete.

Is Relative Humidity only advantage we can get by Dehumidifier?

It is not only low RH which is obtained by Dehumidifier, but fresh air which is dehumidified is continuously fed helps operator to breath and see easily in dusty environment which is created because of blasting application. During coating application all chemical fumes get dissolved into fresh dehumidified air which also prevent operator health.

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