

## PICKLING, AN EXCELLENT SURFACE TREATMENT FOR ALUMINIUM

### Introduction

In comparison with other frequently applied materials such as iron, copper, tin and gold, the use of aluminium is still relatively new, historically speaking. In the meanwhile aluminium has become indispensable as a construction material, in particular because of the combination of favourable qualities such as its light weight, its strength and a high corrosion resistance.

### Passivation and corrosion

Aluminium is a base metal that spontaneously oxidizes when it comes into contact with oxygen from the air. Hereby the aluminium is covered with an oxide skin of aluminium oxide. This natural oxide skin can protect the underlying aluminium, under non-burdening conditions, against corrosion. This process of natural oxidation and the formation of a corrosion-protective oxide skin is called passivating.



*Aluminium pipe system*

However, the natural oxide layer is very thin and vulnerable. Damage to the natural oxide skin reduces the corrosion resistance, because there is no entirely closed oxide skin on the metal. In addition, all types of contaminations may attach to the surface as a result of damage and create inclusions in the oxide skin. Contaminations in the oxide skin may, certainly in a humid environment, initiate corrosion, whereby a white precipitation of aluminium oxides may develop on the aluminium surface. Corrosion processes may often spread invisibly under the skin with aluminium. If there is no or an incomplete passivation, aluminium is insufficiently protected against corrosion.

### Pickling process

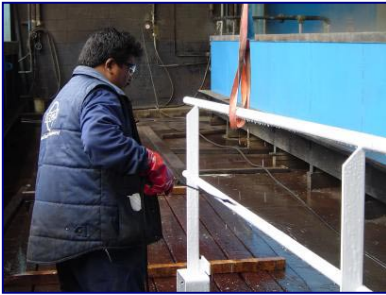
In many cases aluminium is pickled to clean the surface and realise a complete passivation. However, there are also other reasons for the surface treatment of aluminium. Aesthetic reasons may be the removal of welding discolouring and obtaining a uniform exterior. A pickling treatment is also carried out to prepare the aluminium for applying a conversion layer. It is of the greatest importance to have an entirely clean oxide skin before applying a conversion layer, chromating or gluing. After all, contaminations on the surface reduce the bond between the aluminium and the conversion layer and may initiate corrosion. After the pickling process demineralised water is used for rinsing in order to minimise contamination of the oxide skin and for an optimum passivation.



Summarising, when treating aluminium by degreasing, pickling, rinsing and oxidation by contact with oxygen from the air:

- 1) contaminations such as grease, oil and atmospheric contaminations are removed (ultra clean);
- 2) welding discolouring is removed;
- 3) aluminium is passivated and made suitable to be processed and applied, also without a conversion layer;
- 4) the surface is made suitable for applying a conversion layer;
- 5) a smooth, matt or semi-matt surface is obtained.

How does the pickling process work? Aluminium is an amphoteric metal, that is to say, the metal dissolves in an acid as well as in an alkaline environment. The pickling process can be carried out through immersion, circulation (pipe systems), spraying (incl. tanks) or pasting (local).



*Spray pickling and high-pressure rinsing of aluminium handrails*

### **Alkaline pickling**

Alkaline cleaners are subdivided according to etching and hardly etching or non-etching cleaners. A higher caustic concentration and a higher temperature accelerate the pickling process, but as a result the pickled surface also becomes rougher. Strongly corroding cleaners, usually on the basis of caustic soda, are applied if there is a thick oxide skin, or if much degreasing has to be done. This is a very fast pickling process, whereby the exterior soon becomes matt. Hardly corroding or non-corroding cleaners based on silicates and carbonates are used if there are only small amounts of grease or oil on the aluminium surface.

### **Acid pickling**

*Pickling process on the basis of nitric acid:* 1. A limitation of alkaline pickling is that sometimes a grey or black scale may develop with certain aluminium alloys that contain copper or zinc, which is difficult to wash off. In order to remove this formed scale, these alloys are subsequently immersed in nitric acid.

2. Aluminium is only slightly corroded by nitric acid. As a result it is possible to pickle some hours at the ambient temperature, if the concentration of nitric acid is not too high. The great advantage of this process is that, for example, a pipe system can be cleaned in circulation.

*Pickling process on the basis of nitric acid- hydrofluoric acid:* this is a very fast smoothing pickling process that creates a fine smooth matt effect. This pickling process is usually carried out at the ambient temperature in 5-15 minutes. Also when the aluminium contains silicon as an alloy element, this is the appropriate pickling method.

*Pickling process on the basis of phosphoric acid:* this pickling agent is only effective if the present oxide skin is very thin. Thicker oxide layers make it necessary to add fluoride to the phosphoric acid solution. When pickling in phosphoric acid, a phosphate layer is formed that may function as a substrate for a lacquer or paint layer. The phosphate layer is a conversion layer with improved bond qualities.

In the nuclear energy sector and pharmacy the cleaning, pickling and passivating of aluminium has to comply with strict requirements. Vecom can fully comply with the requirements that it has to meet.



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