TECHNICAL NEWS

CORTEM GROUP

To be sure to be safe.

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ALUMINIUM IN EXPLOSION-PROOF ELECTRICAL PROTECTION

Aluminium is one of the materials most used worldwide for the construction of explosion-proof enclosures.

The excellent features of corrosion resistance make this material universally recognized as the most valuable and versatile for most applications.

In respect to the cast iron, aluminium has the advantage of being much lighter and, thus, facilitate both the assembly and the maintenance of the system. Furthermore, it has a excellent corrosion resistance without the need to be protected on the surface, as happens with the cast iron which must be galvanized and varnished protected.

Furthermore, in respect to the stainless steels, it has lower cost.

The mechanical properties of aluminium alloys castings are highly satisfactory for use in the field of explosion-proof electrical protection.

MECHANICAL PROPERTIES OF ALUMINIUM ALLOYS CASTINGS				
Forming Technologies	**Tensile stretch R Kg/mm^2**	**Load at yield point S Kg/mm^2**	**Longation A5 %**	**Brinell hardness Hd Kg/mm^2**
Sand	17 - 20	8 - 10	4 - 8	50 - 60
Chill	18 - 22	9 - 11	5 - 7	50 - 70
Die-casting	23 - 27	13 - 17	1,5 - 2,5	75 - 95
Low pressure	23 - 27	13 - 17	5 - 7	50 - 70

In the past, about twenty-thirty years ago, there was a widespread belief among users that aluminium was not suitable for applications in areas with highly corrosive atmospheres, such as plants in the sea or off-shore, chemical plants with presence of strong acids.

This, in that time, was not entirely wrong, because cases of corrosion occurred in environment like that. This phenomenon was caused by the incorrect use of some aluminium alloys.

We commonly use the misnomer of aluminium, but it's more correct to speak of aluminium alloys, since the aluminium used for the casting is always linked to other compounds which enhance certain characteristics.

Aluminium-Copper alloys are normally used in the automotive industry to produce parts of engines. In this case, the protection against corrosion is not important because the motor is constantly covered with oils. Therefore, the Aluminium-Copper alloys are certainly suitable for their mechanical characteristics and for the easy machining.

The first explosion-proof enclosures were manufactured precisely with these alloys which have the disadvantage of not being completely resistant to corrosion.

Today, extensive studies verified that the alloy copper content causes the corrosion because of the presence of an electrolyte.

The alloys with improved anti-corrosion features are the Aluminium-Magnesium ones. These are the most

commonly used alloys for the components of ships. These alloys, however, can not be used for the construction of flameproof enclosures or of any component that is used in areas with potentially explosive atmospheres.

In fact, the aluminium magnesium alloys may cause sparks when rubbed with metal tools. As you may know, magnesium is a highly flammable metal and its presence in the alloy is not accettable in explosion-proof atmospheres.

The European standard EN 60079-0 admits aluminium alloys with a magnesium content up to 6%.

Aluminium alloys currently used by most manufacturers are the Aluminium-Silicon ones, with a percentage of Silicon which varies, depending on the forming technology, from 5% up to 13%.

Copper is present only as an impurity and the primary alloys used contain copper to a maximum of 0.05% in ingods and 0.1% in the casting. Such alloys ensure perfect protection against corrosion in any environment.

In the past were used alloys with copper content from 0.3% upwardly, then, in the best condition, with a quantity of copper six times higher than today.

The corrosion resistance

The corrosion resistance is a relative factor, as it's necessary to consider the environmental conditions that affect the nature of the attack.

Aluminium and its alloys have generally excellent corrosion resistance in various and different environments.

Despite of it's a very chemically active metal, its behavior is stabilized by the formation of a protective oxide film on its surface. This film, which in case of breakage is able to reproduce itself immediately, has a thickness, if formed in the air, ranging from 50 to 100 Å.

In case of use in more aggressive atmospheres, or when improved with artificial growth processes (anodization), the film becomes thicker.

This oxide film is transparent, hard, adherent to the surface and not leafed. Accidental abrasion of the surface of the film are automatically repaired. Therefore, the conditions that cause corrosion of aluminium and its alloys are those that mechanically abrade the protective film or that favor chemical conditions that degrade it and minimize the availability of oxygen for its reconstruction.

In general, the protective oxide film is stable in aqueous solutions with Ph between 4.5 and 8.5, and it's not attacked by acids and alkaline solutions, such as, for example, nitric acid, acetic acid, silicate sodium, ammonium hydroxide.

As for other metals, the corrosion phenomena are related to the passage of current between the anodic and cathodic areas, then the potential difference of the different areas. In this regard, it should be noted that the size and the morphology of the corrosive phenomena are related to many factors, including the composition of micronutrients, their localization and their quantity.

The improved corrosion resistance is achieved by the pure aluminium, but silicon alloys are also highly resistant to corrosion in marine environments or in the presence of strongly acidic or strongly basic vapors which normally caractherized hazardous areas, where explosion-proof enclosures are normally installed.