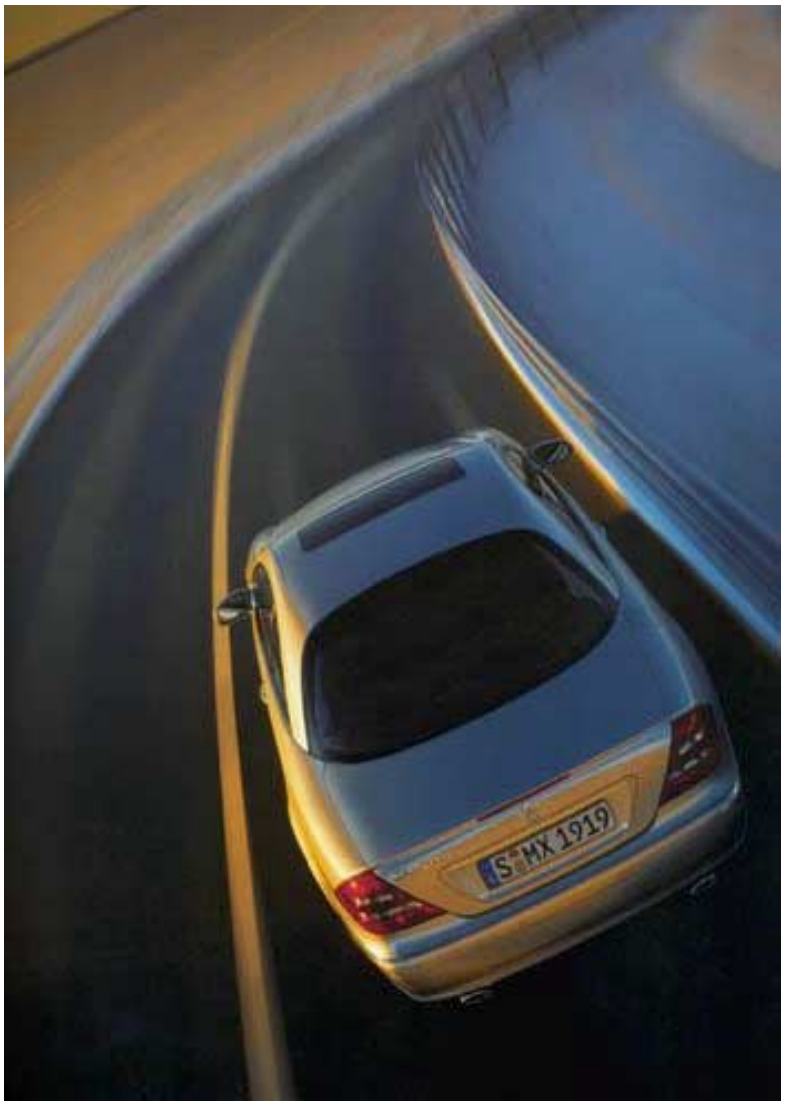


SMC on the road to success

A brief synopsis of the Automotive Seminar held in Coventry, U.K. October 2000

SMC on the road to success

SMC (Sheet Moulding Compound) has a proven history as an engineering composite with many unique qualities. This is true, both for the automotive sector and for the many other industries where the material is widely used; such as construction, electrical and electronics. The message that came through clearly from the recent Automotive seminar staged by the European Alliance for SMC, was that although the material has been established for many years, recent developments in product properties and processability are opening up new applications. In other words, it's time to look again at SMC.

Held in Coventry, U.K. shortly before the British Motor Show, the seminar attracted an audience of over 100 delegates - which not only included moulders and raw material suppliers, but also a sizeable percentage of designers and engineers from leading OEMs such as Ford, Jaguar, Lotus, Renault, VW, BMW, Volvo and Scania. Presentations dealt with important issues such as new developments in Class A surface finish for exterior body panels, paintability of SMC, low weight materials, and recycling issues. The seminar, the first of it's kind in Britain, concluded with a tour of the Jaguar plant at Brown's Lane. What follows is a brief synopsis of some of the papers.

Markets and applications for SMC/BMC

The transportation industry demands materials for structural and visible applications that are attractive, strong, lightweight, temperature resistant, recyclable and, above all, economical in use. SMC/BMC meet these requirements. Although the market for SMC materials is still considerably larger in the United States, new applications and the wider use of SMC for car body panels will see the European market grow by 6% per year according to Dr Giorgio Icardi of glassfibre producer Saint-Gobain Vetrotex. Currently the market for SMC in land transportation stands at around 66, 000 tonnes per year.

The two principal market sectors in transportation are trucks and automotive. Trucks and other commercial vehicles is a long established sector which has been attracted to SMC for a number of reasons, in particular the substantially lower tooling costs compared to steel, lower maintenance and reduced weight. Typical applications include structural components such as cab steps and bumpers; body panels such as roofs, grilles, fenders and doors; and under-bonnet components such as oil sumps, top covers and noise shields. In the automotive market, SMC and BMC have long been used in lower series vehicles such as MPVs (the Renault Espace being a well documented example), 4x4s, estate cars and sports coupes. As in truck applications, lower investment levels and flexibility are factors in favour of SMC, although certain limitations – perceived or actual - have held back the wider adoption of SMC for exterior body panels.

On-line paintability and design freedom

One such concern has been the on-line paintability of SMC to achieve a Class-A finish. On-line painting, where the entire car body is painted as one, is the preferred option because not only is it more cost effective than the modular assembly of pre-painted cars, but it is also superior in terms of colour uniformity and overall quality.

The problem for the on-line painting of plastics is the high temperatures of up to 200°C used in the baking process. To prevent these temperatures from damaging the panel an electrostatic powder has to be applied before on-line painting. Thanks to recent developments in conductive SMC it is now possible to deposit this electrostatic powder onto the SMC surface.

Class A decklid made of SMC (Daimler-Chrysler)

Today SMC stands out as the only composite material that can withstand on-line painting processes, and the Mercedes Benz CL500 decklid is an excellent example of an on-line painted SMC body section. Johann Zeiler of composite moulders Mitras Automotive Germany gave a presentation on this particular project.

Not surprisingly there is now keen interest amongst automotive OEMs in the possibilities for SMC body panels: particularly with the trend towards niche vehicles, shorter life cycles and the need for more flexible, economic materials solutions. And because initial investment levels are lower, SMC components become an economically attractive alternative even for car volumes of 600 units per day.

The design freedom of SMC is also suited to the current needs of model differentiation and customisation. Aside from aesthetics, SMC brings many functional advantages such as weight reduction and the ability to integrate a large number of parts into a single moulding - thereby saving on assembly processes. Styling freedom, together with the inherent transparency of the material to radio waves, means that GPS and mobile phone antennae can also be integrated within the SMC body panels.

In the automotive industry the modular assembly concept is also increasingly popular especially as several models can now be produced on the same platform: which means that complete component production, assembly and painting can now be outsourced to external suppliers. This is a popular concept and is one to which SMC is well suited. A good example of where SMC is used in modular components, are the tailgates made for MPVs sharing a common platform.

Weight saving by material advances

Weight reduction is a major focus for the automotive industry and is set to become an even greater issue over the coming years as environmental pressure increases, consumers demand greater fuel efficiency, and emission legislation gets stricter. Reductions in weight come primarily from either the use of lower density materials or the use of higher strength materials which allow a reduction in wall thickness. Composites such as SMC have already proven their ability to achieve weight savings in a number of applications, but to remain competitive SMC producers need to further develop weight reduction concepts. This is according to Dr Fons Harbers of leading resin supplier DSM Composite Resins.

Isuzu Truck uses low density SMC panels

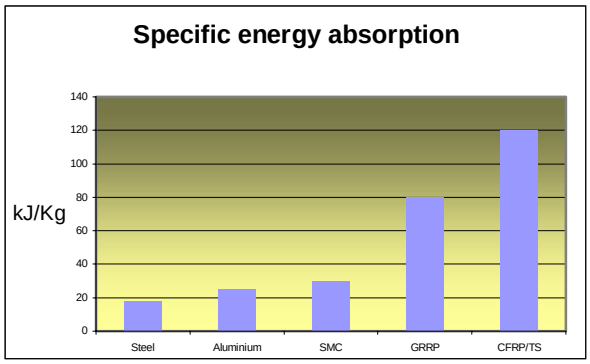
Exterior body panels offer large potential for weight savings. However the current demands for higher comfort levels, safety and increased performance are tending to increase rather than reduce overall vehicle weight. Several weight reduction possibilities for SMC are being explored by DSM, these include: minimising wall thicknesses, reducing or modifying the filler and reinforcement content of the material, and optimising current SMC materials using FEM calculations.

Many SMC parts are currently over designed compared to competitive materials and opportunities exist to reduce wall thickness by 30% in some cases, without compromising appearance or mechanical performance. Carbon fibre as a substitute for glassfibre reinforcement is another development area which is being investigated. Although it is still more expensive than glassfibre, carbon fibre costs are falling all the time as increased volumes bring scale economies.

Weight reductions of up to 65% are possible when the glassfibre is replaced by carbon fibre - with significant enhancements in flexural strength.

Crash behaviour

Impact absorbency of composite materials is generally good compared to metals, since the energy tends to be transmitted along the fibre matrix. Needless to say they don't bend, dent or buckle, so minor impacts do not result in costly repairs. Crash behaviour can also be engineered into the part by localised modifications to reinforcement or wall thickness. At the seminar, Dieter Imbsweiler of Daimler Chrysler AG discussed their tests using energy absorbing crash boxes mounted on the front structure of their vehicles. Crash test rig results, borne out by FEA simulations, showed that composite crash boxes combined excellent crash performance



FRP crash boxes exhibit excellent crash performance which can be engineered into the design.

Recyclability

Recycling is a major issue which affects the entire automotive industry and supply chain. There are four key principles in Europe's common strategy for waste management as explained by Hans Kelderman of DSM Composite Resins. These principals are: the amount of waste should be limited at the source; the 'polluter pays' and 'producer responsibility' principles - which state that the cost of dealing with waste should be met by the producer; the precautionary principle – anticipation of potential problems; and the proximity principle – waste products should be dealt with as close as possible to source. Work has started on a network of directives based around these principles.

The Ercom recycling plant at Rastatt

As far as composite recycling is concerned, industry initiatives began over ten years ago, largely in response to public and political pressure on the German plastics industry to take responsibility for the reuse of their products and materials at the end of

their life cycle. Thermoset composites were especially threatened as they were considered to be non-recyclable. The SMC industry therefore had to either come up with a solution or else surrender market share to competitive materials. Their clients in the automotive and electrical/electronic industries, the main markets for SMC, were also requiring that the industry developed and proved recyclability concepts before SMC would be considered in new applications.

As a result, a number of leading SMC producers, moulders and raw material suppliers got together to found, in December 1990, Ercom Composite Recycling GmbH. Ercom offers a complete system to close the recycling loop. A mobile shredding truck crushes used parts at disassembly and production sites to reduce transport costs. The compacted material is then transported to a fractioning plant in Rastatt from where the material is reprocessed into a range of fibre rich recyclate for resale back to SMC producers and other end-users. Compatibility of recycled SMC, irrespective of the composite formulation, assures the necessary economics in terms of logistics and processing.

Ten years on and Ercom has made considerable progress. Certainly the willingness to use recycled material has increased and, in particular, the automotive industry has supported recycling by approving its use in high performance parts and by specifying recycled content in its components. But much still has to be done by all members of the recycling loop to improve efficiency and economics, and to ensure a high quality product suitable for prime applications.

Conclusion

Ron Woolley of Byk-Chemie, seminar chairman, concluded by underlining the success of the meeting: "We are pleased with the response to our papers received here in Coventry. Knowing that all major automotive OEMs sent delegates to the seminar, confirms the high level of interest and confidence in our materials and the serious interest in working with us. It also indicates, that SMC/BMC parts are a prime choice especially for the UK automotive industry and will play an even more significant role in the future."

Further information

The European Alliance for SMC/BMC has produced a recycling brochure dealing with the current recycling situation of SMC/BMC. It includes the new European legislation for End of Life Vehicles and is the first in a series on SMC and the environment. The Alliance also publishes 'Design for Success', a comprehensive and invaluable guide to designing in SMC/BMC.

For copies of these publications or for further information contact:

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Round-up of SMC/BMC benefits for Truck and Automotive OEMs:

Low weight = improved fuel efficiency

SMC composite parts can typically be some 20-30% lighter than equivalent steel parts resulting in substantial fuel savings over the life of the vehicle. Opportunities for further weight savings are being investigated.

Reduced costs through parts consolidation and modular assembly

High levels of parts integration can be achieved in SMC, greatly reducing the number of sub assembly stages. For example, in front ends a single SMC part with moulded-in threads and inserts can replace a large number of metal sections, leading to greater modularisation less complexity and reduced costs.

Customisation and styling freedom

Tooling costs for SMC are substantially lower than for metal. This facilitates more frequent model changes and styling differentiation. It especially suits the market requirements for niche vehicles where lower volumes are combined with a broader product offering, built around common platforms.

Thermal stability

A major advantage of SMC, as a thermoset material, compared to a thermoplastic compound, is its dimensional stability from –50ºC up to 200ºC. This means that parts can be on-line painted at high baking temperatures, and is why the material has been successfully used for sunroof frames and engine bay components.

Metal compatibility

The coefficient of linear expansion for SMC is very similar to steel and aluminium, which means a good interface fit with no gaps between panels in the winter and no buckling in the summer.

High quality, durable finish

SMC composite body panels are more resilient than metals so minor impacts are more easily dissipated – hence no dents. SMC is unaffected by road salts or other corrosive environments and achieves a Class A surface finish for body panels.

Cost competitive… even on high series

Although traditionally associated with low and medium series vehicles (< 75,000 vehicles per year), recent applications have proven that volume parts of 300,000 per annum can be made economically in SMC.

Recyclable with a favourable life-cycle profile

SMC and BMC parts offer closed loop recyclability. Life cycle evaluation of SMC shows a favourable profile in terms of energy consumed in making the component versus energy saved during the life of the component.

Other benefits

Include reduced noise, vibration and harshness thanks to the good acoustic properties of SMC. Crash behaviour and mechanical performance can also be engineered into the design of SMC components.