Technical Resource

5 STEPS FOR CORROSION PROBLEM DIAGNOSIS

Failure analysis is the process of collecting and analyzing data to determine the cause of a failure and how to prevent it from recurring. Asking questions is an important discipline in order to collect valuable data. The biggest risk is lacking critical information and therefore failing to determine the right cause. Many times, there isn't a single cause of corrosion but rather multiple causes that branch and synergize with each other.

1. **Failure Size and Frequency.** How large in scope is this problem (quantity of parts rusted)? How long have the parts been experiencing this type of rust problem? Was there a previous and/or similar rust problem? The answers to these questions will show you the "failure rate".

2. **Failure Severity.** What percentage of the surface metal has rust? Parts are evaluated for the percentage of surface area that exhibits corrosion and are graded as follows:
   Grade A: No visible corrosion
   Grade B: Very slight corrosion covering less than 5% of surface area
   Grade C: Slight corrosion covering 5-10% of surface area
   Grade D: Corrosion covering 10-25% of surface area
   Grade E: Corrosion covering more than 25% of surface area

3. **Failure Mode.** The manner by which the rust is observed generally describes the way the corrosion occurs. Iron oxides are chemical compounds composed of iron and oxygen. Each iron oxide looks different and its appearance can actually help to reveal details on its formation. 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 will help to identify the *"failure pattern"* and solve the corrosion problem. Properly identifying the type of iron oxide (rust), allows for the design and use of protective packaging solutions that will preserve and protect.

4. **Manufacturing Process.** The way metal parts are formed and shaped will influence the remaining stress on the surface and therefore will upset the tendency to rust. Other factors from the metal processing that can affect corrosion rates are: cold working, machining, heat treating, washing solutions, handling, etc.

5. **Environment.** *Contaminants* – Various chemical and manufacturing processes find their way into the air and onto surfaces. Many of these substances, often present in minute amounts, act as catalysts or initiators of the corrosion process. *Temperature* – Temperature changes can alter the rate of corrosion. A good rule of thumb is that a 10˚C (18˚F) rise doubles corrosion rate. *Relative Humidity* – Humidity levels have a significant effect on promoting corrosion, especially if there are dramatic changes in ambient air conditions.