CHROME PLATING

Have you noticed how some finished decorative products look attractive and appealing? Not just their appearance but the ability to withstand different environmental and atmospheric conditions are as a result electroplating. Since the process involves series of electrochemical activities that change the surface of the metal parts to be more usable in many industries, the importance of plating cannot be overemphasized.

Electroplating on metals makes them suitable and durable for many industrial manufactured products. The plating of a metal part transforms it to be more attractive, resistant to wear, corrosion, enhance its conductivity, and improves its paint adhesion capacities. It leaves a metallic coating on the surface of these metal parts which improves their chemical, mechanical and physical properties.

Many industries are utilizing the mechanisms of electroplating to ensure that their finished products meet the demands and requirements of the clients who are the end users of the products. Industries like automotive, electronics follow the electroplating process to preserve their metal parts before fabrication.

There are many types of electroplating of which there Chromium Plating, Gold plating, Platinum, Rhodium plating, Silver plating, Aluminum plating, Tin Plating, Nickel Plating, Tin-Lead and Copper Plating. There are also many methods of carrying out these plating types of which the most popular two are Barrel Plating and Rack Plating.

In this article, we are going to be discussing one type of electroplating which is known as Chrome Plating.

What is chrome plating?

Chrome is the short term that represents a chemical element Chromium. It is a metal that has no solid state value because nothing can be fabricated from pure chromium. This element can only be used for plating on another object like steel, brass, copper, aluminum, stainless steel or plastic. Sometimes, people have been heard referring any shiny finish on an object as chrome, but they are often mistaken. For instance, when people see electro-polished stainless steel boat rigging, semi-shiny painted wheels, bright and well-polished aluminum motorcycle parts or nickel plated oven racks, they call them chrome without knowing that these parts have no relationship with Chrome.

No one can blame people for making these mistakes in identifying a chrome finish from other ones. Unless you place a chrome finish beside another finish, you may not identify it. It is easy to identify one from the other when they are together because a chrome finish will be more reflective, bluer and very specular. The finish is usually brighter, less grayish, pale or yellowish. Also, the reflection will be less distorted, deeper and looking like a mirror.

If you further put an end of a tape measure on the bright finish, you will be surprised of the inches you will read using the reflection. When you get a high-quality chrome plating, you can even see skywriting.

There are two general applications of chrome plating. There is:

1. Hard chrome plating often called functional chrome plating or engineering chrome plating.
2. Nickel plating which people often referred to as “decorative chrome plating

Hard Chrome Plating

This type of chrome electroplating is not very popular. It is a chrome plating that is applied when there is a need for heavy coating. It is normally measured in 1000sandts, unlike decorative chrome plating that measures a millionth of an inch. It promotes lubricity, resistance to wear, oil retention and even corrosion resistance. Some applications of hard chrome plating can be on pistons rings, hydraulic rods, and rollers, thread guides, mold surfaces, gun bores, etc.
That it is called hard chrome doesn’t mean that it is harder than other forms of chrome plating. Instead, the reason is that its level of thickness makes it measurable than other chrome plating methods. Unlike the nickel chrome plating that has a thin coating measured in a millionth of an inch. Due to this thin coating, you dare not perform the hardness test on decorative chrome plating unless you want it to break.
So since hard chrome plating can withstand the hardness test, the name becomes suitable to describe it. The applications of hard chrome plating are usually on those items that are of steel especially the hardened type of steel. The appearance of hard chrome plating is usually metallic and very shiny. However, it is not decorative at all.

Nickel Chrome Plating

This form of chrome plating starts from electroplating nickel onto the metal part before you apply the chrome. Sometimes, electroplating copper onto an object comes first then nickel electroplating onto the same material follows suit.
Applying nickel after electroplating makes the finish very smooth, able to resist corrosion and increase its reflectivity. That of chrome plating is usually very thin, and you can measure it in millionths of an inch instead of thousandths.
When you observe a decorative chrome-plated surface like the truck bumper of the truck wheel, you should understand that why it looks that way is because of the nickel plating on it. What Chrome does is to add a faint bluish cast so that it can protect the nickel from tarnish. It also helps to reduce scratch and contribute to the corrosion resistance capacity of the object.

On the other hand, if you fail to add the nickel element undercoating, you will not achieve a surface that will be decorative,

reflective and resistant to rust at the same time and therein lies the need for nickel chrome plating.

If you want to apply a finish on a wheel or a car bumper, your choice of plating will not be hard chrome plating but nickel chrome plating. I hope you now understand the differences in appearance, nature, and application of both hard chrome plating and nickel chrome plating.

One thing to bear in mind about chrome plating is that it provides a barrier on an object and once that barrier is broken by a pinhole, rusting will set in as fast as possible. If you do a low-quality chrome plating which is porous and has pinholes, it is better you didn't plate the steel at all because once you have done it, it will force the steel to rust faster.

If you buy a product and it is showing signs of little rusting, bear in mind that it occurred during manufacturing and return the item. Don't mind suppliers who would want to convince you that it was because of the presence of some chemicals in the bathroom because the truth is that it is simply their fault. They already know that the items are defects and yet continue to sell it.

There are other terms used in chrome plating which you should know. When you hear people mention Show chrome, double nickel-chrome and triple chrome plating. It may be confusing, but they are all referring to chrome plating in different standards or quality.

- **Show Chrome**
  This type of chrome is the type that is of exceptional high-quality that can improve the appearance of an item very well to be good enough for anything. To achieve this level of quality, chrome electroplaters copper plate an item, and then, buffer it to a full luster before applying the nickel plating so that it can boost its quality further. This means that there will be a layer of chrome and a layer of nickel.
- **Tipple chrome plating**
  This term is used by electroplaters to describe a process of applying three layers of any electroplating to an item to make it durable and high quality enough to resist corrosion and wear.
- **Double nickel-chrome**
  If there is a double layer of both chrome and nickel during electroplating of an item, electroplaters may use the word double nickel-chrome plating.

However, one thing is sure; if you want to achieve a high-quality plating, there has to be a double layer of nickel. Also, if you want to achieve a durable chrome plating on any item like a vehicle that will be exposed to the outdoor environment, it is advisable to apply two or more layers of nickel before going ahead with chrome plating. For example, you can use a semi-bright nickel first and then apply a bright nickel before finally applying the chrome element.

About coloring in chrome plating, the only color you can achieve by using a contaminant on the metal is black or smoky grey. When you see any things that look colored on a chrome-plated metal, don't assume it is a colored chrome. The truth is that the color you see is just a painting job that looks like chrome. Black chrome is the decorative finish you see on optical equipment and microscopes, automobile parts, solar collectors coatings, etc.

The process of chrome plating metal is not just something that passes only one process. There is a lot involved before you achieve the protective or decorative shield you are expecting on your manufacturing parts. It doesn't start and end with dipping the parts into the electroplating tank. There are so many things you must do before you even get to that point and after you cross that point.

The process of chrome plating starts with carrying out some work like polishing, buffing, cleaning, acid dipping, zincating for aluminum parts, and then copper plating. Now, if you want to go for the Show Chrome quality, after copper plating, you continue with buffing the copper to achieve the best smoothness. Afterwards, you go to cleaning again, then acid dipping the second time and then more copper plating on the same object. After the additional copper, you carry out two or more different nickel plating on the same object before you now think of chrome plating finally. Don't forget that each step you complete, rinsing will come into play before the next step.

After passing through these processes, the idea of restoration work, if you need to re-chrome a metal part, is no joke at all. You will start by first removing the chrome, removing the nickel and also copper if it is necessary, then you will polish the part to make sure that every blemish or scratch is removed.

Polishing is necessary because if you omit it, after the re-plating, all the scratches will show again. After removing these defects, you will then plate the object with copper and "mush buffing" to make sure that you squash any copper into little pits. Afterwards, you start the whole chrome plating process from the beginning.

The truth of the matter here is that it is more expensive to re-plate and old metal part than merely replacing the part with a new one. It is even easier to a little prepping on the replacement than having to re-plate an old piece. Don't forget that your machine or plant operator can easily take care of many identical parts once than having to deal with a mix of non-identical parts because there is no way these parts can go the same time given their differences. This means that a plater will work on your project with more time than necessary as he will be handling them one after the other. I hope you understand the cost implications of such attempt.

Therefore, instead of carrying out restoration work on an old electroplated metal part and spend more time and labor cost, simply replace them with new parts and do a little prepping job on them.

Chrome defects

Sometimes, you may notice that the chrome plating on your product is peeling. This is not a new thing actually because sometimes during manufacturing, such defects can occur. The cause may be one of insufficient adhesion of the electroplating to the piece being plated or some exposure conditions which can cause chrome to pit, or discolor but not peel.

It is not always easy to achieve good adhesion on things like alloy wheels since they are not 100% aluminum. However, it is not an excuse to sell defective part and if you notice any of it, report it to them for compensation or changes.

The truth is that you can chrome plate your parts if you wish but there are very stringent regulations and reasons why taking them to the plating shop is the best alternative. Some of the reasons are Regulations and the chromic acid.

Regulations

Many regulations are governing the electroplating industry activities which covers down to the waste products and even the rinse water of the process. What the whole regulation means is that even a little drop of hose water needs pretreatment and permit before you can discharge it.

So for every waste product coming out from your electroplating activities, you will need to get a permit for it and be responsible till it is disposed properly or rendered harmless to the environment. The reason for the strict regulations on chrome electroplating is that the process requires a highly concentrated chromic acid, H2CrO4, Hexavalent chromium which is very injurious and harmful to human existence.

Hexavalent chromium is so harmful that children who get exposed to it can develop cancer. This is why the factories that are chrome plating will always require exhaust scrubbing. They use fume suppressants that they monitor every day. Also, the platers themselves are usually passing through medical tests to check their blood for absorbed chromium.

Illegal disposal of chromium is never advisable because once you release it, it will pass through the ground very fast and enters the aquifer. Since there is a constant monitor of water supplies and well, it will be easy to detect the introduction of chromium.

If a beaker of chromium drops on the floor of your garage, that little quantity can poison all the water wells around the garage. As a result of the danger involved in the use of chrome, many city councils have banned the use of chrome.
Also, before you think about chrome plating by yourself, be aware that chrome plating process causes hydrogen embrittlement and if you don't bake the parts and relive the hydrogen embrittlement, you can end up turning the hardened steel into brittle glass.

As a result of all the stringent regulations and negative side effects of chrome plating, if are not a professional electroplater, you can choose to polish your aluminum parts. You may be surprised that the result will still be remarkable.

Also, if you want something else that is easier and still look like chrome plating, you can try the chrome-look paints that are now in existence. That is the second option to explore instead of the normal chrome plating which is the use of spray chrome. One good thing about spray chrome is that you can apply it to the items on-site of manufacture. You don't need the toxic acids that traditional chrome plating requires. All you need to do is follow some defined steps and make use of specific sprays. What you will do it to mix the solutions and go by the stepwise process and afterward, you will achieve a very strong and durable surface that looks like a mirror just like what chrome plating gives. By adding some translucent layer on the metallic layer, you can get either a blue chrome look or a red chrome look. Depending on the customized look you are hoping to achieve of course.

You can use chrome spray on any part not mind the size as long as you are ready to do the work in the process. Also, you don't have to choose the right substrate to ensure adhesion because you have varieties of substrate options. You can apply chrome spray on metal, glass, canvas and even wood. This spray is so versatile that you can't compare it to chrome plating. Don't forget that there is no environmental harm in using spray chrome thereby eliminating the stringent regulations and bans which chrome platers face in the industry.

The chrome spray is more advantageous than the traditional plating. Some of the advantages to expect if you decide to use spray chrome are:

1. You will spend less

Yes! Spray chrome is more affordable than the use of full chrome electroplating. Check out the processes and workforce requirements of chrome plating, and that will give you an idea of the cost implications of the process. The estimate of spray chrome is just 20% of the total money you will spend on traditional plating.

2. It offers a short turnaround time.

Spray chrome is faster than normal chrome electroplating. For urgent projects that don't have strict chrome plating requirements, it is better to use spray chrome and save a lot of time. Don't forget that if you want to chrome plate, you will pack up your parts and send them off to the platers. At this point, you are at their mercy because it is when they are through plating that they will return the parts to you.

3. No difference in result

The same durability and shine you get from full chrome plating are what you will get when you use Chrome spray. If there was a difference, maybe one will be preferred to the other, but if you spray chrome, you will get the same good result.

4. A thicker layer

After using the Chrome spray, professionals have discovered that the layer of coating they get is usually thicker than that of normal chrome plating. Also, the finish also resists corrosion and weather.

5. It is versatile

Chrome spray is very versatile and can work on any substrate. You don't need to start selecting the one that will match it. You can use it on metal, wood, canvas, and glass. As for availability, there is no cause for alarm because there are many suppliers you can contact for a kit of spray chrome.
So instead of causing possible harm to the environment or contaminating the water supplies and wells, it is advised that if you can't afford to take your metals to professional and licensed electroplaters, you can order a chrome spray and do it yourself.

Chrome plating process

Chrome plating on an item turns its surface to a high-gloss, very bright and mirror-like metallic nature. Some of the applications of chrome plating are bathroom fixtures, industrial objects, motorcycle trim, and automobile trim and household objects. Chrome plating makes an item resistant to any form of tarnish, protects the metal and also help to reduce surface friction.

However, the process of chrome plating is volatile, highly toxic and involves the use of carcinogenic elements like chromic acid and sulfuric acid. Also, the waste from chrome plating process is also very hazardous.

There are four processes of chrome plating.

1. Use Chrome plating for decorative purposes
2. Using Hard chrome plating for big and functional items
3. Chrome plating with hexavalent chromium solution
4. Chrome plating following the electroplating system

1. Decorative purposes

For objects that can be affected by corrosion, like copper, steel, brass, stainless steel and aluminum, you can chrome plate them for decorative purposes.
Chrome provides clearer and brighter finish with less distortion than any other finish like paint.
The process of using chrome for decorative purposes involves the plating of nickel and chrome onto an item such as a hood ornament or a wheel rim.
The nickel provides shine, resistance, and slickness in chrome-plated items.
Applying a thin layer of chrome, in turn, prevents nickel from scratching, tarnishing and rusting.

2. Using hard chrome plating for big and functional items

Hard chrome is also called engineered or industrial chrome which eliminates wear and tear that could have affected large machines and other items made of steel. Hard chrome is thick and can withstand the thickness test more than other chrome plating but not harder than them.

3. Chrome plating with hexavalent chromium solution

To use hexavalent solution for chrome plating, you have to get the following ingredients in the required mixture and quantity.

For one gallon of chromium plating solution, get the following:

1. Chromic acid - 33 ounces(936 grams)
2. Distilled water - 0.33 ounce (9.36 mm)

You can add or reduce this quantity depending on the surface of the metal you want to electroplate. The quantity above will give you one gallon of solution.

The next thing to do is to mix the solution in a tank where the materials will be immersed for testing or chemical treatments and in some cases, testing and chemical treatments. Then carry out the following activities:

1. Before immersion proper, start by degreasing and cleaning the items carefully and thoroughly.
2. Avoid creating splashes by gradually adding fluids during the preparation of the plating solution.
3. Don't forget the carcinogen effect of the solution on humans.
4. Be careful as you handle the chemicals and go through each of the processes. Since the solution is easily ignited, can produce fire and high in risk if it interacts with other chemicals, you must be careful how you work with it.
5. Chrome plating following the traditional electroplating system.

The first you have to do is dissolving plates of nickel in a sulfuric or chromic solution.

Pass a positive charge from your available power source through the plating solution.

Attach a negative charge to the item to be electroplated and plunge it into the solution.

What happens is that the negative charge will draw the positively charged metals to your target object and the thickness you will achieve depend on the time you allow the object in the solution. For good results, make sure that the temperature of the solution will be between 35-46 degrees Celsius or 95-115 degrees Fahrenheit.

If you are doing hard chrome plating, the ideal temperature for the solution should be between 49 to 66 degrees Celsius or 120 to 150 degrees Fahrenheit.

Make sure you wear a respirator and other safety gadgets before you think of handling or preparing the chemicals. After you bring the objects out from the plating solution, take it to agitating running water and rinse it twice.

Chrome Plating Line

It is not a simple thing to set up an entire plating line for chrome electroplating. You need adequate information and a broader knowledge of what is involved in the whole process. Before you can achieve the perfect chromium plating you wish for, you need to know so many things of what it requires to move a fabricated object from one end of a plating line to achieve a finished product that is shining with a chrome plate as specified.

Some of the things you must know are things like basic geometry, electricity, pollution control with some problem-solving skills. As you commence on the chrome plating process fully, you must know about polishing, grinding, and buffing. You should also know how to rack parts properly, what cleaning and activation procedures you need to do and the necessary rinsing and drying processes that must be carried out.

Also, you must know the stripping procedures if there is a need for it, how to control the solution of any of the bath you are using and how to test the final result for corrosion potential, adhesion capacity and hardness test. Although you can easily get this knowledge and directions for each stage, you cannot neglect the importance of being alert and making use of your common sense.

Those who are actively involved in the plating should be sharp to identify a problem so that they can nip it in the bud instead of allowing it to stop the whole production process. Also, they should not fail to report it to the heads of operation so that they can carry out an adequate investigation that will lead to uncovering the solutions to the problem.

The work of the electroplating supervisor should be to track the source of the problem and apply necessary corrective measures. It is also important that they identify the parts that need extra care both in preparation and electroplating and also identify those parts that do not require much preparation. It is important to take time to separate the parts based on their requirements because it has a cost implication to the finished product.

On the plating line, cleanliness is something that should not be compromised for anything. If the plating line is clean, the electroplaters will be free from harm, and it will be easy to mitigate any form of contamination in the plating baths. It is advisable to be carrying out inspection exercises on the line so that it will serve as a preventive measure to problems. Another important preventive measure is to check the procedures of racking and masking off the parts so that there will be a better deposit and also help to eliminate any problem in the plating baths.

After acquiring the basic knowledge needed for operating a plating line, then you can proceed to take care of the following requirements that exist in the chrome plating line.

Surface Preparation

Once the fabrication is complete, if you check the metal part, you may notice some defects on the surface like mold marks, scale, pits, tool marks, grinding line or scratches. It is important that you eliminate such defects before you start the plating process so that you can be sure of a good finishing.

The operations you need for surface preparation is often polishing and buffing which is done according to the type of defects on the part surface. The three operations you must carry out on the parts are Grinding, Polishing and Buffing.
Grinding; this is a machining operation that removes a large amount of metal from the part's surface. Sometimes after grinding, the surface may only have 20 micro-inches finish or rougher than that.

Polishing follows an abrasion process to remove grinding lines and many other surface defects. It is completed with a cloth wheel or an abrasive belt which has a bonded abrasive medium. The process of polishing also removes a large amount of surface metal while leaving the articles free from all defects that cause damages to the final result. Some of the polishing abrasives include aluminum oxide and silicon carbide.

Buffing; this is another abrasion process that makes use of finer abrasives than polishing. It aims at producing a surface that is bright smooth with no scratch. The process of buffing comes before chrome plating because the same surface brightness and reflectivity of metal parts after it also equal the level of brightness and reflectivity of the surface after chrome plating. The only place where you can achieve leveling is in nickel plating. As for chrome plating, you will achieve geometric leveling. So, you have to understand that the surface smoothness after buffing is very critical to the achievement of a shiny plate after chrome plating. Unless of course, you add post-plating steps like grinding, polishing, honing then, it will cease to be important. Buffing is carried out by attaching a compound to cloth wheels. The compounds are made up of binder or glue and also contains an abrasive. The buffing abrasive are like those used in polishing operation but has a finer mesh size. If you want to achieve good finish after buffing, you must be careful while selecting abrasives, proper compounds, wheel speeds, wheel types, and pressure.

Most of the times, the operators perform both the polishing and buffing operations by hand by processing each of the parts one after the other. However, if the volume of parts to process is vast, there is automated equipment that can do the job. Another method of removing surface defects is mass finishing which may be used instead of polishing or buffing especially when the parts are small and many. Those parts are gathered in tubs that can vibrate or in a rotating barrel where there is a proper composition, shape, and size of abrasive media that suits the application you are running. Another factor that will influence the proper media to select is the operation that you want to carry out like buffing or polishing, the part's metallic composition and the surface appearance you require after the process.

Also, the tubs or barrels where the small parts are gathered will also contain detergent-type compounds that were specifically formulated for the operation which will:

1. Work like buffers for the parts and abrasives
2. Eliminate any form of surface oils that may be on the parts
3. Separate metallic particles from the part surfaces

The above functions show that you can also use mass finishing operation for cleaning purposes. The only thing that will discourage the idea is the parts size, mass and their sharp edges which may cause damages to other parts as they all vibrate or tumble against themselves and the abrasives. There may be a lot of scratches and cuts after the whole process thereby creating more harm than good.

The simple truth is that if you want an inexpensive method of removing surface effects from parts before chrome plating,

your best choice is mass finishing. It is better than buffing and polishing if it can suit the parts. Since it works with small parts, it reduces cost since it needs lower labor requirement and it doesn't also require the services of a specialized operator. Other advantages of mass finishing are fewer rejects and higher productivity.

Generators, Buss Bars, Electricity, and Rectifiers

When you come to what makes up the physical parts of a plating line, you talk about four parts.

There must be an external circuit which will consist of the Direct Current source and a means of transporting the current to the electroplating tank.

Cathodes or the negative electrodes which are the parts to be electroplated and where to position them in the solution to facilitate contact with the source of the direct current.

The electroplating solution

The anodes, the positive electrodes of the metal part to undergo plating or sometimes, insoluble anodes that complete the circuit.

For instance, stainless sheets work as inert anodes in the electro-cleaning baths while lead alloys serve as inert alloys in chrome plating baths.

There may be cases where variable resistance may be necessary especially when your rectifier is serving more than one tanks in parallel otherwise, the regulation of the voltage will be at the rectifier. The plating tank will have three copper conductors which will be running down the length of the tank. These conductors are called bus bars, and these bars have to be insulated from the electroplating tank using ceramic insulators. The bus bars will be fabricated in such a way that they can withstand the flow of the current and also support the weights of the parts and anodes.

The outside bars will be connected to the positive side of the direct current source, and they are the anodes will be hung. Also, the central bus bar will be attached to the negative charge of the direct current source and holds the articles usually placed on racks attached to the cathode bars with hooks.

The main parts of the rectifier which are fully functional in the whole plating process are the transformers for the reduction of the voltage, the diodes for conversion of the current from AC to DC, current and voltage controls for the power output. There is also the overload protection, a cooling device which removes the heat in the rectifier which may either be water-cooled or air-cooled.

Also, before deciding on the type of rectifier to acquire, consider the waveform. A rectifier mainly delivers full-wave or half-wave. The best wave to use for chrome plating is mainly full-wave so that the whole process will work properly.

There are other things like output control which varies in different rectifiers. There are variable controls, tap switches, and fixed output but amongst the three, tap switches and variable controls are the better choices because the fixed output may not match the ever-changing plating loads that may come into play from time to time. Other controls that you can see on many modern rectifiers are current and current density, automatic voltage control which is making things easier for electroplaters.

Tanks, Ventilation, Heaters, and other equipment

Tanks

For alkaline cleaning and striping baths, you can make use of Plain steel tanks. You may also use plastic tanks or plastic-lined tanks that are resistant to alkali. Make sure that the rinse tank you will use has an appropriate lining as well.
In a chrome plating line, it is very necessary to use a separate etch tank so that it can prevent iron contamination or trivalent chromium build-up in the plating tank. Make sure that the chrome electroplating tank and the reverse etch tank has suitable linings like plasticized PVC. When you use this material make sure that the thickness will be 3/32 minimum on the side and 3/16 thick on the bottom and solution level at 3/16.

Don't use polypropylene linings because they can crack and the seam may separate due to stress. Instead, you can use supported molded polyethylene linings. Also, avoid lead lining due to conductivity and corrosion concerns.

Ventilation

If you are using a stripping tank, you need exhaust ventilation with the chrome plating and reverse etch tank. During the chrome plating process, a lot of oxygen and hydrogen evolve, and this causes chromic acid spray to emit. If this dangerous chemical escapes into the electroplating room, it will cause damages and contaminate other baths. Also, the workers will be affected by a lot of health issues.

The chromic acid causes sharp irritation and is also corrosive to a human's mucous membranes of the throat and nose. This danger to workers is why the spray requires an out or suppression so that the workers and plating equipment can be safe. Therefore, there should be an exhaust facility that can remove the air.

Heating

The best method of heating the baths tanks and rinse tanks is with Teflon or Titanium electric immersion heaters which come with automatic temperature control. If it is a larger installation, you can also use steam heating. Cooling coils which you should use for your chrome bath are the ones made of Teflon or Titanium. As for the best construction material, it will depend on the bath chemistry you are using for individual tanks.

To control the bath temperature, first, ensure that the proper volume of the bath is in place. The normal volume is 1 gallon or above of chrome solution for 50 wattages of power. If you use 60 percent of the plating power that is 30 watts, it will produce heat and still maintain the plating solution at the right temperature in a tank that is not insulated. But when the power you apply is above 50 wattages for each gallon, then you need to cool the electroplating bath.

Anodes

Every step of the electrical process in chrome plating requires the anodes operation. If you notice that there are heavy soils on the metals to be plated, you will have to include an electro-cleaner in the chrome plating line. Alkaline cleaners use 304 stainless steel for the anodes or cathode if the cleaner is an anodic type.

You can use the wall of the plain steel tank as the electrode although it has some disadvantages like it will not allow you to remove the electrodes for cleaning and creates room for stray currents.

In the alkaline electro-strip tank, you can also use 304 stainless steel cathodes but make sure you clean them from time to time so that chrome deposit will not plate on them.

Fixtures, Racking, Stop-Off methods

Every metal plating solution follows the same electroplating processes. You must first clean the target parts of all soils on the surface and activate them so that you can remove oxides. Immediately you activate the base metal; you will place it into the solution so that re-oxidation will not occur on the metal surface and cause poor adhesion. The time and cycle which the parts will spend in each bath will be different depending on the base metal and the plating type you are doing.
The part to pass the plating process are converted to cathodic in the solution. If it is a simple operation, the parts will be hanged with a wire or hook from the line's cathode bar. In some hard chrome operations, the parts will be hanged from the plate rack/fixture.

A fixture/rack holds the metal parts in the right position during the electroplating process. If the rack is effective, it must be conductive because it has to connect the metals to the direct current and the bus bar. So while fabricating the fixtures, put some of these factors into effect:

1. Ability to hold parts in position for uniform plating
2. Ease of racking and un-racking
3. Fabricate with aluminum or copper material and should have enough cross section for loads to avoid overheating.
4. Don't use a bolting construction but design with a welded construction
5. Coat the bus bars or all contact areas with Plastisol to avoid bath contamination and corrosion.
6. The tip of the rack must be rigid to hold and maintain positive contact.

Cleaning, Activation, and Preheating

Before plating the parts in the finishing line, it must pass through cleaning and activation to promote adhesion of the deposit with the substrate. So preheating the parts to remove oxides and soils is necessary before you place them in the electroplating bath.

Rinsing and Drying

If you want to achieve the result you expect, the rinsing process must follow the right procedure. When you remove a metal part from a bath, there must be a residue of the solution from which it emerged. Therefore, before you still introduce it to another bath in the line, you must remove the adhering solution by rinsing it properly.

The Electroplating Bath

Before you set up the plating bath, you will first clean and leach the plating tank, then dissolve the right quantity of the chromic acid and add the proper quantity of sulfuric acid plus the Dura Catalysts. It is also necessary to run an analysis of a sample from the bath to know if you may need to add and adjust any element of the sulfate.

Also, you must carry out maintenance exercises on the hard-chrome electroplating tank by doing the following:

1. Check the temperature daily
2. Clean the electrical connections and bus bars
3. Analyze the tank for sulfate content and chromic acid every week.
4. Do a monthly bath analysis that will include sulfate, chromic acid, copper, chloride levels and iron.

Stripping

Stripping chromium given its usefulness and passivity is easy. So it is important that you select a solution that the stripping action will not affect its basis metal.

Pollution Control

The best way for pollution control in the electroplating line is to reclaim and reuse the chrome bath as many times as possible.

Black Chrome Electroplating

Black chrome [BCP] plating is a unique type of coating used mainly for different products such as shafting, linear guides, and actuators. This widely known coating is beneficial in various ways. This we will look into after we must have explained what it is.

Black chrome electroplating is a plating solution based on ceramic – infused fluoropolymer which is applied at a less than zero [0] degree Celsius, which suits loaded rolling element contact. The plating process makes an alloy-like diffusion layer to form at the outer margin of the part. This allows particles to integrate completely at the base material and create a bond which is not easily separable.

Black chrome electroplating operation is a fluoropolymer-based coating deposited into metals like carbon and embedded very deep into the metal material. As a polymer, BCP is not rigid. Flexibility is required in some parts of rolling elements in other to make sure that the material's metallic coating does not flake off. With BCP overtime deflection which occurs in the parts causing the metallic coating flake off does not occur while it does in others. Its advantage is the ability to easily notice the wear when the metallic subsurface begins to shine underneath the black chrome electroplating. Hence, it willrarely affect how hard the component material is and never assist with material lubricity.

Areas of application of black chrome coating are in food, medicals, electronic assembly and semiconductor. In the case of food applications, the BCP protects the components from corrosion since there is a typical plastic wash down. It is unique for most delicate applications that react easily to contaminate. The color itself has an aesthetic advantage over rust which has an ugly appearance, especially for medical applications. Rusted ones signify weakness and outdatedness to customers. This makes BCP a special one since it is a rust preventive coating and its appearance portrays it. Shiny metallic coatings enable light to reflect from the component easily which disqualifies it from being used for optical applications like camera positioning or laser measuring.

The common misconception that using 440C stainless steel will prevent rusting is wrong since it will still rust over time. This, of course, relies on your application and requirements yet our experimentations proved that after 168 hours of salt spray 440C stainless steel eventually rusts. This is because of the heavy carbon content in the metal. It is certain that the clear winner amongst all is black chrome plating since it outlasts the popularly known 440C stainless steel that has a shorter lifespan than the plain 52100 carbon steel.

The newest black chrome plating processes which have been developed presently from a trivalent chrome process achieved its black color by alloying other metals with the chrome deposit. This newer black chrome process places a smoother, more reflective, black chrome finishing which suffers corrosion if a post-dip for protection is not used. The metal plating process

gives excellent coverage to the whole part. Newer Black Chrome plating is advantageous due to the need to be waxed or oiled to improve the final metal finish.

Black chrome plating combinations such as those plated over satin nickel, bright nickel, dull nickel, develops different looks like a shiny black to a matte black finish. Dust chrome an automotive specification is a combination of a satin nickel coating and a black chrome finish.

Plating on Plastics

Production of items made of plastics such as Polycarbonate or Teflon, ABS, Polypropylene to a standard of conducting electricity, requires that the materials should be metalized by adding a metal coating through electroplating on the plastics. Electrodepositing melts ions of metal onto another metal surface. This process has been in existence for eons ago and is a cost-effective plating on a plastic process that can meet universal standard and acceptance.
Electroplating on Plastic Components.

Electroplating is used for wear protection and corrosion resistance, it also increases the hardness of the material surface, and enhances their electrical conductivity as well as polishing the materials' or components. It is a metal on another metal technique of electrodepositing metals onto other non-metallic objects as well. Hence, it is one in a million of our numerous metal finishing specialties. During the early stages of development, the objects were merely plated for decoration purposes since the substrates only have minimal adhesion to the plate.
The beginning of Plating on Plastic.

The automotive industry was the first industry who indulged in the process of plating on plastics in the 1960s. They are still benefitting from its use till date in the areas of providing finishing on fashion items such as shoes, as well as on consumer electronics products like laptop cases and cell phones. The early 1960s marked the insurgence of the first commercial metal plating plastic process primarily for the use in the automotive industry. Automobile manufacturers searched for ways of having highly fuel-efficient vehicles, and this led to increases in the use of lightweight plastic parts and components. The process of electroplating [electrodepositing] served this purpose of metalizing the parts such that they have a gleaming appearance that it is pleasing, enticing and luring in nature to most car purchasers of that era.

The most important development was the advent of a most dependable chemical process for the preparation of the surface of a thermoplastic polymer which offers a special toughness and impact resistance needed for automotive manufacturing applications, the acrylonitrile butadiene styrene [ABS]. This process offered enough adhesion between the substrate [ABS] and the metal coating.

Decline and Resurgence of the Plastic Plating Process.

Plating on plastic continued to wax strong in its use and importance through the1960s till the 1970s as plumbing and electronic industries discovered the merits in its use in their manufacturing methods. This advancement in science and technology such as changes in the automotive industries, reduction in the effective demand for bright finishes on internal and external parts and components brought about a fall in the demand and use of plastic plating which dominated till the late 90s[1990s].

A renewed urge for bright trim by buyers of vehicles and other products led to a resurgence in the desire for plating on plastics by many industries that engage in varieties of products such as North American and European distributors. Hence,

the emergence of more improved quality and environmental compliance have crowned the plating on a plastic method the most reliable manufacturing process ever known.

Steps of Plating on Plastics:

There are three main steps involved in plating on plastics, and they are as follows;

Electroplating
This procedure is used to build an extra thickness to the metal you want to plate by making use of the current.

Prelate
This is a medium by which the molded part of the substrate is processed by using an electroless bath. This process will then transform the molded part to become conducive.

Molding
This is a method that we use to convert the plastic pellets into any part or shape we desire it to be. The phenomenon of molding in plating on plastics is highly essential in the sense that it is a means of ensuring high quality of the material before plating. For you to get the appropriate mold which is vital for plating there are specific guidelines which you must follow such as;

1. Build the mold for the part or shape of your choice
2. If you want to build the mold for the part, you need to follow some necessary design procedures for the finished part such as;
3. Put in gates in the areas that it won't show
4. Make use of the integral parts so as not touch the welded joints
5. Try to eliminate the "sink" dents by designing bosses and ribs
6. Texture the part to cover up any defect like scratches and to break up any large flat surface.
7. Create angles that are up to one degree to help along the removal of the shape out of the mold.
8. If you want to add parting lines for the mold's opening, make sure that they are where it is not significant.
9. Close tolerance fits should consist of the final plate right from the beginning of the part design.
10. You should design the thickness of the wall to standard so that it will be rigid.
11. Make sure that the plates are uniform. You can achieve this by considering the density of the current distribution right from the initial design. You can also make use of no 90o angles, bring the letters nearer to the surface, no V grooves, crown the big flat surfaces and create angles that are large as they can.
12. Make sure the holes for drainage are at the appropriate location.
13. Eliminate blind holes and clear out any contact area that is on the part.

If you follow the above guidelines judiciously when you are designing the mold, the resultant effect will be a perfect part of plating. There are other molding parameters which are essential to follow to produce a good part. They are as follows; Endeavor to keep the melt temperature at the appropriate rate. The melt temperature shouldn't be too low or else; it can generate stress on the part. This condition can lead to failure of the thermal cycle or irregular etching.

The mold should be polished significantly to prevent defects on the parts. Such defects like pits that pop its ugly head on the final plate causing rejects.

Endeavor to dry the plastic Resins properly to avoid moisture since it can cause delamination or "splay" on the part which leads to a blister.

The temperature of the mold should be at the proper rate. If it is not so, the mold may be cold which leads to "skinning," and

as a result, any material that touches the mold hardens immediately. The resultant effect will make the hot content that is beneath to flow to produce a surface skin that can lead to delamination.

The filling speed should be appropriately applied. If the fill speed is too fast, it can overload a mold. This will then make etching very hard to achieve and loss of adhesion. It is better to use a fill speed that is slow if you want to achieve efficient output.

It is vital to follow the molding parameters and design if you are sure that you want to produce perfect parts which are not stressed nor have any other kind of defect. Most of the plastics used for plating are usually evaluated for their stress level. The stress evaluation on clear plastics and polycarbonate is achieved by using the polarized light. In the case of ABS, it is covered in glacial acetic acid and left for a minute, then rinsed after and dried. If at the long run, you notice dents or real breakage in any of the parts, it means that the stress level is too high and the material should not be used for plating under no condition. If you notice white areas, it means stress, peeling of any kind signifies delamination. These signs surely lead to problems on the thermal cycle and poor adhesion. Before making use of any mold release, it is imperative to check them thoroughly since the kind of mold release you use can affect the molded part.

Since the molded parts do not need any secondary operation before they are plated, they need to run through the following processing solutions known as the preplate cycle;

Cleaners
The cleaners are used for the removal of simple dirt, fingerprints, and debris from the part.

Predips
These are usually solvents used before etchants like dimethylformamide for polysulfone to prevent plastic problems.

Etchants
The etchants are a powerful oxidizing solution that diminishes the surface of the plastics into different degrees. Their result is to increase the surface area thereby transforming the part from water-hating (hydrophobic) to water-loving (hydrophilic) material.
Neutralizers
The neutralizers are properties like sodium bisulfite which are used as a chemical reduction to remove excessive etchants from the racks and parts.

Pre-activators
The pre-activation is proprietary properties like polyphenylene oxide or polypropylene used to improve the activator absorption. They make resins that cannot be plated to become plateable.

Activators
These materials are catalysts that consist of valuable metals like palladium, gold or platinum. Their main duty is to create a catalytic site right on the surface of the plastic.

Accelerators
The accelerators are used to eliminate the excessive stannous hydroxide from the part so that the palladium can perform its duty as a catalyst.

Electroless Plating
When the part is rinsed, it then goes on to the final stage of the before plating cycle which is electroless plating. This procedure comes in the form of an electroless bath via a watts nickel or electrolytic copper to render the surface of the plastic conductive.

Electroplating Process
Plastics are non-conductors or insulators naturally yet electroplating on plastics is still obtainable. A more specialized plating process that is more pronounced than immersing in a bath and coating is required for plating on plastic materials. What is required in other materials like metal objects or parts is immersing in a bath and coating a simple technique? The latest nine decades electroplating innovation by our experts is the most proven ways for electroplating on plastics.

The following steps are needed in the process of electroplating of plastic for the material to be ready;

1. Either, apply a conductive paint to the surface before starting the electroplating process, or
2. Etch the material in a chromium acid-base solution to quicken its adhesive capabilities.
3. Secondly, neutralize the excess chromic acid produced in the process.
4. Thirdly, apply a palladium and tin salt solution on the material which catalyzes combination with nickel or copper. Then, coat the surface with copper or nickel extracted from the electroless plating solution.

Benefits of Plating on Plastic

Plating on plastic using metal surface enhances its outlook creating an impression of high quality which makes it often selected when a highly decorative object is desired.

Secondly, it is an effective method of protecting a substrate against corrosion and damage by chemicals used in the production process.

Plating on plastic can strengthen the substrate and make it wear resistance. In the automotive industry, it enhances the appearance of the substance as against some industrial plastic which has a dull finishing. Colorizing plastics makes them virtually appealing but not as bright as the shiny appearance desired by most product owners.
Nickel plating particularly has been adopted by many metal finishing provider as a safer alternative to the hexavalent chromium plating method which poses a high potential health hazard.

Electrodepositing of metal on metal (electroplating) makes non-conductive plastic surfaces conductors of electricity, a highly valuable property to automobile manufacturers of electronic parts and components, aircraft industries and others in that line of product. It can also lead to reflection of light away from a substrate plastic surface which would have damaged it.
A metal coating creates a protective barrier against corrosion as well as harmful gases.

Plastic Materials Prone to Electroplating

Though effective techniques have been introduced for plating on various plastic materials known as thermoplastics [meaning moldable when heated above a particular temperature and solidifying upon cooling], the ABS still possess the ultimate 90 percent of all metal plating on the plastic application. Hence the following plastics can be electroplated.

A brand form of Polytetrafluoroethylene [PTFE] known as Teflon processed by the Dupont Company primarily for the manufacturing of non-stick cookware.

Another plastic that can be electroplated is phenolic which is a laminated plastic material used in the manufacturing of molded plastic products.

Polycarbonate which is common terminology for a group of durable and strong thermoplastic polymers used for automotive, storing of data as well as construction applications.

Polysulfones are thermoplastic polymers popularly known for possession of special strength, transparency, and high service temperatures. They are often used for filtration media, flame retardants and dielectric in capacitors.

Another plastic is Polyoxymethylene: [polyacetal]; is an engineering thermoplastic used for parts and components in high-performance applications in the field of engineering which require high stiffness, low friction and superior stability dimensionally.

Certain plastics are known for their inability to accept plating. Such products are the valox product family. Some plastics can receive plating in a blended form. There are ways of determining the plateable nature of a plastic material to be used in the manufacturing operation and the best metal required.

For example, copper is the best metal to be plated with when there is an obvious need for selecting between alternatives. This is because it can enhance the electrical conductivity of the substrate. To add aesthetic appeal to a plastic product, use Gold or Silver plating plastic. Nickel plating is also acceptable for providing metal finishing to plastics.

Some of the key metals that you can electroplate successfully on plastics are:

Gold; this metal improves the appearance of plastics. It is also beneficial in ways of protecting the plastic materials from corrosion and also turns the plastic to an electrical conductor. Also, gold has impressive heat shielding properties that make it suitable for high-temperature applications.
Nickel; this metal's metallic and bright appearance makes it the best alternative to chrome when you want to plate on automotive plastic parts. It is also a good protector against wear and corrosion. If you alloy it with metals like tungsten and tin, the hardness will increase and further fortified for wear and corrosion resistance.
Copper; this metal is good for electrical conductivity, and as such, it is a great choice if you want to metalize non-conductive surfaces. It can be used for heat stop-off during masking.
Chrome; this metal can also be suitable for plastic plating, and although is a carcinogen, metal shops are still using it for automotive parts.

Hard Chrome Plating

This method of electroplating offers an important surface treatment for the plastic processing industry. It is precipitated electrochemically from standard or mixed acid baths. The higher precipitation rate of the mixed acid baths used of late gives it an edge over other types of Chrome Plating while its aggressive nature which may pose problems during the process of masking of molds is its weakness. Another advantage worthy of note is that hard chrome plating is done at relatively low temperatures in contrast to other types of chrome plating.

Other advantages are shortlisted below;

1. Its ability to harden without distortion.
2. Its wear resistance characteristics.
3. Hard chrome plating makes for smoothness of surfaces.
4. The coefficient of friction is low.
5. The little or ignorable tendency for material adherence.
6. Hard Chrome plating creates high resistance to chemical environments.
7. It is resistant corrosion.
8. The absence of oxidation at elevated temperature.

The factors that may chemically and electrochemically affect the properties of Chrome surface layers.

A great deal of experience is needed to achieve all the desired properties.Hence, the following factors have great influencing power over the properties of the chrome layer.

1. MATERIAL: Analysis, its production mechanism, and surface quality.
2. CONDITIONING: Machining of the surface, cleaning, grease removal and activation.
3. TREATMENT: The system used in treatment, Treatment bath, and its precipitation conditions.
4. FINISHING STATE: Mechanical as well as heat treatments.
5. The fact that great importance must be attached to the base

Material to be hard chrome plated must be clarified. To adequately provide support, a relatively high degree of hardness should be displayed to avoid flaking under high specific loads because of the hard chrome plating.

The mold making materials must also be optimally clean such that defects in the chrome layer deposited are avoided. If there are the presence of pores on the surface, it should be retained as defects in the chrome plating. Heat treatment of molds which are to be hard chrome plated should be done under strict adherence to specific guidelines. The neutral surface is compulsory to avoid carbonization or scaling. Partial oxidation may take place if overheating occurs in the process of surface grinding. This will lead to diffusion of foreign elements with a detrimental effect on the surface. The element components of the salt bath were identified through analysis using microprobe.

Plastic processing tooling particular must possess little or no surface roughness because the surface of the regions which determines the part shape is usually polished. However, with hard chrome plating, increase in surface roughness to a certain level is expected. Excessive surface roughness results require hard chrome plating polishing to generate optimum chrome layers.

The bath should be solely controlled about electrolyte, composition, temperature, current density and so on and so forth for the generation of optimum chrome layers. Without that, a milky white layer which does not possess the required adhesion or the desired Vickers hardness of about 1100 may occur. The relationship between current density, electrolyte composition, and hardness. The normal temperature for electrolyte ranges from 50 to 60 degrees centigrade, while the layer growth rate is of 0.004 to 0.005mmm/h of range. The thickness of the layer used may range up to 0.10mm.

A change in the parameter within relatively narrow limits may lead to a very significant effect. The mold design is very important. If external contours are involved, the corner will grow at sharp edge transitions. The appearance of a high current density at the sharp edges leads to the formation of chrome which is deposited rapidly on them. This gives a few guidelines for the mold to be chrome plated. The fact that sometimes a design is vital to achieving uniform chrome coatings is worthy of note. Hard chrome plating as an electrochemical process liberates hydrogen which diffuses into both the steel and the hard chrome layer.

Hydrogen embrittlement occurs which is intensified if hydrogen is incorporated into the surface during the picking which precedes chrome plating process.Reduction of such embrittlement is necessary for some parts in which toughness is needed. In this regard .hydrogen annealing is vital. The workpiece is usually annealed at a temperature of about 200 C for a long time. Places, where annealing can take place, are; in an oil bath, a batch type furnace or a circulating air furnace. And the reduction in gas concentration as a function of time and temperature.