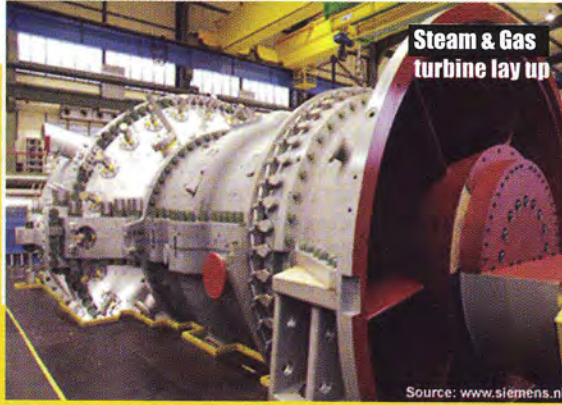


# Corrosion causes large scale losses during

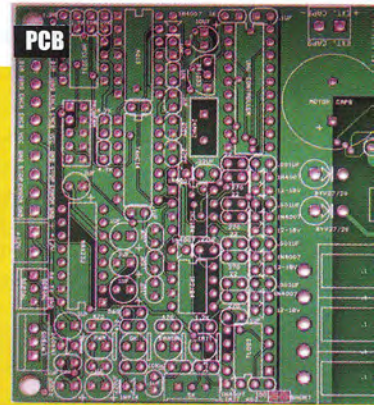


Blasting



Steam &amp; Gas turbine lay up

Source: www.siemens.nl



PCB



Jet Engine Storage



Switchgear rooms

## Rust? Corrosion?

You need controlled  
dry environment

*Bry-Air (Asia) Pvt. Ltd.*

*The devastating effects of corrosion are not unknown. Metal components and equipment tend to rust and corrode during storage, assembly or plant shut down due to moisture in the air. Over the years the most commonly adopted practice for corrosion prevention on metals has been use of anti-corrosion coatings. Though the need for anti-corrosive coating cannot be refuted, the need for alternate methods to control/prevent corrosion should not be underestimated.*

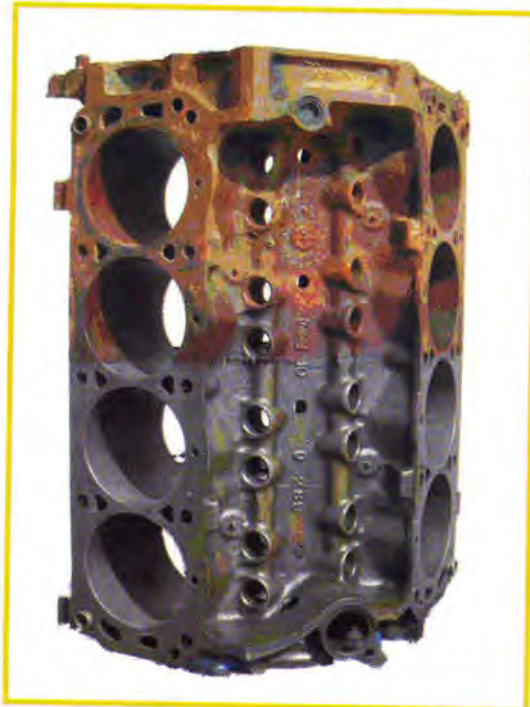


Corrosion does not occur in dry air. The basic problem arises from the fact that the invisible water vapour present in the air condenses, on any surface, colder than the dew point temperature of the surrounding air mass. Also, sudden changes in temperature, within the room affect the internal humidity environment and lead to condensation on any surface. This subsequently leads to corrosion.

### **A little water removal saves a lot of money**

Humidity control or dehumidification provides the answer to controlling moisture in a warehouse or a storage area. Not only does the controlled RH restrict rusting of iron and steel, but also protects other moisture sensitive materials.

*This article will focus on the above aspects of the corrosion phenomenon and its prevention through humidity control.*



### **When Moisture is Torture!!!**

Aircrafts, automotive parts, ammunition, bearings, batteries, chemicals, cardboard boxes, documents, engines, electronic components, leather items, maps, metal parts, assemblies, gearboxes, films, foods,

medicines, precision parts for watches, spares and sea vessels all need to be stored at the raw material, semi assembled or prior to packing stage.

The one single, enemy of goods, in storage, to be contended with is 'Corrosion'. In fact, Corrosion costs the country a phenomenal thousands of crores annually. It costs an organisation, a tremendous amount of vital resources, towards the annual maintenance and replacement of corroded, thereby useless components and parts etc.

### **Corrosion problems are Moisture Problems**

Corrosion does not occur in dry-air. It is the invisible water vapour in the air which is the cause of rusty bolts and industrial foe of product quality and storage.

A certain amount of water vapour is always present in the air. This water vapour or moisture in the air is measured in terms of relative humidity.

The basic problem arises from the fact that water vapour will condense, on any surface, colder than the dew point temperature of the surrounding air mass.

Thus common factor between unlike group of products as corroded machine parts, defective plastic goods, erratic computer data and bad quality newsprint is surprisingly – the root cause of all defects in these products – Moisture. And that creates havoc in apparently dry airconditioned areas.

Also, sudden changes in temperature, within the room affect the internal humidity environment and lead to condensation on any surface. This subsequently leads to corrosion.

### **THE CORROSION PHENOMENON**

**Inorganic Corrosion : Corrosion is defined as destruction of a metal or alloy by chemical or electro chemical reaction with its environment.**

In most instances, the reaction is electrochemical in nature: a flow of electricity between certain areas of a metal surface through a solution capable of conducting an electric current. This electrochemical reaction causes destructive alteration (eating away) of a metal at areas.



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

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

Higher humidities may lead to higher condensation of water on the metal surfaces. The concentration of molecules of water vapour 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).

### Accelerating and Intensifying Factors

In pure air almost no iron corrosion occurs, at relative humidities even up to 99%. But with contaminants such as sulphur dioxide or solid particles of charcoal present, corrosion could proceed at relative humidities of 45% or above. However, pure air is seldom encountered in practice. The critical humidity level which is at 45%, is approximately same for clear and polluted air, however 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. Out of the three factors, oxygen in the air cannot be prevented from coming into contact with the metal surface and very little can be done to control pure and impure air on the surface of the metal due to contamination. However, the water coming into contact with the metal surface can be avoided by surface treatment but most effectively by control of humidity in the environment. The relative humidity must be controlled to a level where it not only prevents condensation but is reduced to a critical level below which corrosion does not occur.

### Organic Corrosion

This form of corrosion is most familiar as..... Mould... Mildew... Fungi Mould, Mildew and Fungi are all different types of bacteria. Outdoor air is well endowed with this bacteria which are small enough to be carried indoors and which will settle on materials.

The spores lie dormant until suitable conditions of temperature humidity are achieved. In general the spores will not germinate below 60% RH. The actual temperature conditions for germination may vary widely between different types of moulds.

Once germinated the mould prospers and the speed of growth is a function of temperature and humidity. The condensed moisture on material acts as a medium conducive to the growth of bacteria. Moreover at high temperature the activity of the micro-organisms increases but a certain amount of activity occurs even at very low temperatures.

Thus micro-organisms growth is injurious to material; as it not only results in decomposition but also mechanical weakening of the products. In most cases bacterial growth can be arrested if RH is maintained below 35%.



### Many Faces of Corrosion

#### Examples of Inorganic Corrosion

- **Defence** : In defence, operational reliability and availability are the key words.

Corrosion is the prime enemy of equipment in storage, like tanks, ammunition, aircrafts etc. The variety and number of items required to back-up a military, airforce or naval unit is immense and while in storage, problems of operational availability, reliability and downtime are confronted.

- **Marine** : In the marine industry, rust spells doom. Machinery, spares, engines, boilers, electrical and electronic systems aboard the ships or near off-shore facilities require protection from corrosion.

- **Power Plants** : In the power industry, the power plant may need to be deactivated for temporary lay up or extended cold standby or simply for storage of back-up turbines. It is during such times, the entire plant needs a safeguard against corrosion.
- **Blasting** : During sandblasting operations, the blasted surface begins to rust immediately after it is cleaned for painting, preventing proper paint adhesion.
- **Storage of parts** : In the storage of precision parts, before assembly of small or big spare parts, or a finished inventory, rust spells a rejection rate as high as 50%.
- **Ball Bearings** : Metal components, precision parts and equipment tend to rust and corrode due to moisture in the air.
- **Data Center** : Rapidly fluctuating humidity, unexpected variation of environmental condition leads to Corrosion.
- **Blades** : Blades are prone to rusting in storage prior to packing, if not stored in humidity controlled area.

### Examples of Organic Corrosion

- **Breweries and Distilleries** : Organic corrosion is an inherent problem in breweries and distilleries where fungus growth on walls, hop storage, fermentation and yeast room is unacceptable under stringent hygiene demands of the process.
- **Seed Storage** : Mold and fungus growth on seeds during storage makes them unfit for consumption and germination.
- **Archival material** : Mould and mildew on stored maps, film negatives, books or paintings in museums and libraries destroys their usefulness and reduces their longevity.
- **Chemical and Pharmaceuticals** : Fungus growth or organic compounds and medicinal substances renders them useless.

### What can be done about it?

The rate of corrosion attack or rusting is considerable above a certain relative humidity. But below the critical humidity the rate of corrosion is negligible. The critical humidity in most cases is about 45%, in some cases even lower.

However, in practice, the relative humidity to be maintained for storage of steel components and machinery should not exceed 35-40%. The rate of corrosion accelerating above 45% RH is shown figure below. Hence, it is imperative that the RH must be controlled.

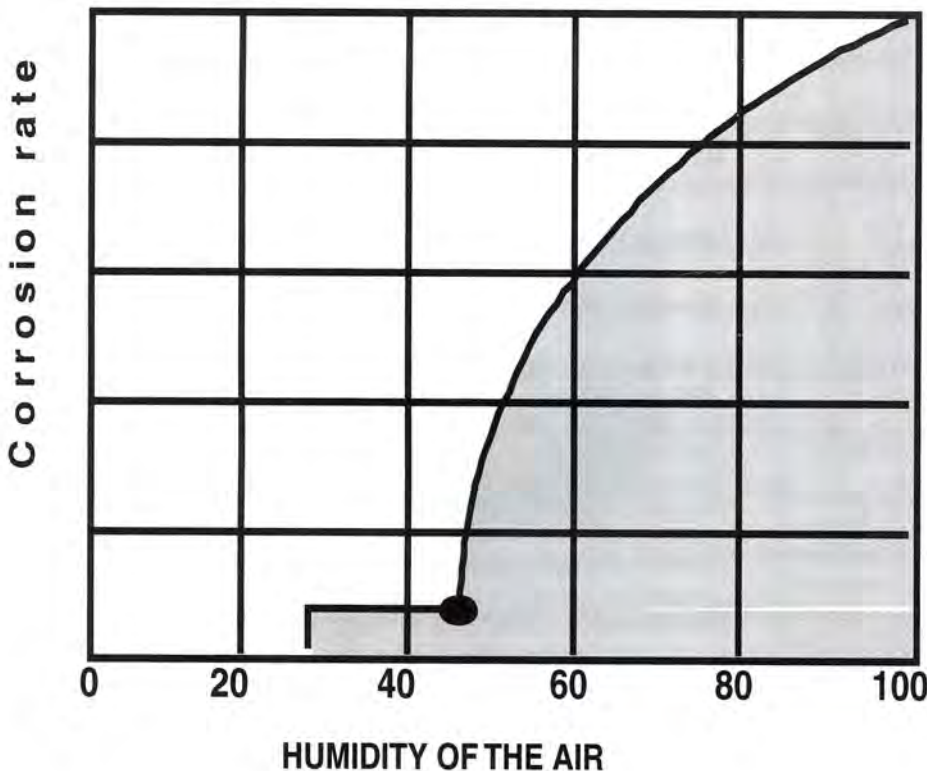


FIG. 2

### Methods for Control of Relative Humidity

In order to maintain a controlled environment in an enclosure at the desired RH level, supply air to the enclosure has to be dry enough to offset the moisture ingress into the enclosure. The process of physically removing moisture from the air is called dehumidification.



## Lowering of RH can be accomplished in several ways, viz. :

- Heating the air
- Application of vacuum
- Refrigeration
- Chemical Dehumidification

However, drying by heating the air and application of vacuum is not practical and is not used at all. Drying through refrigeration is also not really being used.

**Refrigeration system** of dehumidification does actually remove moisture, by condensing it, but has some inherent limitations unless one makes major compromises in application needs.

The limitation are :

- It is suitable for maintaining RH up to 45% or above;
- It continues to pump heat into the enclosure, since the heat of compression is rejected continuously within the enclosure;
- High ambient temperature reduces the efficiency of the condensing system and requires high energy consumption for RH control.

### Chemical dehumidification

has emerged as the best choice for RH control. Chemical Dehumidification based on the principle of physical adsorption reduces the moisture content and dewpoint of the air.

The principle behind chemical/desiccant dehumidification is that the desiccant is exposed to the moisture laden air, from where it is extracted by the desiccant and held.

### Equipment Options for Adsorption-based Dehumidification

- The size of the enclosure in which the RH is to be controlled, the supply air quantity and the degree of dehumidification required vary from situation to situation. Therefore, it is necessary that a wide range of equipment be available to meet the specific requirements of a given situation.

- Adsorption-based dehumidification systems operate on the principle of an adsorbent bed rotating between two sections ; a 'process' section in which the supply air is dehumidified, and a 'reactivation' section in which the adsorbed moisture is removed and the bed is regenerated for a fresh process cycle.

- A wide range of ratings and capacities are available to built from small to very large enclosures, such as storage sheds, warehouses etc. Bry-Air Asia (BAA) offers several options to suit the user needs. viz. :

- Bry-Air Compact dehumidifier (FFB series) is the smallest answer to all massive moisture problems. The Compact Dehumidifier removes moisture through a process of continuous "physical adsorption". They are effective in terms of space occupied and energy billing.

- Bry-Air maintains RH as low as 1% at a constant level, regardless of ambient conditions during, production, processing, storage and packaging.

Bry-Air also provides the custom-made Environliners , an ideal solution to Humidity related storage problems.

It is a humidity controlled mobile housing for safe storage of small equipment like engines, gear boxes, small arms, ammunition, optics, ration, documents, Enviroliners are customised modular PVC store house which can convert any space in whole or in part into cost effective humidity controlled storage area. Equipment and material stored in Environliner is protected against damaging effects of moisture-rust, mold, fungus etc. Enviroliners are custom made using flexible special grade thermo plastic barrier material to 'build' the walls on a framework and 'zipped' closed.

Bry-Air provides short term humidity control solutions through rental of Dehumidifiers through another group company "Technical Drying Services" (TDS).