

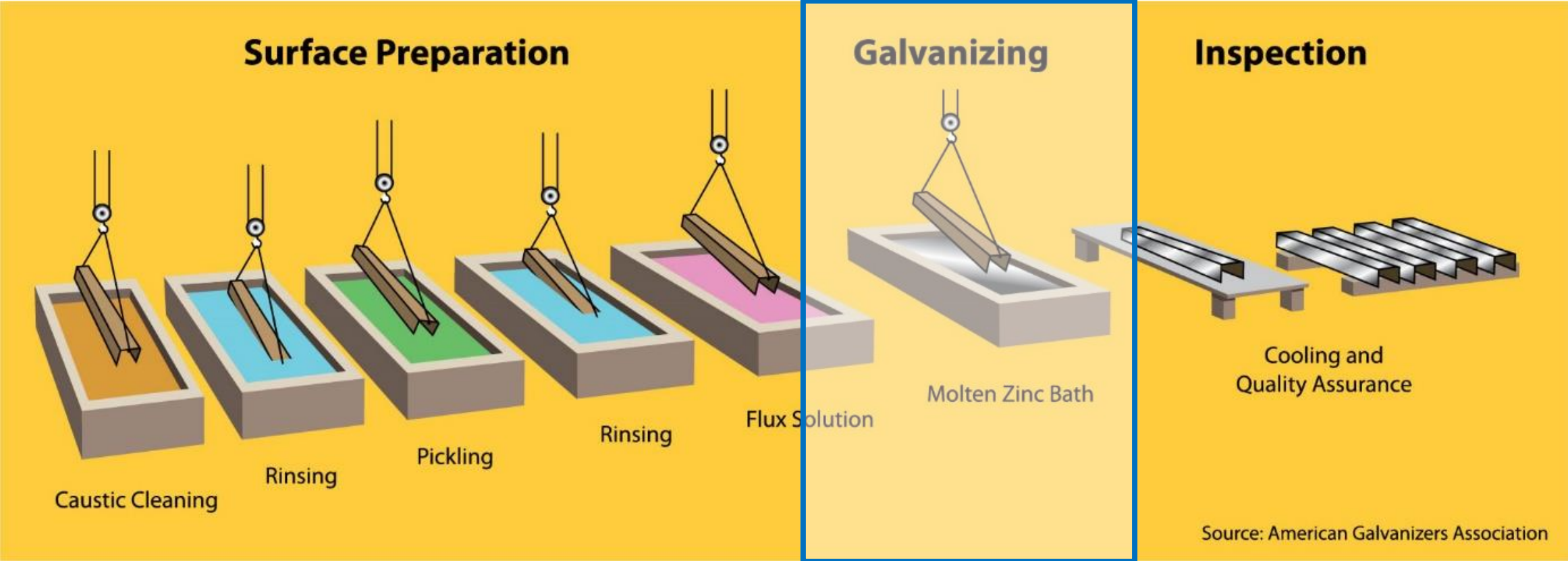


## HDG Process – Best Practices and Advantages of using Alloys

**nexa**

- **Adoption of the best practices** in order to be competitive in the market and maximize the customer satisfaction;
- **Alloys development** aiming the zinc saving and better surface quality;
- **Effects of elements** Al, Ni, Bi in the molten zinc baths.





## Objective:

- To form a continuous and adherent coating that protects the steel against corrosion.
- Quality & Cost

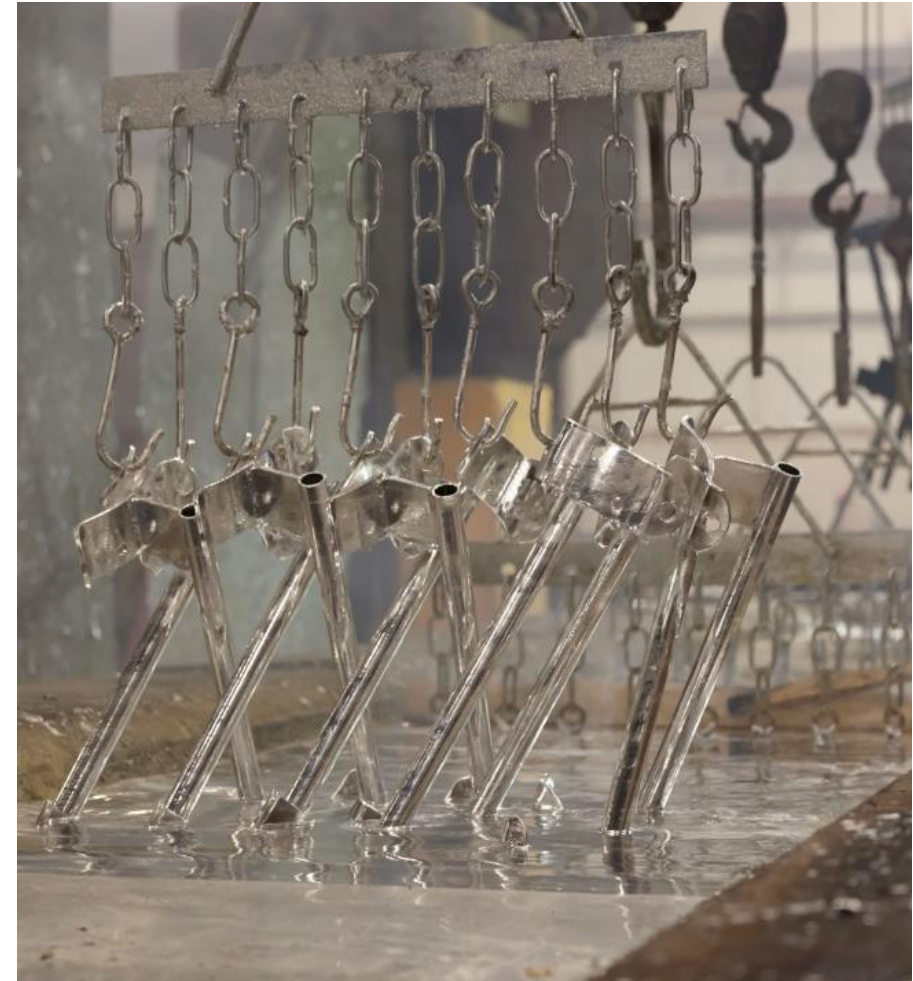
## Remarks:

The coating formed on a particular type of iron or steel depends on:

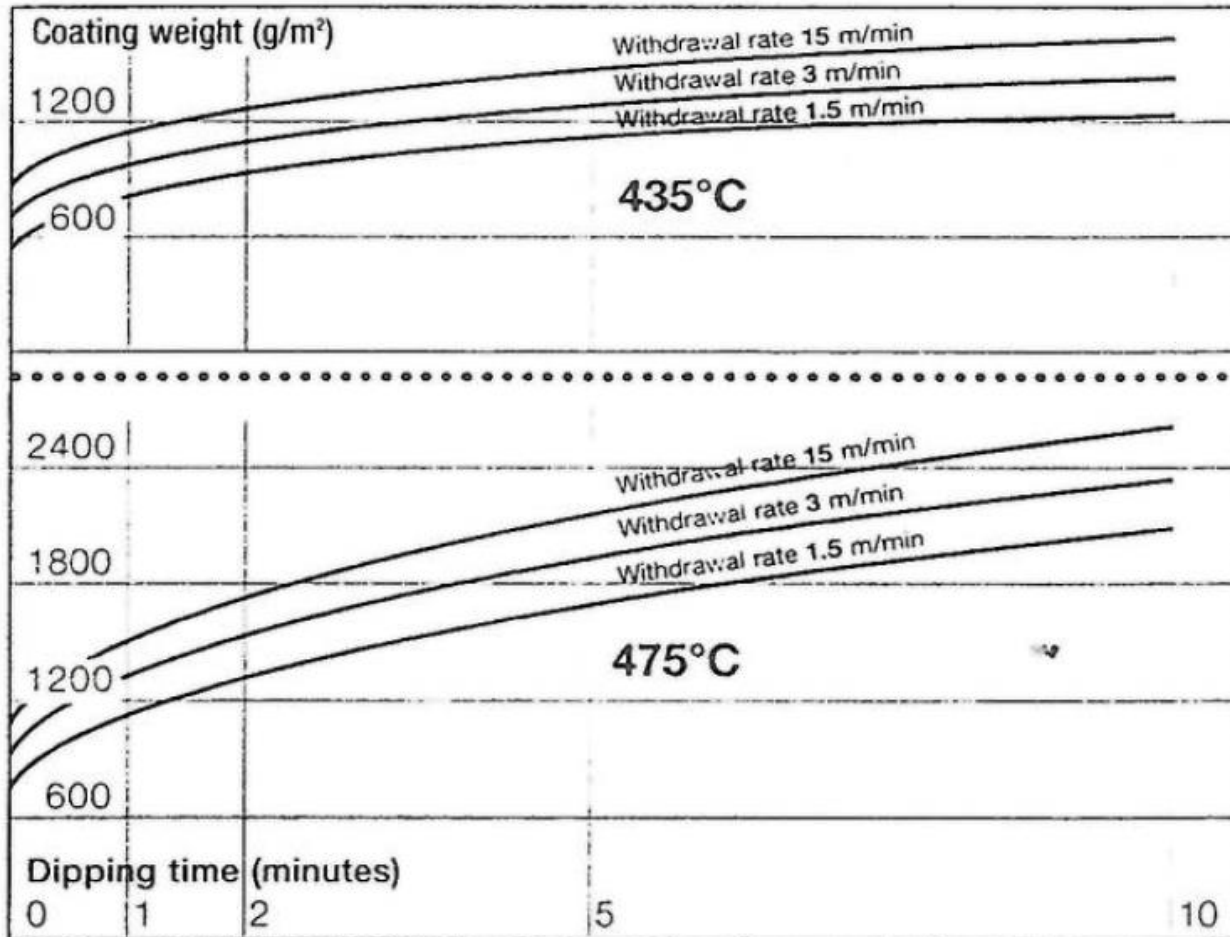
- Quality of the zinc.
- Temperature of the galvanizing bath.
- Time of immersion.
- Rate of withdrawal.

## Temperature of the galvanizing bath

- *Operating Range:* 440 to 460°C
- *Optimum Range:* 448 to 452°C
- *Risks at low temperatures (<440°C):* Low fluidity of the bath, less draining and rougher parts.
- *Risks at high temperatures (> 460°C):* Shorter life of the kettle, increase of dross formation.



## Temperature of the galvanizing bath



### Work at low temperatures:

- Optimizes zinc consumption;
- Minimizes the generation of dross and ash;
- Maximizes the useful life of the kettle.
- Conserves fuel

## Time of Immersion:

- More immersion time = more reaction time between iron and zinc;
- Reducing the immersion time reduces the thickness of the layer;
- To minimize the immersion time is a good practice to wait until finishing the bubbling;

## Rate of immersion:

- Should be as rapidly as possible (operator's safety);
- Influence on the uniformity of the coating;
- Distortion is minimized by rapid immersion.

## What is the dross?



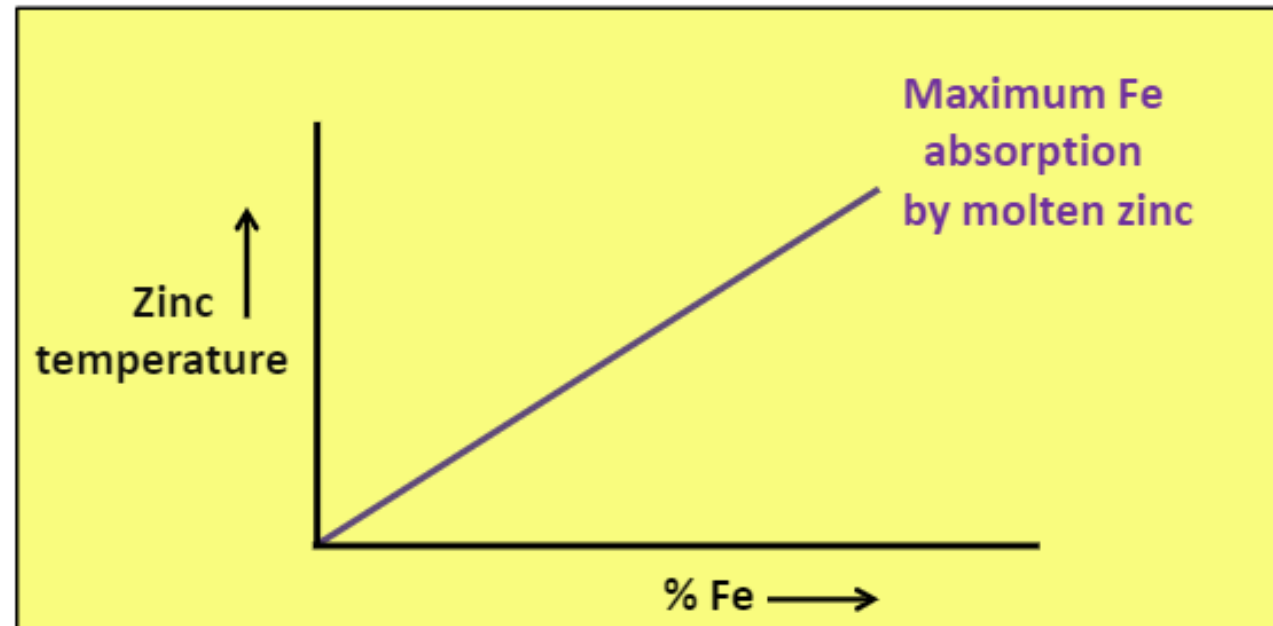
- Fe-Zn crystals insoluble at working temperature;
- Sandy appearance that is deposited in the bottom of the kettle;
- It damages the heating of the kettle (bad conductor of heat);
- Should contain 3% or more of Fe;
- Dross formation is approx. 7-11 % of zinc consumption



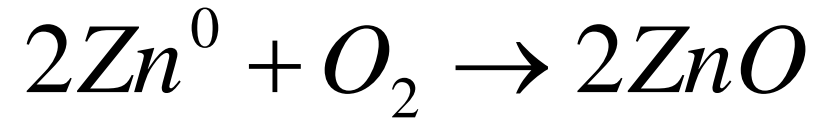


## Reducing Dross:

- Use zinc with very low content of Fe.
- Efficient rinsing of work;
- Maintaining the flux at a low iron content;
- Operating the bath at as low a temperature as possible (Not exceed 465°C);
- Avoiding large changes in bath temperature (+/- 2°C is acceptable);
- Minimize the processing of reactive Steel.



## What is the ash?



- Zinc oxide, metallic Zinc, Aluminum, Chlorides;

Factors that influence:

↑ T → ↑ oxidation

↑ waves → ↑ oxidation

## Reducing Skims:

- Skim slowly – just in front of the material;
- Skim slowly – no waves;
- Use light paddle;
- Do not use NH<sub>4</sub>Cl;
- A vibrator hoist will assist with liquid Zn removal.

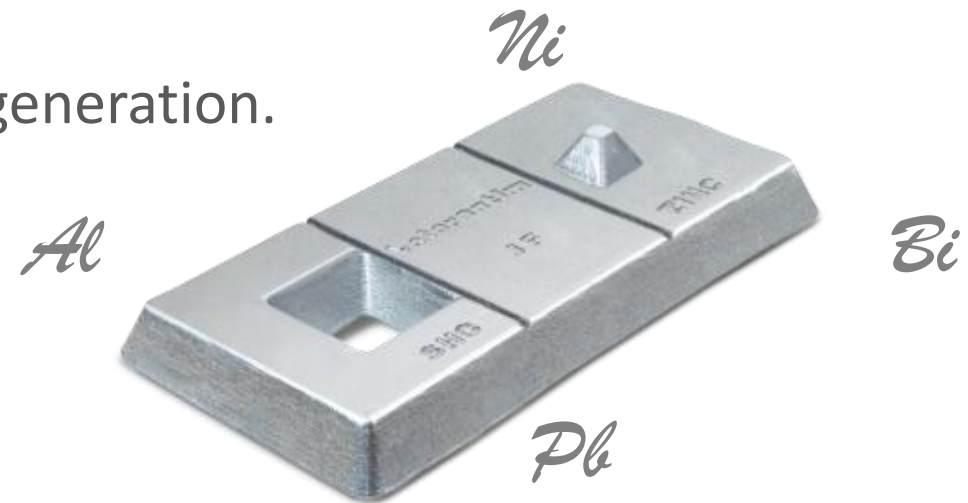


## Typical Consumptions

Product	Consumption	Unit
Zinc	45-60	kg / ton
Product	Generation	Unit
Dross	3-6	kg / ton
Ash	5-10	kg / ton

## Reasons to use alloys in the HDG bath:

- Improve the **quality of the coating** (brightness, spangles);
- Control the **reactivity** of the steel;
- Reduce the **thickness** of the coating;
- Reduce zinc **consumption** and dross/ash generation.



30	13
Zn	Al
Zinco	Alumínio

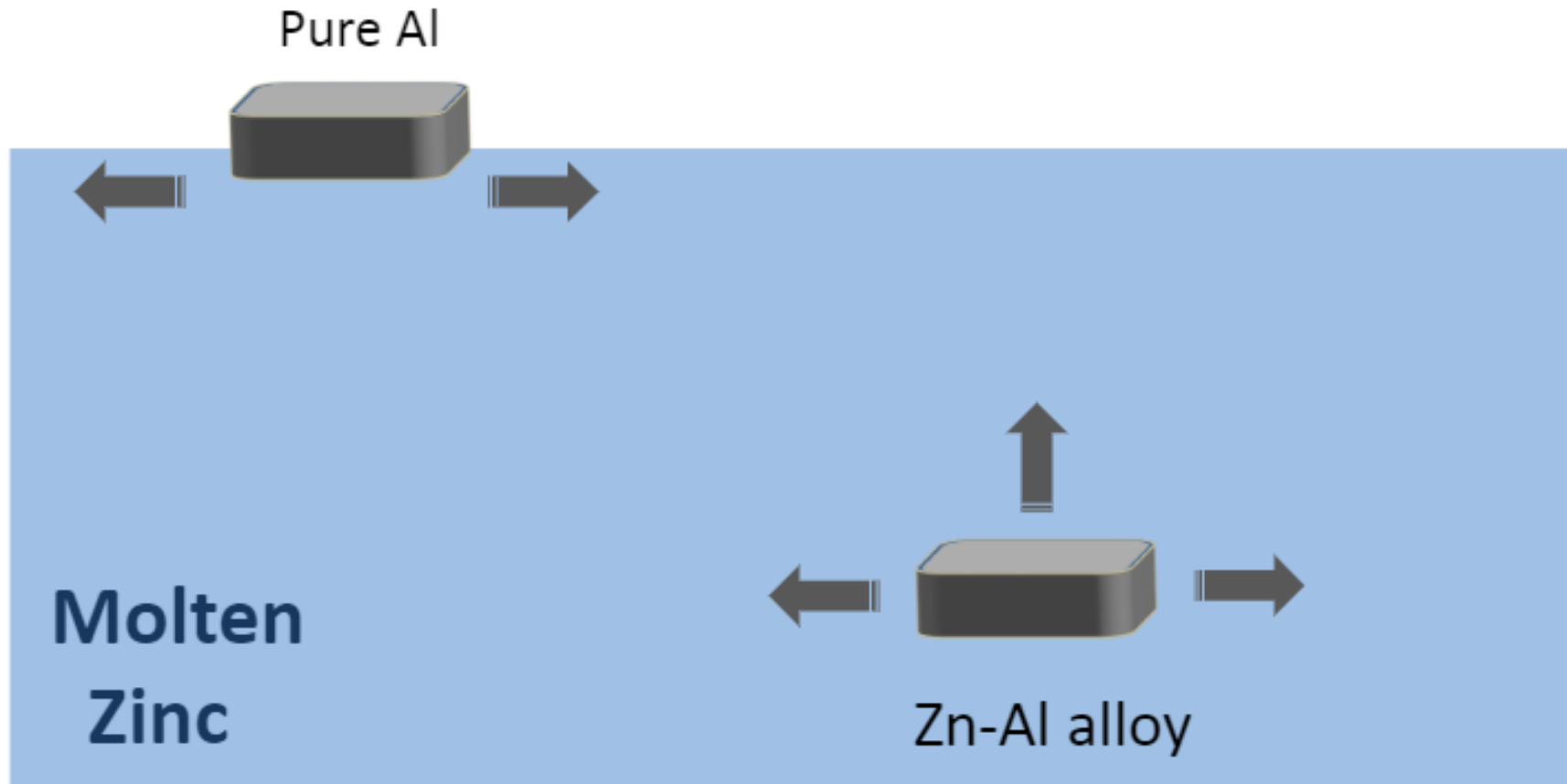
## Aluminum – Zn4E / Zn-Al-5% /Zn-Al-10%

- Used for generating a brighter aspect to galvanized steels;
- It reduces the generation of ashes, because it protects the bath from the oxidation of zinc;
- Optimal content in the bath from 0.005% to 0.009%;
- High contents of Al are not recommended because it can react with the chlorides of the flux and generate black spots in the pieces.



# HDG Process – Advantages of using alloys

30 Zn Zinco	13 Al Alumínio
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30

Zn

Zinco

28

Ni

Níquel

## Níquel – Zn-Ni – 0.5%

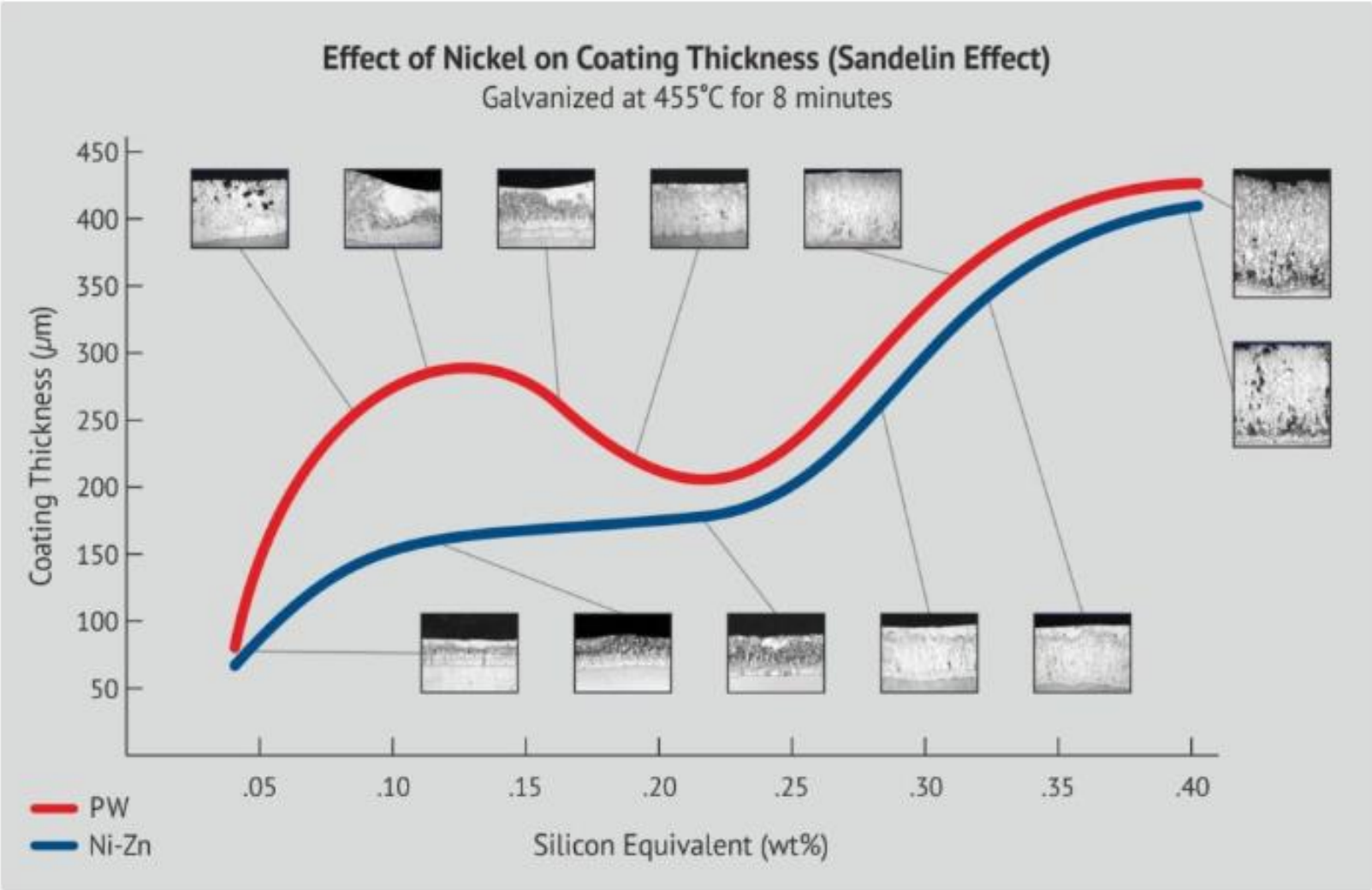
- Used to controls the growth of the metallic phases, main characteristic of the reactive steels (Sandelin effect);
- It is advisable to use when the steel has a Si contents in the range of 0.05 and 0.15% or using the formula  $[Si + 2.5 (P) = \text{position in the Sandelin curve}]$ ;
- Layers with a very high thickness can generate a non-stick coating, flaking the galvanized coating;
- Reduces bath viscosity, improving drainage;
- Recommended content of Ni in the bath: from 0.04% to 0.06%

### Sandelin Effect



30  
Zn  
Zinco

28  
Ni  
Níquel



Effect of Steel Ni and Si content on the thickness of zinc coatings



30

Zn

Zinc

28

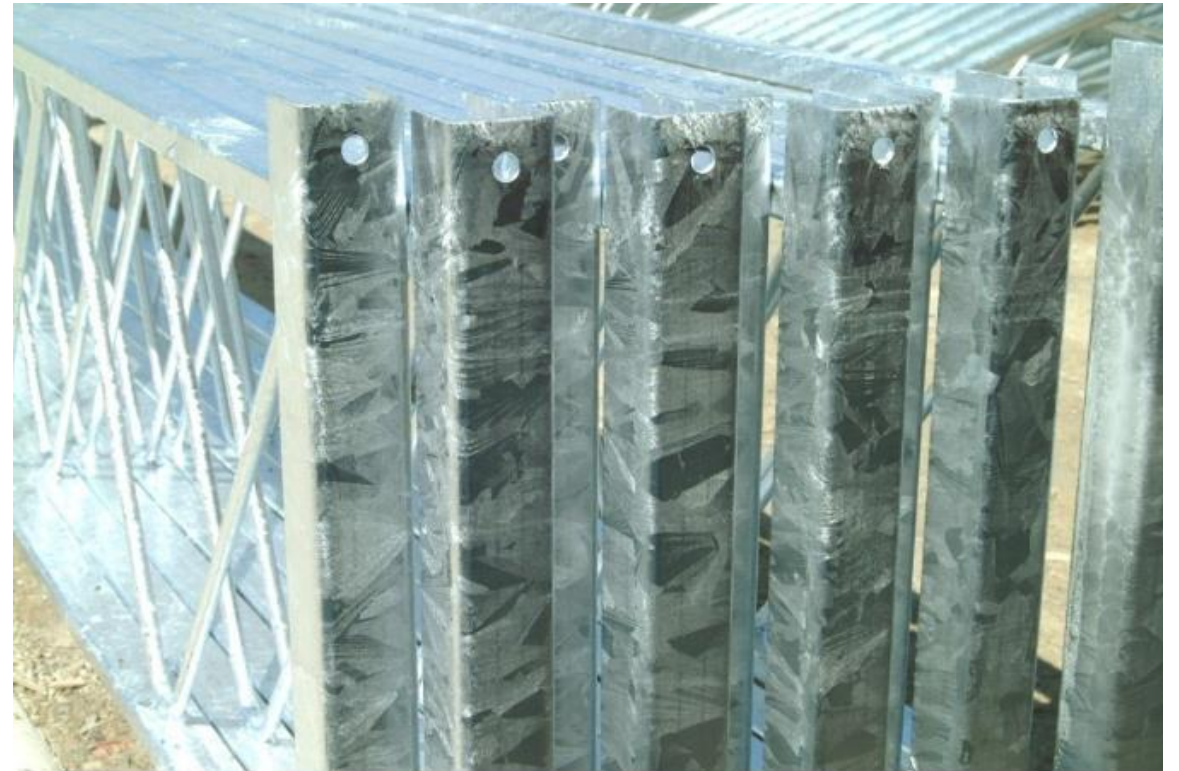
Ni

Níckel

## Zinc - Nickel

- Zinc saving from 5-15 % in weight.
- Increase coating ductility.
- Smoother and brighter surface finish.
- Increase fluidity of the Zn bath.
- Aesthetical coating appearance.

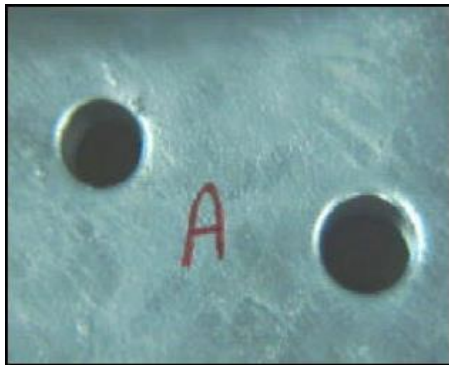
Coating with Nickel



30 Zn Zinco	83 Bi Bismuto
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## Bismuth – Zn-Bi-1%

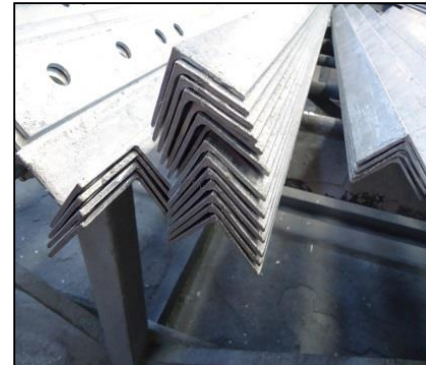
- The Bi has a low surface tension, improving the fluidity of the Zn bath;
- Provides galvanized parts without excess of Zn, in addition to promoting better finishing.
- Reduction of dross generation and zinc consumption (process becomes more economical)
- Bismuth at a concentration 0.1% to 0.5 wt.% has a beneficial effect regarding zinc drainage.
- Bi additions have no effect on the coating structure development nor paintability.



Coating with Bi



Coating without Bi

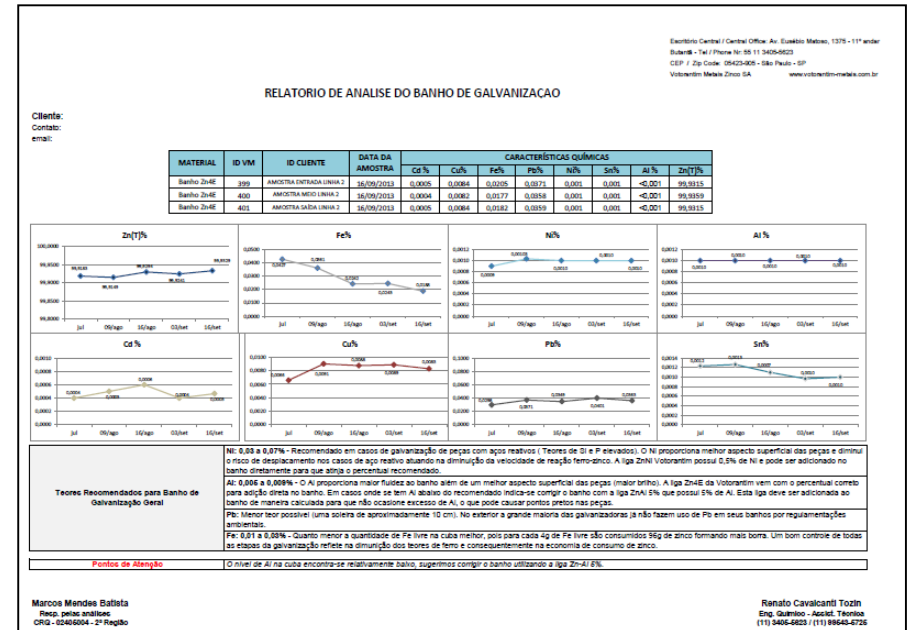
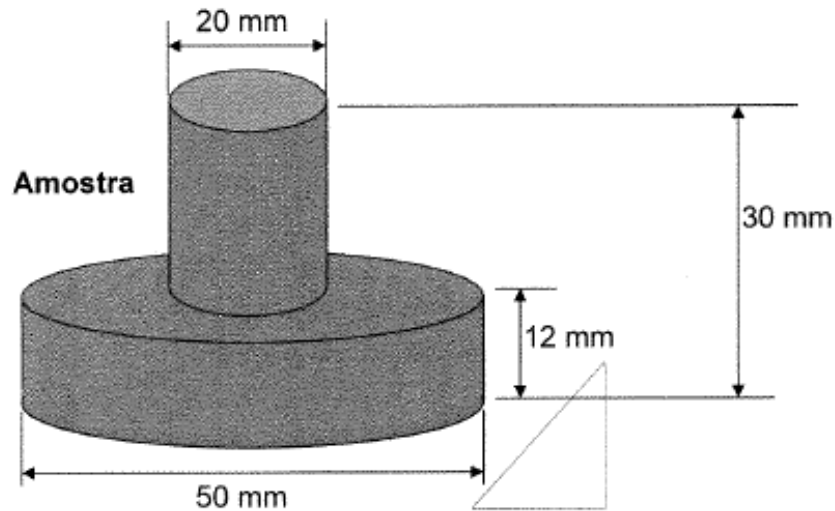


Coating with Bi



Coating without Bi

- **Alloys** Development;
- **HDG bath analysis** and report;
- **Technical Support** for the Process;
- **Kaizen** continuous improvement implementation.





**Thank you!**

**nexa**