



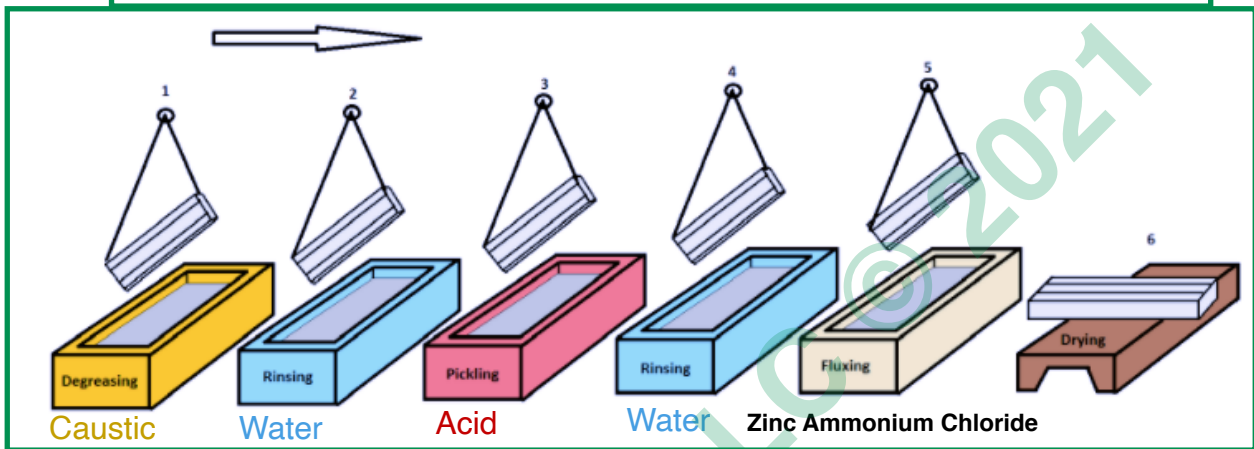
UPSTREAM CONSIDERATIONS:

Both HDG and *ArmorGalv*® use energy to produce the coatings. The Hot Dip Galvanizing tanks are maintained at 450C (840F) at all times to keep the zinc in its molten state whether in production or idle.

ArmorGalv® uses an average temperature of 380C (720F) **ONLY** while in production. No energy is consumed at idle time. This difference is substantial in reducing pollution from the sources of the energy suppliers:

ENERGY USEAGE PER TON OF PRODUCT COATED:

HOT DIP GALVANIZE	700 KILOWATT HOURS
<i>ArmorGalv</i> ®	300 KILOWATT HOURS 57% LESS POWER



1. HOT CAUSTIC DEGREASING

HDG will not coat over oils or grease. These compounds must be removed as a first step. The effluent from this step is hazardous and must be neutralized which produces hazardous waste.



ArmorGalv® is not sensitive to oily parts and generally, the caustic degreasing and the subsequent rinse is NOT required,

2. FRESH WATER RINSING

After **Caustic Degreasing** parts are thoroughly rinsed in fresh water to avoid contaminating the next processing step. The rinsing step uses a substantial amount of water which must be passed through a Waste Treatment department before it can be discharged from the plant.

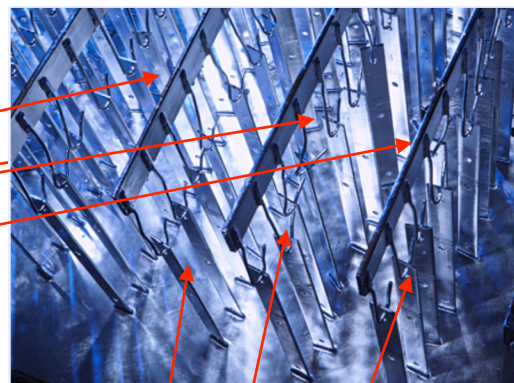
A typical HDG facility with a capability of processing items to 14' in length of product will have rinse tanks containing 2,500 gallons of water. Usually, to maintain the cleanliness of the water, enough fresh water is added during production to replace 50 to 100% of that volume i.e. from 1,250 - 2,500 gallons of water between loads is consumed in this operation.

3. ACID PICKLING

HDG will not coat rusted or oxide rusted parts. The rust is removed with an acid "pickle" mad up of either Hydrochloric or Sulfuric Acid. This step is the source of the following pollution:

- 1. Acid Fumes in the air.**
- 2. Zinc and Lead Metal Waste** - when parts are hung on gantries for dipping into the galvanizing bath, these hangers (fixtures) are subsequently coated with zinc. When new parts are hung from these hangers for processing, the zinc coating on them is dissolved into the pickling acid which is then waste treated and results in hazardous toxic zinc and lead sludge that must disposed of.

Hangers - will be Coated and Stripped in the



Articles for Coating

ArmorGalv® is not sensitive to rusty parts and Acid Pickling with its Attendant Negative Environmental and Embrittling effect is not used.



4. FRESH WATER RINSING

Please see #2 above.

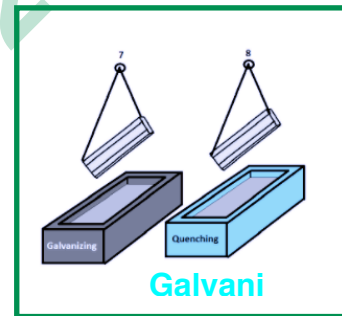
5. FLUXING

This step is a mandatory to assure a proper coating and contains **Zinc Ammonium Chloride**.

“It is believed that the flux creates the bulk of air contaminants from a Galvanizing operation” ¹. For a complete understanding of this please refer to the article below by following the link.

ArmorGalv® does not require this type of process step and causes NO air pollution Emissions.

6. HOT DIPPING



This step applies the zinc coating to the parts. It would appear that this step would be efficient and not result in any pollution or waste of material as molten zinc simply covers the parts.

This is not the case. The two major pollutants from this process are:

1. LEAD:

Lead improves the quality of the HDG coating.

“Lead has a beneficial effect upon the physical properties of the galvanized coating.” ²

The lead in the molten HDG bath will find its way into the air and into the waste stream.

¹ Air Pollution Control Measures for Hot Dip Galvanizing Kettles; Eric E. Lemke , Journal of the Air Pollution Control Ass'n. February 1960, Vol. 10, No 1 Page 70

<https://www.tandfonline.com/doi/pdf/10.1080/00022470.1960.10467904>

² Effect of Lead on Hot Dip Galvanized Steel as Barrier /Sacrificial Coating , Urvesh Vala

<https://core.ac.uk/download/pdf/297713408.pdf>



DiSTeK N.A. LLC

Lead is added to the kettle, to increase work drainage and to facilitate dross settling, is also present in the skimmings waste.³

Another serious issue with the lead is that co-deposits with zinc and causes lead dust in the air when Hot Dip Galvanized parts are to be welded. In order to weld HDG parts, the zinc coating **must** be removed by grinding as Galvanize is **NOT** weldable.

The conclusion of the research is that employees may be experiencing an overexposure during grinding activities on galvanized metal.⁴

The **ArmorGalv**[®] coating is weldable, and does not need to be ground or burnt off prior to welding.

It is because of the health issues associated with lead that the State of California has granted **no** permits to increase production capabilities of existing Hot Dip Galvanizing companies or granted permits for new facilities.

The **ArmorGalv**[®] coating is produced by using a high purity zinc. See chart below.

ArmorGalv[®] is lead free enough that **NSF** has approved it for contact with **Potable Water**.

COMPOSITION
OF ZINC USED
TO **ArmorGalv**[®]

<i>Elements</i>	<i>Method of analysis</i>	Specification	<i>Typical value</i>
Total zinc	Titration	≥ 99.5%	99.6%
Metallic zinc	Titration	≥ 98.0%	98.3%
Pb	AA	≤ 0.003%	0.002%
Cd	AA	≤ 0.003%	0.0001%
Fe	AA	≤ 0.002%	0.001%
Others	AA	≤ 0.001%	Traces

The Kortick Manufacturing Co (Established 1898), a division of The Sicame Group, <https://kortick.com> was issued a permit by the State of California to install an **ArmorGalv**[®] production facility in 2015 and issued a permit to increase its capacity in 2018 in Marin County.

³SKIMMINGS AND DROSS, John Kryzwicki, Thomas Langill PhD, Galvanizing Notes, American Galvanizers Ass'n, Volume 5, Number 1 April 2005. Page 2

⁴ Analysis of Levels of Metal Dust Produced by Galvanized Grinding Activities , Paul T. Schultz, Master's Thesis, University of Wisconsin-Stout 2011

<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.389.6815&rep=rep1&type=pdf>

2. ZINC:

Zinc coated from a molten Hot dip Galvanizing process does form toxic fumes in the air after fluxing.



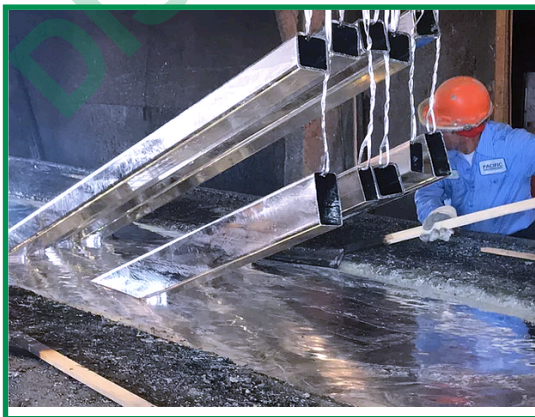
There are two other **MAJOR** source points for zinc pollution in the HDG coating process.

1. SKIMMINGS
2. DROSS

“Galvanizing residues, skimmings and dross, are costly by-products formed in the kettle.”⁵

SKIMMINGS:

“Skimmings are a solid product of zinc oxides and zinc chlorides. A portion of the skimmings are formed from the reaction between the flux coating on the work and the molten zinc during the immersion and “cooking off” stages of galvanizing”⁶



Worker pushing “skimmings” over an 850°F Molten Zinc Bath

⁵ SKIMMINGS AND DROSS, John Kryzwicki, Thomas Langill PhD, Galvanizing Notes, American Galvanizers Ass’n, Volume 5, Number 1 April 2005. Page 1

<https://docplayer.net/59239378-Galvanizing-notes-process-and-design-notes-on-hot-dip-galvanizing.html>

⁶ Ibid; Page 1

2. DROSS

Dross is the product of multiple reactions between iron and zinc. Most of the dross is formed during immersion when iron in the flux layer reacts with the zinc. Generally dross particles form and settle to the bottom of the kettle resulting in dross build-up, which requires frequent removal. Small dross particles can become incorporated into the coating. This usually occurs when bottom dross is stirred up. The affected product is often described by consumers as looking like it has been “rolled in sand.”⁷

Solid residues that are formed during the galvanizing process contain large amounts of free zinc. The main by-products, skimmings and dross, can consume 14 and 15% of zinc, respectively. These residues can cause undesirable coatings on the steel that can hinder appearance and corrosion protection.⁸

HDG inherently **wastes 30% of the zinc of the zinc input** to the process. About **another 5 - 7% is wasted** when the zinc that is deposited in the hangers and fixtures used to hold products while being Hot Dip Galvanized is stripped off during the Acid Pickle step of the process. **A 35% waste of resources cannot be considered “sustainable”.**

The **ArmorGalv®** process utilizes 95% of the Zinc Input, making it MUCH more sustainable than HDG.

The skimming/dross formation is not only wasteful, but can negatively affect the coating quality. HDG is, in effect, a “**Self Poisoning**” coating system that must employ continual safeguards and control procedures to guaranty consistent quality.

Each batch of parts coated in the ArmorGalv® is processed with fresh unadulterated zinc powder which does guaranty the highest consistent quality Batch after Batch

Because of the attributes of the **ArmorGalv®**, The **US EPA** awarded it the coveted **MVP2 (Most Valuable Pollution Prevention) Award** in 2006. It was awarded based on a study performed by the **US EPA** on an **ArmorGalv®** working installation.

For a complete copy of the report:

Approaching Zero Discharge : in plant evaluation of zinc thermal diffusion coating technology, Phase 1 by David Ferguson please go to:

<http://www.armorgalv.com/downloads> and scroll down to: **EPA study on TDG.**

⁷ Ibid;

⁸ Ibid; Page 8.

SOME EXTRAS

We have discussed the superior environmental, health and performance aspects of the **ArmorGalv®** process versus HDG. It has been demonstrated that **ArmorGalv®** requires less energy, produces less toxic waste and is less hazardous to worker safety on an equivalent basis.

Consider This:

ArmorGalv® can be applied at **ONE HALF** the thickness of HDG while achieving superior results.

All the existing specifications for heavy zinc coatings are based on the performance levels of HDG.

Shown below is a comparison of B-117 NSS of 0.001" deposit of **ArmorGalv®** versus a 0.002" deposit of HDG at 1048 hours. The **ArmorGalv®** coating will achieve 3,000 - 5,000 hours of protection at HALF the thickness of HDG - that's "SUSTAINABILITY".



WORKER AND PLANT SAFETY:

This can NEVER happen with **ArmorGalv®**:



ArmorGalv® : Where Environmental and Corrosion Protection Intersect™