COVENTYA
Beyond the Surface

THE DRIVE OFF ROAD
NEWSLETTER

TOPIC

TAILORED PROTECTION SYSTEMS
for modern materials in today´s automobile

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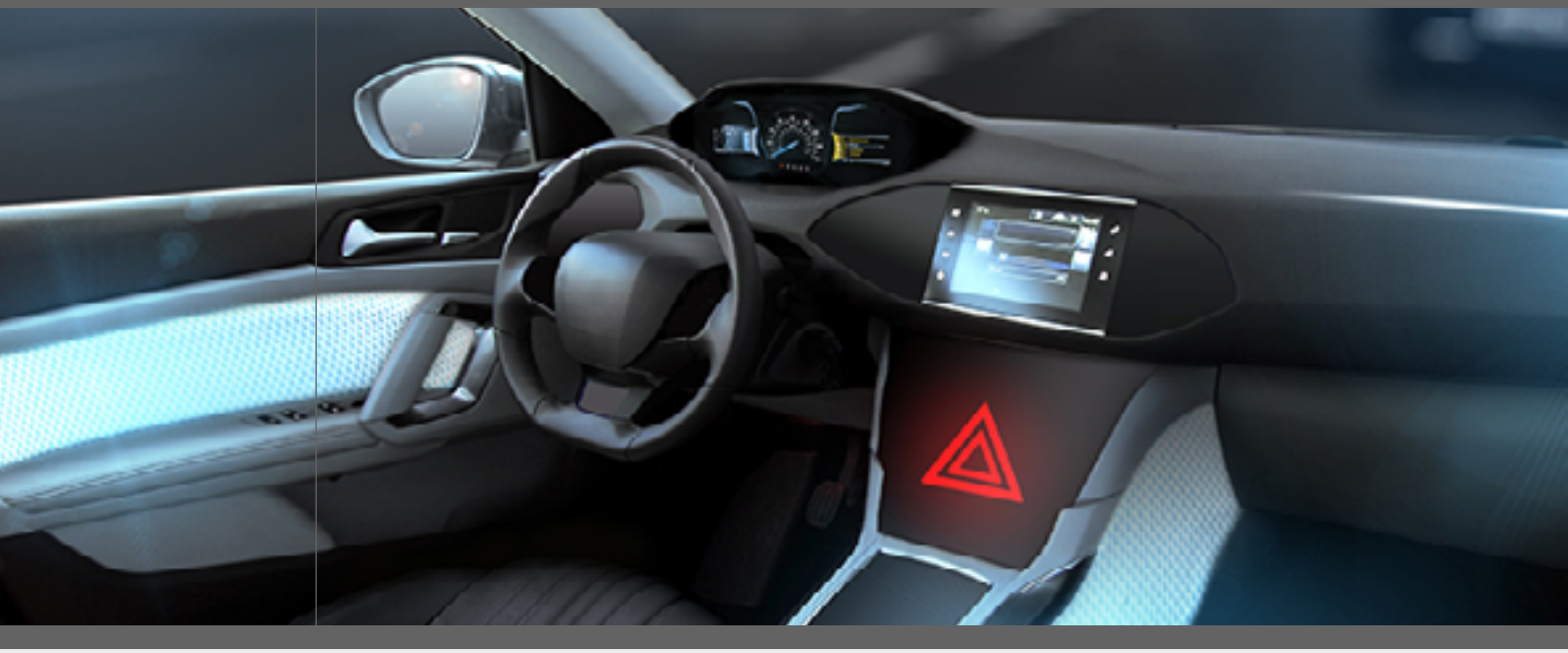

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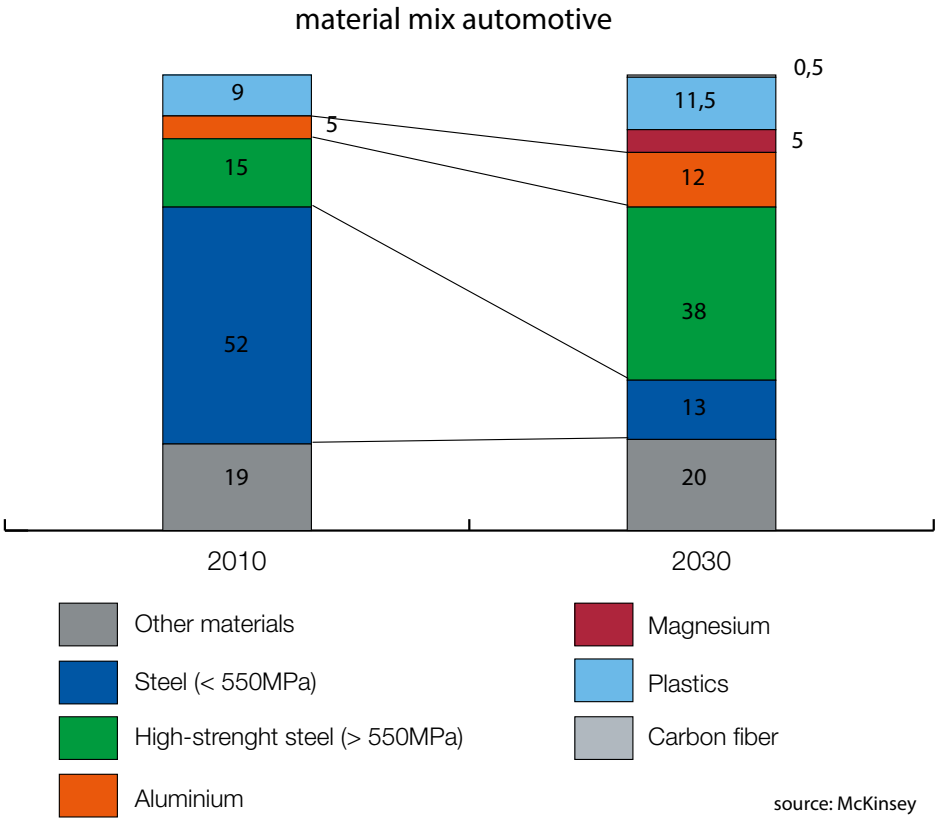
CONTENT

1 BASIC MATERIALS

Past - Today - Future

Automotive engineering has seen many changes since the invention of the Automobile in 1886. At first, most models were built primarily using the traditional carriage materials – wood and leather. By the 1930‘s, steel was the material of choice for the coachwork or autobody and most assembled parts. Only the roof, made from impregnated fabrics, remained unchanged until well into the 1950‘s.
The Oil Crisis in the 1970‘s and the need to improve fuel efficiency, triggered significant engineering and the need for lightweight construction. In 2011,[1] McKinsey compiled a report on the usage of carbon fibre and other lightweight materials. According to this study, the amount of steel necessary to manufacture an automobile dropped from 75% in the 1970‘s to 50% today and is expected to decrease to roughly 13% by 2030. Accordingly, the amount of high strength steel and light metals, especially Aluminium and Magnesium as well as synthetics, is going to increase (pic. 1)



2 FUNCTIONALIZATION WITH COLOR AND CORROSION PROTECTION

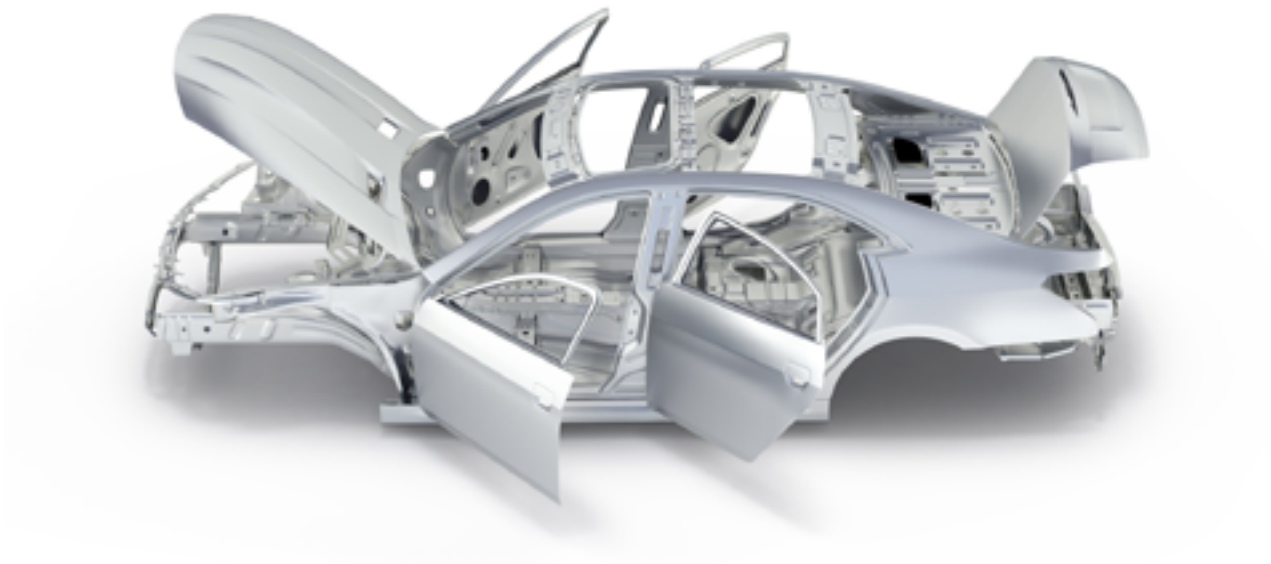
There always have been and still are multiple reasons for selecting a surface treatment: clearly, achieving a distinctive colour is one reason, visible as the bodyworks painting with its multi-layer composition. Protecting the underlying structure from premature corrosion is a second one, albeit, less obvious to the consumer‘s eye. Equally less noticeable are the coatings for many small assembled parts of the cars‘ interior, usually coated with electroplated finishes for increased corrosion protection.

Picture 1: does not look like plastic: metallized gear shift in an upmarket vehicle

Decorative body trims were once almost exclusively made of metal electroplated with Chrome to protect it and provide a bright, attractive finish. Today, these parts are made of synthetic materials, yet the shiny, metallic finish is still a desirable aspect of the buying decision. The plastic materials are not conductive and to apply a classic chrome finish requires a highly complex yet reliable process to electroplate.
Car manufacturers use Zinc and Zinc alloys as sacrificial coatings as favoured finishes to prevent premature corrosion of steel components. As such, electroplating has seen many changes since the 1970‘s and our industry has had to find adaptive technology to satisfy both modern car production and the more eco-conscious world we live in. The ban of Chrome (VI) containing coating systems established by the EC in 2000[2] is an example of one such challenge. During this time, requirements for corrosion protection increased while more attention was paid to appearance and surface texture. The end result was a dramatic increase in coating systems and choices for design engineers. As an example, just a few decades ago the leading technology was “Zinc yellow“ and when necessary, an integrated lubricant. That was state of the art. Today, there are a wide array of finishes, colours and options to choose from. Black, silver, yellow and several other colours, along with added functional properties offer variety but also can present a logistic challenge for the entire supply chain.

3 LIGHTWEIGTH CONSTRUCTION AS A NEW CHALLENGE

The demand for weight reduction to reduce CO2 emissions has led to an increase in the use of Aluminium as a material in the automobile industry. According to the McKinsey report it, this is expected to continue well into the future. Aluminium is lighter than steel and the formation of an adherent, natural passivation layer offers some protection. However, this oxide layer is very thin and easily destroyed during assembly. Additionally, the difference of the electrochemical potential between steel and Aluminium is considerable (E0(Fe) = -0,04 V, E0(Al) = - 1,66 V) which results in bimetallic corrosion when materials are matched in assembly. A comparable situation on an even higher level exists with the second used light metal, Magnesium (E0(Mg) = -2,36V).
Another upwardly trending material are carbon fibres which, in contrast to the common belief that synthetic materials are isolators, do, in fact, have an electrochemical potential higher than that of iron and thus, are more noble.



4 TAILORED SOLUTIONS NECESSARY

It is very important to recognize that combining different materials requires more than just matching and balancing the electrochemical potentials. The respective surface proportions must be respected as well. If the surface of the more noble part is not considerably larger, the less noble part often is found to corrode much faster than expected. This is usually seen when assembling hot dip galvanized parts with high-grade steel bolts. All these factors must be taken into consideration when designing a suitable coating system for corrosion protection. A challenging task indeed. Modern, high quality finishes that provide long term corrosion protection are readily available. These coatings can be improved further with a wide collection of passivates, topcoats and sealers that modify torque, friction values and even colour.
The bimetallic corrosion between steel and Aluminium can be eliminated through the use of Zinc Nickel alloy deposits which reduce the potential difference between the metals by 300 mV. As indicated above, sealers can alleviate the difficulties associated with assembly of a steel bolt into Aluminium.

5 COVENTYA FACES THE CHALLENGES

The growing material mix in automotive production requires intelligent solutions for corrosion protection systems. Close collaboration between the material designer and material “protector” is required to reach this goal.

Coventya, an industry leader in innovative surface finishes, has gained recognition as a reliable partner to both their valued customers and respected OEM‘s throughout the world.

6 REFERENCES

[1]: Lightweight, heavy impact – report of McKinsey, 02/2012

[2]: directive 2000/53/EG

[3]: among others: special edition 829 of the Information Center Stainless Steel

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