Preventing Galvanic Corrosion Reliably

*New Electrically Neutral Compounds Prevent Malfunctions*

Increasingly smaller sizes of complex electrical modules result in higher energy densities and rising temperatures. Occasionally, this leads to damage through galvanic corrosion and the failure of important functions. As this corrosion can also be influenced by plastics, its prevention is one of the major tasks automakers and their suppliers face.

The growing use of electronics has simplified and enriched many areas of our lives. Not only in smart phones and tablets do electronic components find everyday and meanwhile unquestioned application. More and more integrated circuits (ICs) can also be found in the automotive field. These miniature computers work unerringly in the control of many electrical functions: seat adjustment, positioning of side mirrors, window lifters, and windshield wipers. All of these motor-operated components in modern vehicles are controlled by small computers (Title figure).

Microelectronics not only increase passenger convenience – essential functions such as engine management would be impossible without computer power. Also the safety systems in vehicles have been upgraded electronically: airbag control, tire pressure monitoring, anti-lock brake system (ABS), electronic traction- and stability control are just a few of the better-known examples. All of these systems rely on the faultless analysis of physical values, and thereby the control of the associated operations. For example, rotation sensors on every vehicle wheel measure the present speed. The ABS system uses this information to reduce the braking force immediately, if there is a risk of the wheel locking during an emergency stop. Stability control circuits carry out this function individually for every wheel, regardless of the other wheels.

Other sensors determine engine oil level – sometimes even the lubricant’s quality and humidity content – vehicle speed, the distance to the front and rear vehicles, or whether there are problems with the engine. What’s more, even the driver’s condition (e.g. tiredness) can be determined. By means of the collected information, measures such as emergency stops can be initiated even before the driver is able to react himself. This helps to mitigate accidents or even prevent them entirely.

Today, the use of sensors and computers in control circuits makes automobile driving safer and more convenient than ever before (Fig. 1). Consequently, reliably functioning electronics are an important safety feature for the operation of a vehicle. They must be designed, built, and installed in an utmost failsafe manner. ICs are at the heart of this technology. During the past years, they have be-
The modules used in automobiles are often exposed to high operating temperatures. In the engine compartment, these are caused by the heat from the engine, the exhaust train, and the cooling water pipes. In the vehicle’s interior, they are caused by solar radiation on the body and through the glazing. The wide range of functions in modern vehicles means that the components must be installed in extremely limited space.

Conventional soldering technology is no longer possible. Frequently, connections are made with hair-thin wires using the ultrasonic welding method. Moreover, many ICs are manufactured with gold-plated contacts. This ensures that the contact surface does not oxidize easily. Oxidized contacts would impair the required electrical quality. However, gold wires are not used in these cases. Instead, copper, copper alloys, and aluminum are the usual choice, with the result that so-called intermetallic phases are formed at the welded joints.

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ble, certain raw materials are subjected to incoming goods testing applying the new analytical method.

In addition to developments in materials and measurement methods, the manufacture of such highly specialized products also represents a potential source for errors, because undesirable contents in the compound can result in cross-contamination during processing.

The cooling water for the extruded strands can be a possible source of contamination. Akro-Plastic discovered that cooling water containing copper iodide or potassium iodide can contaminate an intentionally electrically neutral product, thereby making it useless. This source of error can be eliminated reliably, if every line in the plant has its own closed cooling water circuit – an approach that was rigorously implemented in Niederzissen.

Another possible source of contamination by iodine or bromine ions arises if the products are manufactured with machines, on which other products, not designed as electrically neutral, had been made previously. Even after intensive cleaning followed by 3 hours production (with a throughput of many hundred kg/h) of the electrically neutral compound, a halogen content above the 1 ppm limit was observed. Therefore, series production with electrically neutral compounds at Akro-Plastic is done exclusively on selected machines and auxiliary equipment. As a result it can be guaranteed today that production is absolutely clean, and that analysis of the product always shows the required iodine or bromine content below 1 ppm.

**Summary**

In future automotive applications, verifiably halogen-free polyamides will become increasingly significant. Plastics manufacturers and compounders must adapt their machines and analytical equipment to meet future demands for electrically neutral compounds, so that customers can benefit from technically mature products. It is not enough to abstain from using critical substances in the recipes. Advanced analytical techniques and good manufacturing practice can ensure that these substances do not find their way into production.

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