2003 GALVANIZING PROCESS SURVEY

John W. Krzywicki & Dr. Thomas J. Langill
American Galvanizers Association

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Introduction

The Galvanizing Process Survey was sent to members in early 2003. The response rate on this survey was average with 63 of 120 plants responding compared to 83 out of 117 plants when the survey was conducted in 1997. The surveys were answered in varying degrees of completeness. The object of the survey was to obtain an overall impression of the galvanizing industry and the tendencies within the industry. The response rate of 53% will provide a sampling of the entire hot-dip galvanizing industry but this survey will not give a complete picture.

The report on the survey results will be divided into nine areas: General Information, Mechanical Cleaning, Caustic Cleaning, Acid Pickling, Preflux, Galvanizing Furnaces, Galvanizing Kettles, Zinc Bath, Zinc Usage and By-Products, and Material Handling. The information reported in each of these sections will be provided primarily in bar graph form. The information is intended to provide a benchmark for galvanizers to locate their position in the industry and to gain insight into the performance levels that can be reached in each category. As the information is presented, there will be references to the 1997 Galvanizer Process Survey. Trends from the 1997 survey to the 2003 survey will be indicated.

The purpose of this report is to provide a benchmark for the AGA member galvanizers and to provide a source of information to evaluate individual galvanizer's performance. Since the purpose is to inform you, the galvanizer, you are invited to ask any question you have about the industry and the survey information. The easiest way to get you the information that you need to evaluate your business is to let you ask the questions that you have about the overall galvanizing business. If you submit your questions to our technical department either through fax or e-mail (technical@galvanizeit.org), we will use the information from the Processing Survey to answer your question. Each business uses their own measure for galvanizing efficiency. The method that you use to measure your plant's operation efficiency can be compared to the industry average. There are always outside factors, i.e. business mix, unforeseen accidents or incidents, or market fluctuations that will affect your company's performance. In looking at the survey results and the situation at your own company try to focus on the average survey result and the high end of the industry to see where you can improve your galvanizing production.

SECTION 1 – GENERAL INFORMATION

The first section of information is the overall plant information about working conditions and total plant production.

PLANT TYPE

The majority of the plants in the AGA are job shops, although the processing survey revealed that 16% of the responses declared that they were totally or partially captive shops. This is down slightly from 23% from the 1997 survey. Captive shops are good for the galvanizing industry, as more products have standardized on hot-dip galvanizing for their corrosion protection system. However, the decreased number of captive shops can be misleading because of the 20% decrease in response rate for the 2003 survey and the tendency of captive shops to believe that the AGA is not a benefit to their businesses.

PLANT LABOR

The galvanizing businesses are generally small in size and usually not unionized. The survey reports that 27% of the plants that responded had unions in their shop. Companies that had multiple plants were not universally unionized. There were many different unions reported in the survey, no single one of which dominated the responses.

PLANT DAILY SHIFTS

The plants that responded to the survey worked an average of two shifts per day and an average of five days per week. The number of plants that worked a three shift operation was 18% of the total plants. These values can change depending on the workloads at the plants and the overall industry workload.

PLANT DESIGN

Plant designers favor the straight-through design, with 55% of the survey responses indicating that type of design. The other two designs, U-shaped and L-shaped, each had 35% and 10%, respectively. This data indicates a slight increase in the popularity of U-shaped plants as an increase of greater than 15% was seen in this design compared to the 1997 survey. A study to explore this issue with galvanizers who are building/rebuilding plants is needed to explain this increase.

PLANT NON-GALVANIZING CAPABILITIES

There are some plants that have other capabilities inside their facility. Some of the plants, 5%, have fabrication capabilities at their location. Another small group of plants, 8%, have painting facilities at their location. Other plants, 11%, have metallizing capabilities at their location.

PLANT PRODUCTION

Many galvanizers compare their performance by measuring the total amount of steel galvanized in a plant per year. Figure #1 shows the distribution of tons of steel galvanized per year at individual galvanizing plants. The majority of the plants are processing between 1,000 and 20,000 tons of steel per year. The actual average of all the survey responses was 15,554 tons of steel galvanized per year compared to 14,788 tons of galvanized steel in the 1997 survey. Also, in this survey, the amount of steel galvanized in the two preceding years was reported as 15,733 and 16,600 tons for the years 2001 and 2000, respectively. This shows a slight drop in the amount of steel galvanized over the past three years, but a 5% increase in the amount of steel galvanized six years ago in 1997.

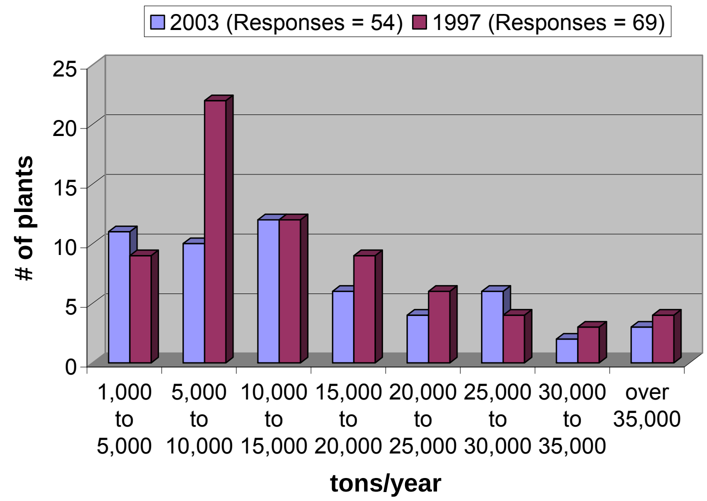

Figure #1: Tons of Steel Galvanized per Year at Galvanizing Plants

PLANT EFFICIENCY

One of the most common statistics used for comparing plant efficiencies in Europe is the pounds of steel galvanized per man-hour of direct labor. Figure #2 shows the distribution in this parameter from the survey responses. The low numbers on this plot are from plants that handle small parts, which consume man-hours in preparation but do not have much weight [The large numbers are for plants that handle large, significantly heavier parts that have significant weight but there are very few of them so manpower is kept very low]. The average for the submitting plants is 479 pounds of steel per man-hour of labor, a 7% increase since the last survey in 1997 (447 pounds of steel per man-hour of labor in 1997). This is very comparable to the values reported by the European companies that the AGA visited in 1996.

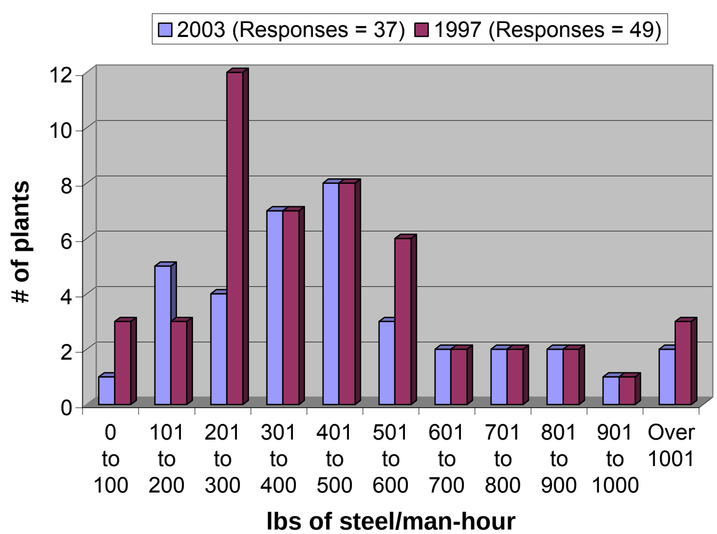

Figure #2: Galvanizing Plant Efficiency

OVERALL CONCLUSION: The galvanizing industry is galvanizing more steel with less manpower than was reported in 1997. We are making some improvements but as you can see at the high end of Figure 2 there is room for improvement.

SECTION 2 – CAUSTIC CLEANING

Most galvanizers begin their cleaning cycle with a caustic bath. There were only four out of 62 responders who had no caustic cleaning baths. There were 16 plants with more than one caustic bath, but most of these plants had more than one kettle in the plant. The general rule of one caustic bath per kettle applies to almost all of the galvanizers.

CAUSTIC CONCENTRATION

There is a wide variety in the concentration of caustic in the cleaning baths. The most common range is from 10% to 15%. Figure 3 shows the distribution of caustic concentration from the processing survey group. Those with very high concentrations of caustic may be faced with painted or prefinished articles to be galvanized, and therefore need the extra cleaning strength.

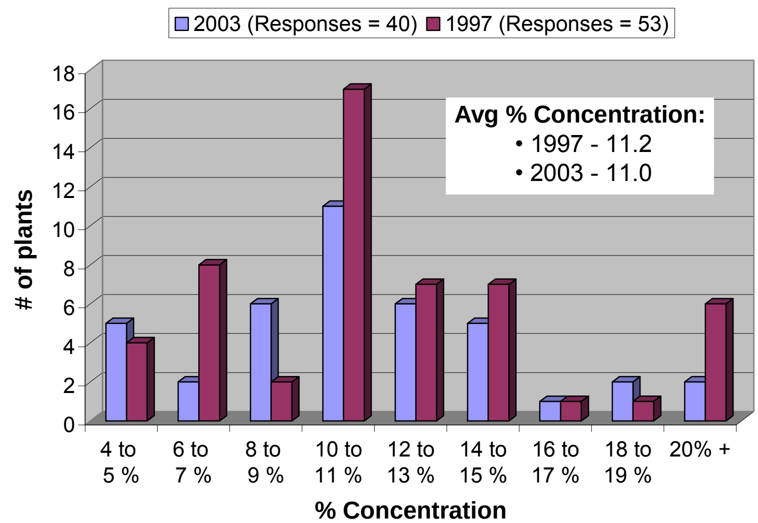

Figure #3: Concentration of Caustic Tanks

CAUSTIC pH

The pH of the caustic bath can be used to control the activity in the bath. Figure 4 shows the distribution of pH values for caustic baths as determined through the process survey. The two most popular pH values are 12 and 14. The values for pH are widely scattered, most likely due to the differing amounts of soil and organic material that are carried into the bath on the steel parts.

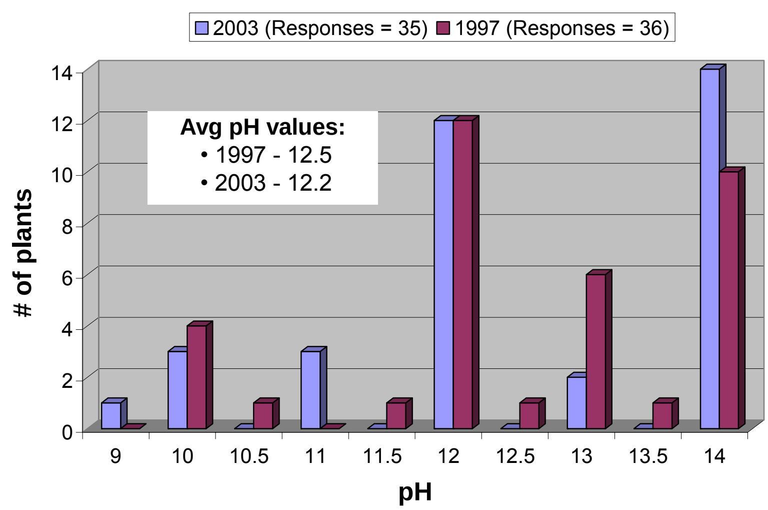

Figure #4: pH of Caustic Tanks

CAUSTIC TEMPERATURE

In order to remove the soils and organic material from the surface of the incoming steel effectively, the caustic baths are heated and, sometimes, agitated with air. Approximately 40% of the galvanizers reported using some type of air agitation in the caustic bath, which, is up slightly from 33% in 1997. Figure 5 shows the distribution of caustic bath temperatures for the galvanizing plants. Most of the baths are between 140 ^{0}F and 180 ^{0}F, with an average of 160 ^{0}F.

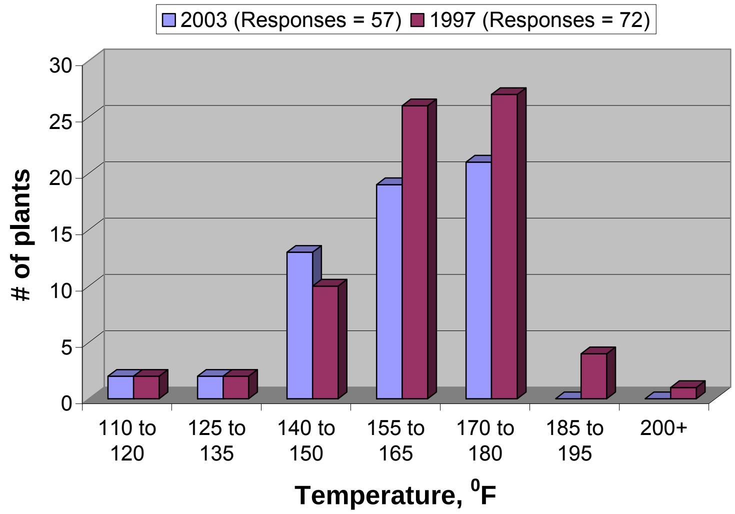

Figure #5: Temperature of Caustic Tanks

The methods for heating the caustic bath are shown in Figure 6 (below) where it is obvious that steam coils are by far the most popular heating method for caustic baths. Most galvanizers (88%) use in-house laboratories to test and analyze the caustic solution. A small percentage of the galvanizers do not rinse before the pickling baths.

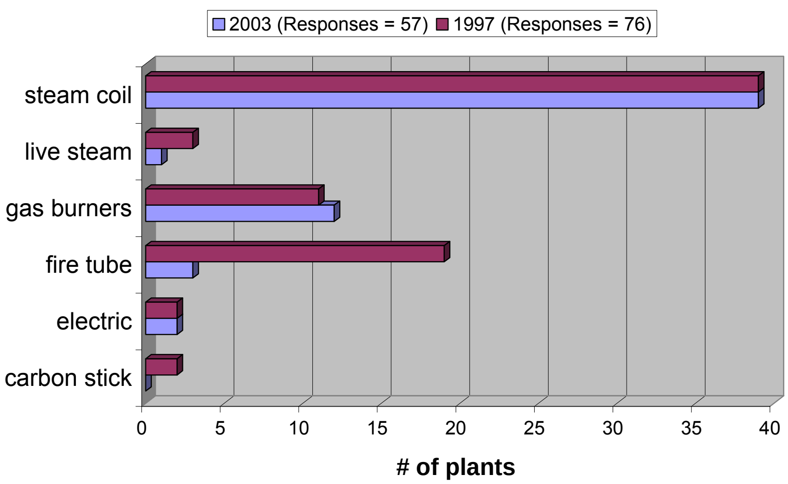

Figure #6: Caustic Heating Method

CAUSTIC RECYCLING AND DISPOSAL

The most common method of treating spent caustic solution is to neutralize the solution and then send it to a landfill. However, 17% of the galvanizers who dispose of their spent caustic solution prefer deep-well injection and 10% reported that they recycle. The spent caustic or the caustic sludge that develops at the bottom of the tank is almost exclusively removed by decanting the liquid and then removing the bottom sludge. This sludge can be neutralized and then land filled. Three galvanizers use an in-line filter to continuously keep their caustic tank clean. Half of the galvanizers also reported that their spent caustic rinse solutions are used as make-up for fresh caustic solutions.

OVERALL CONCLUSION: Caustic baths seem to be in control with the galvanizers being more aware of the need to monitor and more closely maintain their caustic solution. Lower temperatures and higher pH’s may be indicating that it is cost effective for galvanizers to use higher solution concentrations for faster cleaning rates instead of elevating the temperature.

SECTION 3 – ACID PICKLING

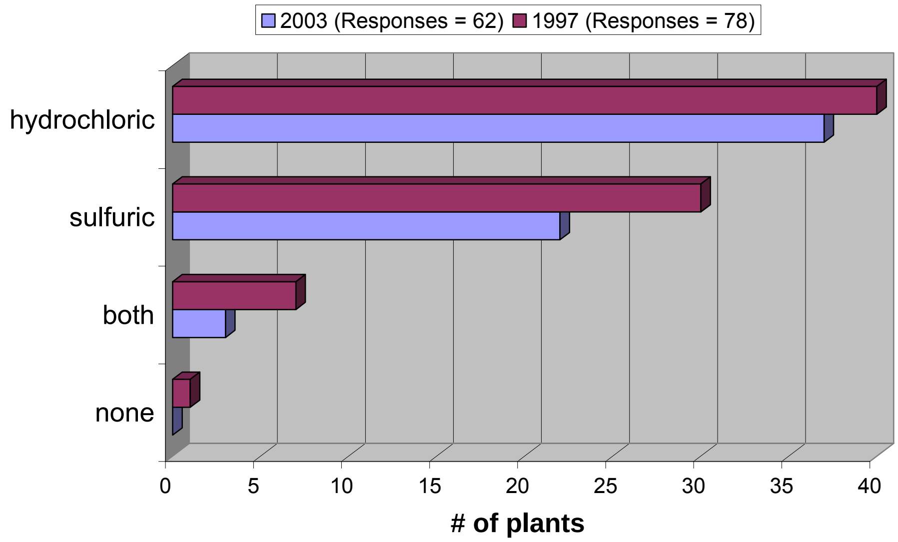

Figure #7: Acid Type

The trend in acid pickling is towards the use of hydrochloric acid as the pickling solution. When a processing survey was conducted in the early 90's, the use of sulfuric acid and hydrochloric acid was evenly divided amongst the galvanizing plants. The 1997 survey showed that 54% of the galvanizers used hydrochloric acid to pickle their steel. The most recent numbers continue to show the transition to hydrochloric acid pickling solutions. Of the 62 survey respondents to the 2003 survey, 60% use hydrochloric acid to pickle their steel. The new plants that are being built are almost all designed to use hydrochloric acid pickling. The major drawback to hydrochloric acid pickling is the lack of a proven recycling system at a reasonable cost as well as the acid's effect on fixtures, jigs, and the plant structural steel. There has been an improvement in hydrochloric acid recycling technologies which may prove to further increase the use of hydrochloric acid. While the sulfuric acid pickling does have a proven, reasonably priced acid recycling technology, there are a couple of drawbacks to the use of sulfuric acid. The major disadvantage of using sulfuric is the need to heat the bath to temperatures in the vicinity of 160 F. The other difficulty in using sulfuric acid is the manner in which sulfuric acid removes the iron oxides by attacking the underlying steel. This can cause difficulties with critical dimensions in machined parts and holes in fabricated parts.

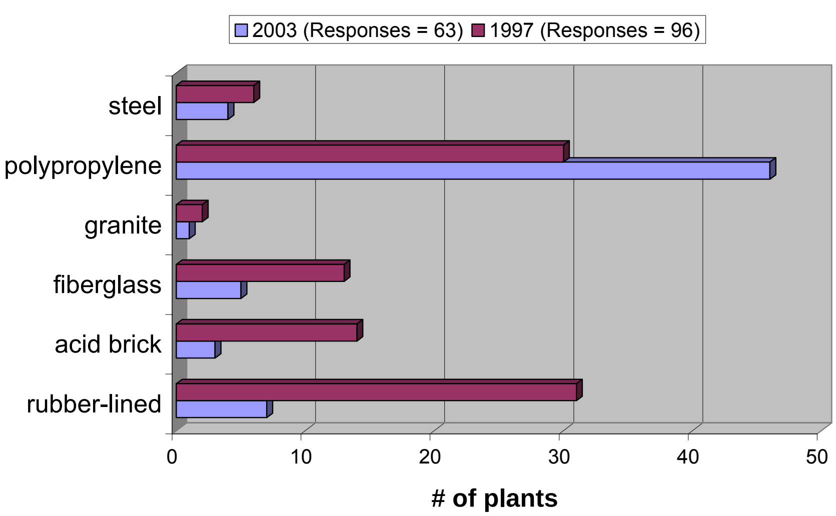

Figure #8: Acid Tank Material

ACID TANK MATERIALS

There are a number of different types of tank materials used by galvanizers to hold the pickling acid. However, nearly 3/4 of galvanizer surveyed last year reported the use of polypropylene tanks. This tank material has made significant progress in the last couple of years and is being used more and more often. The most common material reported six years ago was the rubber-lined steel tank, but it only accounts for about 10% of the responses in the 2003 survey. There are still a few plants with other materials, but as those tanks degrade and require replacement they most likely will be replaced with polypropylene tanks.

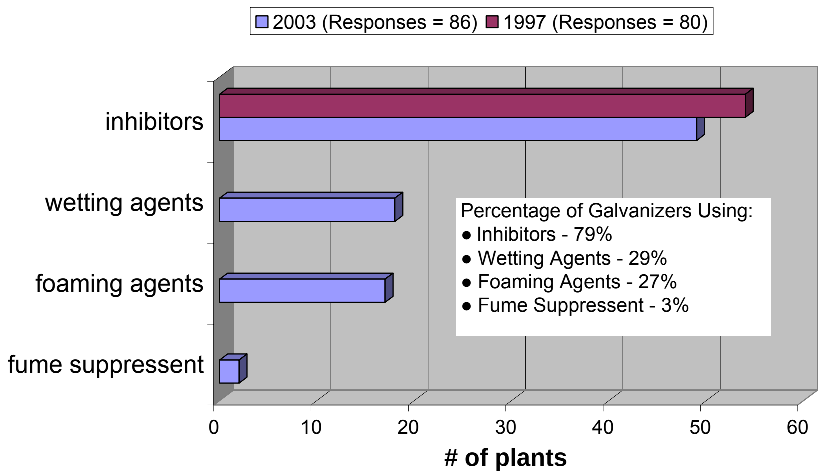

Figure #9: Acid Additives

ACID ADDITIVES

The majority of the galvanizers add chemicals to their pickling baths to either increase the efficiency of pickling or reduce fuming. Nearly 90 % of all galvanizers polled use chemical additives in their pickling tanks. The use of inhibitors with sulfuric and hydrochloric acids aids in controlling the potential for over-etching the surface of the steel.

ACID RINSING

Rinsing the acid off of the steel surface is a very important factor in controlling the flux bath chemistry and maintaining an effective flux bath by reducing the amount of iron carry over from the pickling process. Only four galvanizers who responded reported that they did not use a rinse tank following acid pickling.

HYDROCHLORIC ACID

The concentration of the hydrochloric baths is shown in Figure 10. In 1997, most galvanizers used the recommended range from 10 to 12% acid concentration but, the 2003 results shows, many galvanizers now allow the bath to start with a higher concentration and then allow it to gradually decline to the 10 to 12% region. There is no real benefit to having concentrations above 12% since there is no increased pickling rate at the higher concentrations. The large range of hydrochloric acid concentrations shows that this part of the process is not an exact science. Most galvanizers rely upon their own personal experiences to determine the operation acid concentration for their plant.

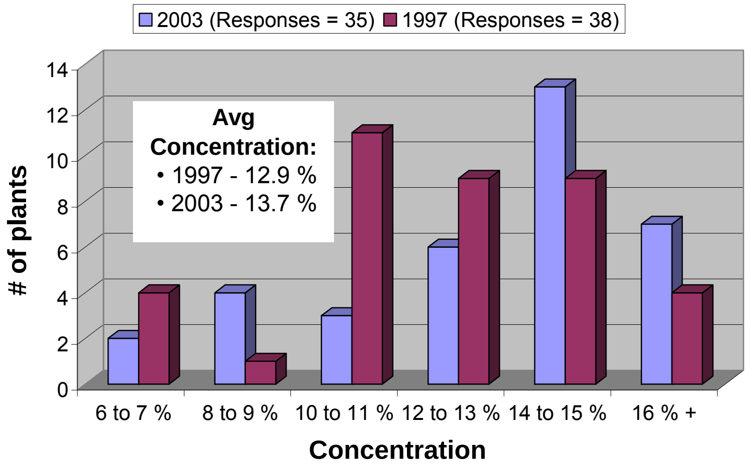

Figure #10: Concentration of HCl Pickling Baths

The number of acid tanks in each plant also shows a wide variance as seen in Figure 11. The benefit to using hydrochloric acid over sulfuric acid is its ability to perform efficient cleaning at ambient temperatures. Figure 11 shows the number of tanks per galvanizing facility. The larger galvanizers use more hydrochloric pickling tanks than the smaller galvanizers. One of the potential difficulties with using multiple tanks and staging the work at these sites is that the use of hydrochloric acid is very hard on the fixtures and jigs.

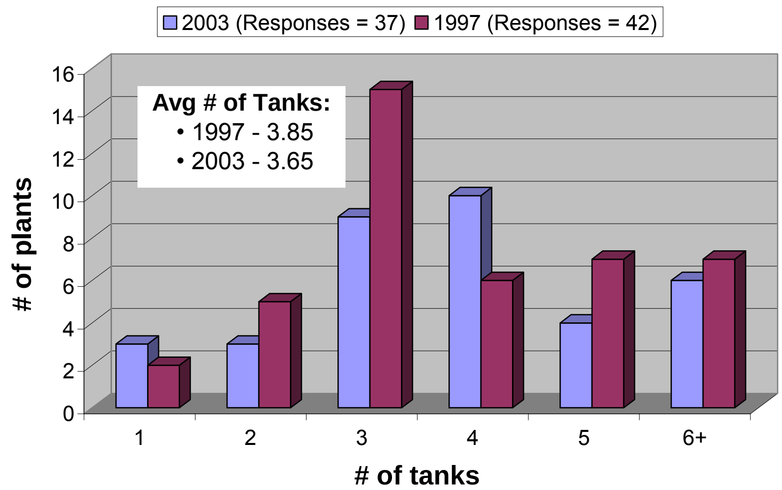

Figure #11: Number of Pickling Tanks at Hydrochloric Plants

SULFURIC ACID

The concentration of the sulfuric acid pickling baths is more tightly controlled as shown in Figure 12. The combination of acid concentration and bath temperature, which is shown in Figure 13, determines the pickling rate in a sulfuric pickling bath. The pickling rate is very important when using sulfuric acid because the acid attacks the underlying steel and roughens the surface if the part is overpickled. The amount of metal dissolved in the acid also has a large role in determining the pickling rate. Parts cannot be allowed to spend a long time in the pickling bath, as the acid will continue to attack the steel material.

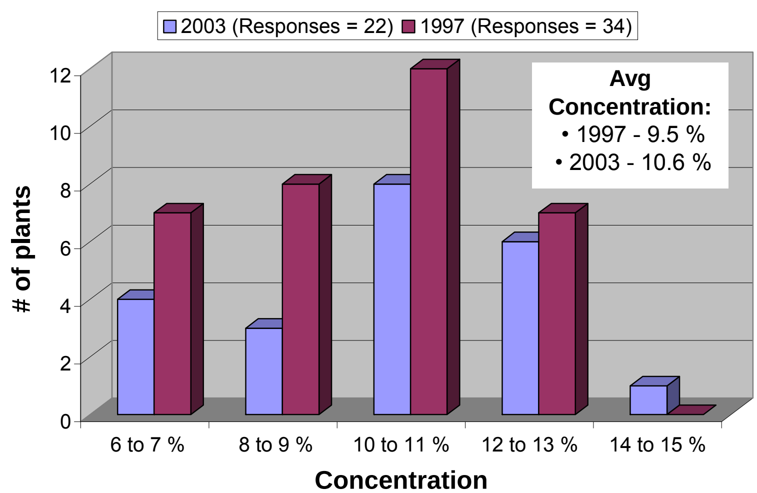

Figure #12: Concentration of Sulfuric Acid Pickling Tanks

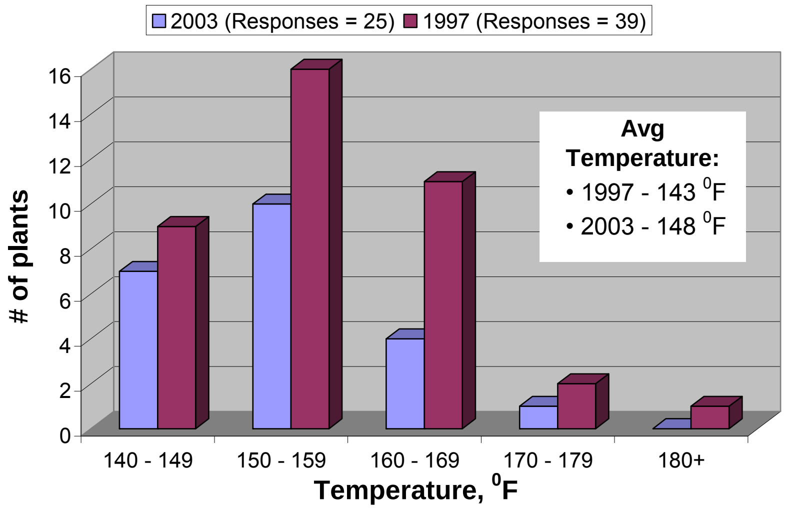

Figure #13: Temerature of Sulfuric Acid Pickling Tanks

Most galvanizers have a low number of sulfuric acid pickling tanks unless they have multiple kettles. The most common number of sulfuric acid pickling tanks is three, shown by Figure 14. Since sulfuric acid pickling can attack the underlying steel, control of the pickling bath and of the bath conditions is critical to successful galvanizing. The most common method of heating the sulfuric acid is through the use of steam coils. Figure 15 shows the different methods used to heat the sulfuric acid pickling tanks. The use of steam coils provides heat without introducing excess water in any form to dilute the acid. There are many different coil materials used to deliver the steam, but these materials are somewhat delicate and susceptible to handling damage.

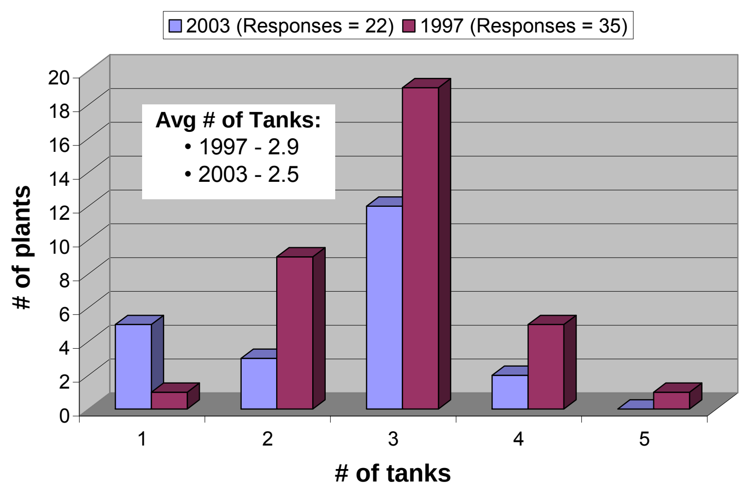

Figure #14: Number of Sulfuric Acid Pickling Tanks

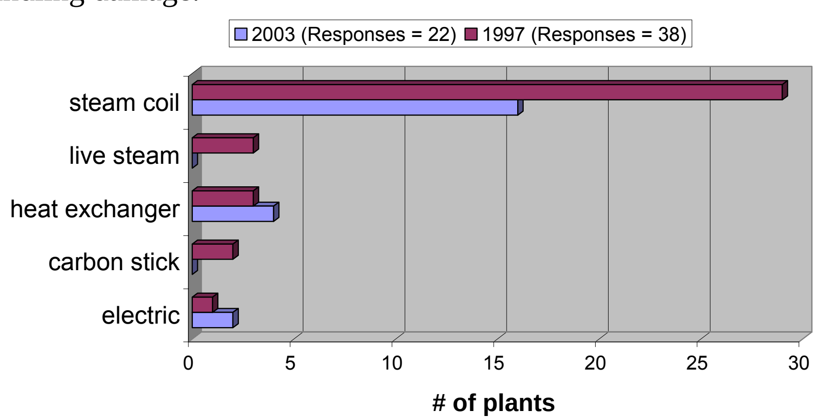

Figure #15: Sulfuric Acid Tank Heating Material

Although sulfuric acid pickling requires more control on the process, it can be accomplished quickly and efficiently with the proper techniques. The disposal of spent sulfuric acid is the major benefit to this technology since there are proven, relatively low cost recycling systems available in the marketplace. Maintaining good bath chemistries and recycling the spent acid are the two key elements to a successful sulfuric acid pickling system.

SPENT ACID DISPOSAL & RECOVERY

Figure 16 shows the number of galvanizers who have the source or the equipment to recycle their acid baths. As can be seen for sulfuric acid pickle baths, a few galvanizers have taken advantage of the recycling technology and have a recycling system. The percentage of galvanizers using sulfuric acid recovery systems has remained fairly level over the past six years. The hydrochloric acid users have a low number of recycling systems, but the introduction of some new systems in the past few years has shown the presence of a cost effective, viable recovery system for hydrochloric acid.

Galvanizers who do not recover their spent acid dispose of it by neutralizing it and sending to a landfill or injecting it into a deep-well. Two-thirds of the respondents that don't recycle dispose of their hydrochloric acid by deep-well injection, the other third by neutralization. Nearly 50% of galvanizers that use sulfuric acid recycle the solution, those who don't recycle, equally prefer deep-well injection or neutralization as their disposal option.

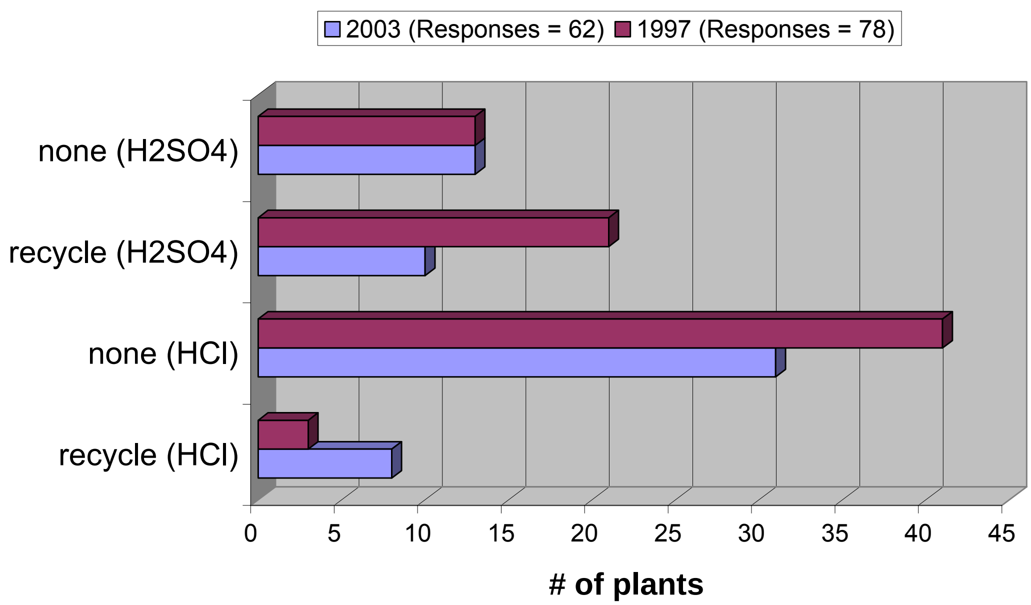

Figure #16: Acid Recycling

OVERALL CONCLUSION: For sulfuric acid the average temperature of the bath is about the same as the last survey but there are fewer galvanizers operating at high temperatures due to energy costs. They may be compensating by increasing the initial concentration of the acid baths. For hydrochloric acid, the tendency is to make this the acid of choice for new plants.

SECTION 4 – FLUX CLEANING

The majority of galvanizers use preflux tanks to apply flux. Figure 17 shows the numbers of galvanizers who use preflux tanks and those who still have top flux systems. There are 8 galvanizers out of the survey responders who still use some type of top flux system in their plants, down from 18 galvanizers who used top flux as reported in the 1997 survey.

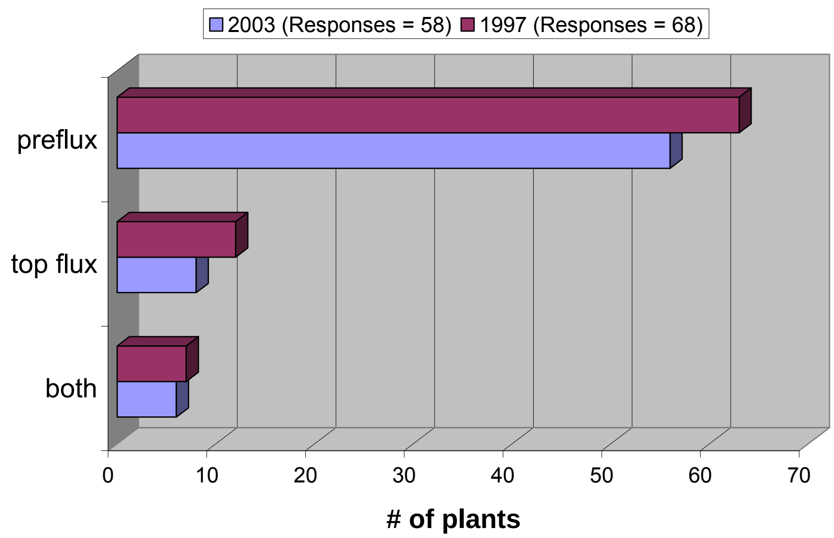

Figure #17: Type of Flux

PREFLUX TEMPERATURE

The preflux bath is maintained at an elevated temperature, usually in the neighborhood of 150 F. Figure 19 shows the various set points for temperature that the galvanizers use in their preflux bath. The higher the temperature of the preflux, the quicker the drying time is after prefluxing. Drier parts have less zinc spatter and, thereby, contribute to lower operating costs.

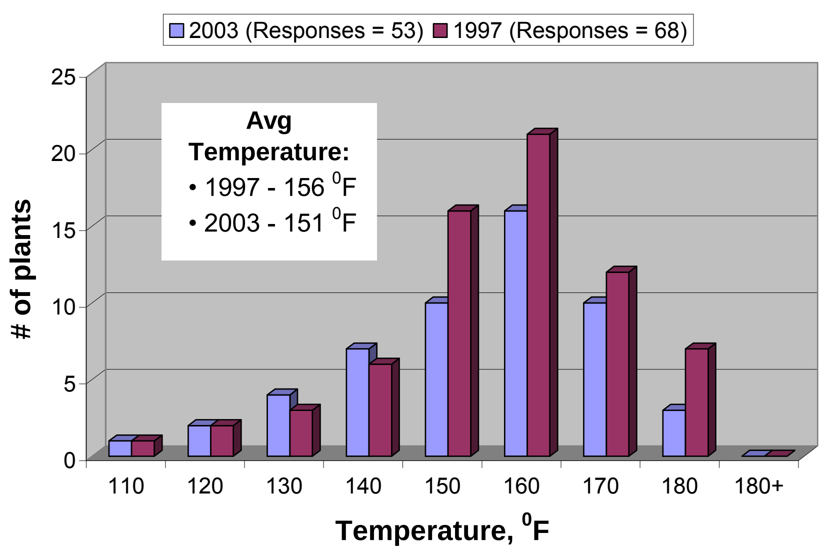

Figure #18: Preflux Bath Temperature

PREFLUX TANK CONSTRUCTION

The preflux bath is maintained in a tank similar to the acid and caustic baths. The materials for construction of the preflux tanks are shown in Figure 20. As in the acid and caustic baths, the predominant material is polypropylene. The use of other materials such as polypropylene is on the rise.

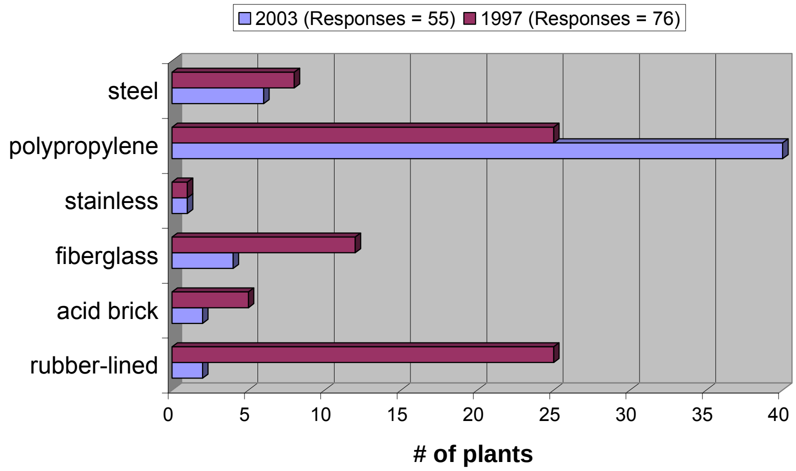

Figure #19: Preflux Tank Materials

PREFLUX HEATING MATERIALS

Preflux tanks must be heated and the heating systems most commonly used are the same as the acid and caustic heating systems as shown in Figure 21. Once again, steam coils are the preferred method of heating the preflux tank. The use of carbon sticks to heat the preflux tanks is second in popularity.

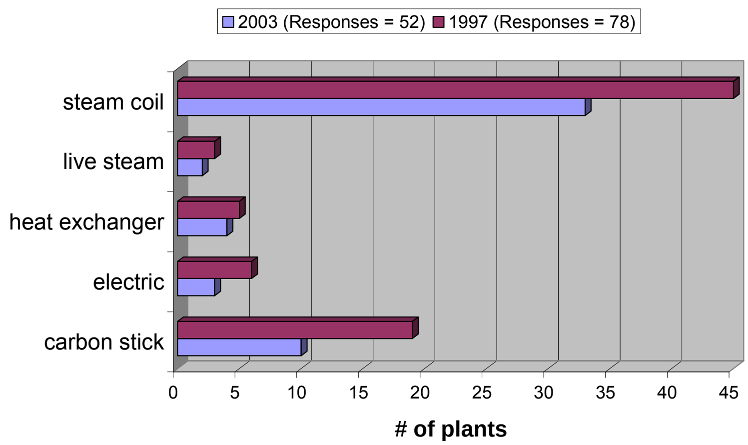

Figure # 20: Preflux Heating Method

PREFLUX MAINTENANCE

The preflux tanks must be cleaned periodically. Figure 21 shows the different methods galvanizers use to clean their tanks. The use of in-line filters and filter pumps is increasing and significantly reducing the number of times that a preflux tank must be cleaned. The preflux tank accumulates a significant amount of iron, some of which can be removed through the in-line filter. More than half of the galvanizers using preflux tanks use the traditional method of removing the liquid preflux and shoveling out the sludge at the bottom of the preflux tank.

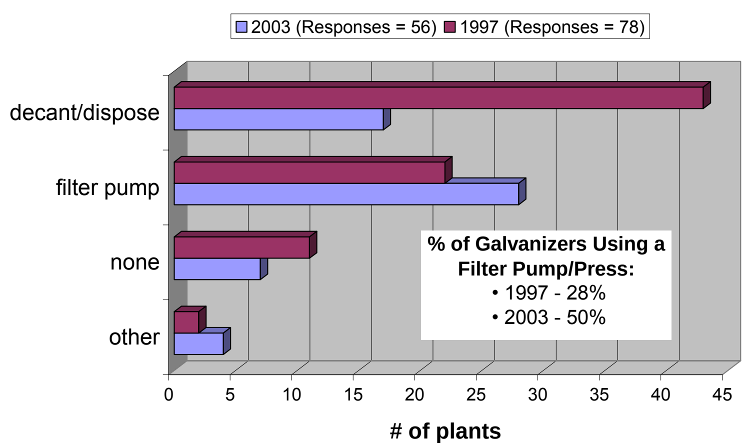

Figure #21: Preflux Maintenance

OVERALL CONCLUSION: The preferred flux system incorporates a preflux tank and this processing technique has been the preferred method for years. Like other heated chemicals, the average temperature is down, which is assumed to be related to increased energy costs. The filtering of flux is becoming very popular as it extends the life of a flux tank significantly and is easier than chemical filtering.

SECTION 5 – ZINC KETTLE

This is an area in which some changes have taken place since the last survey was taken. The standard galvanizing kettle is becoming longer and deeper. In the 1997 survey, 30 of 82 galvanizing facilities had more than one kettle on site. The largest supplier of galvanizing kettles is Columbiana Boiler Company with over 90% of the responders using Columbiana kettles.

KETTLE DIMENSIONS

The kettle lengths for the responding galvanizers are plotted in Figure 22. The distribution of kettle size is fairly even with the exception of the 26 to 35 feet range that includes nearly one-third of the reported kettle lengths. The average length for the galvanizing kettles included in this survey was 32 feet, which is slightly higher than the reported 29.5 feet back in 1997. The main consideration in choosing a specific kettle length is the mix of products that are to be galvanized in a particular kettle. The length of a galvanizing kettle does not significantly affect the total capacity of a particular kettle. However, an increase in kettle size indicates a rise in customer demand to galvanize longer products.

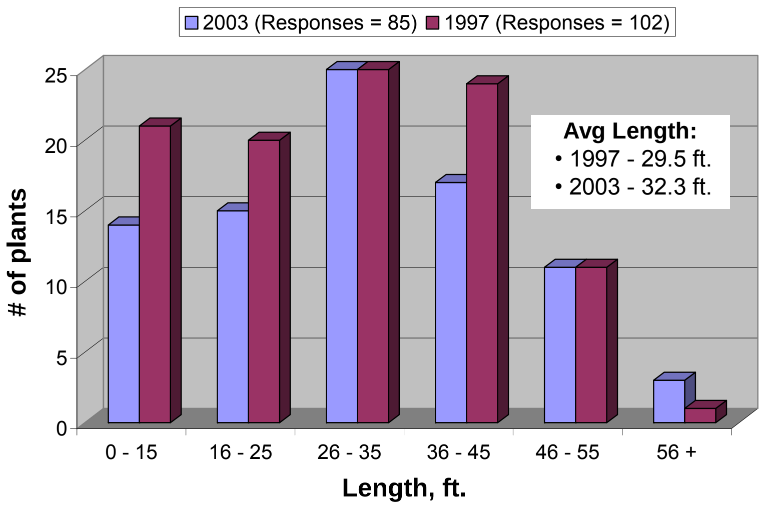

Figure #22: Kettle Length

The width of galvanizing kettles has stayed constant from the last survey in 1997 to the present survey in 2003. Most of the galvanizing kettles are 5 feet or less in width. The increase above 5 feet in width will actually decrease the theoretical capacity of any particular kettle since there is more zinc in the kettle to maintain at the galvanizing temperature. Figure 23 shows the distribution of galvanizing kettle widths from the survey responders. There are only a few galvanizers with kettle widths over 6 feet. As with the kettle length, the kettle width should be chosen to match the product mix for a particular plant.

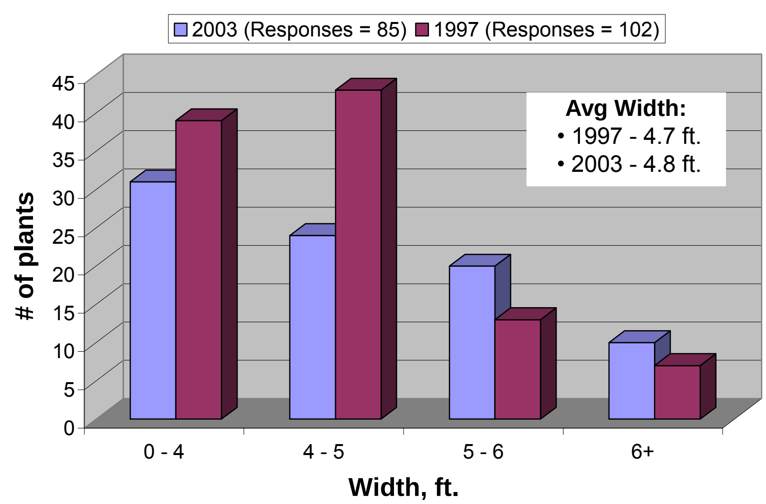

Figure #23: Kettle Width

Kettle depth, on the other hand, has been steadily increasing each time this study has been conducted. Figure 24 shows the distribution of kettle depths from the survey responders. The depth has increased from an average near 4 feet in 1991, to just over 6 feet in 1997, and up to 6.6 feet in 2003. This increase in depth allows the galvanizers to significantly increase their theoretical production capacity. The greater depth in the kettle provides a larger heat sink, which makes kettle depth the most influential dimension of the kettle with respect to theoretical capacity.

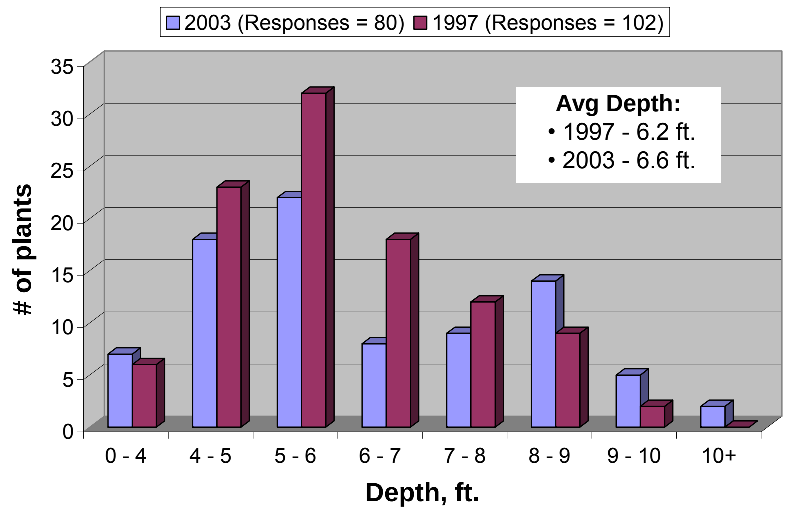

Figure #24: Kettle Depth

KETTLE ENCLOSURES

There have been a number of plants required to have kettle enclosures with bag houses to prevent excessive zinc oxide fumes from escaping into the atmosphere. The survey data shows that 22 out of 62 respondents have enclosures. This indicates a 180% increase in the use of enclosures from the previous data. The survey conducted in 1997 showed that only 16 of the 82 responders had kettle enclosures with bag houses. As environmental restrictions on emissions increase more plants will be required to implement a kettle enclosure and bag house system. These enclosures reported in the survey were manufactured and installed by a number of different companies.

CENTRIFUGE & SPINNERS

Many of the galvanizers had centrifuging capabilities. Thirty-eight of the 62 responders replied that they had spinning capability through either a Barrett Centrifuge or a Spin-a-Batch system. There were a few who had both systems. This data is very consistent with the 1997 survey in which 53 of 82 galvanizers had spinning operations.

KETTLE FURNACE

For the kettle furnace, there are several companies who install furnace systems. A few galvanizers use their own in-house designs. There are two main types of furnaces; flat flame and end-fired high velocity. There is an even split between the two systems. The end-fired system is being installed more frequently in new facilities. Most

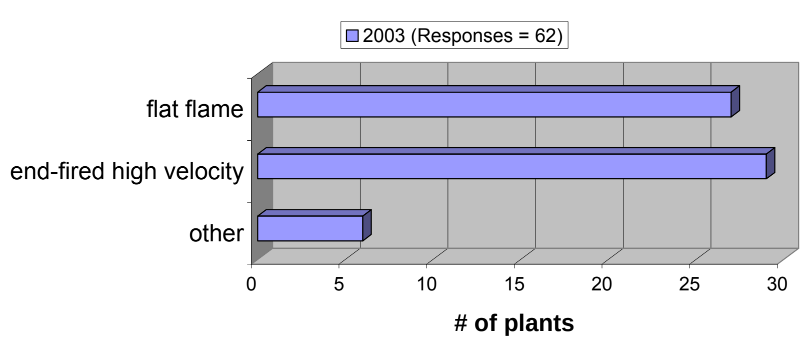

Figure #25: Types of Kettle Furnaces

galvanizers operate their kettle between 825 F and 850 F. However, the averages found in 2003 and 1997 indicate differently. This is most likely representative of galvanizers reporting the temperature at which the kettle is at during off hours. The median of the data is often a better indicator of the most common operating temperature. It is a safe assumption that most kettles operate near 825 F. The average number of thermocouples used to measure kettle temperature is 2.4 and are most commonly installed at the input end of the kettle. All of the galvanizers reported having a high temperature alarm on the kettle and almost all have a low temperature alarm. About half of the galvanizers have a low level alarm and a leak detection system.

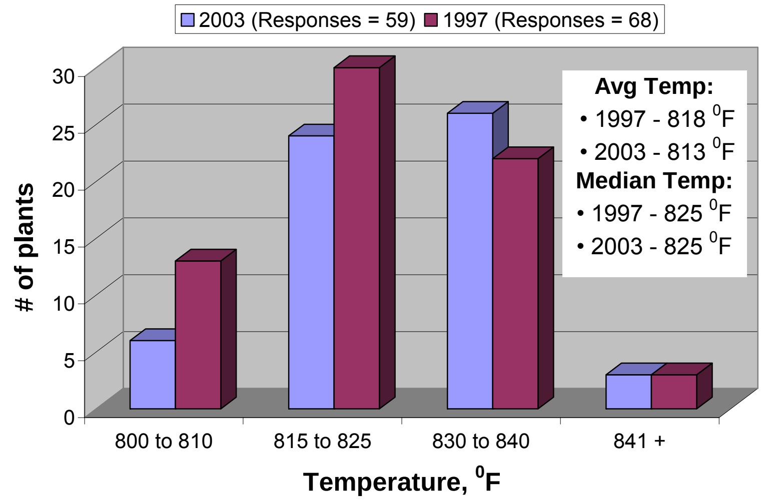

Figure #26: Idle Kettle Temperature

KETTLE LIFETIMES

Galvanizing kettles last an average of five to seven years depending on the usage and the kettle maintenance. Figure 27 shows the reported lifetimes of various kettles. Many of these lifetimes represent planned maintenance events as opposed to actual kettle failures. Galvanizers use one of two criteria for scheduling kettle replacements, either number of years of service or tons of steel galvanized. For those who have very high production rates, a spare kettle is a necessity. The data shows that kettles are lasting one half year longer on average compared to data take from the 1997 survey.

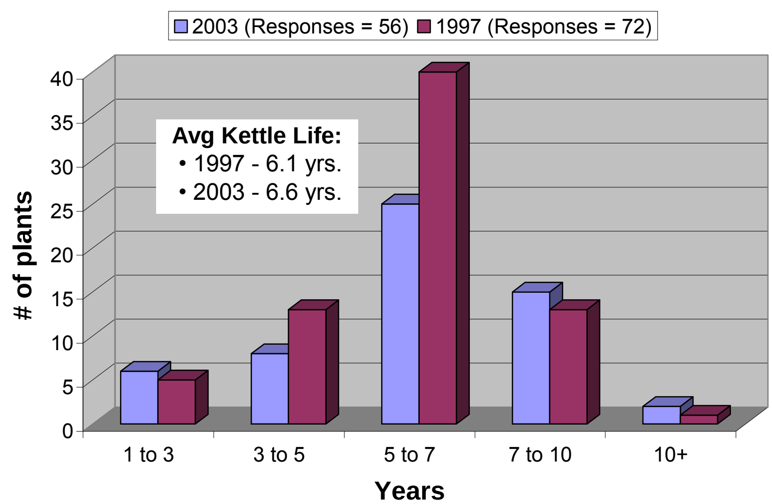

Figure #27: Life of Galvanizing Kettles

OVERALL CONCLUSION: The galvanizing kettles are becoming longer and deeper increasing the overall galvanizing capacity in North America. The care of galvanizing kettles is improving and this is increasing the life of the kettles. The end-fired system of kettle heating is proving itself to be economical and reliable.

SECTION 6 – ZINC METAL

The response from the processing survey showed that the majority of galvanizers use Prime Western zinc. Of the respondents, 44% Prime Western zinc only, 24% use High Grade only, 23% use Special High Grade only, and 9% use a combination of zinc types. This data show a significant trend towards lowering the lead content of galvanizing baths. The number of high grade baths has increased by 50% and the number of special high grade baths has doubled since the last survey in 1997.

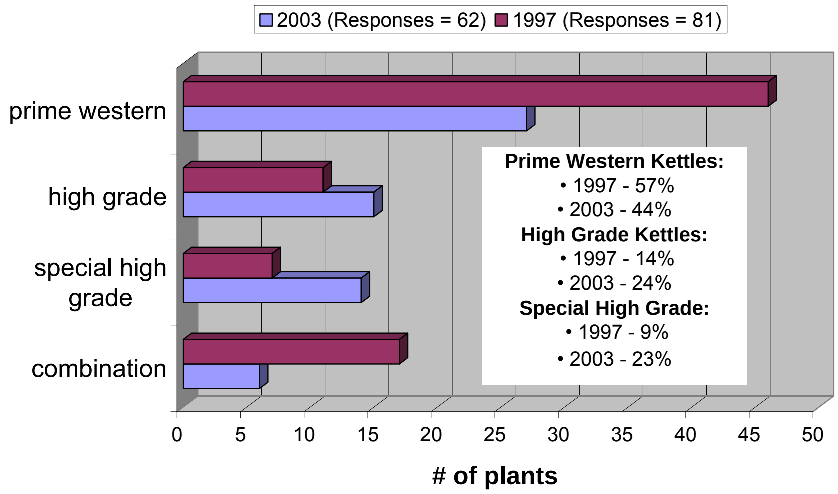

Figure #28: Types of Zinc Used

BATH CHEMISTRY

There were approximately 38 survey respondents who fully or partially reported their bath compositions. Out of the 34 galvanizers reporting lead, nine had lead concentrations below 0.2% in their bath. Aluminum concentrations in the zinc baths were all reported below 0.01%. There were 37 galvanizers who reported using nickel in their bath up from 17 reported in the 1997 survey. Bismuth is being used more in kettles as 35 galvanizers reported bismuth in their kettles. This is up from 15 galvanizers in 1997. As more galvanizers look to reduce lead concentrations in their kettle, bismuth will be used more frequently to increase the fluidity of the bath and thus drainage off of the work.

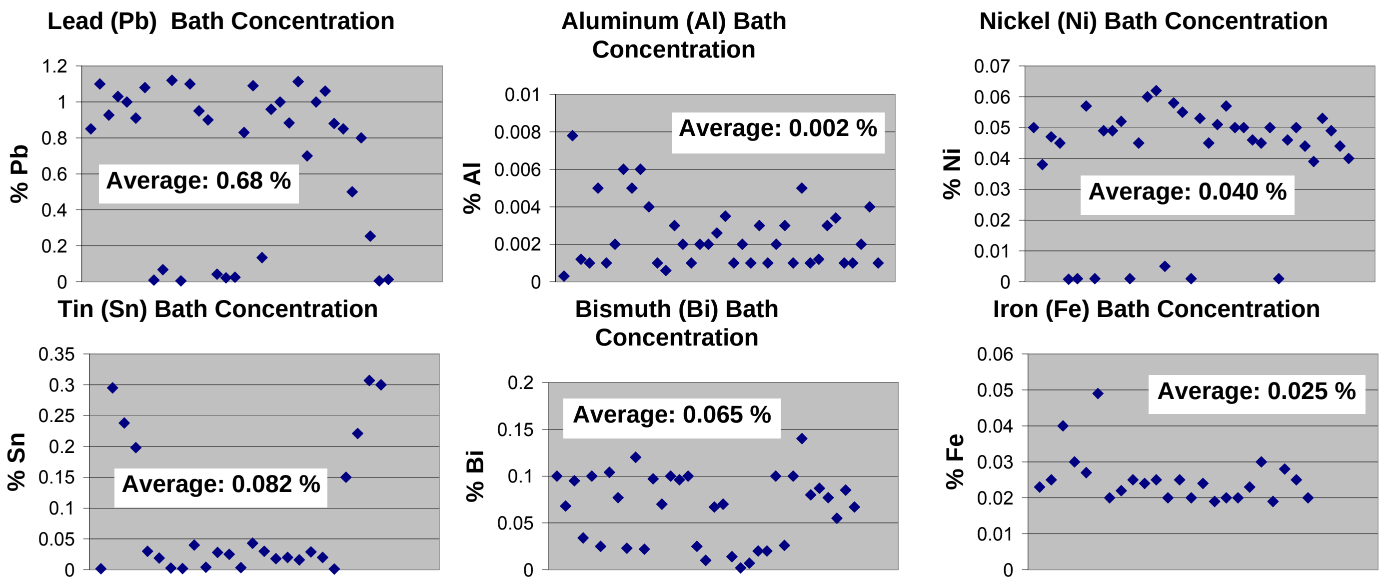

Figure # 29: Zinc Bath Chemistries

OVERALL CONCLUSION: More galvanizers are switching to low lead baths. This switch is going to require more attention in the post-galvanizing cleaning area to give high quality galvanizing.

SECTION 7 – ZINC BY-PRODUCTS

ZINC USAGE

The annual percentage of zinc usage, as calculated from the responses to the processing survey, is an average of 6.07%. There were 47 galvanizers who provided information on this part of the survey. This figure represents the total zinc usage and steel galvanized for these plants. The zinc usage is down from 6.64%, reported by the companies who responded to the 1997 survey.

ZINC DROSS & SKIMMINGS

The average numbers for the zinc by-product figures are 12.73 pounds of dross per 100 pounds of zinc and 13.81 pounds of skimmings per 100 pounds of zinc. The dross production is slightly down from the 14.77 pounds of dross per 100 pounds of zinc reported in 1997, which shows increased galvanizer efficiency in limiting the formation of this costly by-product. The pounds of skimmings per 100 pounds of zinc used stayed fairly level and showed only a slight decrease from the 13.93 pounds reported in 1997. On the average, over 20 pounds of zinc from each 100 pounds delivered leaves the plant as by-products from the galvanizing operation when taking into account the average percentage of zinc in dross and skimmings (94 % and 70 % respectively).

OVERALL COCLUSION: This data shows an industry wide trend to reduce the amount of zinc consumed to lower operating costs at the galvanizing plant. This could be the product of kettle bath additions, such as nickel, which aid in keeping coating weights lower and closer to the ASTM specifications. This could also be the product of better galvanizing operations, as more care is focused towards minimizing by-product formation, and or reclaiming zinc from otherwise wasteful consumers. This yet again highlights the importance of managing the production of zinc by-products in the galvanizing kettle.

SECTION 8 – QUENCHING

The most recent process survey data suggests extensive use of quench baths in the hot-dip galvanizing industry. Of the 62 respondents, 50 report the availability to quench steel articles either in water tanks or tanks containing chromate. Some galvanizers have multiple quench tanks at their plants and have the ability to either chromate quench for passivation purposes or simply water quench to facilitate cooling of the steel. A few galvanizers employ two water quench tanks or two chromate quench tanks. None of the surveyed galvanizers report the usage of any other additives in the quench tank other than chromate.

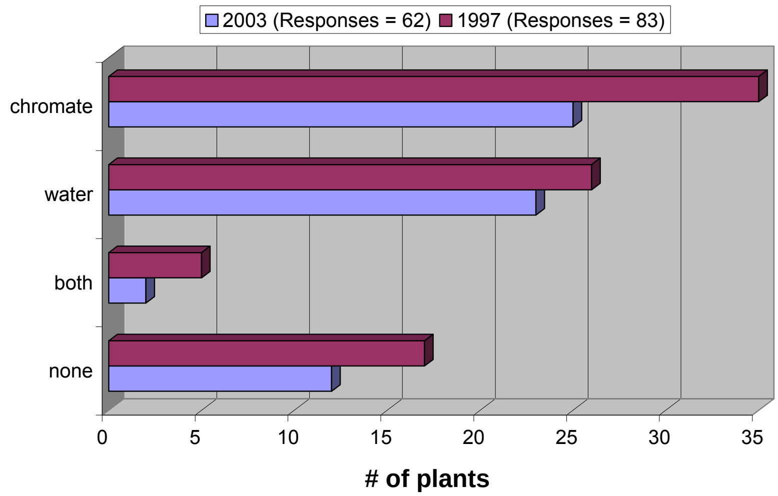

Figure #30: Types of Quench Tanks

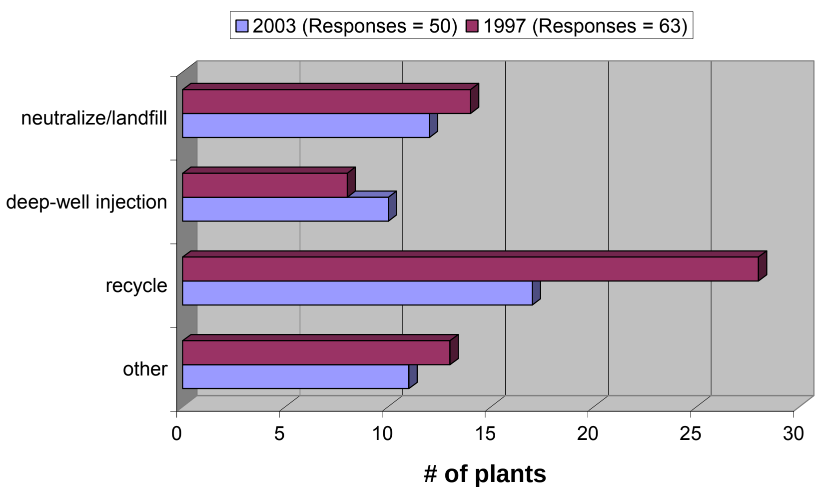

Figure #31: Quench Disposal

There is a fairly good distribution in the way galvanizers handle their spent quench solutions. The majority dispose of the spent solutions by recycling them, or using them as make-up for other tanks in the process. A fair amount of galvanizers simply dispose of their spent solutions by neutralization and shipping to a landfill, or by using deep-well injection. A few galvanizers who solely use water quench tanks reported that the solution is never disposed.

OVERALL COCLUSION: This data shows that suitable alternatives to chromates as a passivation agent in quench tanks have not quite made it into practice. Alternatives to chromates are being researched throughout the world due to the negative environmental aspects of utilizing chromates in industry. However, no alternatives that posses the excellent zinc passivation properties of chromates has been found as of yet.

SECTION 9 – MATERIAL HANDLING SYSTEMS

There are two primary systems for material handling in galvanizing plants, bridge cranes and monorail cranes. Of the survey responders 56 galvanizers reported using bridge cranes in their plants and 55 galvanizers reported using monorail cranes.

BRIDGE CRANES

The galvanizers that used bridge cranes generally had more than one in the plant. Figure 31 shows the distribution of bridge cranes in the galvanizing plants. Those with more than five bridge cranes generally had no monorail systems and had multiple kettles or other processing stations such as painting. The capacity of the bridge cranes is shown in Figure 33. This number can often be the limiting factor for large kettles since the size of the parts to be galvanized is quite large; the bridge crane capacity must be sized to handle the very heavy pieces. Generally speaking, the capacity of bridge cranes is larger than monorail systems. The plants that concentrate on heavy structural parts and assemblies favor bridge cranes for their large loads.

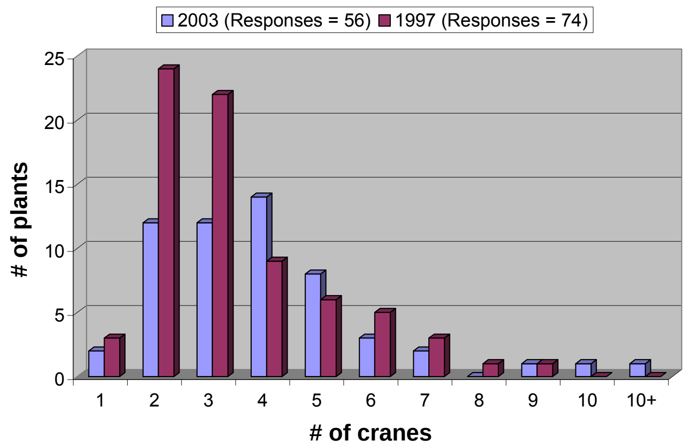

Figure #32: Number of Bridge Cranes

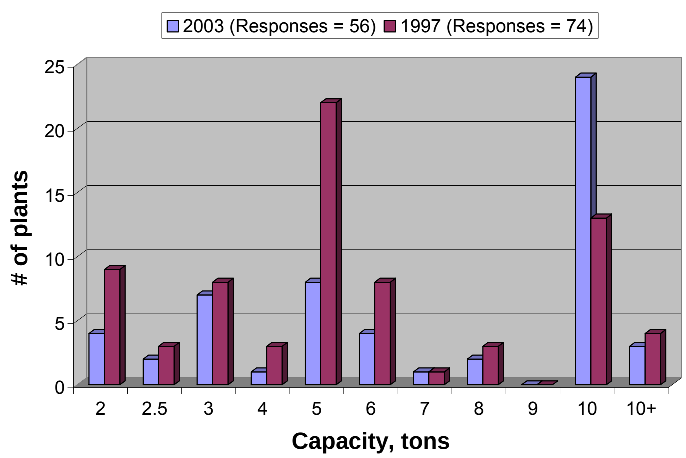

Figure #33: Capacity of Bridge Cranes

One of the features of bridge cranes that limit its usefulness is the inability of the system to travel backwards inside the plant while other work is being performed. The use of multiple bridge crane systems requires staging areas within the production line so that material can be set down and transferred to another bridge crane. Often, in hydrochloric acid pickling plants, this is accomplished by staging pieces in the acid tanks. With only one bridge crane, the crane must be returned to its starting point for each load to travel through the cleaning area.

MONORAIL CRANES

The number of monorail cranes in the galvanizing plants varies widely depending on the plant layout and the number of kettles in the plant. Figure 34 shows the distribution of monorail cranes in the galvanizing plants. The plants with very high numbers of monorail cranes have no bridge cranes in their plants.

The capacity of the monorail systems is, in general, lower than the bridge crane capacities. Figure 35 shows the distribution of monorail capacities for the galvanizing plants. The capacities are small but generally more than one monorail crane is used for a load of steel.

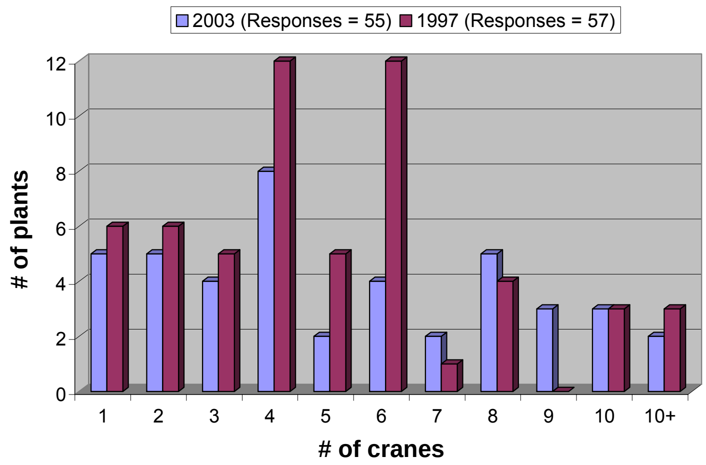

Figure #34: Number of Monorail Cranes

CHAIN & WIRE

Two materials are used for chaining and racking material at most galvanizing plants. The most commonly used material for chaining steel loads is proof coil chain because of its performance in the zinc bath. Chain sizes range from 1/4" up to 1", with 3/8" as the most frequently used size of chain. The most commonly used wire material for ties at the galvanizing plant is #9 soft annealed wires. The largest size wire used is also the most common size and the smallest wire being used is #14.

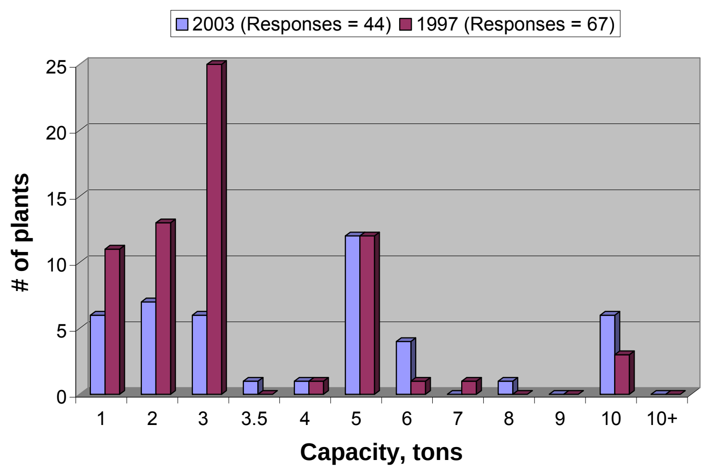

Figure #35: Capacity of Monorail Cranes

RACKING SYSTEMS

Most galvanizers use some type of racking system to facilitate steel movement through the galvanizing operations. Only 15 of 55 responding galvanizers solely use universally designed racking systems, while 40 galvanizers use a combination of universal and their own design to accommodate certain product mixtures.

OVERALL CONCLUSION: More material handling equipment is being used in plants to produce more galvanized steel. Heavier lifts are being done requiring heavier cranes, noted by the trend to 10 ton cranes over 5 ton cranes.

SECTION 10 – FURTHER STUDY

The information that is provided in this survey analysis is only the top level of information available from the survey responses. If you would like to probe deeper into the survey results please let me know what information that you are seeking and I should be able to provide you with an answer to your question. Please let me know if this information will be useful to you.