Application of Hot Dip Zn-Al-Mg Alloy Coatings to steel structures

KOWA KOGYOSHO CO., LTD.
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We have met the needs of our customers since the establishment of a company in 1947 by use of surface treatment (mainly on hot dip galvanizing), metalwork technology. As a metal general processing company, many customers give trust to me now.

An introduction about the Al–Zn–Mg alloy coating "SG mekki" which we made the corrosion resistance for conventional hot dip galvanizing that was in use in us.

The head office: Nagoya-city, Aichi, Japan
Japan: 11 factories, Oversea: 2 factories
The necessity of new coating

Hot dip galvanizing

inexpensive and superior antirust effects

In 1960s
The period of rapid economic growth

Galvanized various steel structures

The effects were not provided in the salt damage area

The necessity of coating having a high corrosion resistance

Corrosion resistance improves when aluminum is added in zinc

It was already commercialized in the field of the coating steel sheet in 1970s. Nobody can see it in the field of general hot dip galvanizing.

About 1980
Started to develop this technology for commercializing.
Establishment of the method of SG mekki

«General hot dip galvanizing»

- Oil stripping
- Etching
- Flux
- Hot dip galvanizing

Al is added to melted zinc
Concentration of aluminum is about 0.05%
Non-coating and un-stabilized coating thickness

Can’t galvanize
SG mekki
High concentration of aluminum

Prepare two galvanizing baths

«SG mekki»

- Oil stripping
- Etching
- Flux
- First bath
- Second bath
Process

1st

Hot dip galvanizing
High-purity zinc (over 99.995%)
Operation temperature: 440~460°C

2nd

SG mekki
5%Al-1%Mg-Zn
Operation temperature: 430~440°C

Pretreatment

Cooling
Decided problems (1)

- Alloy galvanized tool

Use alloy galvanized tool...

Non-coating by the increase of concentration of Al

Can’t use tools time after time.

Take the alloy coating away by acid

Acid does not use

Pay attention to needs of economic and recycle.

Already put the recycling facilities to practical use
Recycle zinc from acid and acid after the zinc collection
Decided problems (2)

- Frequent change
- Danger of the created hole
- Dross

Not use steel kettle but ceramic-bath

Trouble-free
- Frequent change
- Danger of the created hole
- Dross

Use a ceramic-bath made by Sanken Sangyo Co., Ltd.
Decided problems (3)

Control of concentration
- Concentration of aluminum and magnesium were not stable. Floating dross and poor coating appearance was occurred.
  - Selection of supply metals
  - Constructed supplying method

Galvanized bolts
- Bad fitting because zinc put on the screw of bolt.
  - Use a centrifugal machine
  - The bolts on line one by one

Galvanizing for the steel casts
- Galvanize the steel casts difficult
- More difficult by using high quality zinc
  - Adding process of shot-blast to pretreatment
Strong points

SG mekki has higher corrosion resistance than the usual hot dip galvanizing.

- Improvement of corrosion resistance
  - High corrosion resistance at severe corrosive environments.
  - The corrosion rate of SG mekki is more than 10 times that of a coating of the same thickness produced by the usual hot dip galvanizing as a result of salt spray test.

- Good for Environment
  - Containing little impurities (ex. Pb,Cd).
  - Conforming to the compliance of restriction on use of certain hazardous substances.
### Corrosion resistance (1)

<table>
<thead>
<tr>
<th>Red Rust</th>
<th>Hot dip galvanizing</th>
<th>Salt Spray Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>550g/m²</td>
<td><img src="image1" alt="500Hr" /></td>
<td><img src="image2" alt="500Hr" /></td>
</tr>
<tr>
<td>testing time</td>
<td>500Hr</td>
<td>1,000Hr</td>
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<tr>
<td><img src="image3" alt="500Hr" /></td>
<td><img src="image4" alt="500Hr" /></td>
<td><img src="image5" alt="500Hr" /></td>
</tr>
<tr>
<td>SG mekki</td>
<td><img src="image9" alt="500Hr" /></td>
<td><img src="image10" alt="500Hr" /></td>
</tr>
<tr>
<td>350g/m²</td>
<td><img src="image15" alt="500Hr" /></td>
<td><img src="image16" alt="500Hr" /></td>
</tr>
</tbody>
</table>

No Red Rust
Corrosion resistance (2)

Atmospheric corrosion test
(Evaluation by corrosion loss)

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Construction

SG mekki is based on "Fe-Zn alloy layer" of 1st galvanizing. Get coating thickness thicker than continuous coating sheets.

Component distribution of SG mekki

Concentration of Aluminum is higher toward Iron (steel materials).
Good for Environment

- The first bath  Use high quality zinc
- The second bath Adding Al, Mg to high quality zinc

Table  Materials of high quality zinc  (JIS H 2107)

<table>
<thead>
<tr>
<th>chemical ingredient (%)</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Zn</td>
<td>Pb</td>
<td>Fe</td>
<td>Cd</td>
<td>Sn</td>
<td>Cu</td>
<td>Al</td>
<td></td>
</tr>
<tr>
<td>≥99.995</td>
<td>≤0.003</td>
<td>≤0.002</td>
<td>≤0.002</td>
<td>≤0.001</td>
<td>≤0.001</td>
<td>≤0.001</td>
<td></td>
</tr>
</tbody>
</table>

《 Materials of coating of SG mekki 》

<table>
<thead>
<tr>
<th>chemical ingredient (%)</th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Al</td>
<td>Mg</td>
<td>Fe</td>
<td>Pb</td>
<td>Cd</td>
<td>Zn</td>
<td></td>
</tr>
<tr>
<td>11.6</td>
<td>0.93</td>
<td>4.61</td>
<td>0.002</td>
<td>&lt;0.001</td>
<td>82.5</td>
<td></td>
</tr>
</tbody>
</table>

Containing little Pb, Cd restricted in using.
Adoption cases

《Products of SG mekki are mainly used under corrosive environment.》
Coast (1)

Grating

Communications steel tower
Coast (2)

At the fishing harbor

Grating

Windbreak fence
On the sea

The catwalk

The Bridge shoe
Road

Handrail • Guardrail
Railway

The catwalk

The steel pole
Airport

The fence

The tower of obstruction lights
Solar power station

The frame

The steel pile
Wind power station

Bridge
Power station, Steelworks

Duct

Tubes

Radio station tower
Electric components

Bolts, nuts and small parts
In recent years, "steels" from corrosion has been a concern with economy and decrease of CO2. An important theme for the future is to protect "steels" from corrosion and to do so while being concerned with economy and decrease of CO2. "SG mekki" (Zn-Al-Mg alloy galvanizing) is a technic that can realize this theme. It has established the possibility of technic of Zn-Al-Mg alloy coatings for the general steel structures and succeeded in commercialization. It has caught attention in places where corrosion resistance is important in maintenance and is used in hard corrosion areas as a new surface treatment that changes over hot dip galvanizing. In the field of continuous coating sheets, Zn-Al-Mg alloy coating sheets are commercialized. This technic can protect "steels" from corrosion and realize the theme of economy and decrease of CO2. Therefore, "SG mekki" can be an important theme for the future.
The equipments

**Minato-nishi plant**
- Production capacity: 3000 ton/month
- Bath size: 8m(L) × 2.2m(W) × 2.5m(D)

**Nagoya plant**
- Production capacity: 500 ton/month
- Bath size: 3.3m(L) × 0.8m(W) × 1.2m(D)
- Others: centrifugal separator