WHITE PAPER

BUILDING TRUST

BOARDING THE ADHESIVE TRAIN

The global rail industry has navigated turbulent conditions in the last few years, yet it continues to thrive and shows growth potential in the years ahead. Efficiency in rail systems and progress in rail infrastructure are seen as future growth drivers. Advancements in rail window replacement technologies present new opportunities and pave the way forward for a new approach toward rail maintenance.

1 INTRODUCTION

Challenges abound in the rail industry. Manufacturers of trains, locomotives, and other rail equipment often face issues related to cost reductions while working towards improving efficiencies and prioritizing innovation in order to stay competitive. While safety remains a crucial area of importance, railcar manufacturers and fleet operators should ensure that windshields and all other windows adhere to several factors – ease of installation, maintenance, durability, and efficiency also play a significant role.

Adhesives and sealants enable the use of different materials and allow for efficient assembly. They can be used in all kinds of railway vehicles, from high-speed trains to tram rail cars. Bonding enables the use of larger windows, friendlier passenger compartments, and consequently, better acceptance for public transport. For these reasons, an increasing number of railway operators are realizing the long-term benefits of bonded window applications over traditional gasket-glazed windows.

Dr. Starlinger, head of engineering at Stadler Rail, weighs in on the merits of adhesives, "We apply polyurethane adhesives when we combine large metallic structures with composite components. We take advantage of the high strength of the adhesive system itself. But we also use adhesives to compensate for any mismatch in the tolerances due to production and any mismatch in the thermal elongation."

2 BONDED WINDOWS – DISPELLING THE MISCONCEPTIONS

We spoke to rail operators to understand some of their concerns and issues. Bonded windows clearly show unmatched benefits in the production of new rail vehicles; advantages include tolerance gapping and the use of dissimilar substrates. While rail OEMs consider bonded windows to be a good investment in the long term, from a maintenance standpoint, there still seems to be some hesitation in boarding the adhesive train.

Let's dive into these concerns, one at a time:

2.1 LONGER REPLACEMENT TIME

Fast replacement of rail windows is essential, as they are often subject to vandalism and cracks caused by stones, etc. There is sometimes the risk that the corrosion protection layer can get damaged while cutting the glass for window replacement. Downtime costs are significant and can be anywhere between CHF 1,500 – CHF 15,000 a day.

There is a sense of apprehension that glass bonding is a longer process, and the repair of bonded window systems can create long down-times. The Head of Maintenance at RhB Landquart, Alexander Uwe Graf, voiced these concerns and said that bonded systems need to have both a fast-curing speed and ease of handling.

With a bonding system such as Sika PowerCure, the time taken to replace gaskets versus bonded windows becomes almost the same (The working time to replace gaskets is about the same for experienced installers compared with bonding). Sikaflex®-268 PowerCure, an accelerated adhesive system specifically designed for the rail industry, has a drive-away time of around 4 hours. It enables maintenance and repair centers to release the trains faster.

Sikaflex®-268 PowerCure has been used numerous times for repair all around the world. It is the most popular repair system in the European rail market

2.2 LONGEVITY

A concern that rail fleet operators often raise is that large surface bonding applications are challenging to maintain and do not provide the level of longevity that welded structures can.

A recent success story in May 2022 proves these fears unfounded.

23 years after being put into service, the well-known ICN trains of the Swiss railway were inspected from top to wheel to guarantee safety. Sika products such as Sikaflex®-254 have been used for the train assembly, and Sikaflex®- 265 was used for the exterior joint and its maintenance. This project aimed to estimate the risk of keeping the adhesive joints for 20 years and more. Samples of the 23-year-old joints were collected and tested within Sika testing facilities.

At the end of this exercise, it was observed that there was no adhesion loss, as confirmed by both European Adhesive Engineers from SBB, Mr. Olivier Bicart-Sée, and Mr. Andreas Brand, who stated, “The findings confirm that the duration of life of the Sika adhesive can be at least 20 years.”

This leaves no doubt that adhesive bonding is of high quality and extremely durable.

2.3 DIN 6701 (DIN EN 17460-2022) ACCREDITATION

Quality assurance of bonding processes is of fundamental importance for reliability. With the introduction of the DIN 6701 standard in 2005, additional security and quality assurance of the bonding process can be achieved. In Europe, DIN 6701 has become the standard that lays down the regulations for the manufacture of bonded joints on rail vehicles. The accreditation offers several advantages to companies, and it is no surprise that it is gaining international acceptance, with more than 1000+ companies adopting the standard worldwide.

The standard stipulates that all railway manufacturers require adhesive bonding to be designed and executed according to DIN 6701, regardless of whether the adhesive is applied within the production plant, by a supplier or a maintenance provider/fleet operator → DIN EN 17460-2022.

It is becoming increasingly important for companies that aspire to stay ahead of the curve, to invest in solutions that comply with quality and design requirements as per DIN 6701. At the same time, the norm can also be a burden. It requires qualified and trained personnel and additional efforts for the verification and documentation. It is correct; bonding with high-quality standards costs time and money and can be an administrative burden. Fleet operators must invest in qualified personnel. It can impede the acceptance of bonding.

However, education and qualification are also required for other assembly groups and applications. In addition, fleet operators and maintenance centers can rely on professional service providers that can fill in until their own personnel is ready and certified.

3 THE DOWNSIDE TO GASKET-GLAZED WINDOWS

Corrosion is a pervasive problem with gasket-glazed windows, with almost all gaskets guaranteed to start leaking within 6-10 years. The window is in constant movement (due to oscillations or vibrations) in the gasket, leading to slow but constant water penetration into the vehicle, but also water penetration between the gasket and train body. The resulting corrosion can lead to high replacement costs; in extreme cases, the glass would need to be cut out and replaced, and parts of the train body would need to be restored.

In contrast, the bonding system (including the pretreatment and adhesive or sealant) prolongs corrosion for a much longer time. Installation of gaskets is a cumbersome process, with a high associated risk of breakage of the glass or damage to the train body. The rubber gaskets require significant effort to install and immense strength, especially for heavy windows – the larger the window, the more difficult the process of installation.

Gaskets that meet the fire norms are even more challenging to install, as the rubber used in these gaskets tends to be stiffer compared to gaskets that were designed with previous technologies. Cleaning gasket-glazed trains is also a daunting task, as brushes cannot reach within the narrow edges of the gasket. This leads to dirt and dust staying within the gasket.

4 THE FUTURE OF GLASS BONDING

Rail operators have realized the long-term benefits of bonded windows, also noticeably in countries such as USA and India. The perception that bonded glasses take more time than gasket-glazed windows has come undone, as the overall replacement time remains the same. Fast replacement of the glass is critical in the rail industry, and with solutions such as Purform®-based Sikaflex®-668 PowerCure, downtime can be reduced to under 4 hours.

In addition to functionality, the design also plays its part – bonded glass contributes to a modern, futuristic aesthetic compared to gaskets.

The increasing adoption of the DIN 6701 standard at an international level proves that the global rail ecosystem is recognizing the need for a certification system for safe bonding technologies. An initial investment in bonding technologies, education, and personnel reap significant rewards, including the assurance of best-in-class bonding technologies and strong competitive advantage.

Further developments in adhesive technologies are paving the way for advanced adhesives that can withstand aging and extreme weather conditions even better than existing solutions. The long-term benefits of bonded glass include lower life-cycle costs and increased longevity of the train, be it for newly manufactured rail cars or for the existing rolling stock.

CONCLUSION

Adhesive bonding technologies are the future of rail – with their long-lasting, durable, future-proof properties, they have been ushering in the new era of rail cars.

MARTIN GANSNER
Global Marketing &
Product Manager

Supporting the Bus & Rail Industry with sealing, bonding and fire protection solutions.

For more details on Sika solutions for Transportation contact us or visit our website www.sika.com/transportation.