AlZnSi Alloy (Galvalume)

Standard size:
The Zinc coating is a common metallic coating for corrosion protection of steel, which provides a very good combination of galvanic and barrier protection. However, in order to get a longer product life, alloy has been developed commercially known as Galvalume alloy (AlZnSi alloy) which is used in coating of steel just like Zinc. It has been successfully received the market place, especially for metal building roofing. The Galvalume alloy comprised of approximately 55% Al, 43% Zn, and 1.5% Si. Minex produces the AlZnSi alloy (Galvalume) with a special technique to meet the stringent requirement of exact chemical composition and homogeneity, uniform coating and less dross generation during remelting alloy in coating process.

Chemical Composition:

<table>
<thead>
<tr>
<th>Alloy Grade</th>
<th>Chemical Composition (%)</th>
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<tbody>
<tr>
<td></td>
<td>Al</td>
</tr>
<tr>
<td>Galvalume</td>
<td>55 - 58</td>
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Physical properties:

<table>
<thead>
<tr>
<th>Alloy Grade</th>
<th>Density (gm/cc)</th>
<th>Melting point (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Galvalume</td>
<td>3.75</td>
<td>580 – 600</td>
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Advantages and Effects:
Although the corrosion performance is mostly related to Al – Zn alloy, the inclusion is approximately 1.5% Si is vital. The primary purpose for addition silicon is to minimize the growth of the brittle intermetallic layer that forms when steel is zinc-coated using the Hot-Dip-Process. Without Silicon the Galvalume coated steel could not be made using hot – dip – process. In the hot dip galvanized sheet, it is very important to achieve good adhesion of the coating during eventual forming operation by customer; however the intermetallic layer is hard and brittle. It is important therefore, for the alloy layer to be kept as thin as possible (as shown in figure1 microstructure of AlZnSi coated steel). This is the role of Silicon here which restricts the growth of layer. The Advantages of using AlZnSi alloy (Galvalume) in coating is given bellow:

**Coating Thickness Advantage In Al-Zn-Si Alloy Material**
Density of Al-Zn-Si Alloy is 3.75 gms/cm3, and the density of galvanized metal is 7.14 gms/cm3. Due to this density difference, Al-Zn-Si Alloy coating mass gives higher coating in microns as compared to the same coating mass in Galvanized product. Al-Zn-Si Alloy coating gives 52.5% more coating thickness than galvanized coating.

**Al-Zn-Si Alloy Microstructure**
Al-Zn-Si Alloy coating has unique micro-structure consisting of 2 layers i.e. an Al-Zn overlay coating and a Fe containing intermetallic /alloy layer. Alloy layer forms at the interface between the coating and steel substrate (as shown in Figure 1). Due to this, Al-Zn-Si Alloy combines the Galvanic corrosion protection of Zn with the barrier protection of Aluminum as compared to only Galvanic protection in galvanized metal.
Al-Zn-Si Alloy Corrosion Resistance Mechanism
In case of Corrosive environmental conditions, the Zn rich interdendritic portion of the coating corrodes preferentially. As this occurs, Zn being sacrificial to steel serves to galvantically protect the steel substrate. As the Zn portion of the coating is gradually corroded, the interdendritic interstices are filled with Zn corrosion products. The coating is transformed into a composite comprised of an Aluminium rich matrix locking Zn corrosion products to offer a physical barrier and act as corrosion inhibitors.

Superior Heat Reflectivity
Presence of Al phase, bright surface and fine spangles- enhances superior heat reflectivity. This results into ideal cool roof for hot climates- resulting into cooler buildings/reduced air conditioning costs. Al-Zn-Si Alloy has excellent heat reflectivity, up to operating temperatures of about 315°C (600°F). This heat reflectivity makes a building cooler inside on hot, sunny days.

High Temperature Performance
Al-Zn-Si Alloy steel resists intermediate and high temperatures far more effectively than galvanized steel. Specifically, Al-Zn-Si Alloy steel shows no discoloration up to 315°C (600°F) during continuous or intermittent exposure over a prolonged period. Above this temperature, some discoloration does occur and roughening of the surface is possible. Neither this discoloration nor roughening reduces Al-Zn-Si Alloy resistance to rust. Al-Zn-Si Alloy maintains its rust-resistance up to 675°C (1250°F).

Superior Abrasion Resistance
Al-Zn-Si Alloy is twice as hard as Zinc coating. Measurement in Vickers hardness in the coating:- Al-Zn-Si Alloy Coating hardness is 140 Hv 0.5 Kg; Zinc Coating hardness is 70 Hv 0.5 Kg

Excellent Improved Formability
Al-Zn-Si Alloy in acrylic coated condition results in built – in roll forming lubricant. This has ability to suppress galling on the metallic coating during cold profiling/forming thus giving improved roll forming without the use of supplemental lubricants. This results in less roll form build up, less damage to coating and minimum pick up on rolls. This improves resistance to hand & finger marking, improves resistance to differential darkening & finally higher quality appearance.

Excellent Salt Spray Life
Salt spray laboratory results as per ASTM-B-117 gives more than 1000 HRS (in acrylic coated) for white rust corrosion resistance as compared to 72 HRS corrosion resistance in chromated Galvanized material.

While zinc coated steel becomes dark grey during ageing, Al-Zn-Si Alloy ages very well and virtually remains same because of its main ingredient Aluminium which forms fine surface layer of invisible oxide and maintains a pleasing appearance with distinctive white metallic sparkle.

Remelting Operation of AlZnSi Alloy:
Different steel industry has different practice to remelt the AlZnSi alloy. But in general practice (Galvalume) ingot is remelted in a resistance furnace (called premelt bath), temperature is maintained at 630°C. After the melting of alloy, the melt is transferred to coating bath though the launder by inserting ingot into premelt bath as shown in figure. When the ingot is inserted in premelt bath filled with liquid metal, due to buoyancy liquid is raised up and goes into coating bath through launder.