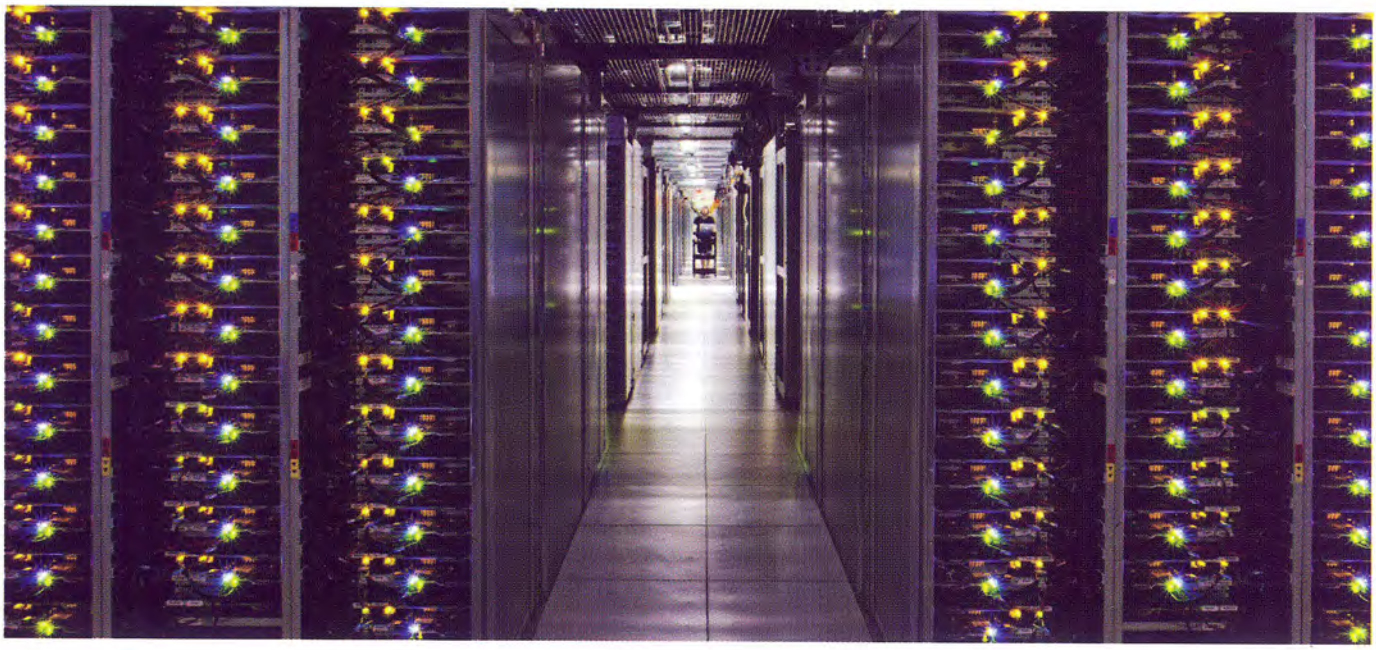
Environment control in Data Centres:

Protection from corrosive gases



Data centres help organizations conduct business round the clock. Primarily, there are 2 types of data centres; Corporate data centres (CDCs) and Internet data centres(IDCs). Corporate data centres are owned and run by private corporations. The primary purpose of Corporate Data centres(CDC) is to support data processing and web based services for their own organization, partners and customers. Internet data centres (IDCs) are used to provide outsourced IT services through the internet.

Data centres are always prone to corrosion because of harmful environment created by infiltration of outdoor particulates and gaseous contaminants. If the facilities are situated near landfill sites, sewerage/drains, high density traffic, process industries, etc., the corrosion problem is worse.

Protecting the electronic equipment in data processing centres from any potential environmental threat is a vital step for a data centre manager. Even extremely low levels of corrosive gases in data centres results in:

- Electronic corrosion Increased downtime
- Low productivity
- Electronic equipment interference
- A non-compliance of electronic warranty specifications
- Failure of electronic components and sporadic circuit failure, leading to data loss and downtime in data centres.

The contamination can be broadly classified in 2 categories:

- Particulate Contamination
- Gas Phase Contamination

While the size of particulate contaminants is up to 0.1 microns, which can be removed by using particulate filters, gas phase contaminants are much smaller.

Sulphur-bearing gases, such as Sulphur Dioxide (SO_2) and Hydrogen sulphide (H_2S) are the most common gases causing corrosion of electronic equipment. So_2 and H_2S alone are not very corrosive to silver or copper but the combination of these gases with gases such as No_2 and/ or Ozone is very corrosive. The corrosion rate of copper is a strong function of relative humidity, while the corrosion rate of silver has lesser dependence on humidity.

"Lead-free" regulations have resulted in increased sensitivity of printed circuit boards, storage devices, etc. to gaseous contaminants. After the introduction of "lead free" law, such as EU directive "on the restriction of the use of certain hazardous substance" ROHS, manufacturers have replaced lead with other substances which are more susceptible to electronic corrosion.

As a result, replacing damaged electronic components due to micro corrosion substantially increases a data centre's maintenance costs.

Due to increasing number of failures, where lead free materials are used, electronic manufacturers have started asking for:

- ISA G1 class environment for warranty compliance as described by the International Society of Automation (ISA) Standard 71.04-2013
- As per recommendation by American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) Technical Committee TC9.9.

For efficient working of data centres, data centre managers have to overcome various operational challenges such as:

- Control of gaseous contamination, which is one of the major cause for electronic corrosion and hardware failures in data centres.
- Reducing maintenance costs and preventing data loss through uninterrupted working of electronic equipment.
- To maintain the severity level of G1 as per ISA 71.04 standard to avoid electronic corrosion.
- To increase performance of IT resources and create a healthy working environment.
- To design and equip data centres with latest energy efficient solutions in order to reduce power costs.

Effects of AIRBORNE CONTAMINATION on data centre equipment can be divided into three main categories:

(a) Chemical effect- Dust settled on printed circuit boards leads to component corrosion and/or electrical short-circuiting of closely spaced features.

(b) Mechanical effect- obstruction of cooling airflow, interference with moving parts, abrasion, optical interference, interconnect interference or deformation of surfaces.

(c) Electrical effect- Includes impedance changes and electronic conductor bridging.

One mechanism by which dust degrades the reliability of printed circuit boards involves the absorption of moisture from the environment by the settled dust. The ionic contamination in the wet dust degrades the surface insulation resistance of the printed circuit board and, in the worst-case scenario, leads to electrical short circuiting of closely spaced features via ion migration.

Deliquescent relative humidity, the relative humidity at which the dust absorbs enough water to become wet and promote corrosion and/or ion migration, determines the corrosivity of dust. When the deliquescent relative humidity of dust is greater than the relative humidity in the data centre, the dust stays dry and does not contribute to corrosion or ion migration.

Leakage current due to dust that settled on printed circuit boards increases exponentially with relative humidity. Keeping the relative humidity in a data centre below 60% will keep the leakage current from settled fine dust within the acceptable sub range.

Most of the problems can be tackled by incorporating a Gas Phase Filtration equipment in data centres. A Gas Phase Filtration equipment removes contaminants and eliminates downtime by removing corrosive gases through the process of chemisorption.

Monitoring air quality:

A low-cost, simple approach to monitoring the air quality in a data centre is to expose copper and silver foil coupons in the data centre for 30 days followed by coulometric reduction analysis in a laboratory to determine the thickness of the corrosion produced on the metal coupons.ASHRAE recommends that data centre operators maintain an environment with corrosion rates within the

following guidelines:

- Copper reactivity rate of less than 300 Å/month
- Silver reactivity rate of less than 200 Å/month

(1 Angstrom Å is the unit of length equal to 0.1 nanometre OR $1x10^{-1}$ metres)

Based on test results of corrosion, it is possible to classify the environment into one of 4 severity levels as outlined in Table below:

Corrosion Level in terms of (in Angstroms) as per ISA

Class	Severity Level	Copper Reactivity	Copper Reactivity
G1	Mild	<300Å	An environment sufficiently well-controlled such that corrosion is not a factor in determining equipment reliability.
G2	Moderate	<1000Å	An environment in which the effects of corrosion are measurable and corrosion may be a factor in determining equipment reliability.
G3	Harsh	<2000Å	An environment is which there is a high probability that corrosive attack will occur. These harsh levels should prompt further evaluation resulting in environmental controls or specially designed and packaged equipment.
GX	Severe	>2000Å	An environment in which only specially designed & packaged equipment would be expected to survive. Specifications for equipment in this class are a matter of negotiation between user & supplier.

Table 1: Gaseous corrosivity levels as per ISA-71.04-2013

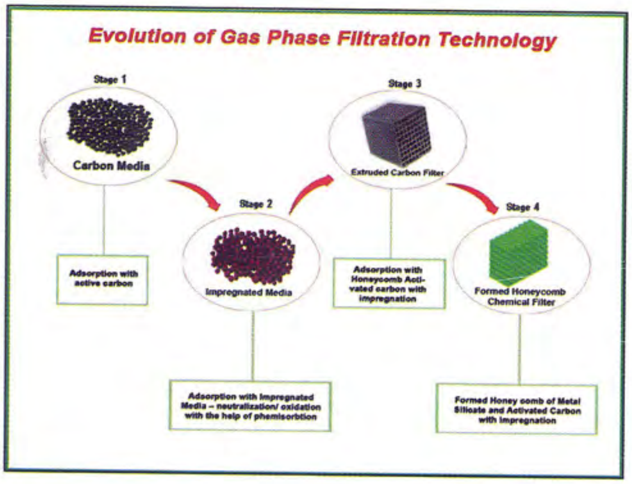
In summary, data centre equipment should be protected from corrosion by keeping the relative humidity below 60% and by limiting the particulate and gaseous contamination concentration to levels at which the copper rate is less than 300 Å per month and silver corrosion rate is less than 200 Å per month.

To help Data Centre facility managers take corrective steps in time, real-time monitoring is recommended with gas-phase filtration air-cleaning systems, in order to track the efficiency of the filters. There are atmospheric corrosivity monitoring tools and services today to track and monitor the overall reactivity levels of gaseous airborne contaminants with excellent accuracy in real time.

How to create acceptable gaseous levels in data centre- Solution is Dry Scrubbers (Gas Phase Filtration):

In dry scrubbers the contaminated air is passed through adsorbent in granular form, impregnated with active chemicals to adsorb the unwanted gases and then neutralize/oxidise the the same through chemical reaction.

Recent Developments in Gas Phase Filtration:



Limitation of using granular based dry scrubbers in commercial installations led to development of technologies allowing adsorbtion media in Honeycomb matrix to be impregnated with active chemical in microporous of the substrate. This new technology can remove contaminants gases, odour elements or volatile organic compounds more efficiently and effectively from air supply stream.

Using Data Centre Air Purifiers (DAP) to maintain a healthy and corrosion free environment for your Data Centres:

In a chemical filter, when gases are passed through the filter, at molecular levels, the gas molecules react with active chemicals. The process is known as chemisorption. Data Centre Air Purifier, also known as DAP, is ideal to protect data centres from the threat of electronic corrosion and failures. Using adsorption and chemisorption, DAP removes corrosive gases and contaminants and maintains ISA standard 71.04, IEC standards and environmental standards followed by electronics manufacturers.

Specially designed Datacentre Air Purifiers incorporating the revolutionary Honeycomb Chemical Filter are now available which not only reduces the size of the equipment but also increases its efficiency. With Data Centre Air Purifiers (DAP) & ACM (Atmospheric Corrosivity Monitor), a data centre manager can ensure minimum breakdowns, reduced downtime and reduced maintenance costs.

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Mr. Dinesh Gupta, President & Director Bry-Air (Asia), a flagship company of Pahwa Group, has almost 3 decades of experience in dehumidification and Indoor Environment Control. He has specialized in application and engineering of environment control equipment like dehumidifiers, energy recovery system and airgineering systems. His papers on humidity control, energy recovery systems and IAQ have been published in various technical journals.