TEXT DEHUMIDIFIERS

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Dehumidification

Introduction

Dehumidification removes moisture vapor from the air to lower its dew point. This section will focus on dehumidification to control the working environment and describes how dehumidification impedes steel corrosion and inhibits flash rusting.

Humidity and temperature impact surface preparation and coating operations

Environmental (ambient) conditions, such as humidity and temperature, significantly impact surface preparation and coating operations and, ultimately the long-term performance of coatings.

In normal environmental conditions, coatings must be applied to surfaces within a few hours of cleaning to avoid flash rusting. Coating work is often delayed because of high humidity and/or low temperatures. This necessary cycle of blasting and coating on the same day can affect the quality of the coating work. Applicators often hurry to try to beat the weather. Mistakes can add to the overall cost.

In many cases, such environmental controls as heating, ventilation, protective enclosures, lighting, and dehumidification can improve the economics and quality of coatings work.

Present-day coatings can only reach maximum protective potential when applied to a high-quality surface. After adequately removing oil and grease, steel surfaces are usually blasted to remove old coatings, rust, and scale. Coatings must be applied before the surface loses its bright appearance and flash-rusting begins.

A well-written coating specification requires close monitoring of the surface preparation phase of the coating operation so the full potential of the high-performance coatings may be achieved.

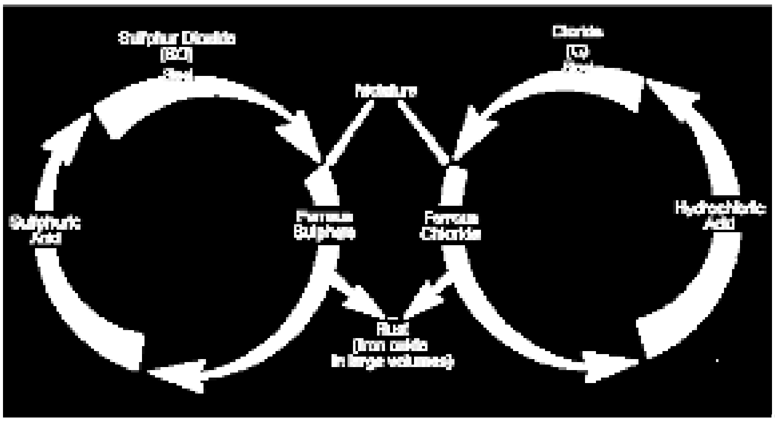
Corrosion and Corrosion Rate

It has been established that corrosion can occur on steel when the four elements of a corrosion cell (anode, cathode, metallic pathway, and electrolyte) are present. The most common source of electrolyte affecting most paints in atmospheric exposure is atmospheric moisture in the form of rain or condensation.

Steel temperature changes the corrosion rate in much the same way as it affects a typical chemical reaction. Higher temperatures generally create higher corrosion rates. Atmospheric humidity and pollution control the corrosion rate, first by creating an electrolyte, then by affecting the efficiency of the electrolyte. Research shows that steel exposed to high humidity and high levels of atmospheric pollution, such as in an industrial area at a sea coast site, will corrode 15 to 20 times faster than steel exposed in a rural area of high moisture and low pollution.

Figure 3.1: Air Pollution and the Corrosion Cycle

In a rural area the steel may frequently be wet, but the film of relatively clean water produces a low rate of corrosion. In an industrial area, such atmospheric pollution as sulfur dioxide, chlorides, and sulfates cause



the water to become acidic, which improves the function of the electrolyte and accelerates the rate of corrosion.

Either way, moisture is a prime contributor to the corrosion process. However, the presence of moisture does not necessarily mean the steel will feel wet. Contaminants on the surface can absorb moisture from the air and hold it on the steel surface in a microscopic layer of water. It would be a mistake to think that keeping the surface apparently dry by stopping condensation is enough to stop corrosion. Rather, to stop corrosion it is necessary to keep the air dry enough to prevent the contaminants on the steel surface from absorbing moisture.

Moisture and Humidity

In normal conditions, all air contains some moisture, and the amount it contains depends on the temperature and pressure of the air. Generally, pressure is not a significant factor, so only temperature needs to be considered.

Relative humidity =

amount of water vapor in a given volume of air x 100%

maximum amount of water vapor (if air is saturated) at the same temperature

Air can have relative humidity in the range of 0 to 100%. At 0%, the air would be perfectly dry; at 100% it is completely saturated.

Warm air can contain or “hold” more moisture than cold air. The amount of vapor held in the air in the summer may be three times greater than that in the winter. When the air contains the maximum amount it can hold at a given temperature, it is said to be “saturated.” If it contains less, say one-half as much, it is said to be partially (50%) saturated, or is said to have a relative humidity of 50%.

Heating the air does not change its moisture content, which is a quantity of vapor, but it does improve its

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ability to hold more moisture vapor; and thus, it decreases its relative humidity. Cooling the air reduces the ability to hold moisture vapor and, thus, increases its relative humidity.

When air is cooled, its saturation level is reduced, and the relative humidity is increased toward 100% until the air finally becomes totally saturated. When the air is further cooled, the quantity of moisture vapor present exceeds the ability of the air to hold moisture; and the excess moisture vapor, which it can no longer hold, will condense as a fog, mist, or dew on any surface exposed to the air.

Whatever the humidity level, it is always possible to cool the air enough to reach saturation and then produce condensation. The temperature to which the air has been cooled enough to be saturated and capable of producing dew is called the *dew point temperature.*

As relative humidity decreases, water tends to evaporate faster because the air can absorb more of it. As relative humidity increases, water evaporates more slowly. The same is true of most solvents. Most coatings cannot be applied successfully when the relative humidity is greater than 90% because the solvent evaporation rate decreases at higher relative humidity and reaches zero evaporation rate at 100% relative humidity.

This condition can result in solvent entrapment in the applied coating film, together with an impaired cure process, and is likely to cause subsequent coating failure in the form of blistering or severe peeling.

The relationship between relative humidity, temperature, and dew point can be found in charts and tables or with special slide rules or calculators. The use of the psychrometric chart is illustrated in the following example:

Applications

Dehumidification equipment is commonly used in the coatings industry for tank-lining projects in adverse weather conditions. The ambient atmosphere in the tank can be controlled throughout the project. It is common to allow blast-cleaned steel to stand for days or weeks before coating, provided low relative humidity can be maintained. The prudent applicator will keep a standby dehumidifier on site because any equipment failure may result in the loss of days of surface preparation work, particularly if the equipment fails at night and the problem is only found the following day.

Buried tanks are particularly appropriate for the dehumidification process because of the high-insulation factor of the surrounding earth. Blasting and painting ships' ballast or cargo tanks are other common applications.

Dehumidification equipment can be helpful in tropical climates throughout the year, provided it is sufficiently powerful to cope with sometimes extremely high temperatures and moisture levels.