

Araldite® adhesives facilitate the spread of innovation across Europe's railways

Driven by rising road congestion, demand for mobility and concerns over climate change, in Europe considerable emphasis is now being placed on developing rail as a key transport mode by promoting step-change innovations for passenger rolling stock, freight transport and rail infrastructure.

Here, Laurent Pourcheron, Marketing Manager for Adhesives at Huntsman Advanced Materials, takes a look at the adhesive technologies which are enabling the production of sustainable developments, helping manufacturers in the sector achieve competitive edge and secure long-term growth.

The impetus behind innovation

Rail is amongst the most efficient and climate-friendly forms of transport, yet currently it only carries approximately 10% of European cargo and 6% of passengers each year. The level of global competition is high and manufacturers need to focus on innovation leading to better services and reduced costs that offer an attractive choice for customers.

The need to develop rail as a key mode of transportation is reflected in the establishment of the European Commission's 'Shift2Rail' initiative. This new public-private partnership has been set up to invest just under €1 billion in research and innovation to support better rail services and encourage more passengers and freight onto Europe's railways.

Amongst the key areas identified for investment, the Shift2Rail initiative highlights production process improvements, new designs, weight savings, compliance to stringent safety and environmental standards and low maintenance costs as being vital to success.

In this context, adhesives are playing an ever increasing role, providing well established solutions in addition to more advanced and innovative developments for all kinds of rail bonding applications.

Delivering long term performance

Adhesive bonding enables the most efficient methods of assembly. Whilst maximising long-term potential and performance, it also optimises manufacturing methods with easy handling and simplified assembly procedures which speed up cycle times and reduce costs in parts production.

Adhesives form a continuous bond providing more uniform stress distribution within a leak proof solution which is also less prone to corrosion and therefore well placed to provide a longer service life under load on a wide range of applications.

A bonded structure is often cited as a safer structure as the occurrence of fatigue cracks are reduced through the uniform distribution of stress concentration. Bond lines are also frequently described as crack formation stoppers.

As there are no holes, rivets or fastening elements to weaken structures, adhesives also facilitate the integrity and strength of materials, giving a smooth appearance to designs with improved aesthetics on finished parts and greater design flexibility.

For complex assemblies, such as composite sandwich structures, adhesives tend to be the only fastening technique that can successfully bond them together. They can also join dissimilar materials together and compensate for differences in the coefficients of thermal expansion, helping to lower ongoing maintenance costs.

What's more, adhesive bonds can provide an electrically insulating barrier between surfaces and offer good dampening properties which are useful for reducing sound or vibrations.

Extending the service life of parts, simplifying designs, streamlining assemblies and helping to produce lighter, safer structures, today's adhesives offer advanced properties which can deliver economic advantages at every level of the industry.

Structural adhesives

Huntsman offers four main types of structural adhesives for all segments of the rail market – from high-speed trains, mainline, regional, metro, suburban and freight trains, as well as the infrastructure around them.

The key features of Huntsman's epoxy, polyurethane, methacrylate and phenolic-based adhesive systems are as follows:

- Epoxy adhesives offer excellent adhesion to metals and thermoset composites, providing excellent durability, chemical and temperature resistance (up to 190°C) with low shrinkage
- Polyurethanes are more suitable for bonding thermoplastics, offering good long-term durability, strength and flexibility
- Methacrylates offer good adhesion on metals, thermoset composites and most thermoplastics, providing both rigid and flexible mechanical properties and minimum surface preparation requirements
- Phenolics are well suited to metals and friction materials. They offer outstanding temperature and chemical resistance, ease of application and a virtually infinite open time once applied

Huntsman's structural adhesives all have different chemistries with discrete structures and physical characteristics that make them suitable for targeted applications and specific processing requirements.

Rolling stock applications

For structural parts such as roofs, doors, floors and semi-structural products such as floor coverings, seat to floor attachments, door frames and hinges, Araldite® AW 4859 / HW 4859 is an example of an epoxy adhesive which offers the advantages of ease of application, high strength and shock resistance on multi-material assemblies.

In Italy for example, this adhesive is being used to bond a simple overlap joint aluminium seat fixture within a high-speed train. In this instance, Araldite® AW 4859 / HW 4859 was selected for its excellent dynamic load and fatigue resistance.

Araldite® AW 4859 / HW 4859 also offers excellent chemical resistance and thermal stability even in temperatures ranging as high as 140°C, making it particularly beneficial for exterior applications on carriages where it helps to reduce structural weight whilst improving fatigue resistance on metal assemblies.

Araldite® 2013 is a further case in point. This epoxy adhesive is now used to bond GRP driver cabins because it offers excellent adhesion, high durability in ambient weather conditions, fatigue resistance and toughness. It also enables greater design freedom, supporting the structural strength and integrity of the more complex and ergonomic shapes of driver cabins now seen on the latest generation of high-speed trains.

In Germany, another epoxy adhesive from Huntsman, Araldite® 2015 is replacing the welding process used to assemble aluminium substrates on the driver compartments of regional train units.

As a result of weld distortions, this process was found to be both time intensive and costly, often requiring the need for re-working and further sealing techniques on the compartment door leaves.

By contrast, adhesive bonding using Araldite® 2015 maximises process and performance benefits by minimising the steps in production, reducing costs and improving the design ergonomics whilst helping to extend the compartment's service life, thanks to its superior strength.

Because it forms joints with elastomeric type behaviour that are water tight and durable, Araldite® 2015 is also used in Italy to bond an anti-vibration damper to a train body. In addition, in both Germany and Austria it is used to bond aluminium driver door profiles on

trams and trains.

The methacrylate adhesives, such as Araldite® 2021, tend to be used for bonding metal hinges to GRP interior panels and on a range of interior furnishings such as fold tables, luggage racks and ceiling liners, where their fast curing properties provide significant time saving advantages.

In both Spain and Sweden, manufacturers are benefitting from this adhesive's rapid assembly and peel resistance on a range of rolling stock interior components, bonding doors to lockers, reinforcing train roofs and constructing WC modules.

By contrast, the flexible properties of polyurethanes make them the adhesive of choice for joining tough-to-bond engineering thermoplastics, rigid plastics and composites, finding application in sandwich panel lamination and assembly for frames, wall cabinets, partition walls and panelling.

In Spain for example, the combined flexibility, ease of application and colour of the polyurethane adhesive Araldite® 2029-1 have made it the ongoing adhesive of choice on a carriage floor joint bonding project.

Designed especially for application as a friction lining material, phenolic adhesives such as Araldite® 64-1 and Araldite® 71 are finding increasing application in steel and aluminium brake bonding applications.

Infrastructure applications

For trackside applications such as signal light boxes, traffic control boxes and rail joint construction and repairs, where electrical insulation, very good weathering, thermal resistance and flame retardancy are essential, Huntsman offers a number of products in its epoxy and methacrylate-based adhesives ranges which are fit for purpose.

With Norwegian manufacturers attaching train detection sensors on the track with Araldite® adhesives, Swedish businesses utilising them to assemble rail shifters and rail companies in the UK, Spain, Romania and beyond using them for rail joint bonding assemblies, adhesive bonding is rapidly becoming the preferred method of assembly for many high performance applications.

Araldite® AV 5308 / HV 5309-1 and Araldite® AW 106 / HV 997 are two adhesives from Huntsman which now feature on British Rail's Register of Approved Adhesives and are found in application in the UK on fishplate rail line butt joint assemblies.

Innovation in adhesives

Huntsman's innovations in adhesives go beyond improving mechanical properties to focus on important features such as flame retardance, low smoke density and low toxic emissions.

Leveraging a long experience working in the aerospace industry, the business continues to develop products that meet stringent FST safety criteria. Araldite® 2033 is an example of a recent development from Huntsman which offers excellent adhesion on metals and composites alongside the advantages of flame retardant properties that are UL 94 V-0 and NF F 16-101 I2 and F2 approved.

Huntsman Advanced Materials' testing laboratories in Basel are accredited according to ISO/IEC 17025 for synthetic materials testing and quantity temperature calibration. This accreditation also ensures that in-house testing methods conform to the DIN 6702-1 standard requirements for the rail industry.

In summary

With the impetus behind innovation in the rail sector taking shape, adhesive bonding has started to emerge as the standard in manufacturing parts which deliver superior performance and durability on rolling stock and infrastructure applications.

Huntsman's adhesives help manufacturers to improve their production processes, secure long-term performance and the safety of assemblies. This results in reduced maintenance costs, increased design freedoms and the development of lightweight structures for better energy efficiency and aesthetics – all important factors in making rail an increasingly attractive choice for all its customers.