



Fasteners and the Environment

In recent years both government regulators and self-policing industries have made giant strides in more environmentally conscious activities. Although the fastener industry does not possess the multitude of opportunities for improvement that some industries do, the industry is not completely absent of them either. This article will explore six trends within the fastener industry that are reaping positive results to an ever increasing environmentally conscious society.

by Laurence Claus

ISO 14001

ISO9001, the Quality Management System standard, has been around now for almost twenty years. This standard delves into many aspects of participant's business and can perhaps be better described as a general guideline for developing a business culture of continuous improvement and system/process control. Not long after gaining widespread acceptance, the theoretical foundation of this standard was utilized to create more specific and targeted standards, such as QS9000 (later to become TS16949) for automotive suppliers and AS9100 for aerospace suppliers. These would soon be joined by a targeted standard for environmental awareness and protection, today's ISO14001.

In the last ten years ISO14001 has become widely accepted and a symbol of truly progressive and world-class companies. In fact, it has become so important in certain industries, such as automotive, that it is often requested of suppliers. ISO14001 is similar to other Quality Management Systems in that it stresses companywide awareness and use of best practices, management participation, and continuous improvement. The difference is that unlike the broad based, overall business results achieved by systems like ISO9001, ISO14001 focuses only on matters related to being good environmental citizens.

One of the advantages of these systems is that although there are standard guidelines, every participating company has the ability and even responsibility of customizing a program that is most meaningful to them. For example, one company may focus a great deal of effort on recycling while another company will direct its primary attention on workplace awareness of dangerous chemicals. Many fastener companies have embraced this certification and made it part of their everyday activity. These companies strive to be better stewards of the earth and its resources. Fastener companies possessing this certification tend to be more proactive than those that don't and consistently rank higher in customer's perceptions than their peers.

Air Quality

When I started in the business thirty years ago, I can recall the stark difference in air quality walking from the office into the plant. In fact, it was common to be confronted with a heavy smoke filled haze as soon as you crossed the threshold into the plant. It was made worse with temperature and humidity, so that a hot summer's day made the plant environment a very unpleasant and likely quite unhealthy place to be.

Fortunately, with increased consciousness for the environment and employee health and safety, many fastener manufacturers have gone to great lengths and invested heavily in equipment that filters and cleans the atomized oil from the air. In doing so they have reaped significant improvement in air quality, reducing their release of noxious oil and smoke into the environment, recovering and reclaiming gallons of otherwise wasted oil, and producing a more pleasant and healthier environment for their employees.

Surprisingly, the technology to accomplish this is pretty simple. Powerful air handlers are able to take the factory air in on one side, pass it through filters, and reintroduce the "cleaned" air back into the plant or outside. Normally, collection areas are strategically located over areas of high smoke generation such as inside a header enclosure or over the parts collection bins at the exit of the header. In addition to the other advantages already cited, the reduction of oil in the air results in less oil depositing itself on every surface in the plant. This reduces the amount of regular cleaning and preventative maintenance required to keep the plant safe and looking good.

Cadmium Plating Replacement

The replacement of cadmium plating is not a new phenomenon. In fact, cadmium plating was

completely eliminated from automobile fasteners over twenty-five years ago. However, in some industry segments, aerospace and military in particular, cadmium plating is still commonplace.

Cadmium plating is difficult to replace because of several unique functional qualities. Specifically, cadmium has a natural lubricity not found in the other common metal electroplatings. Therefore, cadmium plated parts usually don't require the post plating treatments common to other metal platings such as zinc. In addition to lubricity, cadmium has good corrosion protection characteristics, is durable, and is easily applied. For these reasons, easy replacement has been elusive and, no known equivalents exist.

In automotive, cadmium plating was simply replaced with zinc plating and dip-spin zinc and aluminum flake coatings. The latter are often applied with a top coat containing integrated lubricants to either match or exceed cadmium's natural lubricity. This has worked well for the automotive industry but has not necessarily been universally adopted in other industry segments. Recent investigation by aerospace companies and the US Defense Department into zinc alloy platings, especially zinc-nickel, has shown promising results and appears to be getting a lot of attention in these industry segments.

Cadmium's dangerous qualities stem from its classification as a "heavy metal". This means that it can accumulate in the human body without easy ways to purge or cleanse it. As a result, prolonged exposure causes increasing accumulation levels. These increased levels ultimately become toxic resulting in neurological and other bodily damage. Naturally one might worry that simply touching cadmium plated parts is dangerous and risky. Like any other substance of concern, best practice is to limit or avoid contact. However, the real danger comes from airborne sources of cadmium. This means that individuals working around open plating tanks and vibratory bowls containing cadmium plated parts in this fashion must take extra care to avoid or limit exposure from breathed-in air or nearby dust contamination.

Hexavalent Chromium

About twelve to fifteen years ago, the European Union passed legislation regarding "End of Life Vehicles". In summary, this legislation was intended to get automakers conscious about what happens when a vehicle comes to the end of its life and how that vehicle is best recycled and repurposed. In particular, the legislation set-out to limit components which contained substances dangerous to the environment or to people that would make recycling difficult or impossible.

One of the substances slated for control and/or elimination was hexavalent chromium. The chromium

atom can form two different ions, one with six outer valence electrons, known as hexavalent chromium, and one with three outer valence electrons known as tri-valent chromium. The hexavalent form is known to be dangerous to human health.

Up until this point in time, hexavalent chromium was one of the most common and prevalent constituents in surface plating, finishes, and protective coatings. Hexavalent chromium containing substances performed very well and were used everywhere with great success. Therefore, the elimination of hexavalent chromium from the surface finish industry posed a significant challenge and threat to both that industry and its customers, including fastener manufacturers. The surface finishing industry was, however, left with little choice and so in the last ten years has pretty well eliminated hexavalent chromium containing substances and compounds from its product mix. In its place, a variety of tri-valent chromium and chrome free alternatives have developed. In doing so, the industry has eliminated one of the most significant environmental liabilities that it had. Unfortunately, many of these alternatives do not perform as well as their hexavalent chromium counterparts. Therefore, although the environmental benefits have been positive, new performance challenges have been introduced to fastener manufacturers and consumers alike.

REACH

In December of 2006, the European Union passed a new regulation called REACH, short for "Registration, Evaluation, Authorization, and Restriction of Chemicals". This new law, which went into effect in 2007, is the European Union's answer to regulating and using chemical substances that have potentially detrimental effects on human health and the environment.

Although this regulation is written only for the European Union, it has far reaching effects on companies that export goods to the region. It is a complicated law but basically requires European importers or users to register their importation of chemical substances or objects containing chemical substances in quantities greater than one metric ton annually. The regulation also has a portion dedicated to what is referred to as "substances of very high concern". The intention of the legislation is that these materials will eventually be phased out and replaced with safer alternatives. This is the part of REACH with the greatest impact to the fastener supplier because cadmium, lead, and hexavalent chromium are all on the list of substances of very high concern. On the downside, however, it is likely that most fasteners will fail to exceed the 0.1% of the total mass of the object of these regulated constituents. On the downside, however, investigation will be required on a part-by-

part basis to verify this. For parts that exceed the 0.1% limit, alternative solutions will have to be found.

RoHS

About the same time that REACH was being passed, the first requirements of RoHS or the Restriction of Hazardous Substances Directive were taking effect. This is another European Union Directive. It is actually short for "Directive on the restriction and use of certain hazardous substances in electrical and electronic equipment". One of this directives primary intentions is to help meet targets for recycling and recovery of electronic waste.

Although it is commonly believed to be a restriction solely on lead solder, RoHS actually restricts ten different substances, including lead, cadmium, and hexavalent chromium. Of the ten, these three are the substances that may be present in fasteners. Unlike REACH which sets limits on the total weight of the object, RoHS makes the restriction on each "homogenous material" in the product. This means, for example, an electric circuit board comprised of multiple components, must be broken down and assessed for each homogenous part. This can get complicated because many components can be further broken down into smaller parts. The directive states that

the limits apply to the smallest single substance that can be, theoretically, mechanically separated. For fasteners, that likely means that the base fastener and surface finish (plating or coating) need to be considered separately. This effectively means that the surface finishes must not contain cadmium or hexavalent chromium, or be made from common, lead-containing screw machine material.

Conclusion

It is clear that today's society demands that industry be "solid citizens" and wise stewards over the environment. It is no longer acceptable to callously disregard the health and well-being of employees and consumers alike or to wantonly disabuse the environment in which we all live. Although these six developments in the fastener industry are noble and positive advancements, they come with challenges. Many of the products and processes used today have been defined with years of experience and know-how and cannot be easily replaced. Our challenge as an industry, therefore, is to rise to these challenges and find new, innovative ways to make exceptional products that are not at the expense of our health or the environment.

The Impact of Automobile Weight Reduction on Components and Fasteners

by Feny Chen, industrial analyst of MIRDC

The Trend of Automobile Weight Reduction

To discuss this topic, please look at **Fig. 1** to see how this trend has developed. One reason was that the price hike of oil before 2009 prompted many countries to reduce their dependence on oil imported from other countries. Another reason was the rising awareness of environmental protection and health, resulting in the reduction of emissions from power plants, industries and motor vehicles. To internal combustion engine vehicles, weight reduction plays a very important role on energy saving and emission reduction; according to relevant studies, If the weight of an automobile is reduced by 10%, its fuel efficiency may be increased by 6 to 8%; in addition, the reduction of every 100 Kg of weight would lead to the reduction of carbon dioxide emission by 3g per Km. Therefore, weight reduction has become a trend that automakers are forced to follow.

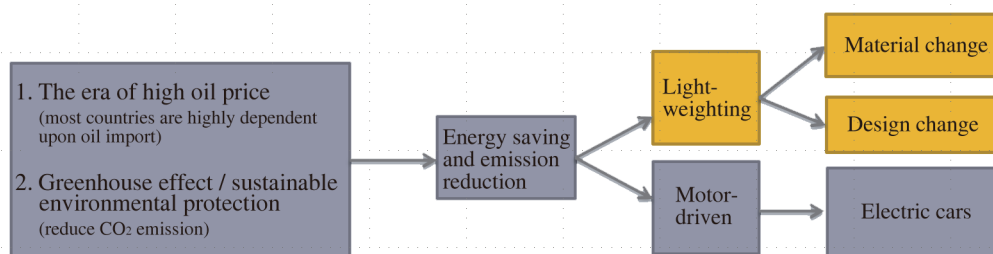


Fig. 1: How This Trend Has Developed

Data source: drawn by the MII of MIRDC (March of 2016)