2019 GALVANIZING PROCESS SURVEY

American Galvanizers Association

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INTRODUCTION

The American Galvanizers Association (AGA) conducted Galvanizing Process Surveys in 1998, 2003, 2007, and 2019. The 2019 Process Survey Report includes the results from 2019 survey questions, and (where applicable) a historical trend analysis comparing 2019 data to previous years. The Process Survey Report is a tool that galvanizers can use to compare their performance to the galvanizing industry as a whole. From these comparisons, galvanizers can identify areas where they are lagging and areas where they are excelling.

The Galvanizing Process Survey is comprised of categories: plant productivity, degreasing, pickling, fluxing, galvanizing kettle, zinc consumption, and misc./other plant equipment. ***Generally, the y-axis (vertical axis) of each graph is the percentage of respondents that supplied a particular answer***. In some cases the overall percentage may be slightly higher or lower than 100 percent due to rounding.

The AGA created the 2019 Process Survey to help you, the galvanizer, understand where the galvanizing industry has been and where it is headed. If you have questions about this information, or would like to see more categories added to future surveys, please send an email to technical@galvanizeit.org.

EXECUTIVE SUMMARY

The AGA previously conducted Process Surveys in 1998, 2003, 2007, and the most recent survey was conducted in 2019. The survey consists of general questions about the overall galvanizing operation, the cleaning processes, and the galvanizing kettle. The survey results have been compiled into bar charts and graphs including results from previous surveys. The galvanizer responses to the survey were gathered anonymously so unless the galvanizer responded to the initial questions on the type of plant that was being reported, there was no distinction between plants of different sizes. The 2019 number of survey questions was reduced from previous surveys in an attempt to make the response easier for the galvanizers. However, the response rate was lower than previous surveys as the industry was very busy in the past twelve months so many galvanizers could not find the time to fill out the detailed survey. The average production numbers were nearly identical to the previous survey average for all types of plants. Some of the trends that were noticed in the survey responses for the cleaning processes are the increased use of acid to perform the degreasing of incoming steel, the decreased use of top flux on the surface of the galvanizing bath, and the introduction of a plant-sized hydrochloric acid recycling system. The survey results showed a continued decline in the use of Prime Western zinc in the galvanizing operations. There are only 10% of the responders that still use Prime Western zinc in their galvanizing kettle. The total zinc usage per pound of steel galvanized has continued to improve, with the overall zinc usage at or below 5% for the survey responders. Another change in the zinc usage is the increased use of MZR system to reduce the zinc content in the skimmings and return usable zinc to the galvanizing kettle. In general, the industry is making small steps forward to improve the overall efficiency of the galvanizing operations.

RESPONSE RATE

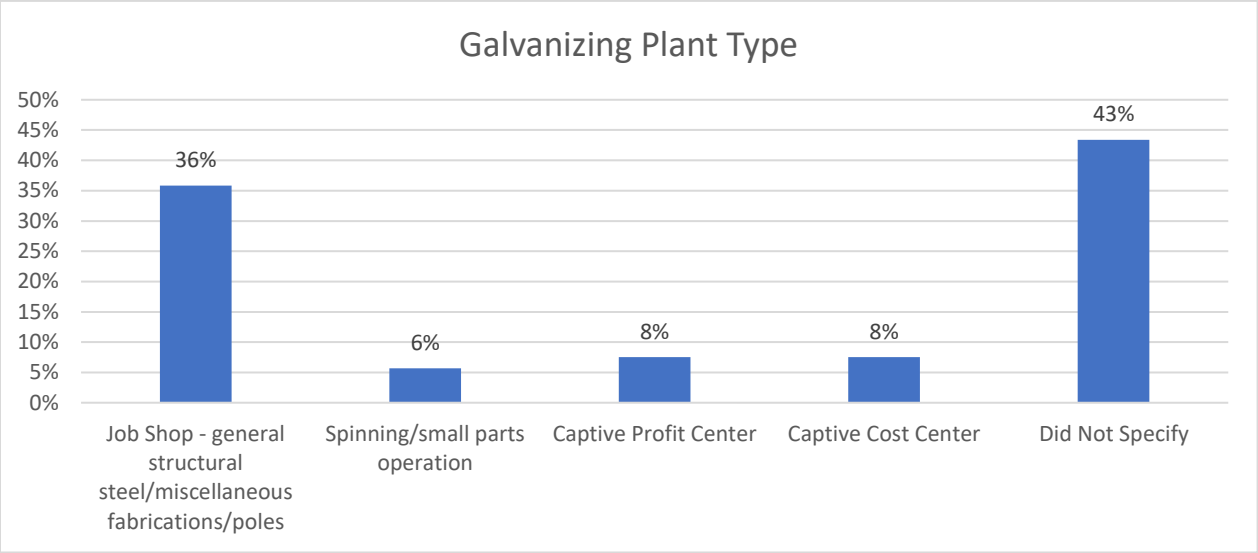
The AGA conducted a Process Survey in 1998, 2003, 2007, and 2019. Each time the AGA has conducted the Process Survey, less galvanizers have participated by supplying ***less*** information from their plant. In an effort to increase response rates, the 2019 survey was conducted anonymously, shortened, and provided in digital survey format.

Historical Response Rates:

- 1997 - 83 out of 117 plants responded (71%)
- 2003 - 63 out of 120 plants responded (53%)
- 2007 - 65 out of 126 plants responded (52%)
- 2019 - 53 out of 169 plants responded (31%)

PLANT PRODUCTIVITY

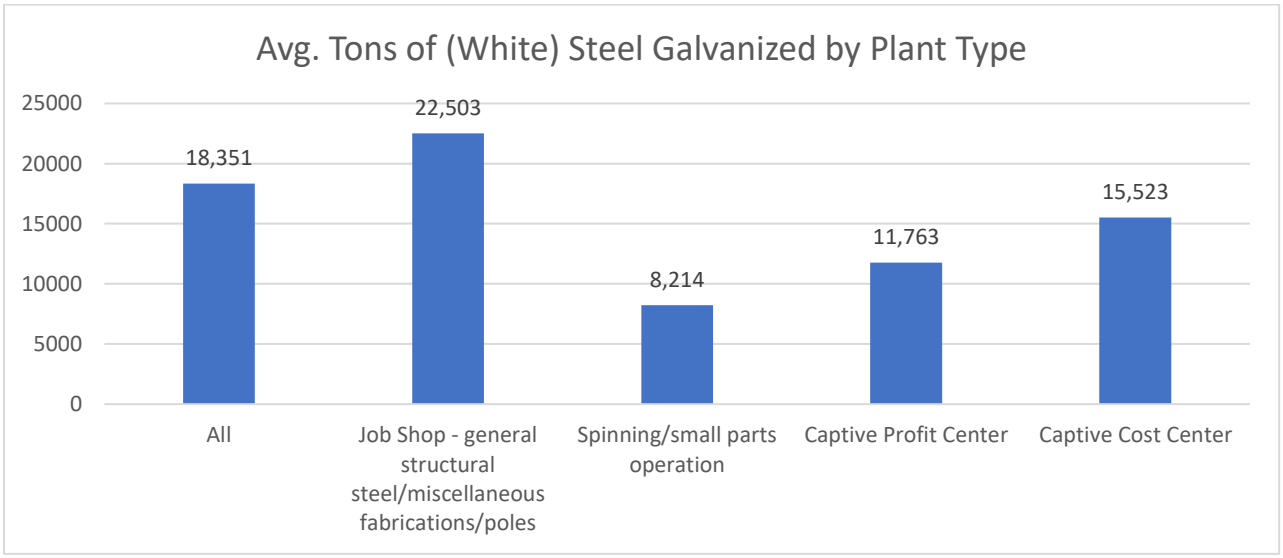
Galvanizing Plant Type



It is known that values for desirable production and sales metrics can vary based on the type of galvanizing plant type. The 2019 Process Survey aimed to separate relevant results based on plant type. Of the galvanizers that reported galvanizing plant type, the majority were Job Shop galvanizers.

Captive Profit Center: greater than 80% of production is the galvanizer's own manufactured products
Captive Cost Center: greater than 80% of production is the galvanizer's own manufactured products

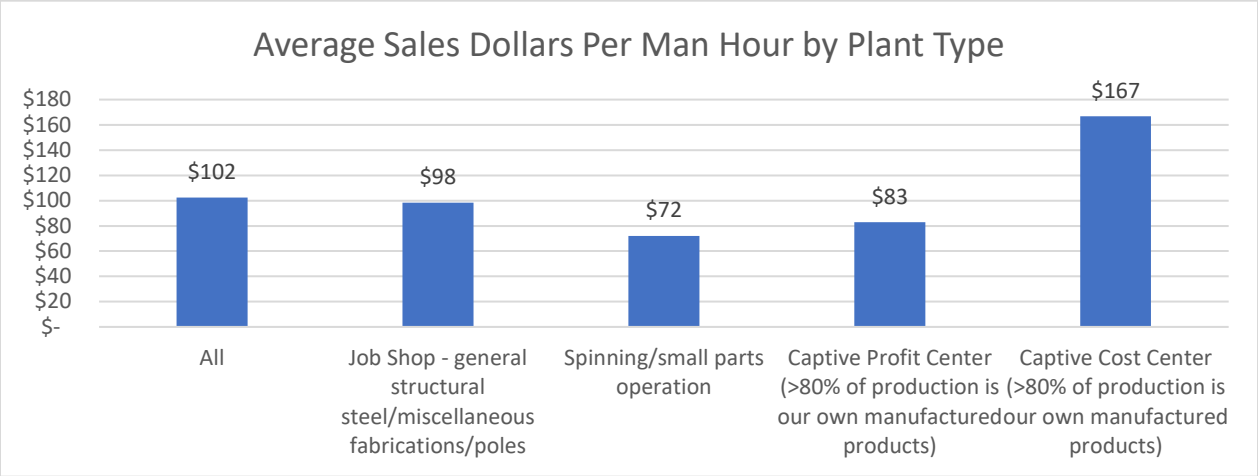
Production



Galvanizers were asked to provide how much steel (tons galvanized or "white") was galvanized in the year 2018 at the plant. The average results for all plants (18,351 tons) was very similar to the survey results obtained in 2007 for avg. tonnage galvanized (18,687 ton).

Captive Profit Center: greater than 80% of production is the galvanizer's own manufactured products
Captive Cost Center: greater than 80% of production is the galvanizer's own manufactured products

Sales Dollars per Man Hour

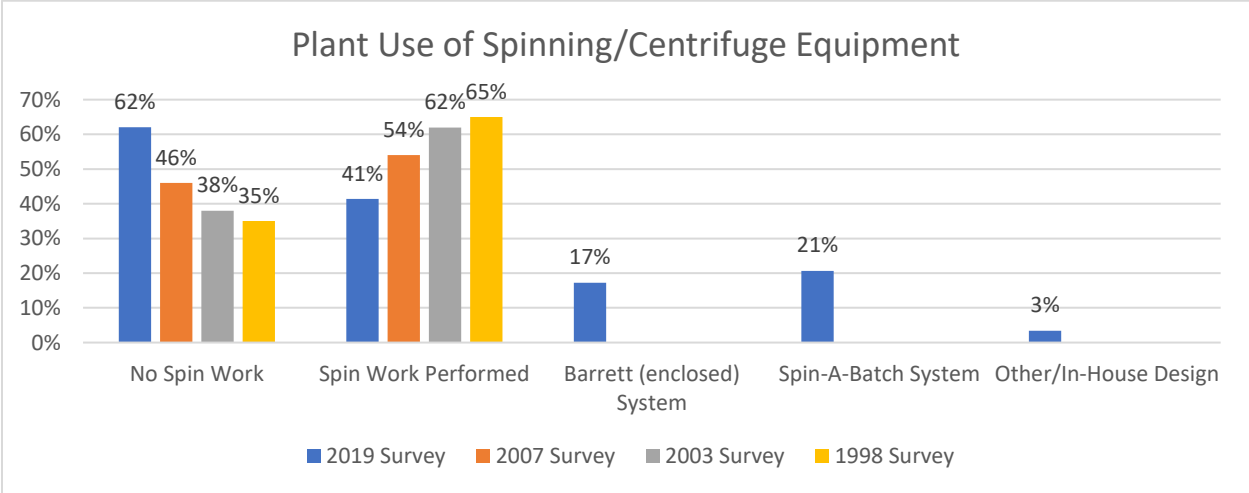


Average sales dollars per man hour were reported based on galvanizing plant type, with captive cost center plants averaging the highest rate. Sales dollars are in USD and exclude dross and skims revenue. Man-hours include all permanent and temporary hourly workers (excluding office staff) in addition to 40 hrs/wk for each salaried worker such as foremen, plant manager, superintendent (excludes GM & salespeople). To clarify using an example: if sales are $6 million and total man-hours are 40,000 the sales dollars per man hour would be $150.

Assumptions:

- 1 USD = 1.24 CAD, 1 CAD = 0.806 USD
- 1 USD = 18.15 MEX Pesos, 1 MEX Peso = 0.055 USD

Use of Spinning/Centrifuge Equipment



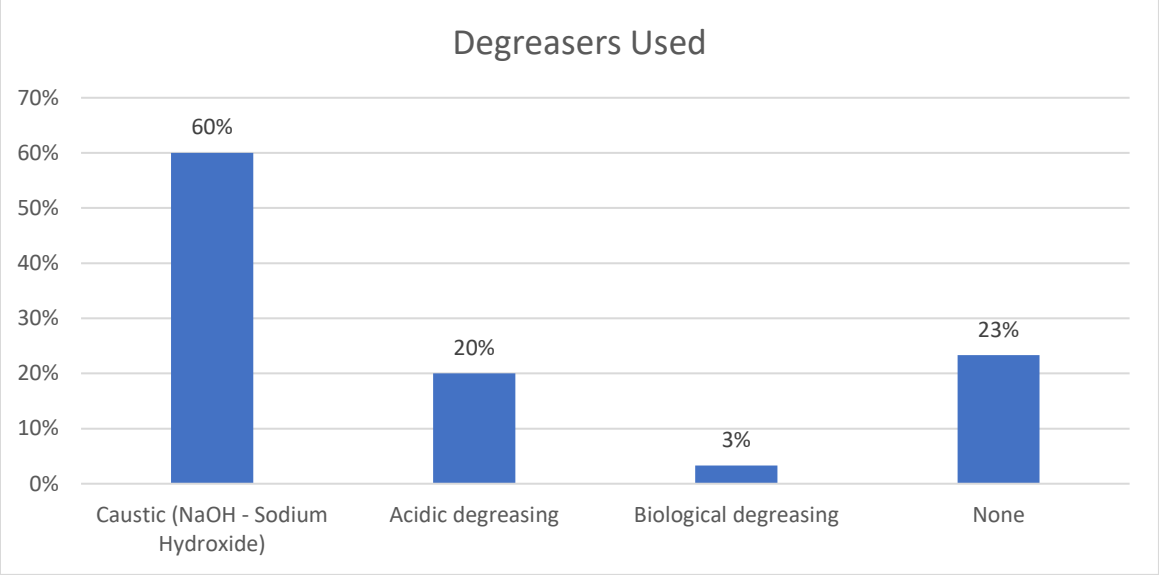
Of the respondents surveyed in 2019, a trend continues to show the number of galvanizing plants that perform spin work is decreasing over time. Of the galvanizers that perform spinning operations at the plant, 17% of plants utilize an enclosed system, 21% utilize a Spin-A-Batch system, and 3% utilize an in-house design(s) to remove excess zinc from small parts and threads.

Percent Spin Work at the Plant

Of galvanizers that perform spin work in 2019, the amount of spin work relative to overall production varied from 1-90% of total production. On average, plants that perform spin work attribute 42% of production to spin work.

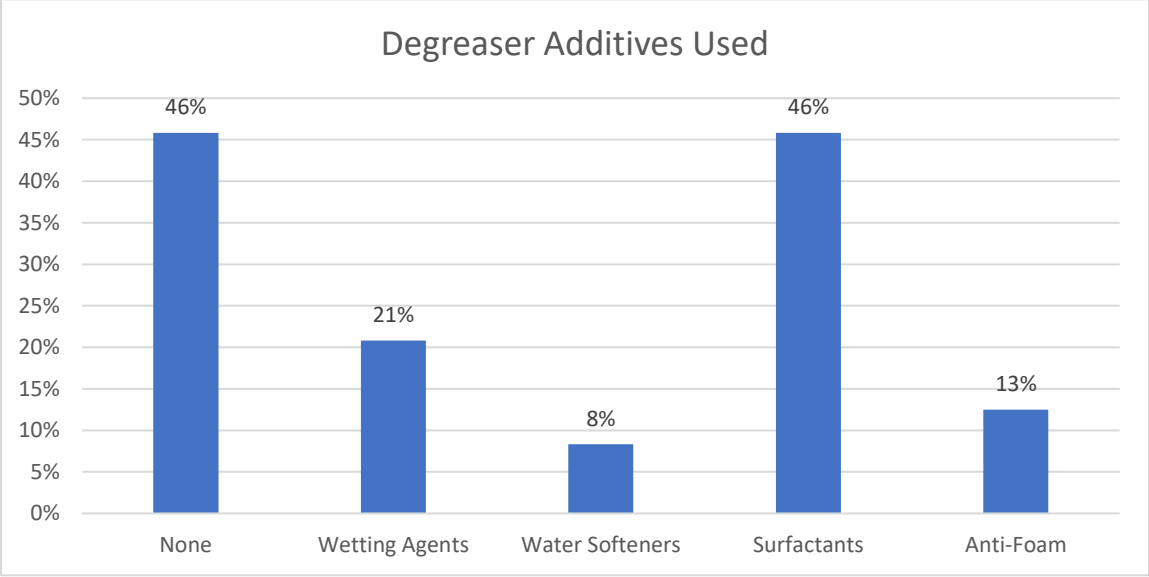
DEGREASING

Types of Degreasing



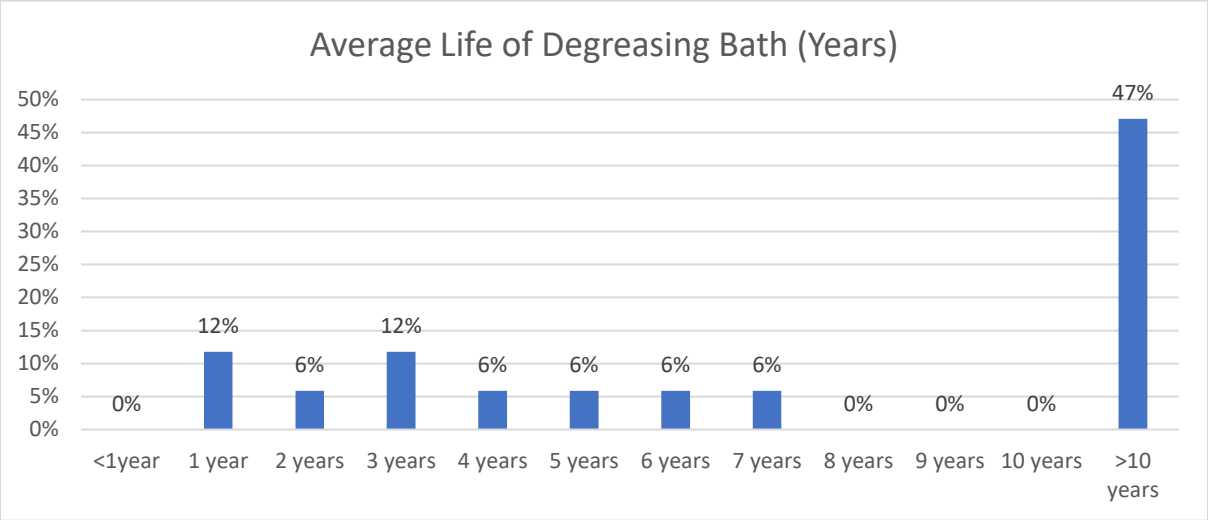
Of the galvanizing plants surveyed, an increased number of plants utilize acidic degreasing in comparison to previous AGA Process Surveys.

Degreasing Bath Additives



A slight majority (54%) of galvanizers surveyed utilize additives in the degreasing tank. Of galvanizers that purchase these additives, 85% utilized surfactants. The use of wetting agents, softeners, and anti-foam were largely added in combination with the surfactants.

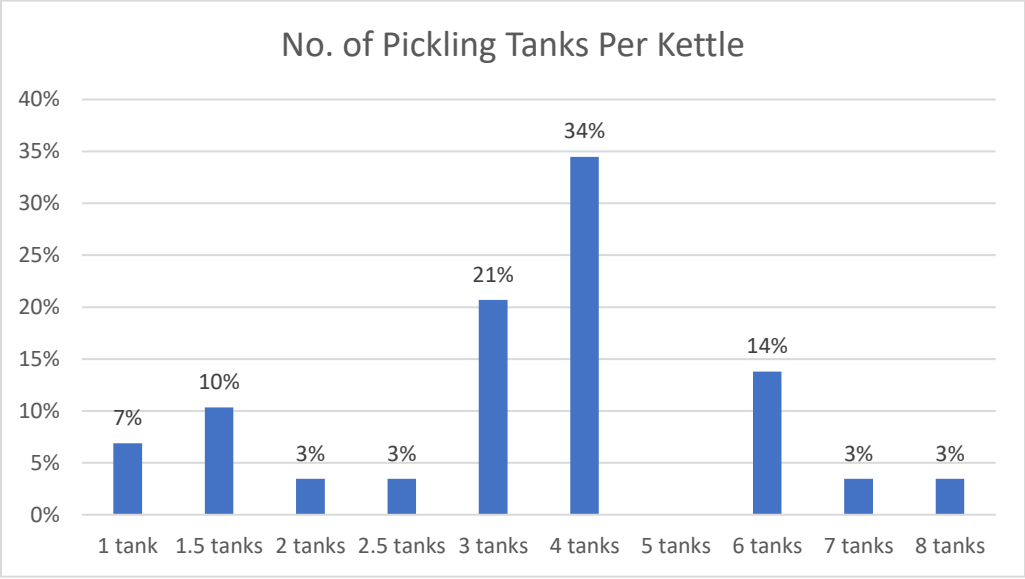
Average Life of Degreasing Bath Solution



The chart shows a divide in reporting degreasing bath solution life in years. Galvanizing plants reported changing their bath within 7 years or greater than 10 years. However, it was most common to have a degreasing bath last over 10 years before disposal.

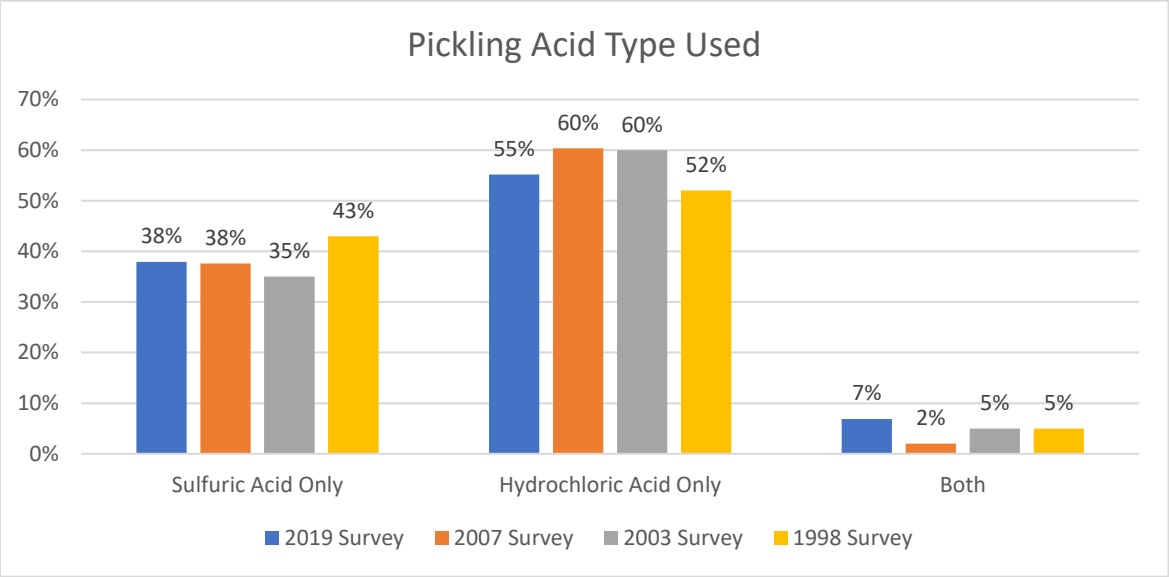
PICKLING

Number of Pickling Tanks Per Kettle



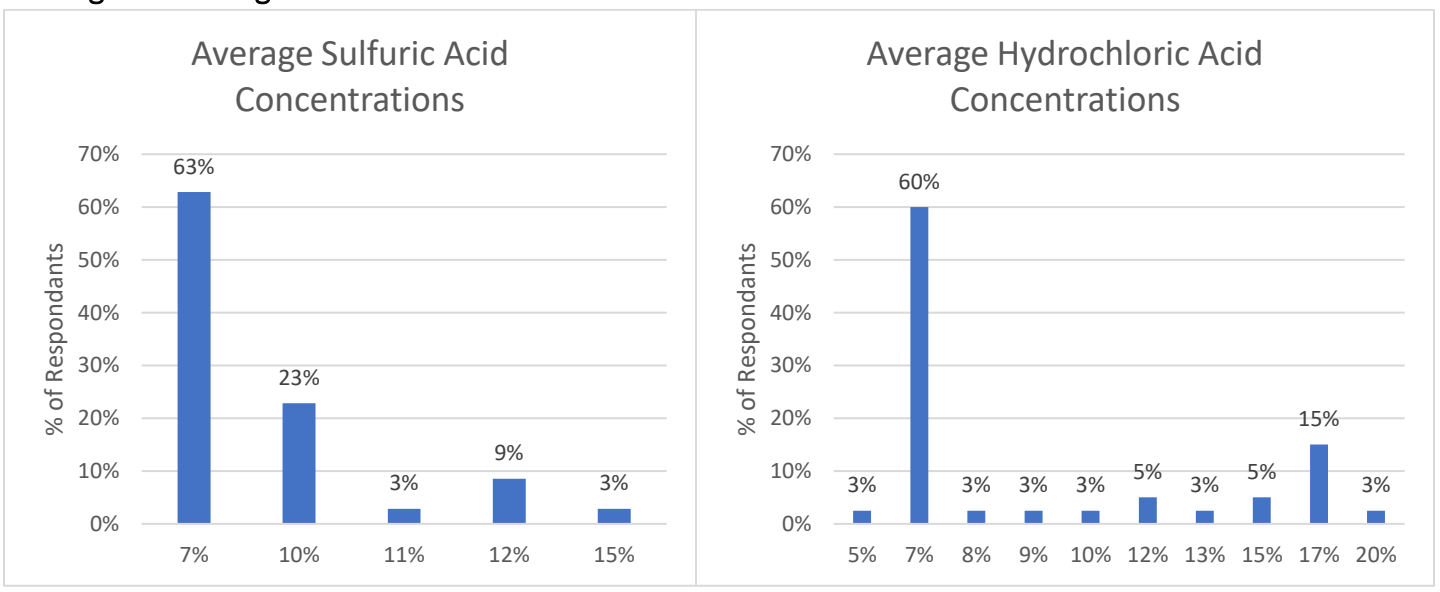
The average galvanizer has 3.7 pickle tanks per kettle, while the most commonly reported numbers of pickle tanks per kettle among the respondents is 3 or 4.

Type of Pickling Acid



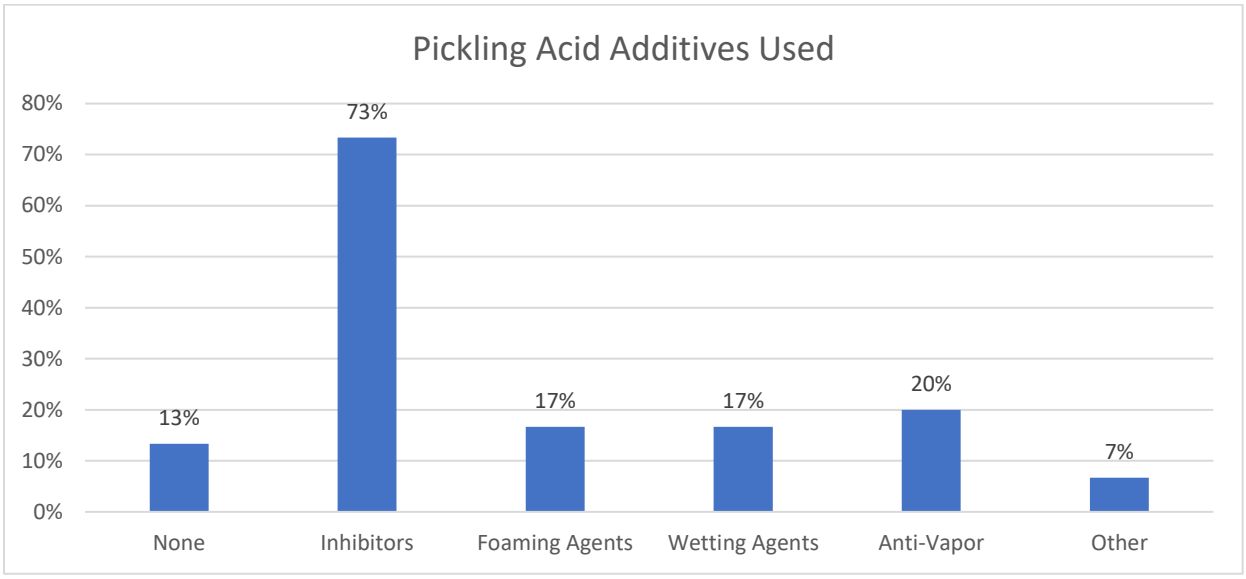
Hydrochloric acid is the most common type of acid used to pickle the steel prior to fluxing with 55% of respondents. The percentage of plants utilizing sulfuric and hydrochloric acid has not changed significantly since the survey conducted in 2007 or 2003. However, based on 2019 survey responses there is an increase in plants utilizing both acid types.

Pickling Acid Strength



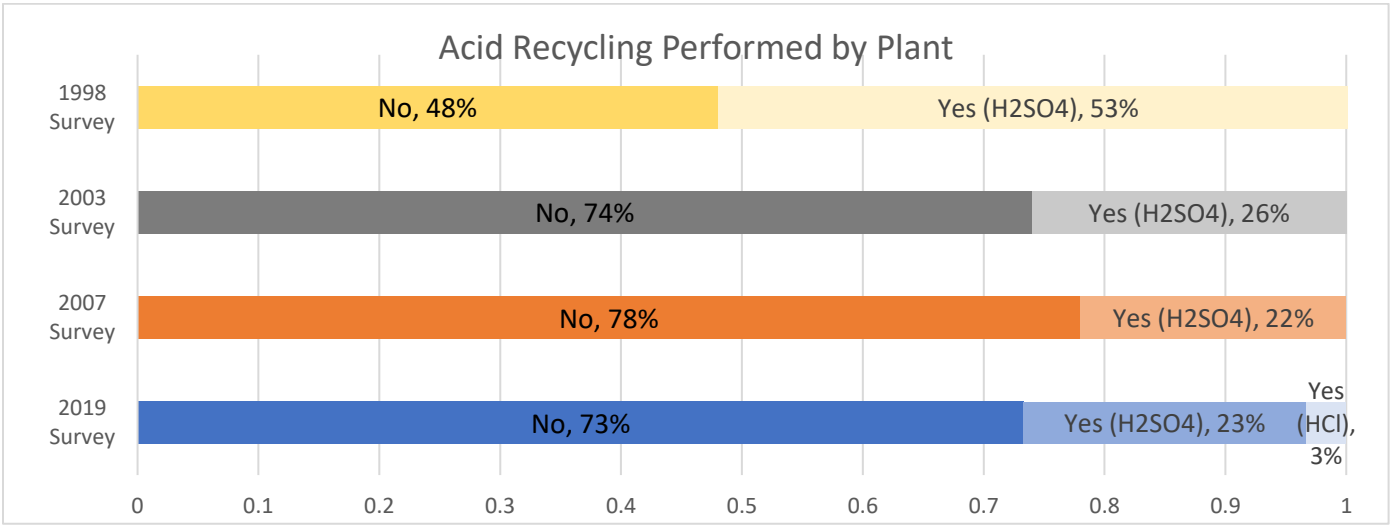
Galvanizers reported pickling acid concentrations based on type of pickling acid used. 7% acid strength was most common among users of sulfuric and hydrochloric acid alike. These values do not take into account variations in operating temperature or use of additives.

Pickling Bath Additives



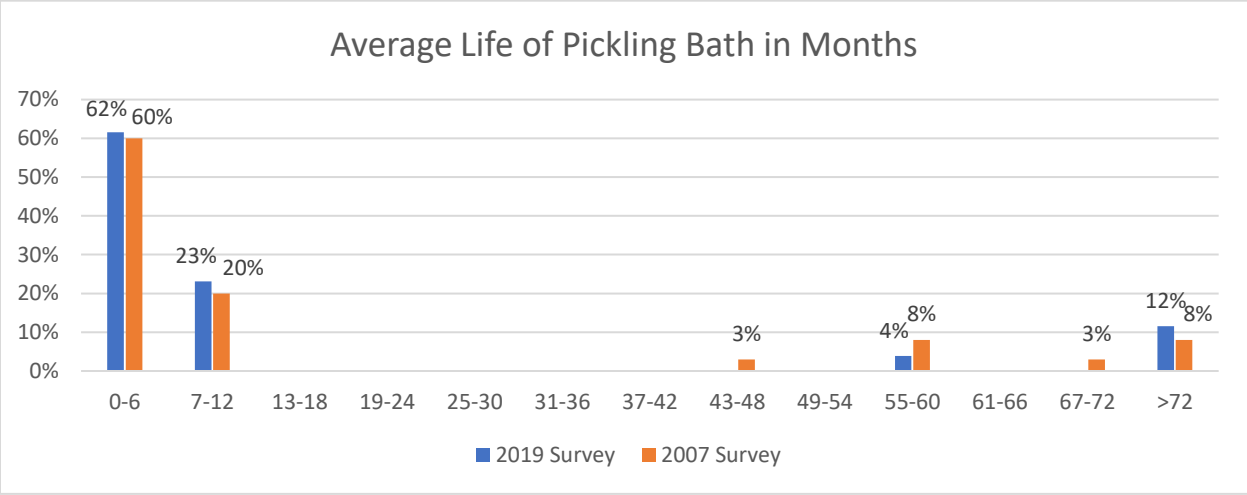
Survey results show that 73% of survey respondents use inhibitors. This is nearly the same value as reported in 2007 (75%) and 2003 (76%). Galvanizing plants reporting the use of wetting agents has dropped approximately 50% since 2007. “Other” responses included fume control and use of a degreaser additive with inhibiting and anti-vapor effects.

Recycling of Pickling Acid



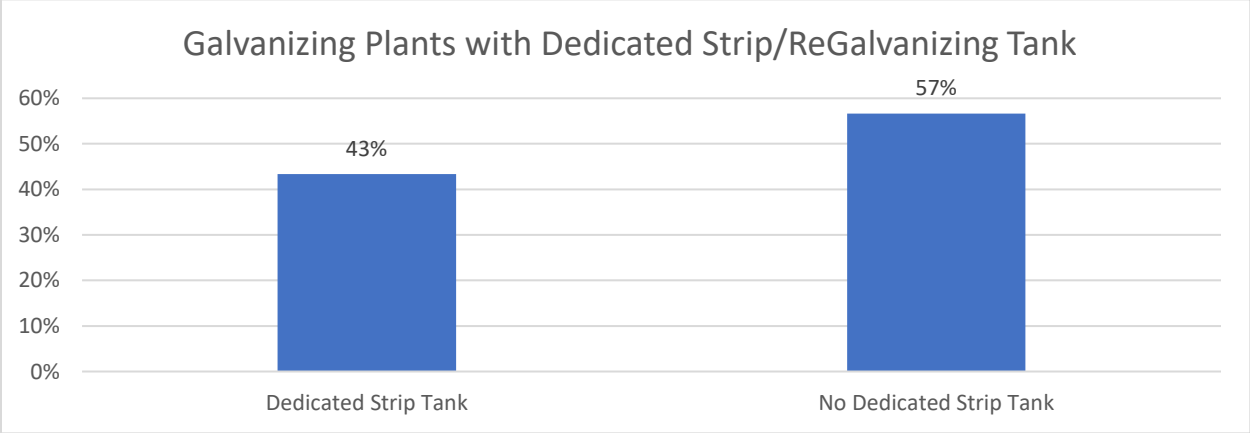
Historically, only sulfuric acid recycling was available to hot-dip galvanizers in North America. Survey results from 2019 note that some galvanizers have adopted the use of newer hydrochloric acid recycling technology, but the overall percentage of galvanizers that perform acid recycling at the plant has remained mostly unchanged since 2003.

Average Life of Pickling Acid Bath in Months



Respondents reported a sharp divide in how often they change out pickling bath solutions. Galvanizers reported changing their tank within 12 months or they wait longer than 42 months. All galvanizers who indicated an average pickling bath life beyond 12 months also indicated the use of an acid recycling system. A significant amount of galvanizers (12%) dispose of the bath beyond 72 months.

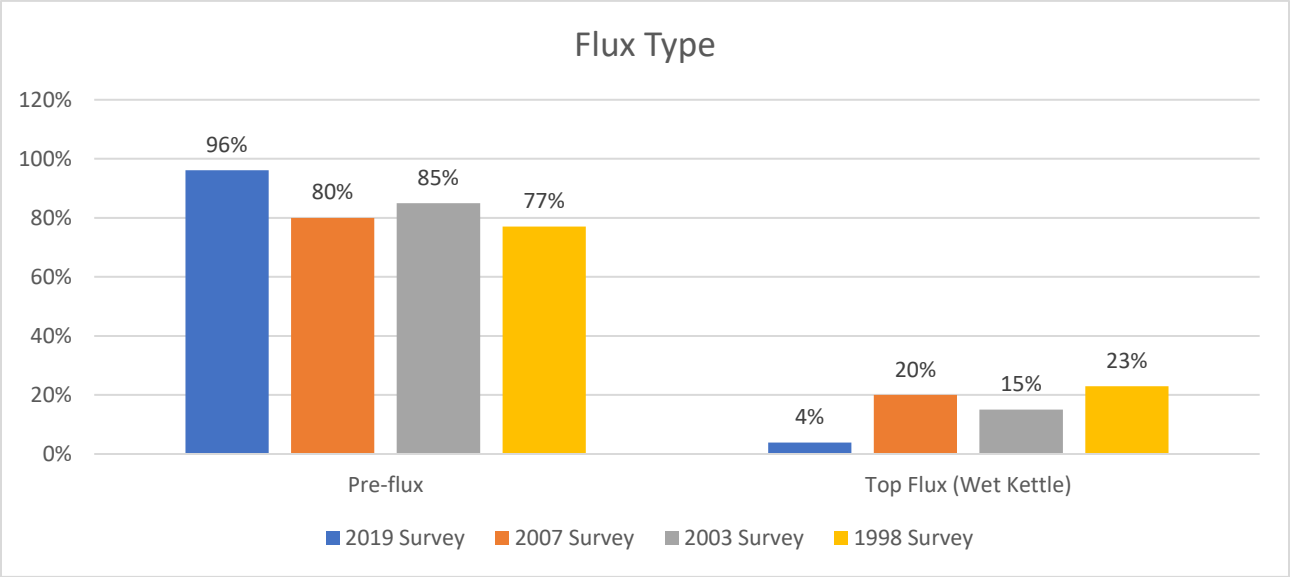
Galvanizing Plants with Dedicated Strip/Re-galvanizing Tank



The AGA receives regular requests from our galvanizing members regarding the strip/re-galvanizing tank maintenance. To develop useful guidance on this topic, the AGA needed to asses the methods used for strip/re-galvanizing, in addition to the effect of zinc content on pickling rates over time. The survey results indicated a majority of galvanizers with and without acid-recovery systems do not utilize a dedicated strip/re-galvanizing tank, but instead utilize a pickling bath located in the primary galvanizing line or utilize other methods such as blast cleaning. Where necessary, the impact on having a dedicated strip/re-galvanizing tank can be measured in comparison to the average life of a pickling bath and zinc/iron levels in the bath over time. The impact of zinc content on pickling performance is currently being investigated by the AGA and further guidance on strip/re-galvanizing will be developed upon it's conclusion and in combination with the information obtained by this survey.

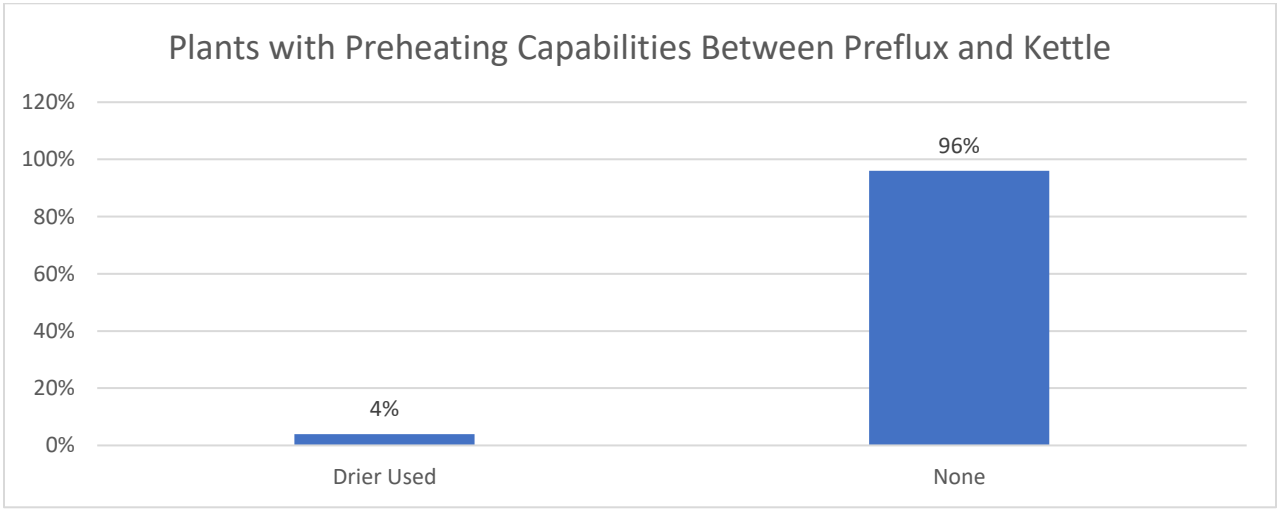
FLUX

Flux Type



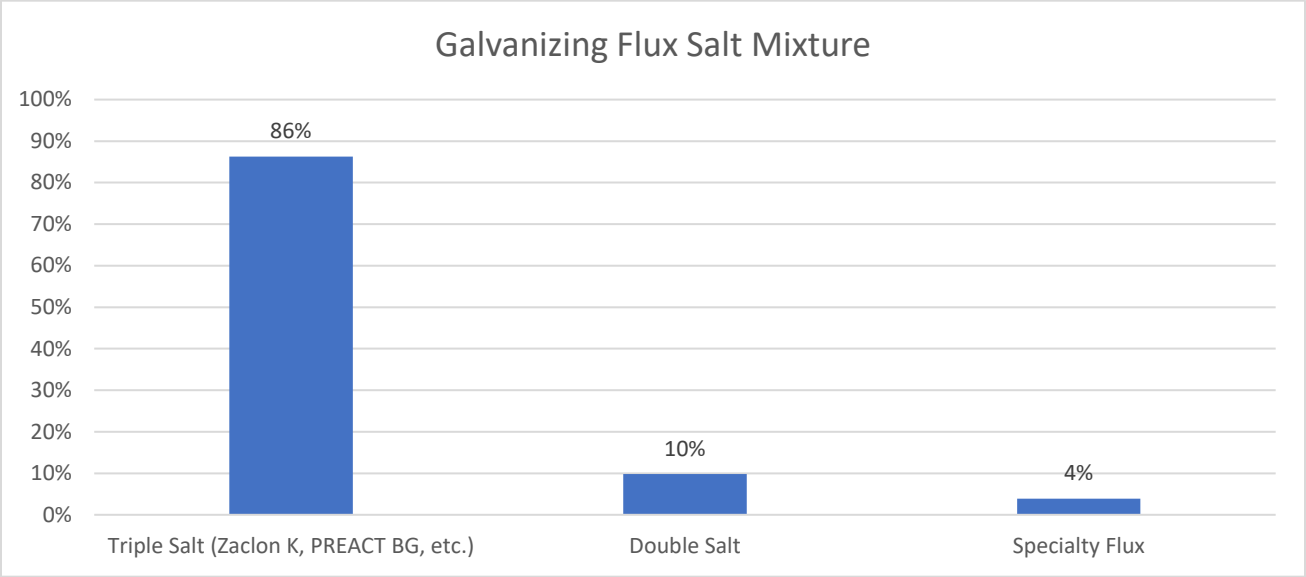
The overall trend is galvanizers are moving away from the use of a top flux, with only 4% of respondents utilizing a top flux (down 80% from 2007). No respondents were utilizing both a preflux and top flux.

Preheating Between Preflux and Galvanizing Kettle



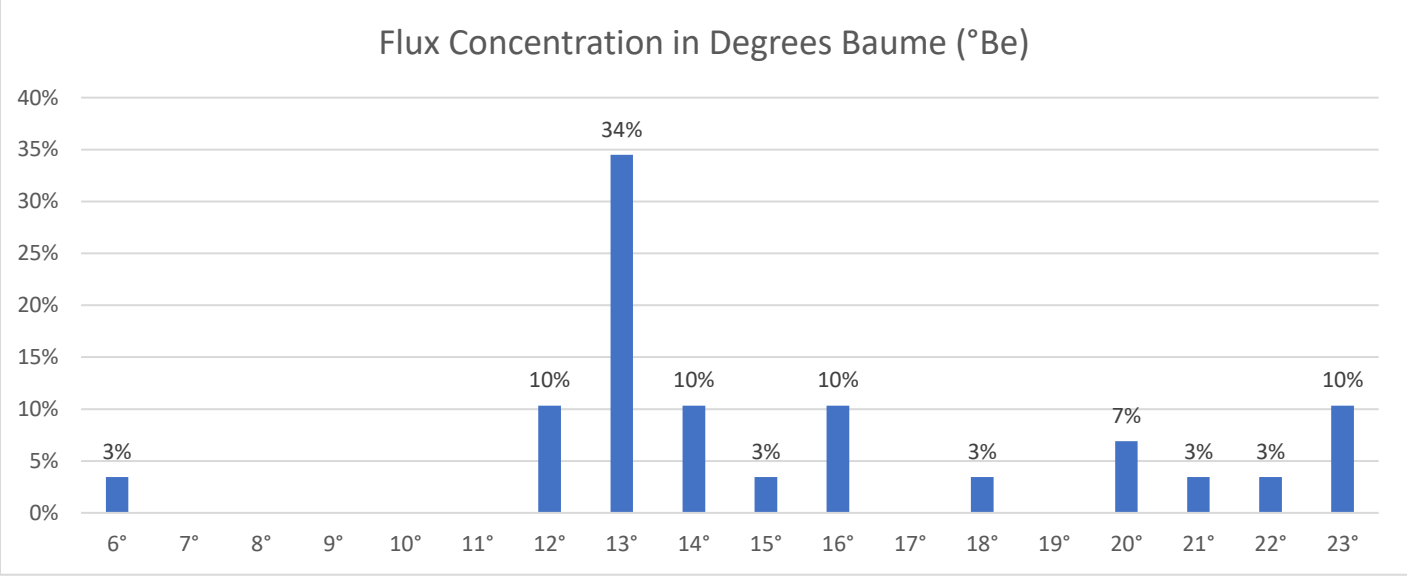
Preheating the steel increases kettle productivity by allowing more pieces to enter the kettle per given time period and helps maintain the desired kettle operating temperature. Due to the added cost to implement preheating in North America, it not surprising only a small percentage of galvanizers preheat steel prior to immersion in the kettle (4%), however, this method is more prevalent outside North America.

Flux Salt Mixture



The triple salt, 0.85 ratio, is a high activity flux and is by far the most common ratio used in North America. The double salt, 1.27 ratio, is used by a minority of galvanizers (10%) and is more commonly used when longer dry times or preheating are involved.

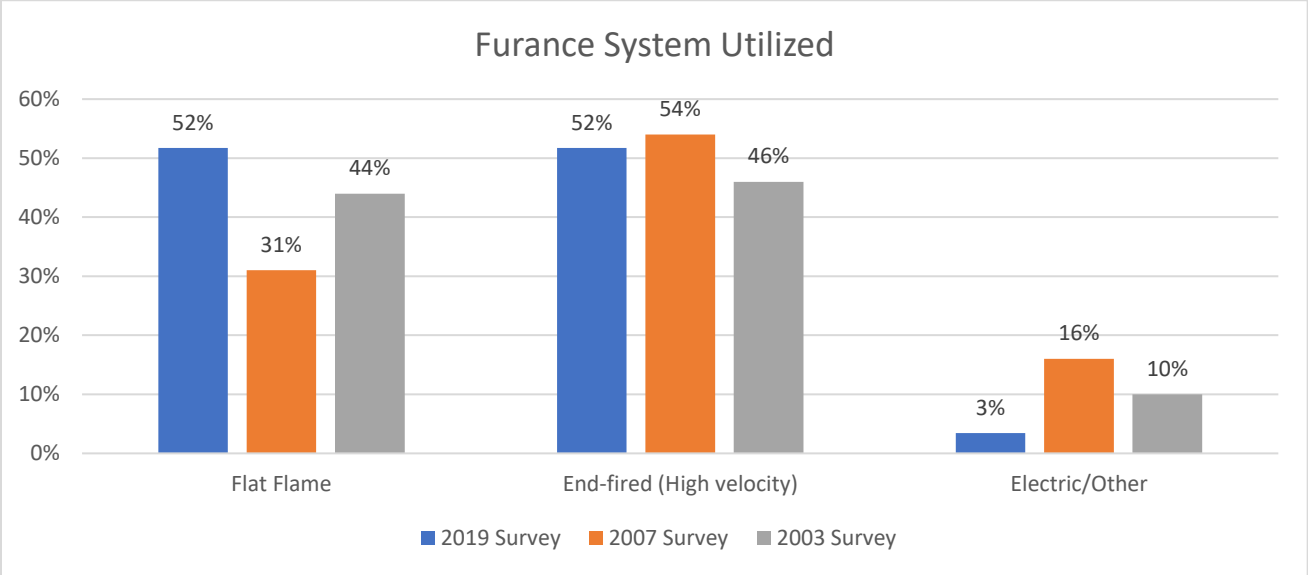
Flux Concentration



The average flux concentration among respondents was 15.4 degrees Baume (Be), with a majority of galvanizers reporting flux concentrations of 13 degrees Baume (Be).

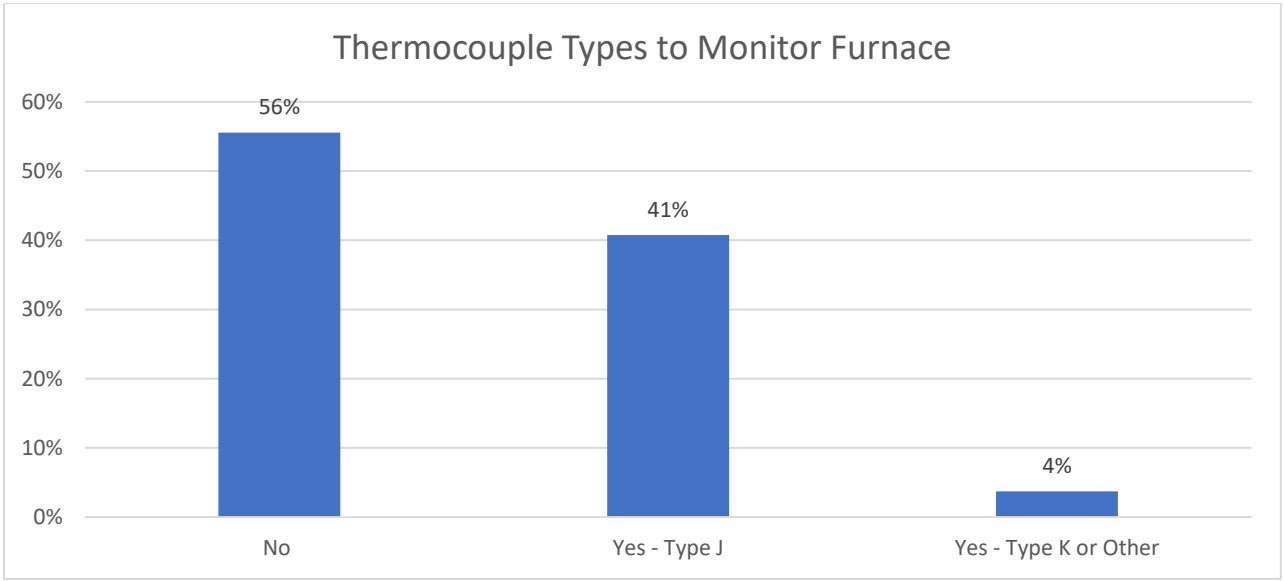
GALVANIZING KETTLE

Furnace Type



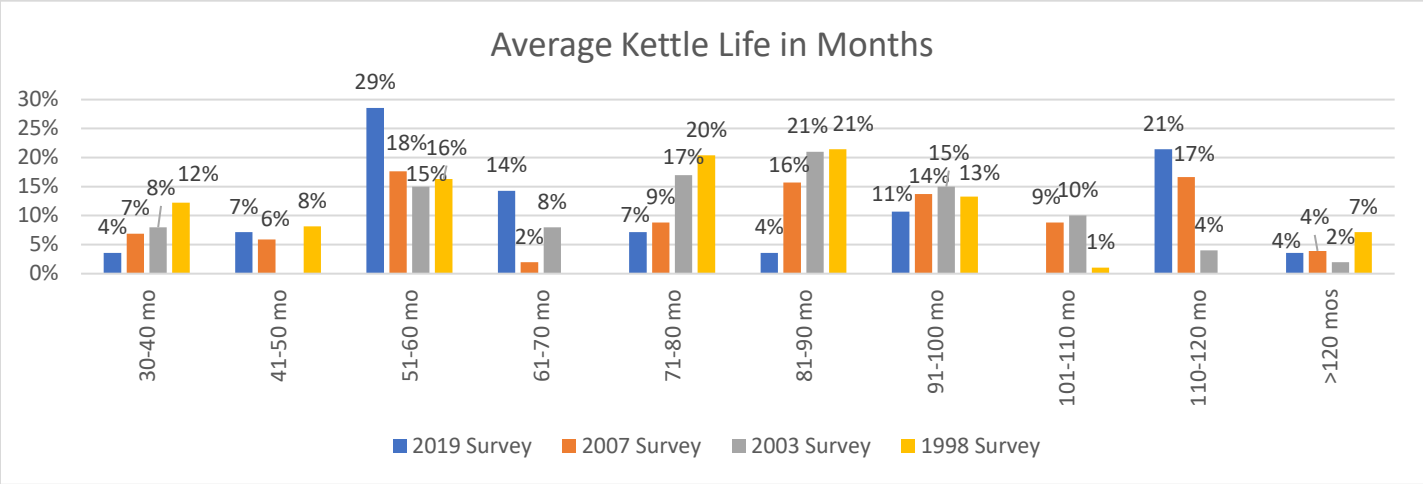
The chart shows that end-fired high velocity systems were used as frequently as flat flame systems in 2019. This represents an increased use of flat-flame systems and movement away from electric and other furnace types. Because some galvanizers reported multiple kettles with more than one furnace type, results for 2019 do not add up to 100%. Instead, values represent the percent of respondents that have each furnace type for at least one kettle at the plant.

Thermocouple Types Used to Monitor Furnace



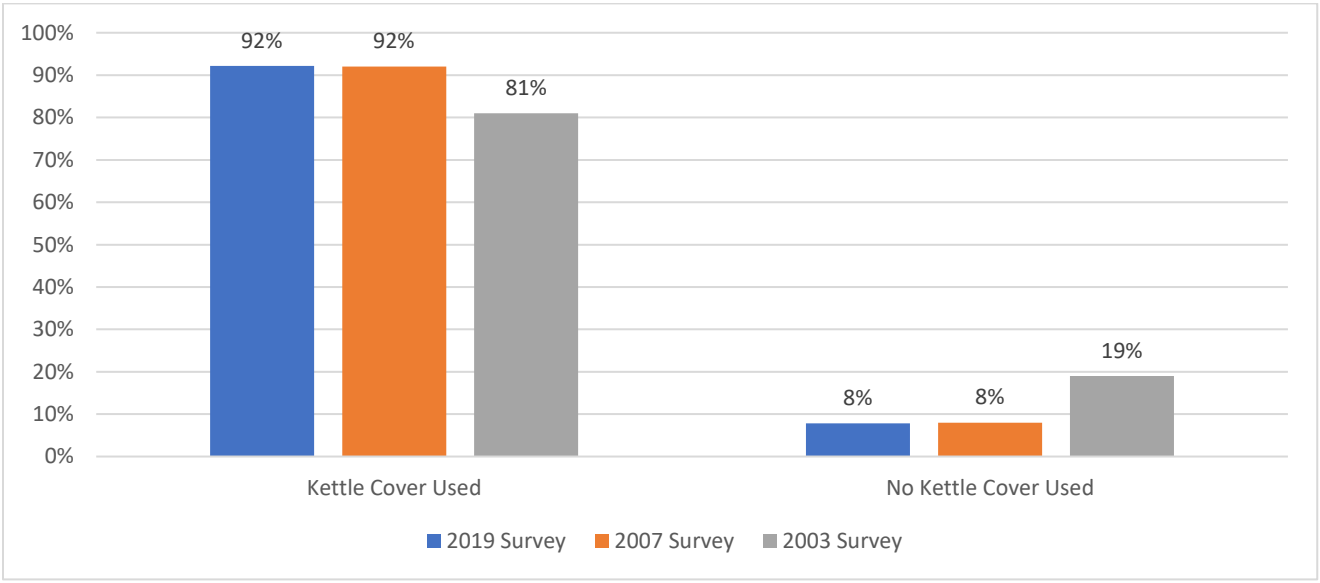
A majority of respondents (55.6%) do not utilize thermocouples to monitor the furnace. Of those that do monitor the furnace temperature (44.4%), a majority utilize Type J thermocouples to monitor. **Note:** As a result of rounding percentages to in the graph to whole numbers, values do not add exactly 100%.

Average Kettle Life



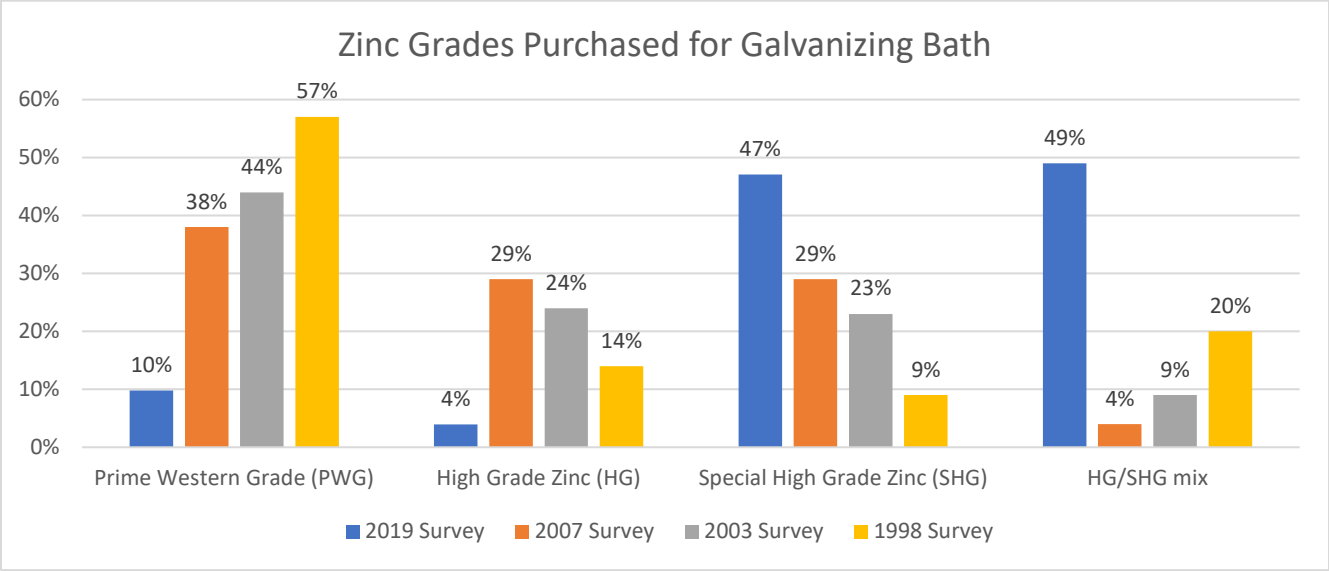
In 2019, the average kettle was replaced at 80.5 months or 6.7 years. In 2007, the average kettle was replaced at 7.1 years. For 2003, the average kettle life was 6.6 years and in 1998 it was 6.1 years. The lower average value in 2019 may be the result of an increased number of plants where kettles were reported to be replaced within 51-60 months on average.

Use of Kettle Covers



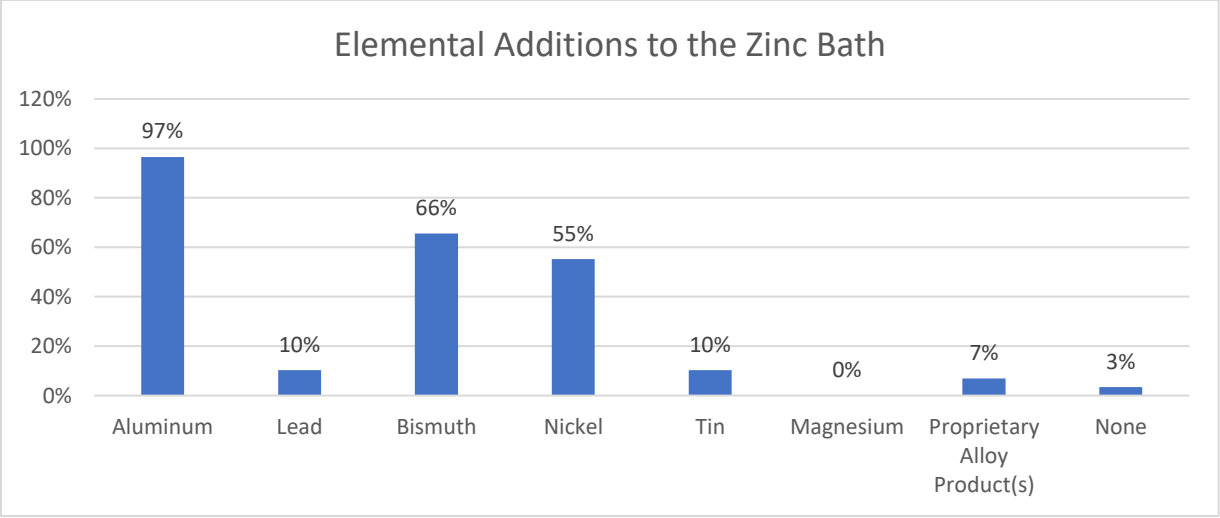
Kettle covers are utilized by a majority of galvanizers to conserve energy when the galvanizing kettle is not in use. The percent of galvanizers utilizing kettle covers has not seen a change since 2007.

Zinc Grades



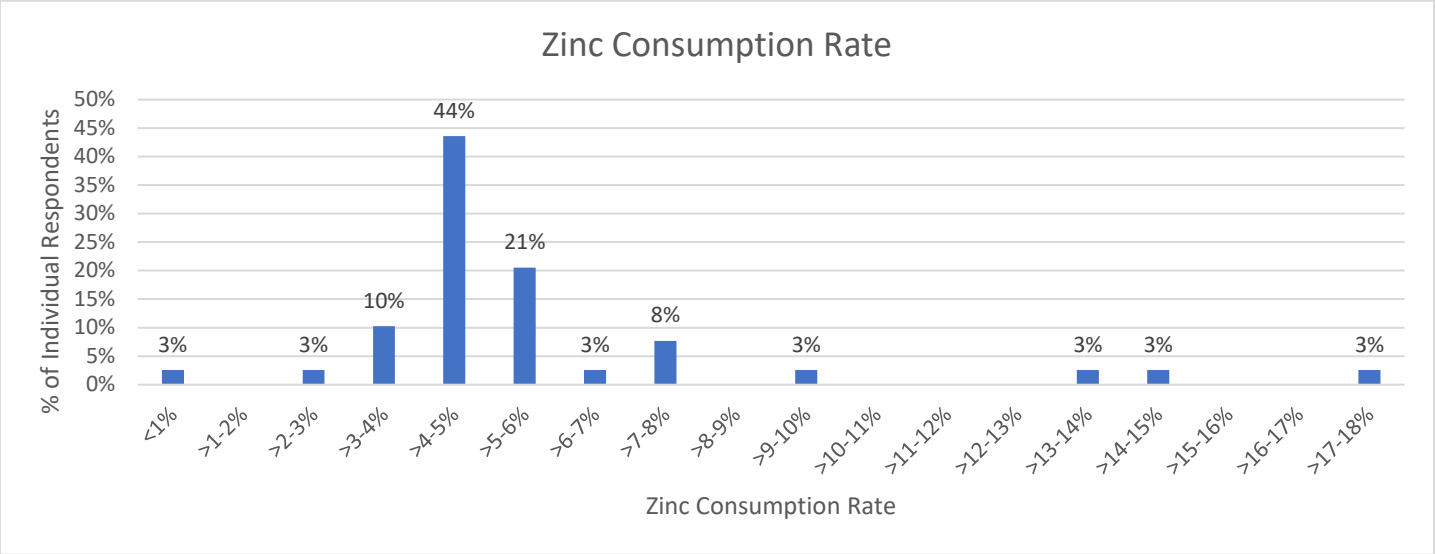
High grade and special high-grade zinc were the most popular zinc grades in 2019, a trend which has been on the rise since Process Surveys have been conducted in 1993. Only 10% of respondents in 2019 utilize prime western grade, a 73% decrease in use from the year 2007. 90% of galvanizers in 2019 utilize either high grade, special high grade, or mixture of the two. This trend is mostly attributed to increased pressure from environmental/health/social initiatives which demand products with decreased lead content.

Elemental Additions to the Zinc Bath



Aluminum was the most common element addition to the galvanizing bath with 97% of all respondents adding aluminum. Because 90% of galvanizers utilize HG/SHG zinc, the use of bismuth (lead-alternative) by 66% of galvanizers supports the notion many galvanizers are choosing to increase the fluidity of the zinc bath with bismuth while minimizing lead content to meet environmental/health concerns. Nickel is also prevalent among galvanizers, with 55% of respondents choosing to add nickel to the kettle.

Zinc Consumption



According to process surveys conducted by the AGA in 2003 and 2007, a typical consumption rate of zinc for batch hot-dip galvanizing (defined as lbs. of zinc per lbs. of steel production) was around 5.2% - 5.5%. In 2019, average zinc consumption rate for the industry can be calculated a few ways:

- Industry average zinc usage (875 tons) per industry average steel tonnage (18351 tons): 4.8%
- Average value of zinc consumption rates from the individual plants that reported both zinc usage and steel tonnage: 5.7%
- Average value of zinc consumption rates from the individual plants that reported both zinc usage and steel tonnage, but only evaluating plants that reported below 10% zinc consumption rate: 5.0%

In addition to these calculations, 60% of galvanizers reported zinc consumption rates below 5% while 81% of galvanizers reported zinc consumption rates below 6%.

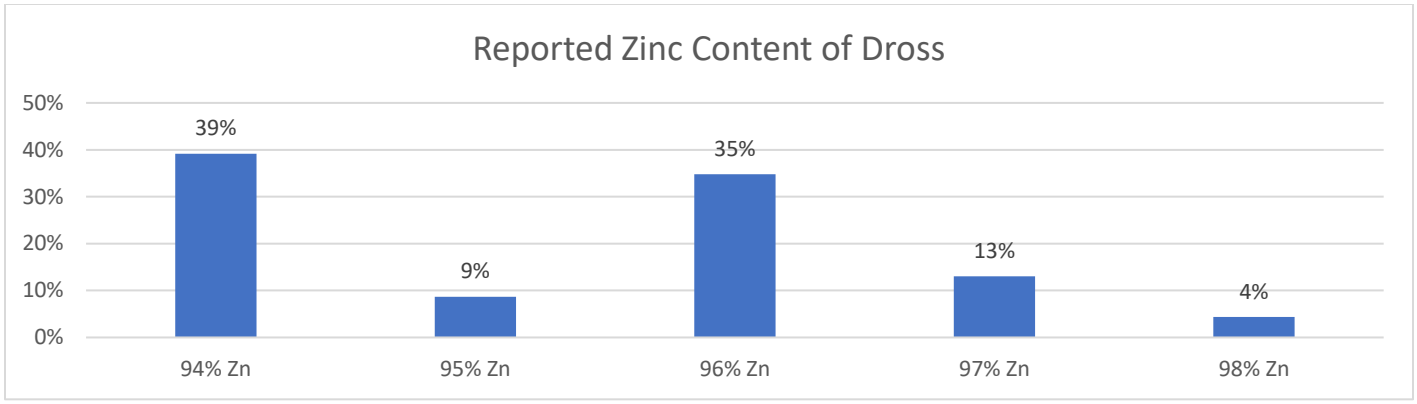
Table: Zinc, Skims, and Dross Production

Avg. lbs. of zinc added to the kettle	1,750,968 lbs. (875 tons)
Avg. lbs. of dross generated	231,698 lbs. (116 tons)
Avg. lbs. of skimmings generated	170,340 lbs. (85 tons)

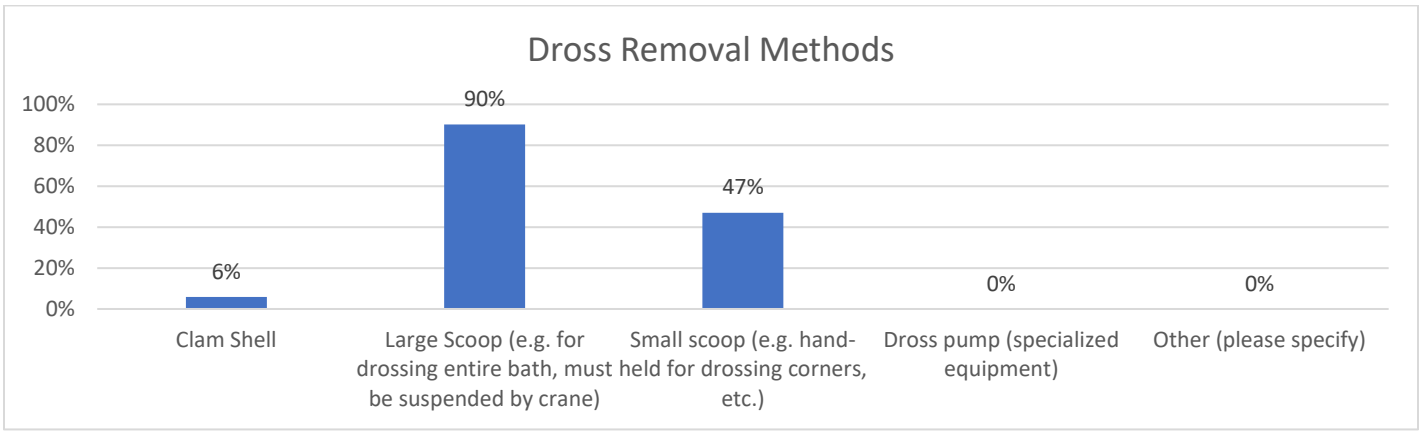
The average amount of zinc added to the kettle in 2019 was 875 tons. However, this value included some low outliers. When evaluating only the galvanizers that added >200 tons to the kettle, the average weight of zinc added to the kettle was 1002 tons. This value is lower than the average reported value from all respondents in 2007 (1159 tons).

The average reported weight of dross generated (116 tons) is slightly lower than the average reported value from 2007 (131 tons). The minimum amount of dross generated by a respondent in 2019 was 2.5 tons, while the maximum reported dross generation in 2019 was 482 tons. These results may indicate some improvement by the industry in overall dross management since 2007.

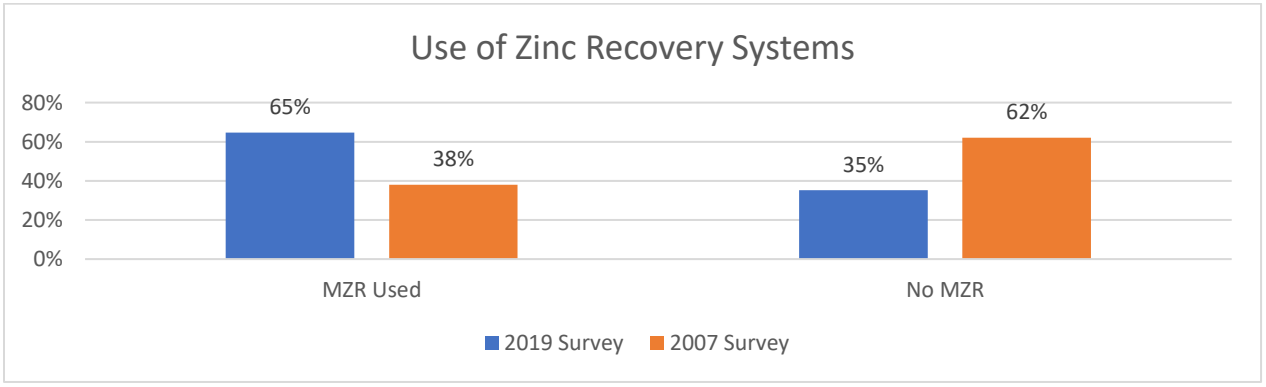
The average reported weight of skimmings generated (85 tons) is significantly lower than the average reported value from 2007 (236 tons). The minimum amount of skims generated by a respondent in 2019 was 2 tons, while the maximum reported skims generation in 2019 was 281 tons. These results indicate increased used of MZR (from 38% of galvanizers in 2007 to 65% of galvanizers in 2019) may have a direct impact.



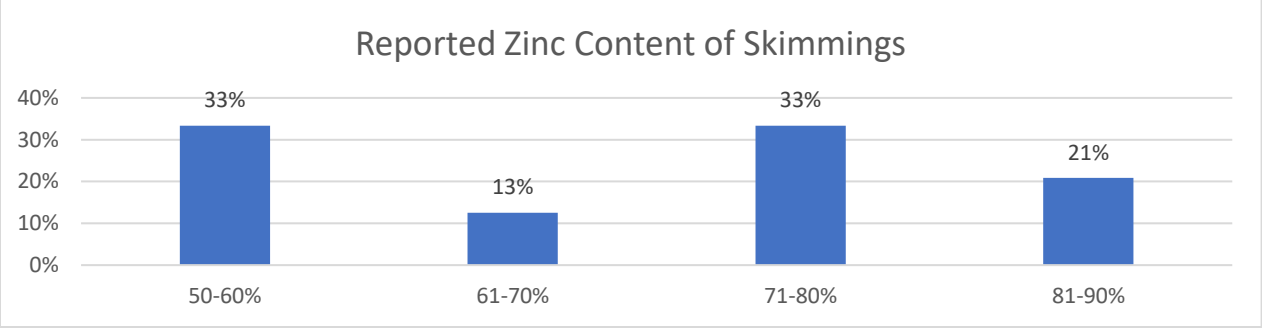
The reported zinc content in the dross was most commonly 94% or 96% Zn, with 94% zinc being the most commonly reported value at 38% of respondents.



90% of respondents indicated they used a large scoop to remove dross from the kettle, but 47% of galvanizers used a combination of small scoops along with a large scoops or clam shell device. No galvanizers reported the use of other specialized dross equipment.



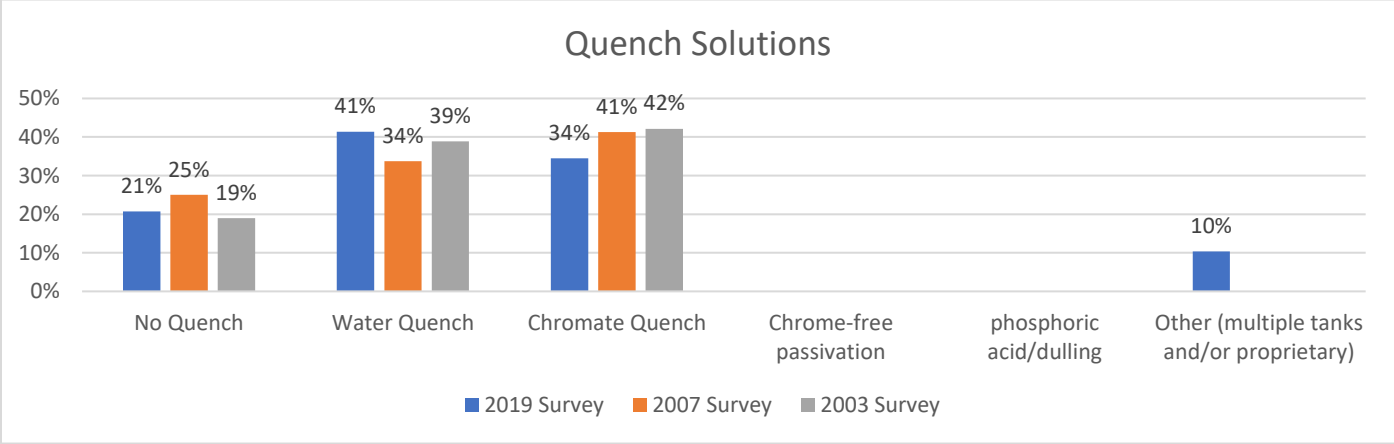
The use of MZR units to recover zinc metal from skimmings has increased in popularity since 2007. As of 2019, a majority of galvanizers (65%) utilize a MZR unit, up from only 38% in 2007.



Wide variation was found among galvanizers who collect information on the zinc content within the skimmings. It was most common for galvanizers to report between 50-60% zinc in skimmings to 71-80% zinc in skimmings. Similar variation was seen in 2007.

MISC. & OTHER PLANT EQUIPMENT

Quench Solutions

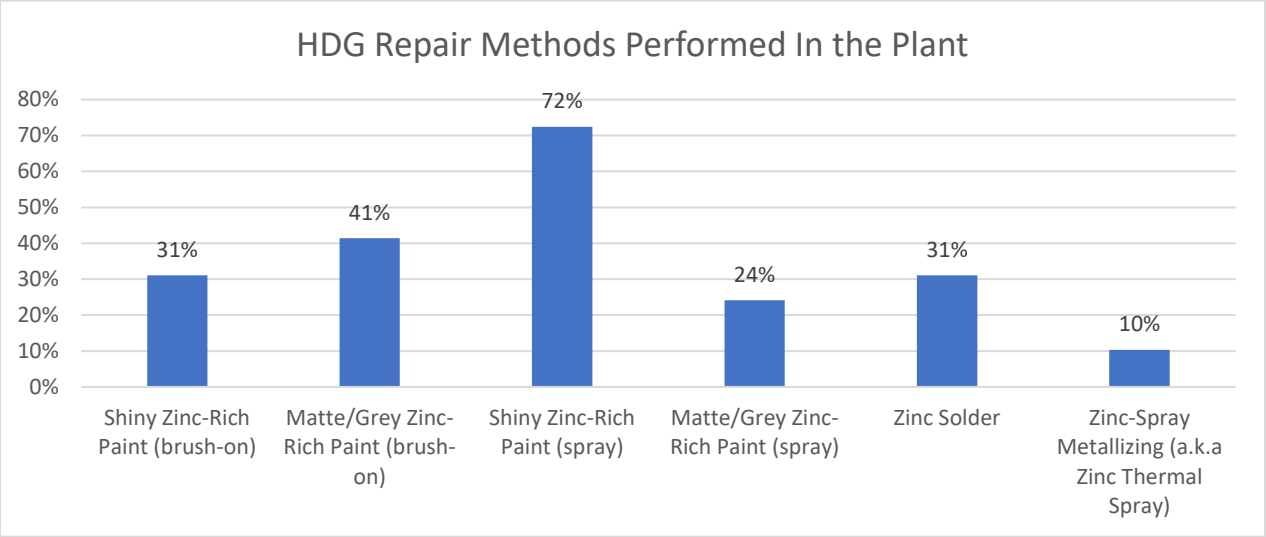


Overall, the percent of galvanizers with quench baths has not varied greatly over time. However, from 2003 to 2019, there appears to be a decrease in the use of hexavalent chromate solutions for the quench bath, with only 34% of respondents utilizing a chromate quench solution in 2019. This may be the result of increased environmental pressure regarding the use of hexavalent chromium in the industry.

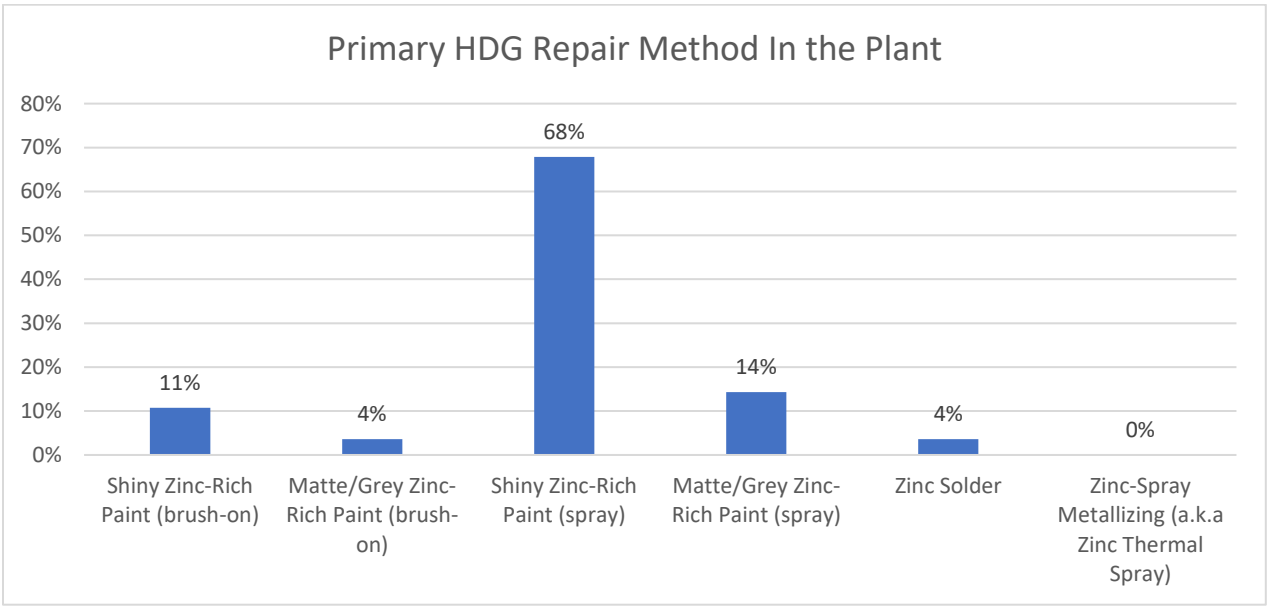
Crane Lift Capacity

The average galvanizer has a maximum crane capacity of 16,193 lbs, with the smallest capacity recorded at 400 lbs and the largest capacity recorded at 40,000 lbs.

Touch-Up & Repair

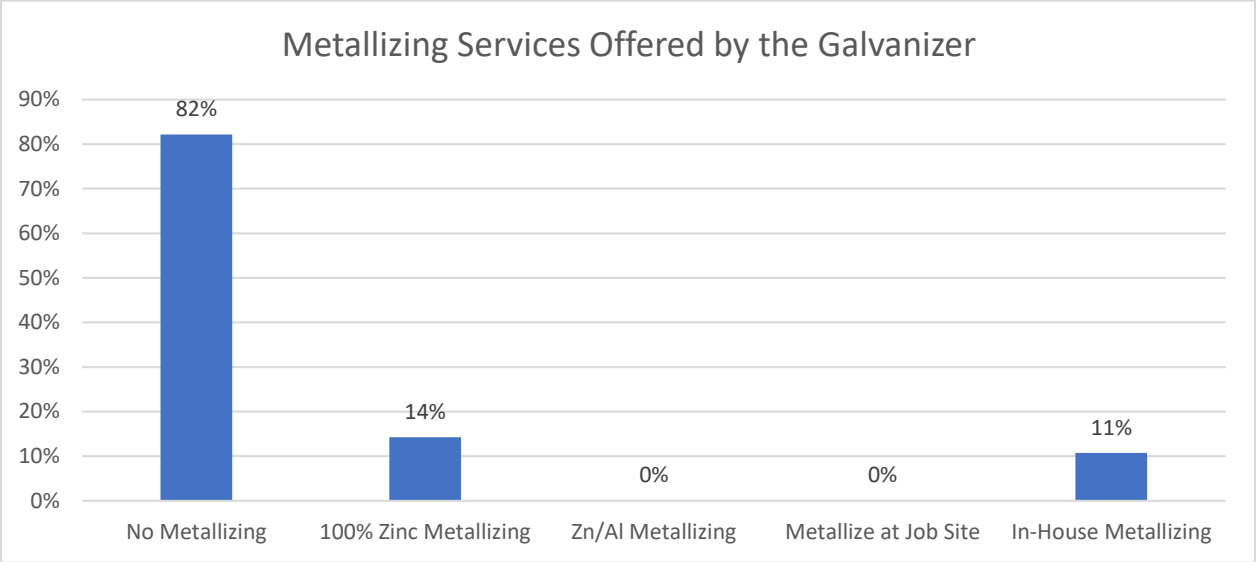


The chart represents the prevalence of **all** repair materials offered among respondents (i.e. each plants indicated **all repair materials utilized at the plant**). Shiny zinc-rich paint spray is the most common repair method provided used by all galvanizers. All zinc rich paints are more widely used than zinc solder (31% of plants) and zinc-spray metallizing (10% of plants). All plants that perform zinc solder and zinc metallizing repairs also utilize zinc-rich paint.



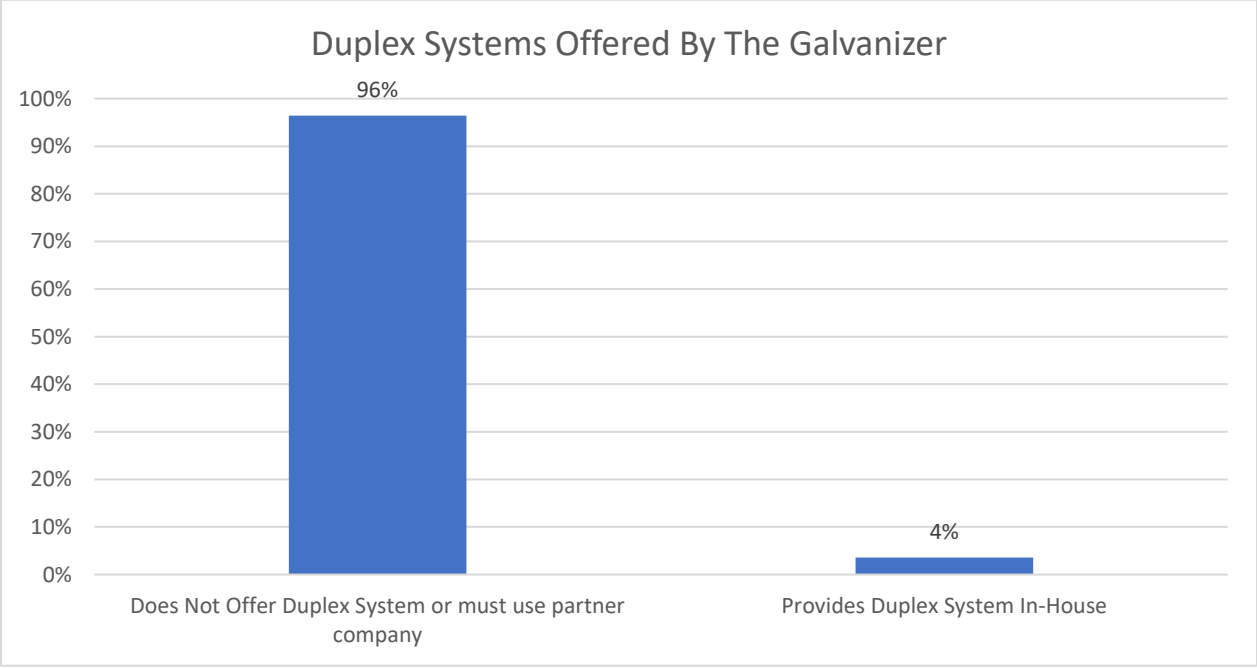
This chart represents the **primary** repair method for each respondent, while the previous graph represents the prevalence of all repair materials offered among the plants. Of galvanizers that utilize zinc rich paint, it is the primary method for repair at 96% of galvanizing plants. The 10% of galvanizing plants that perform metallizing do not perform metallizing as the primary repair method, however, some portion of galvanizing plants utilizing zinc solder for repair use it as a primary method.

Metallizing Services



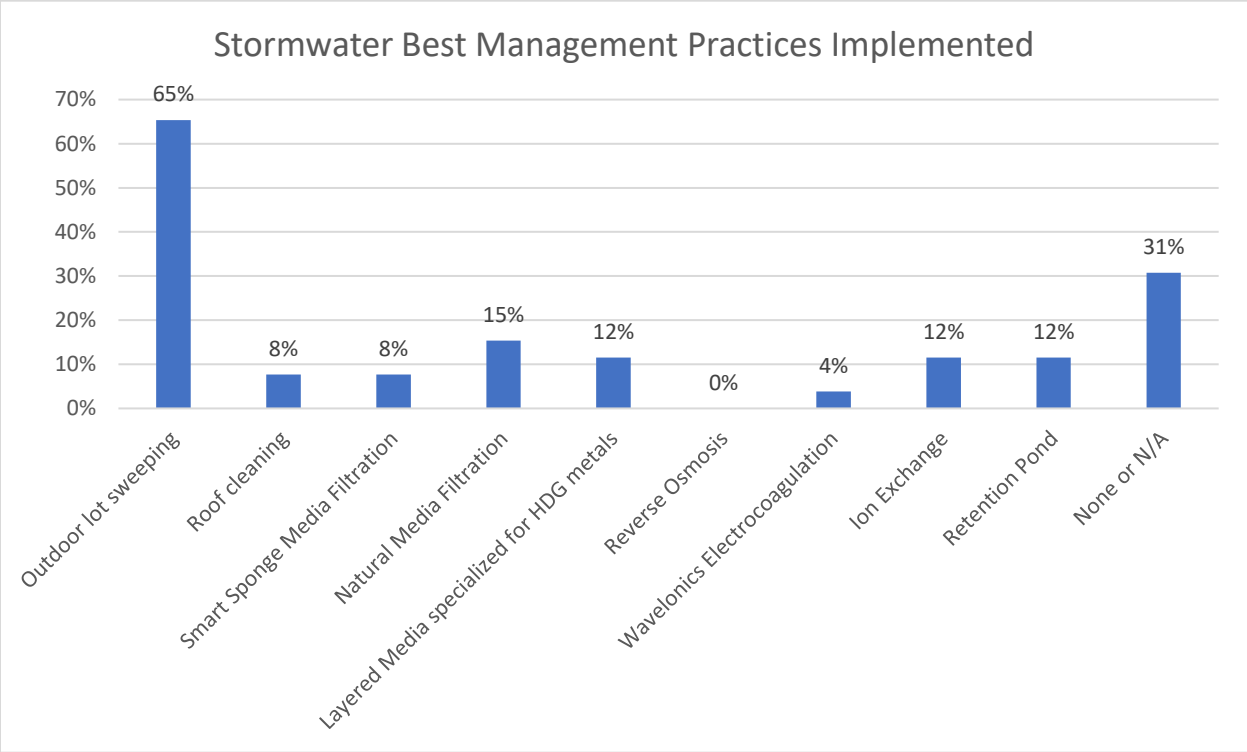
The AGA is often asked if our galvanizing members offer metallizing services. Only 12% of galvanizers offer metallizing as a full coating services beyond touch-up and repair. Almost all galvanizers offering metallizing services provide 100% Zn metallizing in-house.

Duplex System Services



Only 4% of galvanizers offer the customer the option of a duplex system in-house. The majority of galvanizers either do not offer a duplex system, or partner with a local company to provide this service.

Stormwater Treatment and/or Best Management Practices



A sustainable practices survey was conducted in 2017 which asked about various practices employed by galvanizers. In this previous survey, 34% of members utilize a stormwater system or management practice, and 76% of galvanizers reported they monitor emissions to water for stormwater permits. The 2019 Process Survey aimed to dig deeper and survey the types of stormwater treatment and/or best management practices performed by the respondents. Outdoor lot sweeping was the most common practice at 65% of plants, with a variety of practices.

FURTHER ANALYSIS

The information provided in this survey analysis is the top level of information available from the survey responses and is available to members of the AGA only. If you would like to probe deeper into the survey results or have any questions, please let the AGA know what information you seek by contacting technical@galvanizeit.org.