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Electroplating on plastics

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Electroplating on Plastics

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Electroplating and electroforming typically account for 9 to 11% of total nickel consumption. In the last few years, therefore, the industry has consumed between 60,000 and 70,000 tonnes of nickel per year in the Western World, with the major application being in the production of bright, decorative and corrosion resistant finishes. It is estimated that this application accounts for about 80% of total nickel anode consumption and the remainder is for functional or engineering plating and electroforming.

The substrates on which nickel is electroplated vary widely. Steel is the most common but others include copper, brass, stainless steel, zinc, aluminum and plastics. Plating on plastics (POP) requires very specialized techniques because the substrates are non-conducting but it is one segment of the plating industry in which nickel is used almost without exception.

This publication presents a historical review of the industry and describes its present status and future expectations. It is based on information obtained through ongoing contact with industry representatives, mostly in North America and Europe and to a lesser extent in Japan and South East Asia. Contacts included plastic manufacturers, chemical process suppliers, electroplaters, end-users and industry organizations. It also describes the technical progress that has been responsible for the improved performance and acceptance of plated plastics. The size of the market and growth forecasts are discussed and related to total nickel consumption in the electroplating industry.

Historical Review of the Market for Plated Plastics

For many years, rapid advances in resin development and production technology have resulted in the replacement of metals by plastics in a wide range of applications. Advantages of plastics are ease of fabrication, one stage moulding of parts, greater design flexibility and weight savings. Although decorative finishes can be obtained on plastics by moulding in colour or painting finished parts, a reliable method was required for producing the high quality, bright reflective surfaces that were available on metallic substrates by nickel/chromium plating. Aesthetically, bright finishes have well-established and popular appeal and also offer important functional advantages, such as their wear resistance and hygienic properties. It was the need to produce bright finishes on plastic substrates that led to the development of the processes used so successfully today.

The Process

The electroplating of plastics was introduced commercially in Europe and North America in the early 1960s, with only limited acceptability. The major breakthrough that led to good growth in the industry was the development of chemical processes for the surface preparation of acrylonitrile butadiene styrene (ABS), which enabled good bonding to be obtained between the plastic substrate and the metallic coating. ABS remains the

plastic most widely used for plating applications and excellent quality is now obtained routinely on plated parts.

However, the industry experienced many difficulties before these high quality standards were possible. The major problem to be overcome was in producing the initial adherent, electrically conductive coating on the non-conductive plastic surfaces. This coating is the base on which conventional electrodeposition can take place and its adhesion to the plastic surface is the key factor in obtaining sufficient durability for the practical application of plated plastics. But in the early stages of development, the adhesion was not good. The conductive coating was frequently applied using graphite or silver paints over plastic surfaces that had been roughened either physically or by solvent attack. Alternatively, chemically-reduced silver coatings were used but in all cases, bonding was poor and inconsistent and the processes were not suited to large scale production.

The most significant breakthrough in the technology came in the 1960s with the development of a chromic acid based etchant which produced genuine adhesion between the plastic substrate and the metallic coating. It also made the plastic hydrophilic and therefore suitable for processing in typical aqueous processing solutions. At the same time, advances were also being made in the technology of electroless nickel and electroless copper plating. These parallel developments enabled conductive coatings to be deposited on plastic substrates, adherently and economically, using processes suitable for large scale production. Current processes are still based on the techniques developed at that time. Nevertheless, there are many improvements and refinements which have been made in the process technology and there are also many more types of plastics which can be plated.

In general, the procedures used for preparing plastics for electroplating include the following stages:

- etching of the plastic surface to provide a hydrophilic surface and good deposit adhesion. Typically, the etchant consists of a concentrated solution of chromic acid and sulphuric acid and its effectiveness is heavily dependent on the surface condition and composition of the substrate.
- activation of the etched surface to produce the catalytic sites on the non-conducting plastic that will enable electroless nickel or electroless copper to deposit. These sites are typically produced from solutions containing palladium chloride and tin salts, which produce a very uniform distribution of minute palladium particles on the plastic surface.
- deposition of a thin electroless nickel or electroless copper film to provide an adherent, conductive base suitable for conventional electroplating.

Once this conductive deposit has been produced, parts are ready for conventional electroplating. Nickel is used in practically all applications for plated plastics and is responsible for the most important properties of the metallic deposit - its good corrosion resistance and its lustrous metallic appearance. In most applications it is used in combination with a chromium topcoat but it is also used with precious metal topcoats, such as gold.

The Market

The major driving force for POP was the automotive industry. The need for increased fuel economy required a reduction in vehicle weight. The industry saw in plastics a durable, light, more easily fabricated substrate which had the potential to replace more traditional metallic materials, such as zinc die castings, at a lower cost. Consequently, plastic materials became used for a wide range of automotive components such as grilles, light bezels, emblems and other bright trim.

The rapidly developing technology began to spread into other markets but automotive applications remained dominant. Plated plastic plumbing fixtures such as bathroom and kitchen fittings appeared, as did control knobs for electronic equipment, plated buttons for clothing and a variety of household and personal care items. Thus, from a slow beginning in the 1960s, rapid growth occurred during the early and mid-1970s. Many electroplaters added POP to the services they could provide and many new plating operations were built that were dedicated to the plastics plating industry. During the peak years, it is estimated that as many as 80 plants in North America processed plated plastics. Many of them were very small. In Europe the numbers were probably about the same, while Japan had about 150 similar operations. The mid 1970s were recognized as good years for this industry. The late 1970s and early 1980s saw a steady decline in the demand for plated plastics and the industry suffered severely in all parts of the world. Only recently has there been a general upturn.

Reasons for the Industry Decline

Automotive Industry Changes

The plated plastics industry had been strongly dependent on the automotive industry during the growth years. In the late 1970s and continuing throughout the 1980s, dramatic automotive styling changes occurred. Bright work for both exterior and interior applications was greatly reduced and on many models was completely eliminated. These changes were more severe and occurred much more rapidly in Europe than in North America. The objectives were to reduce weight and fuel consumption and improve the aerodynamics of the car body. The new styles drastically reduced the requirement

for bright nickel/chromium finishes on all components, whether they were steel, aluminum, zinc alloys or plastic. In Europe, any bright work that was retained was mostly limited to the luxury end of the market but even these requirements were small. The overall effect of these changes on the European POP industry was less severe than in North America as plastic platers were less dependent on automotive applications and the industry was much smaller. In North America the reduction in bright work occurred more slowly and was less drastic than in Europe but nevertheless the impact was enormous. Coloured plastics rather than plated plastics became widely used, much of it being black or coordinated with body colour. These style changes resulted in an enormous contraction of the entire plating industry and POP, in particular, suffered tremendously. This was unquestionably the main reason for the decline but there were certainly several other contributing factors.

Quality

Poor quality was a frequent problem. Many plants were operated without the required expertise and inferior parts were produced, many with serious deposit adhesion problems. In many cases, this resulted in plated plastics gaining a reputation of being a cheap product that would not perform well. This affected all end use applications. Although insufficient expertise and experience in the preplating processes were major causes of poor quality, problems also resulted from poor plastic mouldings, which could not be satisfactorily etched to provide good bonding. Many small platers were at the mercy of plastic moulders to provide parts with surface quality suitable for plating but this did not always happen. Now much more is known about surface quality requirements and many of the largest and most successful plating plants have their own plastic moulding operations to ensure consistently acceptable quality.

Design

A change from metal to plastic components provided opportunities for designers to introduce more complex shapes. This was often done with no consideration for the problems that this could cause the plater. Consequently, much faith was lost in plated plastics as unsatisfactory, non-uniform deposits were usually attributed to the plating process rather than to the real problem, the design of the component.

Costs

Pricing had some effect on the decline in the POP industry, as it did on nickel/chromium plating generally, especially in automotive applications. Pricing pressures sometimes applied by the automotive companies could not be handled by many platers, who were forced to diversify or shut down. These pressures generated an extremely competitive situation in the POP industry, especially with the large plating capacity that had been established. Cost cutting by platers then caused a serious decline in profits and the subsequent closure of some plants.

Cost has been a very significant factor in the decline of the POP industry in Japan and continues to be so. It has resulted in the transfer of much business to lower cost areas in South East Asia such as Hong Kong, Taiwan and more recently Thailand, Indonesia and Malaysia.

Environment

Environmental issues are considered as only a small factor in the closing of POP operations, even though they have had a significant effect on the overall plating industry. Hexavelant chromium has been a major target of the environmental agencies. Not only is it used in the chromium plating process but also in the preplating process as an etchant. At this time, it appears that the remaining plastic plating operations are meeting environmental requirements, although the capital costs have been high and operational costs continue to be a burden.

The Current Market for Plated Plastics

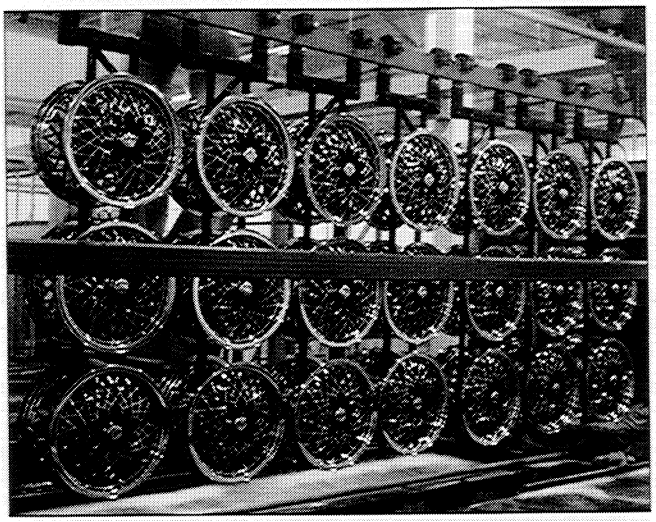
A recent market survey made by NiDI and subsequent contacts with the POP industry have revealed a more positive and optimistic attitude in the North American and European markets than has been witnessed for many years. The renewed optimism is a result of a marked increase in demand which is expected to continue. The automotive industry continues to be the major end-user for plated plastics and there has recently been a marked increase in the use of bright trim. This trend has become very evident in Europe and North America and is expected to continue for a number of years. The high visual quality and durability demanded by the automotive industry in the 1990s will ensure that nickel/chromium on plastics will be preferred for many applications. In addition, plastic components offer significant weight savings compared to metallic ones. The optimism is supported by other end-use applications for plated plastics but these will have a lesser impact on growth when compared with the automotive industry.

Unfortunately, this optimism does not extend to the Japanese market, which is described as stable and mature. Power, environmental and labour costs in Japan are such that growth in the POP industry is not predicted. However, this does not necessarily mean that more bright trim will not appear on Japanese cars but business will probably continue to move to other Pacific rim countries or parts will be sourced locally in North America or Europe to supply Japanese transplant operations in those areas. At this time, for instance, platers both in the U.S.

and the U.K. are heavily involved in producing parts for Japanese automotive companies. Although the POP industry in Japan will still remain heavily dependent on the automotive industry, there is an obvious trend towards an increase in the percentage of the total industry that is devoted to engineering applications.

It is difficult to determine accurately the number of companies around the world that are now plating on plastics. They range from very large companies whose entire operations are dedicated to moulding and plating plastics to small plating shops that have manually operated lines for plastics as part of their overall participation in the finishing industry.

In 1993/94, it was estimated that in North America there were 25 to 30 plants and the three largest accounted for over 50% of nickel consumption. They were the largest plants in the world for plating on plastics. The industry in Europe is naturally much more fragmented but it is estimated that approximately 60 companies in France, Germany, Italy, Scandinavia and the U.K. are actively involved in POP, while as many as 30 to 40 small plants are believed to be operating in Spain alone. In Japan, it has been reported that there are about 50 companies now plating on plastics. A reliable total figure for South East Asia is not available as this is a complex market area that would require a specific, detailed study. It is believed however, that Hong Kong alone has about 100 small plastic plating shops, each employing no more than about ten people. There are much larger plants elsewhere in South East Asia but many small operations continue to operate throughout this market area.



North America has the largest plants in the world for plating on plastics.

Courtesy of Lacks Industries Inc.

The North American electroplating market consumes more nickel than any other market area. This applies not only to the total market but also to POP. In the following table, estimates of nickel anode consumption in the POP industry in the major market areas are shown and these are related to total nickel consumption for electroplating.

Nickel Anode Consumption for Plated Plastics (1993)

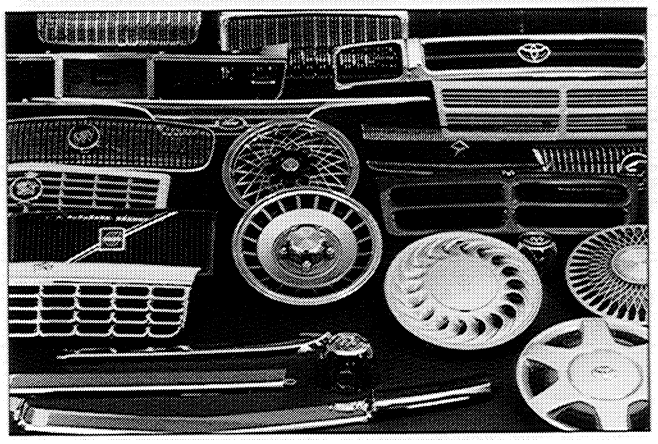
	Tonnes	Percent of total nickel plating
North America	1350 - 1500	7 - 8
Europe	650 - 800	5 - 6
Japan	800 - 900	13 - 15
*South East Asia	750 - 1200	5 - 8
TOTAL	3550 - 4400	5 - 8

* The figures shown for South East Asia are calculated estimates only, based on a total nickel consumption for plating of 15,000 tonnes and an assumed 5 to 8% of this being used for plating plastics, as it is in North America and Europe.

Applications for Plated Plastics

Almost all nickel consumed in the plating of plastics is for bright, decorative finishes and only a small part is for engineering applications. Estimates in North America are that 75 to 90% of the applications are in the automotive industry, 5 to 15% for plumbing and the remainder is split between household appliances, engineering and other applications. The distribution is similar in Europe but some changes have occurred in Japan in the last few years. Up to 90% of the applications were automotive but with much of this being transferred to South East Asia, estimates now range between 50 and 80%. Engineering applications have increased accordingly to the 20 to 30% range.

The automotive industry has many applications for plated plastics. These include radiator grilles, light bezels, wheel covers, mirror housings and reflective surfaces, miscellaneous interior and exterior trim, emblems and licence plate frames. The majority of these parts are for OEMs (original equipment manufacturers) but there is also a good demand for "after market" plated plastic parts, especially in North America.



Typical applications for plated plastics in the automotive industry.

Courtesy of Lacks Industries Inc.

Applications in the plumbing industry include plated bathroom fittings such as taps, shower fittings, sink drains, towel rails, toothbrush holders etc. Compact sink units for boats and recreation vehicles are now often made from plated plastics. In Europe the appearance of many plastic bar fixtures, such as beer pulls and drip trays, is enhanced by a nickel/chromium finish, which is chosen for its resistance to abrasion and its hygienic and aesthetic qualities.

The use of electroplated plastics for engineering applications has become well established and is of growing importance. Such applications are primarily in the electronics industry, where nickel is widely used as a base for gold in providing excellent electrical contacts. Nickel further acts as a diffusion barrier between the substrate and the gold. The use of nickel in combination with thermally stable plastics now presents the opportunity for soldered joints to be made on plastic components. Recent developments such as M.I.D. (Moulded Interconnect Devices) technology and the introduction of more thermally and dimensional stable plastics have been very positive factors in expanding the use of plated plastics for engineering applications.

Other applications, which in general have a smaller share of the market include personal care items, buttons, appliance trim, spectacle frames and various accessories such as bottle caps for perfumes and fragrances. This latter application is, however, of major importance in some European countries such as France and Spain and accounts for a large number of plating operations in these areas.

Plastics Used for Electroplating

Although there is a wide range of plastic materials used in this industry, it is still dominated by ABS. At present, ABS is estimated to account for about 90% of the market worldwide. The percentage in Japan is thought to have declined to about 80% over the last few years, because of decreased use of plated plastics for automotive applications and the increase in engineering applications.

A recent development from the plastics industry has been the introduction of a new series of resin blends, combining ABS with polycarbonate, generally referred to as ABS/PC blends. These typically contain 40 to 60% ABS, the remainder being polycarbonate, although a wider range of compositions can be used, depending on the application. These materials are having a significant effect on the POP industry. This is due not only to their higher inherent mechanical strength but also to their superior ductility in the as-plated condition. They have already found acceptance in the automotive and computer industries and are predicted to have excellent growth potential.

Other plastics used for plating applications include polypropylene, nylon, modified polyesters, polysulphones, polyimides, polyetherimides and rubber modified styrene maleic anhydride copolymers. The latter copolymers are finding an increasing number of engineering applications in which good thermal stability is required. In addition, such resins with high heat capability provide good market possibilities for the use of highly abrasion resistant, high temperature curing, translucent lacquer. It is now feasible, therefore, to provide a range of translucent finishes on lustrous bright nickel as a practical, hard wearing alternative to chromium.

Polyimides are also high performance materials with the excellent thermal and dimensional stability often required in engineering applications. There is a significant market for electroplated nylon in automotive applications as a superior alternative to ABS where exposure to lubricants and hydrocarbons is possible.

Industry Status and Future Expectations

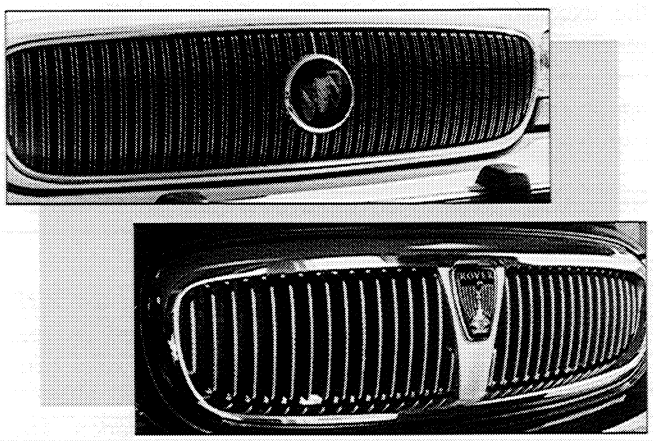
Automotive Applications

The impact of the automotive business on the POP industry is enormous both in North America and Europe, where this market accounts for 75 to 90% of total consumption. It is also of great importance in Japan where it is estimated to represent 50 to 80% of the market. The recent NiDI market survey revealed that all sectors of the industry - electroplaters, chemical process suppliers and plastics producers - were expecting a significant increase in demand for plated plastics on both North American and European vehicles. This expectation has been fully justified. In fact, in Europe it is fair to say that it has been exceeded. After the absence of bright work from almost all European vehicles for many years, plated plastics are now being used quite extensively by a number of the

major vehicle producers on high volume models and whole model ranges.

Plastic platers will benefit from the overall demand for bright work, although there is much competition, from plated steel, plated and unplated stainless steel, plated and anodized aluminum and plated zinc die-castings. Even sputtered indium coatings have been introduced as a bright finish. The POP industry, however, appears capable of strong participation in business arising from the new demand for bright work.

Trucks and the more expensive cars still account for much of the bright work requirements but there are indications that the trend could extend into large volume ranges although in a more limited way. In designing cars to obtain optimum aerodynamic properties, automotive companies have reached a stage where many models are not easily distinguishable from their competitors. Harking back to the individualistic designs of thirty years ago, bright work is now being used by many important manufacturers to add distinctive features. Identification of certain models with design features can have a huge impact on public acceptance. In North America, uniquely designed plated plastic grilles on certain models, have contributed significantly to their success. Similarly in Europe, one producer has reported that the recent introduction of bright plated grilles has contributed to increased sales. As a result, the company is in the process of introducing plated plastic bright trim across its entire model range, thereby greatly increasing its requirements for this finish.



Nickel-chrome plated plastics grilles provide distinctive design, features, visual appeal and long-term durability.

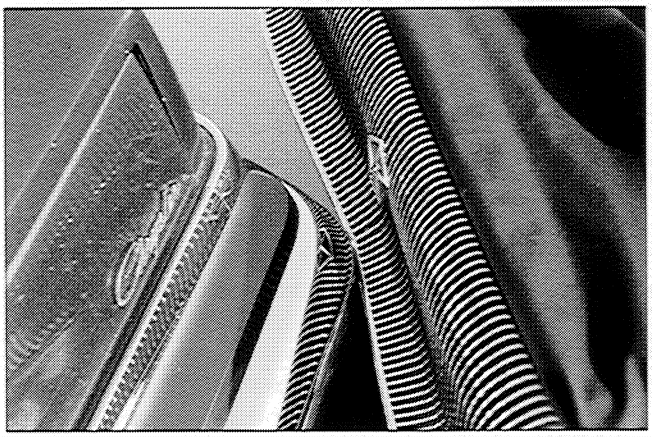
Other car manufacturers in Europe have made some commitment to electroplated plastics based on the cost and quality now available. Not only will they be used in some new bright trim applications but there are also plans to further extend their use as a replacement for zinc die-cast components in the near future.

It is of great interest to see that cost and quality are now positive factors for plated plastics. End-users now have confidence that the present POP industry can consistently supply high quality parts at controlled costs and as a result the industry appears to be in a strong position for future growth.

There are several reasons why quality has improved so dramatically since the initial rapid growth of the industry in the 1970s. The present plating operations that survived the decline in the 1980s have a very good appreciation of the process and the expertise required to operate it. Most of the unreliable operations did not survive and overall quality is better as a result. There has been a big improvement in the understanding of how mould design and moulding conditions affect the surface properties of the plastic part. This allows consistent etching of the surfaces to be obtained and consequently better and more uniform adhesion. In addition there have been some very significant advances in electroplating technology, principally the development of multi-layer nickel systems and microdiscontinuous chromium. These have brought about a radical improvement in the corrosion resistance of nickel/chromium electrodeposits and they are now able to comply fully with the stringent quality demands of the automotive industry. The widespread application of the S.T.E.P. test (Simultaneous Thickness and Electrochemical Potential), used to determine not only the thicknesses of the semi-bright and bright nickel layers but also the difference in their electrochemical properties has had a major influence on deposit quality and consistency. Combining this type of control of the nickel process with the use of microdiscontinuous chromium has resulted in a great improvement in the overall performance of plated parts.

These have all been positive factors for the industry and an additional beneficial impact has been the acceptance of ABS/PC blends, recently introduced in North America, Europe and Japan. Although they currently account for only a small percentage of the total plastics used, rapid growth has been predicted over the next few years. In North America, electroplaters and plastic producers are predicting ABS/PC blends will take over a substantial share of the market at the expense of ABS alone. A market share of 20 - 30% is forecast by some. There are very good reasons for this and the impact that such blends could have on materials selection in the automotive industry is large.

The advantages of ABS/PC blends are in strength, flexibility and recovery properties. These properties have already been used to good advantage in the design of wheel covers and grilles. The complete recovery of plated production parts after severe deformation is impressive. Similarly, prototype bumpers have been reported to recover their shape after standard impact testing. Some forecasters consider that the use of ABS/PC blends for bumpers will be established in the near future.



Strength, flexibility and recovery properties are important features of ABS/PC blends.

Courtesy of Lacks Industries Inc.

Automotive companies favour flexible grilles and so ABS/PC blends are highly regarded. Their strength and recovery properties are such that they will require less protection than that required for ABS or zinc die-cast grilles and so they can be moved further towards the front of the vehicle which will provide the very real advantage of more space in the engine compartment.

From the technical point of view, there is one concern in the use of ABS/PC blends but it is minor. Some platers feel that they can successfully use the same preplate processes as used on ABS. However most disagree, if similar bonding is to be obtained between the substrate and the electrodeposit. Generally, blends with high ratios of polycarbonate, e.g. 50%, certainly require modified etching techniques and this becomes less critical at lower polycarbonate contents. However, it has been learned from one plater that when using the same etching procedure on a 20% polycarbonate blend as would be used on ABS, adequate adhesion is obtained but it is inferior to that on ABS alone. The concern is that less than optimum bonding could detract from the many advantages of the ABS/PC blends and recreate the bad impression of plated plastics that originally plagued the industry, i.e. poor adhesion. It is anticipated however, that the resin producers and the major platers, who now have such a large interest in these blends, will not allow such potential difficulties to hinder growth in their industries. Quality, performance and good marketing will ensure increased use of these resin blends.

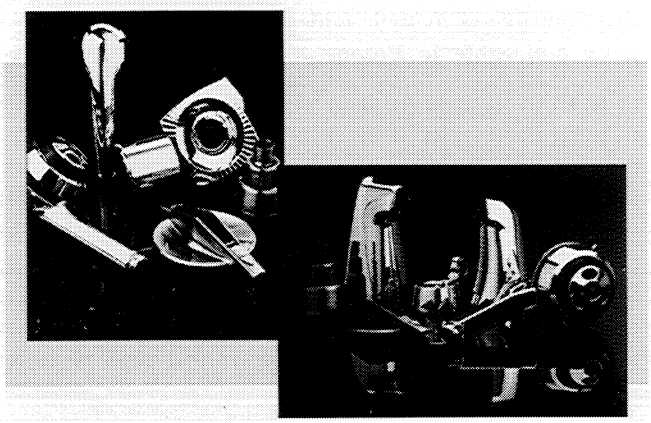
The North American POP market is perhaps benefitting most from the increased use of brightwork in the automotive industry and this is due to public acceptance and economy of scale. Although the use of brightwork has been very limited for many years, it has remained evident on many types of vehicles from huge transport trucks to luxury automobiles. Nickel/chromium finishes have maintained their popularity to a much greater extent than in other market areas. Recent design trends have therefore resulted in a strong demand. If this demand is combined with the cost competitiveness that results from the scale of operation, aggressive marketing practices and high quality, it is obvious that the North American market should be very positive.

Other market areas suffer to some extent from the scale of operations. Most large plating operations that were once dedicated to the automotive industry have disappeared in Europe for instance. Unless there is a long term commitment from the automotive industry in these areas for nickel/chromium finishes, it is difficult to see large investments being made to build new plants or expand existing ones.

Nevertheless, present trends have generated considerable optimism within the industry with annual growth rates in excess of 30% being reported, due to a number of very significant new applications appearing in 1994 and 1995.

Plumbing Applications

The status of the POP industry for plumbing applications is very similar in North America and Europe. The decline appears to be over and the market is described as steady to improving. It accounts for about 5 to 15% of the POP industry. The situation in Japan is less positive and it appears that South East Asia has benefitted through some transfer of this segment of the industry.



Nickel plated plastics with chromium and gold finishes have experienced renewed growth in the plumbing industry.

Courtesy of Shipley Co. Inc.

Plated plastics offer several advantages over competitive materials. Plastics offer very good design flexibility and nickel/chromium finishes offer an attractive appearance with excellent resistance to wear under frequent handling conditions. They also provide hygienic qualities and an attractive appearance which are so important in kitchens and bathrooms.

Some growth is expected in this industry due to several factors. The trend to coloured bathroom fixtures is stalled after experiencing some limited success and bright finishes are again in favour. Of these, nickel/chromium is by far the most popular but gold and translucent coloured lacquers over bright nickel share a small part of this market.

When compared with more expensive brass fixtures, the light weight of plated plastic units is often considered an indication of inferior quality. The POP industry has begun to respond to this concern by producing heavier units from much higher density plastics. These are produced by adding fillers and some resins now used are described as being more like ceramic than plastic.

An environmental issue in California is also seen as being positive by North American electroplaters. The issue relates to the lead content of brass and the risk of water contamination in use. Concerns have also been expressed about the health of process workers, especially those buffing brass fixtures. Environmental issues in California carry a strong impact in North America and plastic platers are following this with some optimism.

New applications for electroplated plastics have been appearing in the last few years and their use is now well established in many of these. These include their use in boats and recreation vehicles where compact sink units moulded from ABS and plated with nickel/chromium are well accepted based on cost, weight and durability. The appearance, hygienic properties and wear resistance of nickel/chromium and nickel-gold plated plastics have also contributed to their widespread use. This is especially noticeable in Europe, where plated plastics are used extensively for bar fixtures such as drip trays, sales display fittings and beer pulls.

The appearance of bar fixtures is often enhanced by plated plastics.

Electrical and Electronic Applications

This area represents only a small percentage of the market for electroplated plastics in North America and Europe. Estimates of 5 to 10% are typical and these would include both engineering and decorative applications. An estimate of 25% was obtained for Japan. The range of applications is wide. Nickel/ chromium plated plastics are used extensively as decorative trim for many electronic items such as personal computers, shavers, control knobs and buttons. In addition, general engineering applications include those where parts such as plugs are frequently handled and exposed to wear conditions. However, new and interesting applications are appearing with the development of improved plastic materials and advanced technology. As an example, the development of more heat resistant plastics has opened up a new and potentially good market for nickel plating connector blocks to allow direct soldering to their surfaces. Plastics such as polyetherimides, polyethersulphones and rubber modified styrene maleic anhydride are used for such applications.

Of growing interest for electronic applications is the development of M.I.D. (Moulded Interconnect Devices) technology. It will not become a major area for nickel consumption but is an excellent example of the way in which electroplating and plastics technology can be combined to produce circuit systems with interconnecting paths on two and three dimensional shapes. M.I.D.'s are high technology units, which when compared with conventional assemblies can reduce production costs, improve performance and greatly reduce the number of components and assembly time. They are already employed in many industries. For instance, in the automotive industry they are used for stop-light and window-washer controls and in the aircraft industry for control of illuminated signs. Typically nickel plating follows the identification of the circuit pattern by copper metallization in these applications.

Innovative engineering should ensure growth of plated plastics for electronic applications.

Other Applications

This segment of the industry includes other household appliances such as trim on refrigerators, freezers etc. but there appear to be no signs of growth in this area. The same trend applies to a variety of personal care items, ladies dress accessories, spectacle frames and metallized buttons. Although all of these items are produced in North America, Europe and Japan, the largest quantities are believed to originate in South East Asia.

Plated plastics provide design versatility and visual appeal for prestige products in the perfume industry.

Courtesy of Sarrel

The importance of the perfume business to plastic platers in certain geographical areas, particularly in southern Europe, cannot be understated. High quality plated components for packaging applications are consistently produced for a competitive market where design and prestige allied to excellent visual quality are of critical importance. These are frequently produced in extremely large numbers. In this industry nickel is used as a bright base for a number of selected decorative finishes including chromium and precious metals. Despite its importance in certain localities this market sector does not constitute a large part of the overall POP industry due to the small size of the components processed and is not forecast to change significantly in the near future.

Issues Facing the Industry

In spite of the positive attitudes within the industry, there are still some environmental concerns that plastic platers will have to address. These are related to the present dependency of the industry on chromic acid for etching and chromium plating plastics and on the issue of recycling plated components. In most parts of the world strict regulations are enforced on the use of chromic acid and discharge of waste containing hexavelant chromium. If even stricter controls are introduced, as is likely, the effect could be serious. However, the industry is already taking a responsible approach by investigating alternative oxidising agents, such as permanganates, for etching. For chromium plating, although the use of the more environmentally acceptable trivalent electrolytes is currently quite limited, they are starting to become more widely used in the industry. This can be ascribed to improvements which have been made in the stability of the solutions, the overall reliability of the processes and the ability with modern systems to produce deposits of a colour approaching those obtained from hexavelant chromium solutions.

Recycling of plated plastics is a more recent concern and strict government regulations are anticipated in most industrialized countries. The first requirement will be to separate metal from plastic and development work is in progress. In North America, for instance, major plastic producers have formed a consortium to study the problem and some individual companies are attempting to develop economical processes e.g. cryogenic separation methods.

Industry Forecast

The present attitude within the POP industry is very positive. Based on communication with contacts in all parts of the industry, it is evident that significant growth has already been experienced and it is expected that this expansion will continue in many geographical areas and market sectors. The optimism is seen to be strongest in North America and Europe and this is greatly influenced by current automotive design trends. These reflect a new cycle in the automotive industry requirement for bright trim, which is now being specified more frequently than has been seen for several years. This is already evident on many production models in both North America and Europe although the change has become most obvious in Europe, primarily because bright work has been largely absent from that market for more than a decade. Industry sources expect this present trend to last for at least five to ten years.

There are also signs that many of the other traditional markets for POP, such as bathroom fittings, will at the very least maintain their position in the market and may well show significant growth. This, combined with new uses emerging for decorative finishes and for functional applications in the electronics industry, supports the optimism of growth forecasts.

The positive attitude is greatly enhanced by the ongoing development of improved plastic materials, the cost competitiveness of plated plastics and the very high quality standards that are now well established within the POP industry.

The Nickel Development Institute is an international nonprofit organization serving the needs of people interested in the application of nickel and nickel-containing materials.

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