Technical Resource

VISUAL CUES HELP TO IDENTIFY THE TYPES OF IRON OXIDES

Iron oxides are chemical compounds composed of iron and oxygen. In total, there are sixteen known iron oxides and oxyhydroxides. Each iron oxide looks different and its appearance can actually help to tell you a story. Industrially-used metals will spontaneously react with oxygen and form a Primary Oxide Layer (POL). The appearance of the “POL” is dependent on the surrounding conditions and is specific for every metal. Changes in relative humidity and pH will change the POL from more stable to less stable.

By observing the rust on a metal part you can collect valuable information that can help to solve your corrosion problem. Of the 16 known oxides, there are four that are most commonly found in the metalworking industry. Photos and details about these four are provided below.

Name:
Iron(II) oxide ferrous oxide

Chemical Formula:
FeO

Appearance:
Black-colored stain rust that is attached to the surface of the metal.

Oxidation State:
+2

Formation:
Limited to near-zero oxygen and high amounts of moisture.

Cause:
Metal parts were sitting on water or a pile of wet metal parts were stacked together.

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Name:
Ferric oxide

Chemical Formula:
Fe_2O_3

Appearance:
Dry, loose brown powder on the surface of the metal.

Oxidation State:
+3

Formation:
High oxygen, low moisture. This type of rust is typically called atmospheric corrosion. It is a dry form of rust (it hasn't yet absorbed or incorporated any water molecule in to its structure) and it is usually localized and confined to a small area of the metal part.

Cause:
Unprotected metal that has been directly exposed to the environment (air). No barrier was in place or used.

Name:
Hydrated oxide

Chemical Formula:
$Fe_2O_3.H_2O$

Appearance:
Red powder on the surface of the metal.

Oxidation State:
+3

Formation:
Water + Oxygen = Corrosive Environment. This type of rust forms due to high oxygen and water exposure.

Cause:
Unprotected metal with heavy exposure to air and moisture with the presence of a possible contaminate (salt). This rust first appears as brown in color and then it absorbs moisture and turns a shade of red.

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Name:
Iron oxide-hydroxide

Chemical Formula:
FeO(OH)H2O

Appearance:
Yellow powder on the surface of the metal.

Oxidation State:
+3

Formation:
Very high concentration of water and oxygen.

Cause:
Standing water on the surface of metal. Improper or ineffective drying station leaves metal parts wet. Condensation due to temperature fluctuations.

Properly identifying the type of iron oxide (rust) you are battling allows for the design and use of protective packaging solutions that will preserve and protect. ARMOR offers a full line of cost-effective rust preventative products that are clean, safe and easy to use.