

THE REINFORCER

KORDSA | BULLETIN | N.06 | 2017 | TURKEY

Determined to Create Value

KORDSA

STRONG

IMAGINATION

EFFECTIVE

SOLUTIONS



We reinforce life



2 out of every
3 aircraft tires



Every 2nd
automobile tire



**REINFORCED BY
KORDSA®**

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Contents

03 / 04 **Foreword**
Cenk Alper

05 / 06 *Güler Sabancı*

07 **CSR Projects**

08 / 09 **Awards**

10 / 16 **News**

17 / 18 **Are you ready for the
perfect storm?**
Tekin Gülşen

19 / 22 **Carbon Fiber / Epoxy Composites:
Ideal Materials for Orthopedic
Prosthetics.**
Selim Küsefoğlu

23 / 25 **Nylon 6.6 As Superior Cap Ply**
Sadettin Fidan

26 **A Customer-Tailored Value Chain**
Kadir Toplu

27 / 29 **Lightweighting For Heavy Trucks**
İsmail Erhan Eyol

30 **He is coming again!**
Vahe Hanamirian

Life without challenges would be very boring. Never forget that the hearts and minds of 4,000 Reinforcers are with you, whatever your challenges.





Foreword

CENK ALPER

CEO

Dear Esteemed Partner,

A new year, a new issue of The Reinforcer, new challenges and our new identity.

Kordsa | The Reinforcer. We Reinforce Life.

While everybody was expecting a peaceful year, 2017 has started with its own challenges and turbulence in the political and economic arena. The rally of the U.S. dollar against emerging market currencies, increasing protectionism and decreasing growth rates will be the main theme of 2017.

Despite all political and economic challenges, technology continues to change our lives more than ever. On one hand, electric vehicles, smart mobility, and light-weighting are changing all the dynamics of transportation; on the other, the internet of things, big data, and intelligent robots are reshaping the competitive dynamics of manufacturing through the Industry 4.0 or Smart Manufacturing models.

At Kordsa, we are preparing ourselves for the new normal, so that we can be much stronger in our vision of reinforcing life.

With the opening of our third “Safety Training Center” at our plant in Salvador, Brazil, we continue to improve safety awareness not only among our employees but also across society using real-time simulators. More than 2,000 employees and visitors worldwide have already experienced the possible damages of safety incidents at our test centers.

On the other hand, our engineering, operations and lean teams at Kordsa have been studying the factory of the future. We are clear that with the implementation of Industry 4.0 concepts in our plants, we can be much more competitive in terms of productivity and quality and can better serve our customers. The lean engineering projects that we have completed in recent years proves that the implementation of Industry 4.0 is not just a dream at Kordsa.

Kordsa will proudly take its place in a book by Professor Ben Bensaou entitled “The Innovation Machine”. He has already explained the journey of innovation Kordsa has begun at Innovation Week in Istanbul.

The record number of patent applications in 2016 indicates that the innovators of Kordsa are relentlessly preparing a new product portfolio for lightweight reinforcements. Please follow us at upcoming industry events at JEC and Construction USA. Our technology and marketing teams will be closely working with you to implement our reinforcement solutions for your products.

Our efforts to reinforce life are not limited to our products. Now, we are part of the Borsa Istanbul Sustainability Index. Our Reinforcers continue to reinforce the environment, the economy and society in every part of the world in which we operate. Please see our 2015 Sustainability Report to learn more about this aspect of our work.

Life without challenges would be very boring. Never forget that the hearts and minds of 4,000 Reinforcers are with you, whatever your challenges.

For We are Reinforcers and We can reinforce Life.

Enjoy reading this issue,



Sustainability Report 2015

Today we are offering our reinforcement technology that reshapes the industry to the whole world.





GÜLER SABANCI

Chairman, Sabancı Holding

We live in a world where innovation drives the sustainable development in almost any industry, determining all business and product development processes at a global scale. Advances in technology that occur at an unprecedented pace combined with the need to use available resources effectively and efficiently open up new horizons for us. Reducing our environmental footprint by developing highly value-added and innovative products and using available resources effectively through our investments in R&D activities are the complementary links of the industrial chain in today's world.

Lighter and stronger materials that are produced using reinforcement technologies have been introduced in our lives and already started shaping the industrial production processes of the future. The focus is no longer on durability; but also on light-durability. And design is the ultimate ingredient in this recipe. More durable, lighter and custom-designed high-tech products reinforce cars, airplanes, and bicycles and thus have become a part of our daily lives. The same technology is also used to reinforce industrial materials like energy turbines or pressure vessels.

Henceforth, we may predict that composite technology will take up a bigger part in our lives. For example; with composite technology, aircrafts will be lighter and thus, carry more payload, have a wider range, travel faster, become more durable, and hence have a longer lifetime and consume less fuel. While increasing the payload capacity of air transport services, it reduces fuel consumption and carbon emissions, which have a major impact on our environmental footprint. We can easily make a similar claim for motor land vehicles. Lighter vehicles, lighter tires, reduced commercial costs and environmental impact that translate into benefits in many areas.... To sum it up; the magic touch of R&D and innovation that we are already feeling today will only become more prominent in the near future.

The experience we have gained over the years, the know-how that we have produced, and our vision to always see what's beyond the horizon has transformed what has started as tire production into 'The Reinforcer'. 'The Reinforcer' is more than simple words to us. Our principal goal of "moving forward with value-added and innovative reinforcing technologies" also incorporates creating sustainable values not only for our customers, employees, and shareholders, but also for the community and the world we live in.

We are now channeling this vision that differentiates us with value-added innovations and our know-how in tire reinforcement that we have accumulated over long years to construction reinforcement and composite technologies. The Composite Technologies Excellence Center, created in collaboration with the Sabancı University, is a first in Turkey and will become a role model for others. This model enables students, researchers, faculty members, entrepreneurs, and engineers from different cultural backgrounds to work together in a common ecosystem to produce faster and more effective solutions. This, in turn, translates into a unique perspective that creates value.

Today we are offering our reinforcement technology that reshapes the industry to the whole world. Our technological know-how, innovative approach, and R&D activities, a record number of 407 patent applications in 2016, our collaborations with universities at national and international level, our innovative investments, our operational excellence, an ethical approach to productivity, and a determined governance style aligned with our strategies have resulted in global recognition of our 'The Reinforcer' brand.

We now continue our global brand journey with the goal to introduce our new reinforcement technologies that will consolidate our brand to the entire world.

WE REINFORCE LIFE

CSR Projects

Kordsa Leaders Once Again Reinforce the Future

Every year, Kordsa holds a Global Leadership Summit (GLS) where it takes leaders from its production facilities all over the world. Once again, this year's leaders did their bit to reinforce the future. Kordsa's reinforcers this year renovated a school in İzmit, renewing the pre-school and elementary school heating systems and whitewashing the school's walls. The project completely renovated every room in the school, from the library to the playground, and from the math classrooms to the visual arts room.



Kordsa Run for Good



Reinforcement professionals have not wasted their energy this year either and have been running for good. Kordsa reinforcement professionals took part in the Vodafone Istanbul Marathon on behalf of The Spinal Cord Paralytics Association of Turkey. 35 people from the company ran in the marathon, with five people participating by pushing wheelchairs.

USA Plants' CSR Projects

Kordsa has undertaken two corporate social responsibility projects in the USA.

In line with the company's aim of reinforcing the societies in which it operates, employees at its Chattanooga plant in the USA carried out two CSR projects. Traditionally, every year Kordsa Chattanooga raises money for the Susan G. Komen Foundation, supporting the charity's aim of raising awareness for the fight against breast cancer. This year, Reinforcers sold doughnuts and fresh fruit cups during a fundraising event organized by Kordsa.

Following this event, Reinforcers visited DuPont Elementary, a local elementary school adopted by Kordsa. Besides serving breakfast, Reinforcers shared the good news that Kordsa would be sponsoring the school's new Reading Room, starting with a donation to get it underway.



"İzburs" Selections Completed



The İZBURS scholarship established by Kordsa Reinforcement Professionals and overseen by the İzmit Scholarship Association has completed its selection process for the 2016-2017 educational period. The outcome is that 18 new scholarship-holders have joined the İzburs family. Funded through donations from people associated with Kordsa, the İzburs scholarship fund was launched with the aim of offering non-refundable scholarships to successful college students in Turkey who are in need of financial aid. Recipients are supported throughout the duration of their studies. Currently, 55 college students from all over the country benefit from İzburs scholarships. İzburs provides monthly funding to selected college students for 9 months, and each scholarship-holder that achieves the required grades every year continues to receive the scholarship until his/her college education is completed.

Kordsa Joins Children at New Year



Kordsa employees in Brazil and the U.S. joined their little friends as part of new year celebrations. Kordsa Brazil employees wearing Santa Claus costumes spent a fun day with orphaned children along with the attendees at the "Excellence Visit" at which examples of working excellence were at the Brazil plant were presented. Meanwhile, Kordsa USA employees went to the elementary school that they support to celebrate the new year. During the visit, the children were presented winter hats as a gift to keep them warm.

WE REINFORCE LIFE

Awards

Among the Best R&D Centers of the Year for the Third Time in a Row!

After being selected as the best R&D Center of the Year in 2014, Kordsa was ranked among the best R&D Centers nationwide in Turkey in 2015 as well, according to the Turkish Ministry of Science, Industry and Technology's Performance Index for R&D Centers. At the award ceremony, Kordsa was given two prizes - "Third Best R&D Center in All Sectors", and "Best R&D Center in the Textile Sector" - with the awards being presented by Minister of the Economy, Mr. Nihat Zeybekçi and Minister of Science, Industry and Technology, Mr. Faruk Özlü.

Leading companies from various sectors who conduct R&D activities attended the Fifth Private Sector R&D Centers Summit, at which Minister of Economy Mr. Nihat Zeybekçi and Minister of Science, Industry and Technology Mr. Faruk Özlü awarded prizes for the best R&D centers in various sectors.



Best Employee Award Goes to Indonesia for its “Safety Experience Center” Project



Representatives of the Employers' Union and the Bogor Region Union have been introduced to Kordsa's "Safety Experience Center" project, realized within the scope of Total Productive Maintenance in Indonesia. Kordsa leader who realized the project was named "Best Employee". In the "Safety Experimentation Center", Kordsa employees have the chance to experience safe simulations of accidents they may encounter. The trainings, in which Kordsa employees of all ranks participate, have the ultimate goal of zero accidents, zero quality defects and zero machinery-stoppages.

Indonesian Export Award

The conductor of Kordsa's Asia-Pacific operations, Indo Kordsa, has received the Indonesian Export Award, which is given to companies thought to have contributed to economic development. Companies are granted this award for superior performance, once Ministry authorities have carried out an assessment based on realized trade volume. Kordsa was presented the award by the Indonesian president Joko Widodo, acting on behalf of the Ministry of Customs and Trade. After the award, H. E. Mr. Wardana, Indonesian Ambassador to Turkey, made a courtesy visit to Kordsa's Composite Technologies Center of Excellence, where he met with Reinforcers.



Among the Best Employers in Thailand for the Seventh Time!



For the seventh time, Kordsa, which carries out its activities in Thailand as Thai Indo Kordsa, was granted the accolade "Superior Employee-Employer Relations and Welfare Level" at a ceremony organized by the Thai Ministry of Labour. At this ceremony, the Ministry rewards leading companies on the basis of an assessment of employee-employer relations and employee welfare level among the companies carrying out business in the country. In all the countries where it operates, Kordsa follows a people-oriented approach. It has received the Thailand Ministry of Labour's award in five consecutive years, leaving lots of rival companies behind.

Kordsa is one of the Best Employer Brands in Brazil!



Kordsa achieved seventh place in the Best Employers list for Bahia region, by Great Place to Work Institute. Based on the anonymous responses in the randomly-distributed surveys undertaken by the Great Place to Work Institute, Kordsa was placed in the 86th percentile in the trust index. Outstripping a good many of its competitors in the trust index rankings, the company once more confirmed how much it is appreciated by its employees.

Kordsa Receives Great Prize at KalDer's Quality Circles Conference

Kordsa has been awarded "The Best Quality Circle" prize at the 19th Quality Circles Conference run by KalDer, the Turkish Quality Association. Kordsa's submission to the competition had been the sensor system it implemented to prevent the tag mix-up problem experienced in cord production facilities.



NEWS

Kordsa, the “Innovation Machine”



Kordsa shared its history of transferring its competence in the tire reinforcement market into composite technologies at the “Innovation Week” event held by the Turkey Exporters Assembly (TEA). Kordsa CEO Cenk Alper and INSEAD Technology Management Academic Prof. Ben. M. Bensaou spoke on a panel preceded by a musical recital with cellos produced using carbon fiber reinforced by Kordsa.

Kordsa, a global player in the tire, composite and construction reinforcement technologies market, participated in the Turkey Innovation Week held by the TEA over December 8th-10th at the Istanbul Congress Center.

Kordsa shared its journey of innovation, in which it transferred its tire reinforcement knowledge that had accumulated since 1973 into its construction and composite technologies and reshaped the industry with its “Reinforcement” position, with panel attendees at Innovation Week. Kordsa CEO Cenk Alper, participated in the panel “Blue Ocean: A Reinforcement Story” with INSEAD Technology Management Academic Prof. Ben. M. Bensaou; one of the most important mentors behind the Blue Ocean Strategy, analyzing how Kordsa transformed through innovation as a case study.

The panel started with a music recital with cello produced using carbon fiber reinforced by Kordsa. Cenk Alper said that the company had transferred its experience in tire reinforcement and in weaving and resining technologies into the composites market, and that they now reinforced within many more fields throughout the world.

Expressing their aim of creating another Kordsa out of Kordsa through innovation, Alper continued:

“We are a reinforcement player in the global market. While working on the lightweight technologies of the future with big tire manufacturers, today we are also talking about composite technologies that will transform every industry. We introduced an innovative approach for the R&D and manufacturing of composite technologies, and now, at the Composite Technologies Center of Excellence, academics and industrialists are working together towards innovation. We research and develop together, we produce prototypes using the results of this research, and then we step into the production process. Through this center, we are going to continue to produce technology, not just for Turkey, but for export to the whole world.

Kordsa will be a case study in the book “Innovation Machine” by Prof. Ben M. Bensaou, one of the most important names in Blue Ocean Strategy and in the field of innovation.



Kordsa at Innovative Tire Forum

Kordsa shared its tire reinforcement technologies and new generation tire reinforcement technology trends this year at the 2nd “Innovative Agricultural and Industrial Tire Improvement Forum” held in Frankfurt.

Kordsa Ceo Cenk Alper Speaks at the Financial Times Conference Organized in London: “We are Creating Value by Consuming Less Resources”

Kordsa CEO Cenk Alper spoke at the “Future of Manufacturing Summit” organized by the Financial Times in London. Addressing the session on “Remaking Manufacturing – Circular Economy Opportunities”, Alper explained the link between maintaining a sustainable brand, the manufacturing process, and the value created for customers.

Speaking at the session “Remaking Manufacturing – Circular Economy Opportunities” in the summit organized by the Financial Times, Cenk Alper emphasised that the company’s strategies are based on sustainable and profitable growth. Pointing out that Kordsa follows the objectives of consuming less while manufacturing, meeting a zero-waste target, and offering customers value-creating products that can serve the circular economy, Alper went on to say the following: “Today, it is the circular economy that determines the manufacturing processes we industrialists use. All of us are searching for ways to use natural resources in a more efficient manner. At Kordsa, what makes our manufacturing processes more efficient is our approach to sustainability. By employing measures such as consuming less water and saving energy, we abide by the sustainability principle and do our bit to protect the planet.

Alper continued by saying: “In accordance with the concept of the circular economy, we have integrated sustainability programmes into our manufacturing processes, so as to reduce consumption of already limited natural resources. We apply the principles of zero-waste, energy saving and minimal water consumption during manufacturing. Thanks to our wastewater treatment plant, we are able to recover and reuse at least 25% of the wastewater generated during manufacturing. We are working to a goal of zero-waste while manufacturing nylon 6.6 products, the field in which we have become the global leader. All the waste generated during manufacturing is used in adjacent markets. On the other hand, our energy-saving program means that we aim to consume on average 10-15% less energy. The good news is that, by means of the award-winning energy-saving program that we launched in 2014, we are now able to use less energy in our manufacturing process, and we have also succeeded in reducing our carbon emission rate. These developments are encouraging.

As well as taking a responsible approach in the manufacturing process, we are also trying to ensure that the products in our sector remain part of the circular economy. Within the tire reinforcement market, of which we are the leader, the main issue is how to reduce fuel consumption at a time when tires are getting ever lighter in weight. We are undertaking innovations to make tires even lighter, and we are also contributing to fuel-saving. Not only have we made



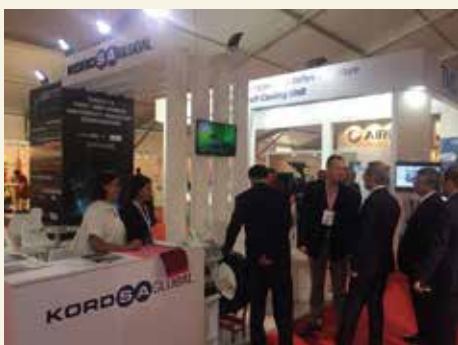
tires lighter, but we have also made the technology associated with them greener still. We have eliminated Formaldehyde from the process of adhering tire reinforcement products to rubber and have introduced a new chemical bath to that end. This new green bath represents an important step for occupational health and safety. We are working to spread this innovative technology across the world and in so doing to transform the tire industry.

Back in 2015, we transferred our experience in tire reinforcement technologies to the composite technologies that will serve the circular economy. Now, with the help of composite technologies, we are able to make parts of vehicles even lighter. In this way, by helping to produce lighter aircraft and lighter vehicles, we will contribute to reduced fuel consumption.”

Cenk Alper ended with these words:

“In the field of composite reinforcement technologies, the most exciting outcome of our circular economy approach is the Composite Technologies Center of Excellence. This is the first time in Turkey that industry and a university have been brought together under one roof. The Center is an important ecosystem, housing the entire cycle, extending from R&D to the manufacturing process. The cycle will start with R&D activities related to the new product in question. It will continue with production of the first prototype of this innovative product, followed by commercialisation processes. Academics and engineers will pool their brains, in a single location. Through the value created in this ecosystem, we are trying to position Turkey as a major global site of technological innovation.”

Kordsa at the Istanbul Airshow



Kordsa has participated in the Istanbul Airshow held at Istanbul’s Ataturk Airport. Its innovative tire products and examples of composite reinforcement technologies were showcased to visitors to the fair. Undersecretary for the Defence Industry, Professor İsmail Demir, visited the Kordsa stand and congratulated the company for supporting sustainable growth through its employment of composite technologies.

“Innovation Visit” From INSEAD

A representative of one of the most prestigious MBA schools in the world, INSEAD, has paid an innovation visit to Kordsa. Technology Management Professor Ben Bensaou's links with Kordsa in the context of innovation go back to the Blue Ocean Strategy training he gave there ten years ago. In view of Kordsa's successful implementation of BOS methodology over the last ten years and its strikingly innovative outputs, Bensaou has decided to include the success story of Kordsa in his book Innovation Machine.



Kordsa Listed in BIST Sustainability Index for 2016-2017



Kordsa has gained a place in the BIST Sustainability Index. The Index lists 43 companies traded at Borsa İstanbul that boast high level corporate sustainability performances.

Borsa İstanbul has completed the process to determine which companies can be listed in the BIST Sustainability Index for the period 2016-2017. As a result of the evaluation, it has been confirmed that Kordsa will be listed in the BIST Sustainability Index for this period.

Kordsa's transparency, its corporate web site and the scope of its annual activity report were the key factors that resulted in it being included in the Index.

Corporate sustainability means creating long-term value for companies by ensuring that company activities and decision-making mechanisms take account of economic, environmental and social factors. This is achieved through corporate management principals and the management of risks that may arise from these factors. The BIST Sustainability Index aims to foster the awareness, knowledge and implementation of sustainability in Turkey, especially among Borsa İstanbul companies. By enhancing the prestige and familiarity of member companies in the eyes of investors, the Index helps companies to increase their competitiveness both nationwide and internationally.

Kordsa Sets Up Camp At Its Partners

Prominent tire producers continue to show interest in Kordsa's program “Behind the Borders”, which the company started for the benefit of its business partners. Reinforcement specialists organized another embedded training camp within the framework of the “Behind the Borders” scheme. Through detailed analysis and the exchange of ideas, they determined several areas for improvement. Kordsa launched “Behind the Borders” to get closer to its business partners, thereby creating value, and reinforcement professionals will ensure that the program goes from strength to strength.

Kordsa Participates in an Annual Conference on US-Turkey Relations

Kordsa participated in the 35th Annual Conference on US-Turkey Relations. The theme of the conference organized by the American-Turkish Council and Turkey-US Business Council in Washington was “Shaping the Future: Business, Innovation and Growth”. Important figures from private and public sectors in both the USA and Turkey participated in the conference.

Diplomatic and trade relations between the United States and Turkey were discussed in the conference, of which Kordsa was one of the sponsors. The topics handled were The New Digital Economy, Methods for Penetrating US and Turkish Markets, Defense and Security, Healthcare Services, and Cyber Security.

In the conference, James Del Piano, Deputy Director-General for Kordsa's Northern American Operations, spoke in the session titled “Assessing the US Market from Turkish Manufacturers' Point of View”.

Sharing his experience of the North American market, in which Kordsa are a leading manufacturer, Del Piano talked about Kordsa's operations and emphasized the importance of the region to the company. Pointing out that Kordsa is a reinforcement brand that spreads its reinforcement technologies throughout the world, Piano stated that Kordsa now serves the US region through its production facilities at Chattanooga and Laurel Hill.

Having recounted how Kordsa started its journey as a Turkish manufacturer, Piano stated that they are now a global leader in the reinforcement technologies market. He informed conference participants that Kordsa has endeavored to transfer its knowledge and experience in tire-strengthening technology to the composite and construction-strengthening markets, underlining the fact that the company now serves as “The Reinforcer” to the whole world, in three different business fields.



Kordsa Opens “Reinforcement Center” for Work Excellence



Kordsa held the opening of the “Reinforcement Center” established to maintain and improve standards of work excellence, with the participation of Kordsa CEO Cenk Alper and the top management. The center includes a Safety Experience Center in which employees will be able to observe potential work accidents through visual and physical models, a Perception Improvement Class which aims to change employees’ perspectives, and an Ability Enhancement Workshop that will strengthen employees’ TPM, 5S, process competence and quality awareness abilities through scenarios prepared on model machines.

Innovative Reinforcement Solutions for Transportation Projects

Employing its construction reinforcement technologies, Kordsa has reinforced one of Turkey’s most important projects: the 3rd Bosphorus Bridge and the Northern Marmara Highway.

Presenting an innovative solution to harmful interference to signaling systems in toll booths and magnetic FPS (Fast Pass System) areas, Kordsa reinforced the project using KraTos macro synthetic outfit instead of the traditional steel outfit. By reinforcing the sub-rail concrete so as to impede the magnetic current, Kordsa also reinforced the Light Rail System between Samsun Train Station and Tekkeköy. Kordsa construction technologies are making it possible to gain increased long-term durability, endurance against corrosion and a time advantage of 30% in electro-magnetic fields in transportation projects.

Safety Training Centers Established by Kordsa in Brazil and Indonesia



A New Safety Experience Center, established in accordance with the principles of Total Productivity Maintenance (TPM), has been opened at the Kordsa plant in Brazil. The first of these Safety Experience Centers, which are part of best practice procedures, was set up in Indonesia. These centers are now being opened at all Kordsa plants as a principle. The aim is to raise awareness levels by allowing accidents to be simulated in a safe environment, thus reducing future work accidents. Following the opening of the Safety Experience Center in Indonesia, now a Quality Center has also been opened there. Established with the aim of maintaining excellent quality standards and extending good quality practices inside Kordsa, this center is also planned to be made standard across Kordsa plants.

Kordsa Meets with İşbank

Kordsa CEO Cenk Alper spoke on a panel organized as part of the “Meetings with İş” events, which İşbank held for the 40th time. On the panel “Increasing Turkey’s Competitive Power” moderated by Hakan Gldağ titled , Alper shared Kordsa’s experience with attendees on how Kordsa carried out its technological leadership in the global marketplace. “Kordsa operates on four continents. We have put a Total Productive Maintenance approach in place at all our plants. This principle depends on targets of zero work accidents, zero machine stop time and zero quality errors, providing Kordsa a basis for operational excellence in all locations and markets”, he said.

Wind Vehicle Reinforced by Kordsa Competes in Holland

Kordsa continues to support university students who realize innovative projects.

Kordsa Composite Technologies provided carbon fiber fabric for the wind vehicle Pardus16 produced by Yıldız Technical University’s Wind Energy Club. Coming to life after a hard year’s work, the vehicle competed in the world’s biggest sustainability contest, Holland’s “Racing Aeolus Den Helder”. The Pardus16 team competed against groups from Holland, Denmark, Canada and Germany, and came in fourth, in what is the ninth year of this contest.



Carbon Use in the Automotive Sector

Kordsa shared its predictions for the future of fiber-reinforced composites in the automotive sector and its approach to the composite technologies market at the 11th Turkish Plastics Industry Congress, held by the Turkish Plastics Industry Foundation (PAGEV).

Kordsa Carries Out Excellence Visit



Kordsa reinforcement professionals carried out their final excellence tour of the year at the İzmit plant. During the visit, they listened to presentations prepared specifically by Kordsa employees in regard to their own field of work on exceptional projects and TPM, ending with a meeting attended by Kordsa's employees and top management.

Kordsa Participates in Quality Congress

"The New Normal" was the theme at the Quality Congress, at which Kordsa CEO Cenk Alper was a panelist. Kordsa was the event sponsor for this year's Congress.

Cenk Alper spoke at the panel titled "The Economic Perspective: From Developing to Developed" which took place within the framework of the Quality Congress organized by Turkey's Quality Association (KalDer). Among the other speakers at the panel was Prof. Özgür Demirtaş, Chair of Finance at Sabancı University, and speakers addressed topics such as "What should Turkey do to be among the top 10 economies in the world?", "The importance of creating value-added products", "The importance of creating worldwide-known brands" and "Which sectors should we concentrate on?"

The Quality Congress, the biggest event of its kind in Europe, brought together participants including the 11th President of Turkey, Abdullah Gül, business people from around the world, and a large number of academics.

KalDer holds its Quality Congress every year, in order to share knowledge regarding current approaches, problems and solutions at the management level, and to help Turkey retain its deserved position within a world where problems have become increasingly global, the welfare level being one just example. In keeping with the theme of this year's Congress, "The New Normal", participants spoke about topics including Redefined Norms, The Changing World, Technology and New Discoveries, Big Data, and Artificial Intelligence.



"Accident-Free" Goal Achieved Simultaneously at Two Ends of the World!



Kordsa factories in Thailand and the USA reached their second accident-free man hours goals at the same time. Aiming to establish a 100% accident-free and safe working environment in all the countries in which it operates, Kordsa has been delighted to celebrate accident-free hours in two corners of the world!

Kordsa Academy Trainings Continue

Kordsa Academy was established with the aim of sharing Kordsa's experience in reinforcement technologies with its employees, customers and other sector representatives. The Academy has held another training session. The training was intended to help Kordsa reinforcement specialists appreciate customer needs in developing countries. The training was provided by Srin Ramachandrivasan, a specialist in the fields of tire technologies and paste mixtures. The subjects discussed at the training that took place in Kordsa's R&D Center were new market dynamics and technological developments.

Kordsa at Risk Management Conference

Kordsa's Deputy Director General for the Asia-Pacific region, Zeki Kanadıkırık, participated in a "Risk Management Conference" held by the Enterprise Risk Management Academy in Bali. Kanadıkırık spoke on the panel titled "Risk Management in Manufacturing in the Digital Age" and shared the experiences Kordsa underwent during the Thailand flooding disaster, including its experiences preserving digital data and continuing production without disruption, along with the company's risk management approach.



Kordsa at Composites Europe

Kordsa has attended Composites Europe, held in Germany.

Kordsa participated in Composites Europe, the most important meeting in Europe for the composite materials and equipment sector, attended by thousands of visitors every year.

At the trade fair held in Düsseldorf, Germany, where the composite industry exhibits its latest innovations, Kordsa displayed the bicycle it had manufactured using composite technology. Kordsa also shared with other fair participants details about its Composite Technologies Centre of Excellence, an innovation and production centre dedicated to the development of composite technologies. Basic research, applied research, technology development, product development, entrepreneurship and production are all carried out at this centre, where industry and academia collaborate under a single roof.



Kordsa Participates In “Export Summit” Organized by Turkish Exporters’ Assembly



Kordsa CEO Cenk Alper has participated in a panel titled “Industry 4.0: Tomorrow’s Business Models”, organized by the Turkish Exporters’ Assembly within the framework of Export Summit 2016.

Other panelists besides Cenk Alper included Ziya Altunyaldız, Chairman of the Committee on Industry, Trade, Energy, National Resources, Information and Technology; Hüseyin Durmaz, Chairman of Durmazlar Makina; and Prof. Ersan Arslan, Undersecretary to the Ministry of Science, Industry and Technology.

In the panel, Cenk Alper stated: “Our target is to create our own trends. The main goal here is to keep on prioritizing safety issues and involve people in more valuable processes by having robots do the heavy work.”

Kordsa Suggestion System Presented as Example at KalDer Workshop

Invited to attend a workshop organized by the Turkish Quality Association (KalDer), Kordsa shared the details of the suggestion system it has been applying for years. Participants at the workshop were told about the contribution made by this system, which since 1984 has enabled the sharing of more than 50,000 suggestions from the factory in Turkey alone. Accessible to both white and blue-collar employees, the system makes it possible for employees of all ranks to share suggestions and put them into effect. Companies from the aviation, defense and technology industries displayed a notable interest in Kordsa’s Suggestion System.



Kordsa’s Composite Technologies Center of Excellence Receives Leed Gold Certificate



The Composite Technologies Center of Excellence, established in collaboration with Sabancı University, received the Leed Gold Certificate, which is considered the most important certificate issued to energy efficient and environmentally friendly buildings.

Bringing Kordsa and Sabancı University under the same roof for the technology of the future—composite materials—the Composite Technologies Center of Excellence has received a “Gold” level Leed Certificate as part of the United States Green Building Council certification system for energy efficient and environmentally friendly green buildings. With the certificate, the Composite Technologies Center for Excellence has been registered as a “green building”.

Established in order to produce the technology of the future, the center is a sustainable and environmentally-conscious building that derives maximum efficiency from its water and electricity sources. Additionally, the Center has a structure that integrates it into its existing environment, based upon the green buildings in the technology park where it is located.

Kordsa Participates in “Export Under the Stars” Summit

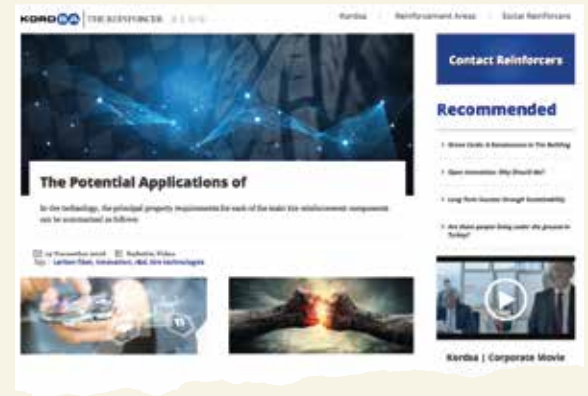


Kordsa’s Deputy Director General responsible for the Middle East and Africa regions, Ali Çalışkan, participated in the “Export Under The Stars” summit. At the summit, Ali Çalışkan shared Kordsa’s experience in the global marketplace, pointing out how Kordsa has a wide manufacturing network and supply chain that reaches from Asia Pasific to the U.S.

Kordsa Embraces its Stakeholders on a New Digital Platform

Kordsa has established a new digital platform, to enhance communication with its stakeholders. The blog www.reinforcer.com increases the influence and reach of the magazine The Reinforcer, two issues of which are distributed globally every year. Like the magazine, the blog includes academic articles by opinion leaders from the sector.

www.reinforcer.com comprises articles on innovation, R&D and sustainability, penned by important players in the tire, construction and composite reinforcement industries. In this way, The Reinforcer brand will be retained yet raised to a higher level. Besides developing this platform, Kordsa makes other uses of the power of digital, taking its relationship with its stakeholders even further.



Kordsa Publishes Its 2015 Sustainability Report



Kordsa has published its second Sustainability Report. The first Sustainability Report, published by Kordsa in 2014, was awarded two prizes by the League of American Communication Professionals.

The report discusses Kordsa’s social, economic and environmental performance during 2015. It details Kordsa’s products, the markets in which the company operates, and the figures related to those markets. Moreover, the report describes the actions, innovative products and processes of Kordsa R&D Center, all of which result from the Center’s great innovativeness.

Under the heading of environmental management, the report covers biodiversity, waste and water management, and energy emissions. The reader will also find information about Reinforcer’s transformative and innovative products such as green tire cord fabric, as well as examples of best practice like the “Safety Experience Center”, which has contributed to the “accident free” target being achieved.

Kordsa’s first Sustainability Report, related to its economic, environmental and social performance for the year 2014, won gold prizes in both the “Chemical” and “Materials” categories at the LACP Vision Awards Competition. Organized by the League of American Communications Professionals, this competition is regarded worldwide as one of the most prestigious annual report competitions.

Kordsa Participates in Ministry of Science, Industry and Technology Meeting

Participating in the “Research & Development Centers Information Meeting” hosted by the Ministry of Science, Industry and Technology, Kordsa Chief Technology Officer and Composite Technologies Business Unit Leader İbrahim Özgür Yıldırım told the success story of Kordsa’s R&D Center. Yıldırım recounted the history and achievements of the Kordsa R&D Center, which the Ministry of Science, Industry and Technology had selected as “Best Research-Development Center” in the textile category of its Performance Index and “Third Best Research-Development Center” in its general rankings.



On the whole, the digital transformation is a major driver of innovation and creativity.

CREATIVITY





Are you ready for the perfect storm?

TEKİN GÜLŞEN

Director, Global Information Technologies & Corporate Planning

The convergence of groundbreaking new technologies is forming the perfect digital storm for all kinds of industries. For some IT and business leaders this storm will provide the chance to fill their sails and move ahead of the competition, while others will struggle to keep their boats afloat. Leaders of an industry as old and established as manufacturing have an even bigger challenge, as they navigate large and legendary, yet legacy systems through this storm.

Following the previous generations of mechanization, steam power, assembly lines and automation, a new generation is now upon us, with cyber-physical and smart systems. The future of manufacturing is here with the convergence of all newly emerging technologies, such as autonomous robotics, big data, simulation, the internet of things, augmented reality, additive manufacturing, cloud computing and cyber security.

Some people call this new era Industry 4.0, others call it Internet of Things (IoT), but whatever its name, most people recognize this challenge and feel the urgency to act. Industry 4.0 is not a pre-defined, one-size-fits-all solution. Rather, it is a combination of these different technologies utilized in accordance with overall company strategies. Companies do not need a separate digital strategy, they need an updated corporate strategy that incorporates all relevant digital trends that can generate value for their business.

Industry 4.0 can help companies accelerate production, enhance efficiency, increase flexibility and enable extensive customization. On the whole, the digital transformation is a major driver of innovation and creativity. Industry 4.0 will have a significant impact on the whole supply chain, on the way products are designed, manufactured, operated and serviced.

There are many important success factors for an organization that is about to execute a digitization roadmap, depending on the organization's culture and level of technological maturity. Some of the critical factors are outlined below.

- **Management ownership:** The CEO and the entire executive team need to incorporate digitization initiatives into the company strategies and provide executive sponsorship for these initiatives. The strategy must be very clear, and be fully understood and espoused by the entire organization. Management also needs to manage shareholder expectations and to be patient in terms of financial returns and tangible outcomes. In some cases, the teams need to explore, experiment and learn from failures.
 - **Harmony of operational and information technologies:** The line between IT and OT systems is becoming blurred by the integration of these types of technologies. Not only do the technologies need to be harmonized, but the IT and operations teams also need to work very closely as one team in order to ensure successful execution.
 - **Value-oriented approach:** No matter what the topic, we should never lose sight of the ultimate objective: creating value for the customer and the company. All initiatives therefore need to put the customer or employee at the center of the design of any new system.
 - **Corporate entrepreneurship and innovation:** In order to obtain new, creative ideas that can transform a product or process, entrepreneurship and innovation within an organization need to be encouraged. We need people to see beyond the borders of the well-established manufacturing processes and status quo. This requires a major cultural change in most mature companies with well-defined and established processes.
 - **Continuous improvement approach:** Manufacturing companies apply many different models and systems in order to continuously improve their operational excellence. In addition to innovative ideas, they also need to look at existing systems and use new technologies to try to improve them.
 - **Supplier ecosystem:** Companies need reliable solution partners and vendors that are willing to invest and work together in order to jointly develop these new and customized solutions. Suppliers will also have to develop themselves with these challenges.
 - **Talent and skill development:** All critical internal resources need to be developed and trained on these new digital technologies in order to come up with fruitful solutions by utilizing these technologies.
 - **Share knowledge and best practice:** A lot of companies want to embrace Industry 4.0 and take action but lack ideas about where to start and how to use these technologies in various parts of the operational processes. Sharing experiences and ideas within the organization and in professional networks can foster even more ideas and solutions that will benefit both parties.
- While focusing on digitizing the manufacturing systems and the shopfloor, it is also important not to ignore the most important assets of an organization: its employees. All these new technologies can also be utilized to boost the productivity of white-collar and blue-collar employees. At the end of the day, leaders will need the execution success of employees in order to emerge from this perfect storm even stronger and ahead of the competition.

Why are carbon fiber / epoxy composites so successful in the production of prosthetics?





Carbon Fiber / Epoxy Composites: Ideal Materials for Orthopedic Prosthetics.

SELİM KÜSEFOĞLU

**Professor, Boğaziçi University, Department of
Chemistry, Consultant,
Composite Technologies Excellence Center**

Melville beautifully describes the tock-tock-tock sounds made by Captain Ahab's wooden leg as he paces on the deck of the whaler Pequod, chasing the great white whale, Moby Dick! However, artificial legs, or orthopedic prosthetics as they are nowadays called, have undergone fundamental changes since the time of Captain Ahab.

The greatest leap in technology occurred in the last 5 to 10 years with the use of carbon fiber composites and light-metal alloys in the production of prostheses. Modern prosthetic devices (Figure 2) help tens of thousands of individuals to at least partially compensate for their missing limbs and lead a high quality life. Some of the users engage in sport activities, even break records.

Why are carbon fiber / epoxy composites were so successful in the production of prosthetics? What is the determining factor: their attractive look, price, simple manufacturing process, or their technical superiority as suggested by material sciences? To answer this question, we have to focus on the required specifications of prosthetics and on the properties of carbon / epoxy composites.

1. Modern Molding Techniques:

The key feature of modern prosthetics is the fact that they can be custom-made to match the height, weight, and muscular structure of the individual. It is impossible to give the prosthesis the desired shape using a manufacturing process that involves machining. Thus, the material used has to be suitable for the molding manufacturing technology. The greatest advantage of fiber composites is that they lend themselves to the production of deep components with thin walls and compound curves. Using split dies in combination with resin transfer molding and prepreg methods, it is possible to produce any kind of complex structures.



Figure 1. Northern Care Prosthetics



Figure 2. Dynamic Prosthetics IC60 (www.medicaexpo.com)

2. Varying Mechanical Properties Along the Component:

A prosthesis is expected to fully replicate the functions of the natural organ it replaces. Thousands of years of evolution have turned human muscles and bones into perfect structures with a high resistance / weight ratio and varying properties at different regions. Nature is everything but generous: It doesn't allow any part in our body to be stronger and heavier than necessary. When we examine a bone, we see that different regions are not identical but have different collagen, hydroxyapatite and pore ratios. This phenomenon, referred to as the Wolff's law in medicine, stipulates that bones have a higher density and strength at high-stress regions (e.g. tips) while low-stress regions have a lower density and strength. The tip of the tibia has 50% higher density and compressive strength. Due to the long time spent in zero gravity, the bones of astronauts become weaker. With recent advances in the molding methods of composite materials, it is possible to obtain varying levels of strength and modulus in different regions of a component. Especially using resin transfer molding and modern fiber lay-up (tow placement) methods, varying wall thicknesses in different parts can be obtained with a high accuracy. Thus, it is possible to produce components with varying strengths in different regions that mimic nature as stipulated by the Wolff's law.

3. High Specific Strength:

In warm-blooded animals, muscles and tendons facilitate body's movements while bones and joints are the weight-bearing components. Prosthetics that are currently approved by medical authorities and routinely used in practice take over the function of the bones. Active prosthetics with an internal power sources are still in the stage of development. A prosthesis that replaces a bone has to have a mechanical strength similar to the native bone. Currently available carbon / epoxy composites easily produce a tensile strength of 700 MPa and a modulus of elasticity of 70 GPa. Considered together with its density of 1.6 g/mL, the very high specific strength of this material becomes more evident. In addition to its tensile strength, a high compressive strength and fracture toughness contribute to the superior qualities of this material. There are also other candidates for the production of prosthetics. Conventional wood, fiberglass/polyester composites, glass and carbon fiber / thermoplastic composites, metals and their alloys, or ceramics may also be used in prosthetics. Figure 4 shows a comparison between the various candidate materials and native bone. Carbon / epoxy composite most closely resembles native bone with regard to absolute strength, modulus, and fracture toughness.

4. Ideal Weight Distribution:

The specific strength of the aforementioned carbon / epoxy composite is so high that it is possible to produce a prosthesis that has the same strength as a natural leg, but is 60% lighter at the same time. The first carbon fiber prosthetics produced were indeed very light. Thanks to this new material, a total leg prosthesis could weigh as few as 2 to 3 kilos. The leg of a man weighing 80 kilo, however, weighs around 13 to 14 kilos. Experiments in the 70's have shown that these ultra-light prostheses were not practical at all. Interfering with the optimum weight distribution of the human body produced poor results. Changing the weight distribution of the human body makes activities like sitting, bending, or reaching up more difficult. This indicates that rather than the total weight of the prosthesis, it is the weight distribution and the resulting angular momentum that matters. Especially for lower limb prosthesis, adding lead weights to a light component near the knee region facilitates the movements of the joint. It was also discovered that the weight of the arm prostheses must be approximately the same as what the muscles are accustomed to move throughout their lifetime. Fine tuning by attaching a weight to the most appropriate location in the prosthesis, spreading out or focusing this weight at one point is extremely simple with carbon fiber / epoxy composite, which makes this material very successful in the manufacture of prosthetics.

4. Hygiene: In addition to a high strength, any material that is used in a prosthesis must be easy to clean, non-hygroscopic, resistant to corrosion and to bacterial and fungal infections, UV-resistant, not sensitive to sweat and salt, and cosmetically acceptable. Following curing and washing, epoxy resin does not irritate the human skin and is non-allergic. Accidental exposure of the skin to the prosthesis does not cause any harm. Carbon composites exhibit all the desired properties.

5. Elastic Properties:

An important characteristic of proteins found in muscles and tendons called myelin and elastin is that they act like a spring in steady state. Over thousands of years, elastin, the main building block of tendons, has evolved into the perfect "Hookean Solid". A material that exhibits a linear relationship between the applied stress and the resulting strain is referred to as a "Hookean Solid". Examples of such materials include a steel spring or a rubber band. The elastin in the Achilles tendon of a kangaroo acts like a perfect spring and enables the animal to run long distances using relatively small amount of energy. Each time the kangaroo hits the ground, there is an elastic collision and nearly all of the kinetic energy is transformed

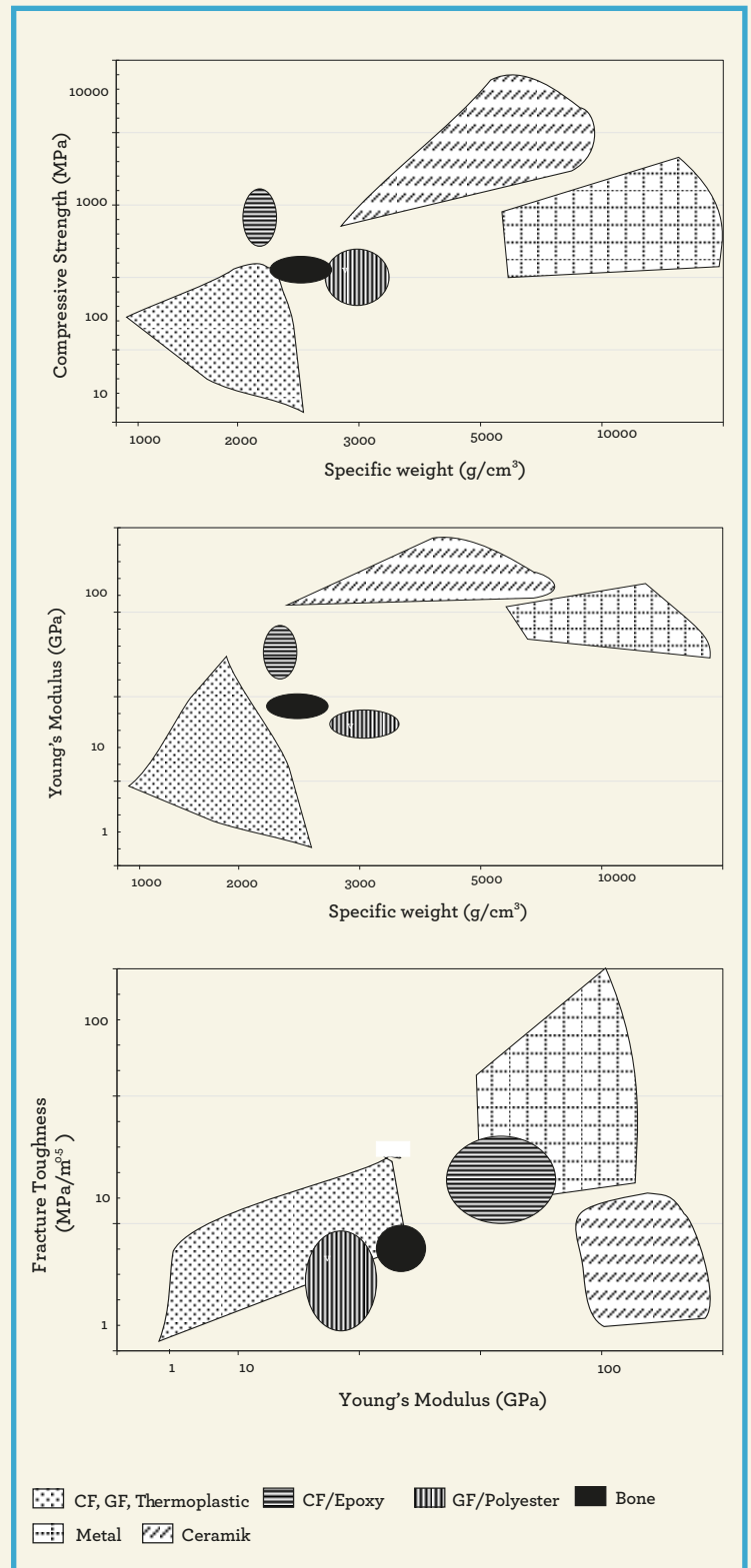


Figure 4. Mechanical strengths of bone and materials that are used in prosthetics (S. Scholz, et al., Composite Science and Technology, v. 71, 1791 (2011))

into potential energy. Thus, only a small amount of additional energy is required for the next jump. When walking or running, humans make use of the same kinetic/potential energy transformation. The linear zone (characteristic of Hooke solids) that is observed at the beginning of the 3-point bend testing of glass, aramid, and carbon fiber composites is most pronounced in carbon / epoxy composites. Among these three different composite materials, carbon fiber composite agrees best with the Hooke's law in case of small deformities. I believe that this is the main reason why carbon / epoxy composites are the material of choice for prosthetics.

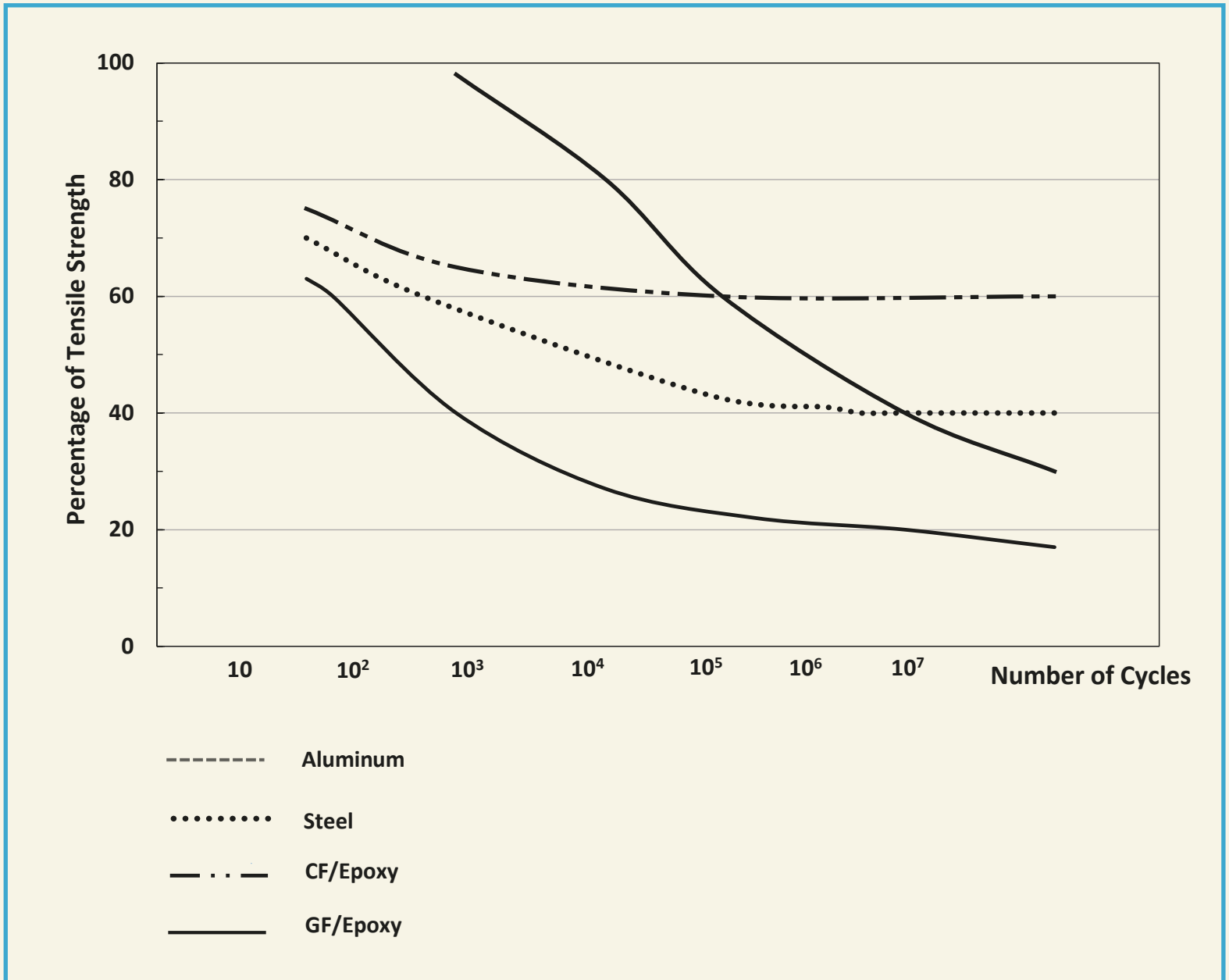


Figure 5. Decline in the strength of different materials as a result of fatigue

6. Fatigue Strength:

Another requirement of a prosthetic material is fatigue strength. It is obvious that the load a prosthesis is subject to does not remain constant, but changes with every step, with the device continuously bending and returning to its original shape. Every known material loses some of its strength upon repeated bending for a certain number of cycles, ultimately leading to component failure. Naturally, a gradual reduction in the strength and a short lifespan is not acceptable for a prosthetic device. The lifespan of the aluminum prosthetics from the 60's was only 1 year. Cracking of the polymeric matrix, fiber rupture, delamination of the layers, and separation at the matrix/fiber interface are the four distinct modes of failure that are observed with composites upon repeated bending. The separation at the fiber / matrix interface has the greatest impact on the life of the component. The plot in Figure 5 shows the degree of strength loss as a result of fatigue for different materials. The high residual strength of carbon fiber / epoxy composite following exceptionally high number of stress cycles can be seen on this chart. The use of carbon fiber / epoxy composites in aerofoils, wind turbine blades, and Formula 1 racing cars speaks for the extremely high fatigue strength of this material.

7. Conclusion:

When selecting a material for the production of prosthetics, carbon fiber / epoxy composites stand out as the material of choice due to a number of factors including their tensile strength and compressive strength, modulus, impact resistance, fatigue resistance, specific weight, ease of manufacturing, hygiene, and aesthetic factors. Tens of thousands of people all around the world live a better and more fulfilling life thanks to carbon composite prosthetics.

Polymeric cap ply protects the metallic belt cords against moisture, and the ply separation resistance of the belt edge zone is enhanced thanks to the compressive forces of Nylon 6.6 at high temperatures.





Nylon 6.6 As Superior Cap Ply

SADETTİN FİDAN

IP and Technology Manager,
Tire Technologies

Current tire production technology and the need for high performance call for bi-elastic cap ply: Nylon 6.6 fulfills this requirement

Radial tires, with their heavy steel belt package and flexible sidewalls are subjected to strong centrifugal forces under high speed conditions which leads to the diameter increase (tire growth), and belt edge separation failures as a result of intense pantographic (angular) movements of steel cords.

Winding cap ply strips around the circumference of the belt package, so that they cover the whole width of the belt package, serves to reduce tire growth and improve high speed durability by preventing belt edge separations.

Cap ply in a tire ensures comfort and the flexibility or rigidity of the belt package, whilst improving impact resistance and steering stability. It also leads to reduced rolling resistance and improved high speed durability. Polymeric cap ply protects the metallic belt cords against moisture, and the ply separation resistance of the belt edge zone is enhanced thanks to the compressive forces of Nylon 6.6 at high temperatures.

Owing to its superior properties, Nylon 6.6 offers the following advantages when deployed as cap ply:

1- Bielasticity: Whilst Nylon 6.6 promotes high initial extensibility, enabling tire building even with very high lifting ratios (tire expansion during curing process), it also leads to high final tensile modulus (much higher than in the case of PET), which enhances restraining forces applied to the belt package under high speed conditions.

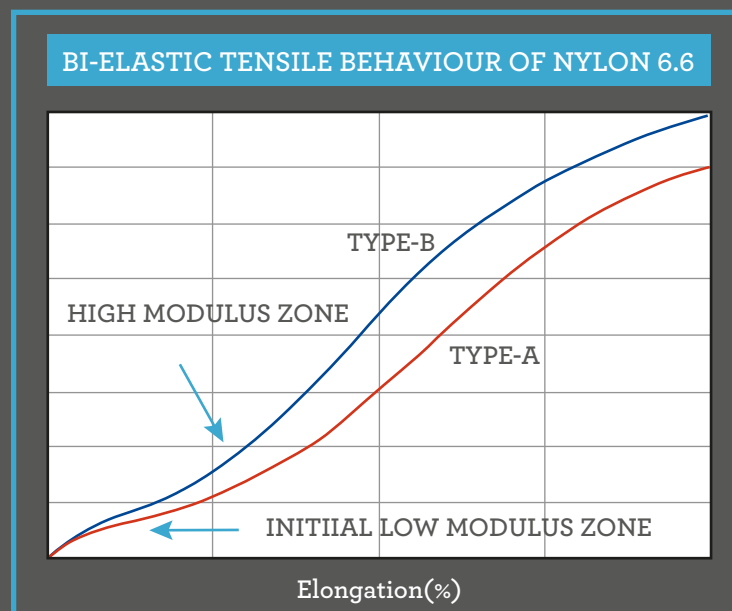


Figure-1

2- High thermal contraction force: Even at relatively low temperatures, an increase in temperature in line with speed generates a thermal contraction force (shrink force), which compensates for the modulus reductions due to polymer softening at temperatures above T_g (glass transition temperature).

3-Stress relaxation: By adjusting LASE value, Nylon 6.6 makes it possible to control in-tire cord tension after curing process. For superior comfort, the LASE value can be lowered, or for increased belt package rigidity it can be increased.

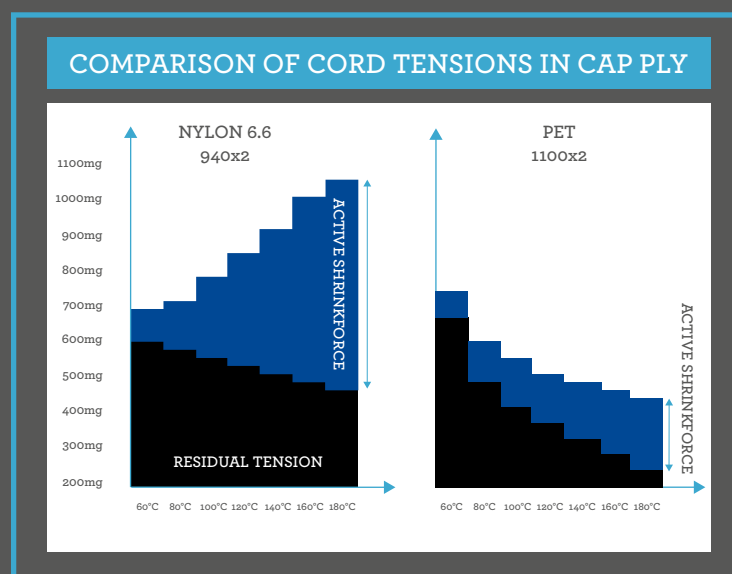


Figure-2

4- High flex and compression-fatigue resistance: The molecular structure and its morphology enable a high level of bending and axial compression-fatigue resistance. Fatigue resistance can be further increased using the 3T (Time-Temperature-Tension) process. By controlling dip diffusion between the filament bundles, the cord strength can be maximized.

5- High breaking energy: With the help of Nylon 6.6, impacts under high speed conditions can be easily absorbed without cord breaking (enveloping property), in this way, cap ply also functions as a protective covering for steel belt layers.

6- Fiber surface functionality: Due to the surface activity of the filaments, a sufficient level of static and dynamic adhesion can be obtained even with conventional RFL dips, without having to resort to additional adhesion promoters, which could negatively affect dynamic properties by increasing cord-bending stiffness (decreased potential for the individual filaments to slide on each other).

As mentioned above, owing to its bi-elastic tensile behavior and high thermal shrink force generation, Nylon 6.6 has been widely used for several years as cap ply reinforcement.

Under high speed conditions, Nylon 6.6 can minimize the pushing-out effect of the steel belt layers as well as the pulling-out effect of the tread on the cap ply. This is because of the high effective hot-modulus of Nylon 6.6, which is wound around the circumference of the top belt layer. A higher temperature increase in the belt edge zones raises the thermal contraction force of Nylon 6.6, leading to further compression of the belt edge steel cord layers (sandwich effect) without any resultant ply separations (belt edge separations).

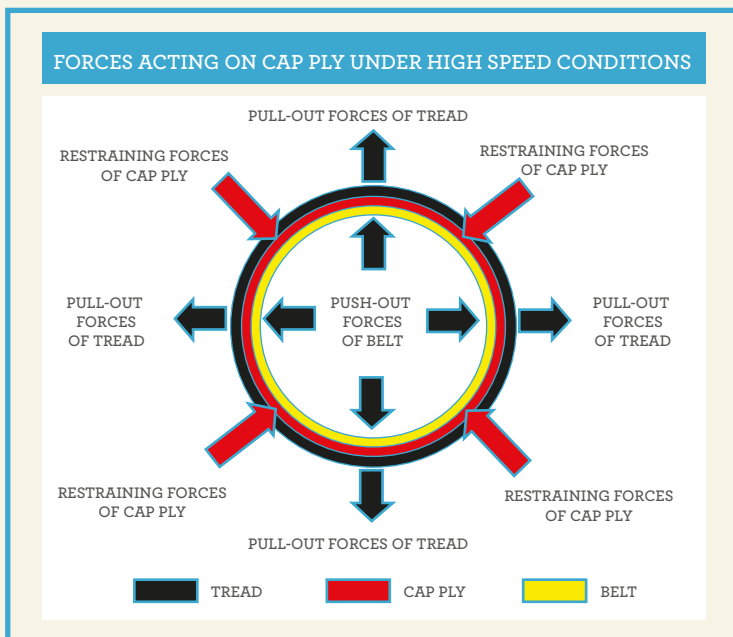


Figure-3

When choosing a cap ply reinforcement, two points must be kept in mind:

1- In-tire cord properties like cord tension and thermal contraction force (shrinkforce) are different than initial cord properties. As a result of stress relaxation during the curing process, the initially raised cord tension caused by applied winding tension and process expansion (lifting) will be reduced.

2- The specified thermal contraction force (shrinkforce) of the dipped cap ply cord becomes much higher when the cord is embedded in the tire. This is due to the existing residual cord tension (especially at the crown center). The initial expansion tension during the curing process adds to the amorphous orientation in molecular structure (cold stretching effect in the 160-180° temperature range), which will enhance the cap ply cord's force-generation potential in response to increased temperature.

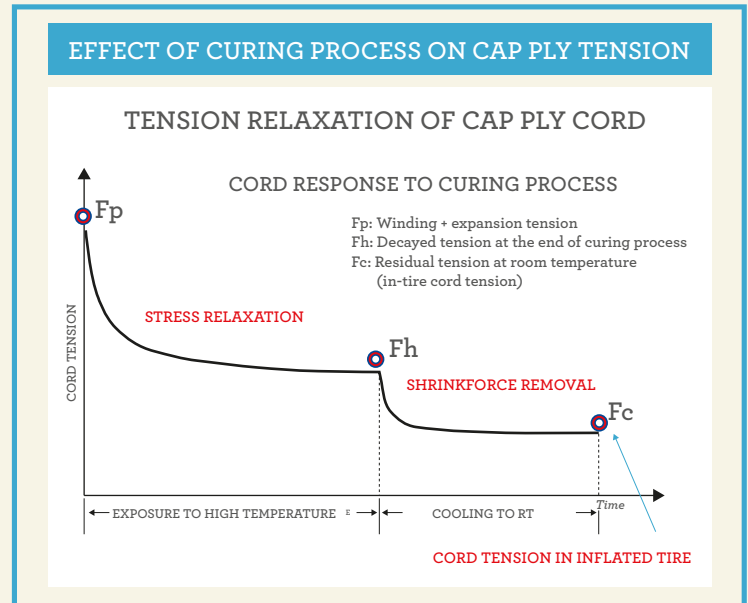


Figure-4

In principle, a high bi-elastic modulus can be regarded as the most important property of a cap ply cord. In contrast, simple high modulus (mono-elastic) cords like PET or PEN or aramid cords are in theory not suitable for use as cap ply, due to the extremely high cord tensions generated by process expansion during the curing process. When cap ply cords endure such large forces, they may cut into the skim compound of belt layers, which become soft at cure temperature, and the cap ply cords may therefore come into contact with the steel cords, causing failures due to mutual abrasions. At the same time, a large difference in cord tension between the belt edge and the crown center will give rise to a butterfly-shaped footprint, so that tread wear will not be even.

The second most important property required of a cap ply cord can be said to be medium shrinkage and high shrinkforce (thermal contraction force). Temperature increase in line with speed gives rise to additional forces, which help in protecting the belt package from tire growth under the effect of centrifugal forces. In this way, durability at high speeds is ensured.

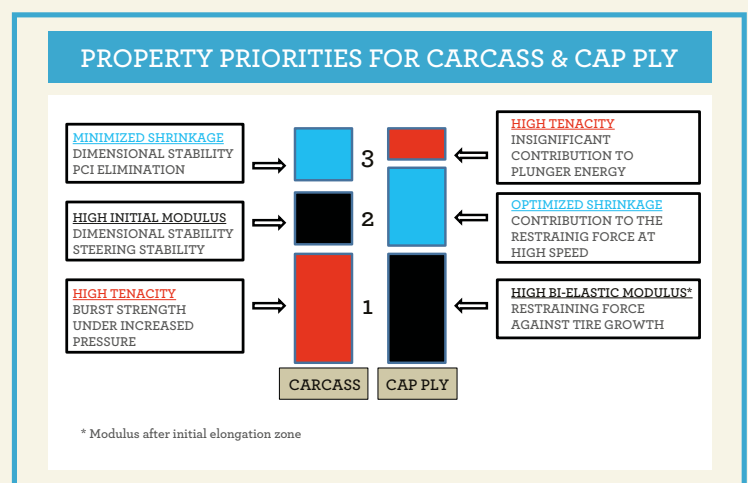


Figure-5

In order to further improve the performance of Nylon 6.6 as cap ply, Kordsa is developing new Nylon 6.6 products with increased bi-elasticity (effective modulus/initial modulus) and thermal contraction modulus (shrink-modulus), all of which makes Nylon 6.6 irreplaceable as a material for cap ply.



A Customer-Tailored Value Chain

KADIR TOPLU

Global Supply Chain Director

In the ancient fable about the tortoise and the hare, the speedy and overconfident rabbit fell asleep on the job, while the "slow and steady" turtle won the race. That may have been true in ancient times, but in today's demanding business environment, "slow and steady" won't get us out of the starting gate, let alone win any races. Therefore, Agility, Adaptability and Alignment –AAA– are our main capabilities as a world-class value chain.

Uncertainty and risk are inherent in every supply chain, therefore we design and manage our supply chain with the aim of eliminating as much uncertainty and risk as possible as well as dealing effectively with the uncertainty and risk that remains.

Supply Chain Management is an important component in fulfilling our customers' needs and providing value. There is no real customer value without a close relationship with our customers and we are improving our value proposition to customers by continuously improving our supply chain outcomes.

A supply chain is a dynamic system that evolves over time. Customer demand characteristics change over time, and supplier capabilities change over time.

We handle incoming customer orders in the best possible manner, allocating inventory and production to individual orders. Our supply chain process simultaneously manages the procurement cycle, manufacturing cycle, replenishment cycle and customer order cycle.

Our main proposition is being closer to our customers, understanding them, and fulfilling their needs on time and in full.

Nowadays, the growth of technologies such as IoT, Big Data, etc., enable us to maintain a greater level of collaboration between our supply chain trading partners.



Our supply chain capabilities are;

- Responding to wide ranges of quantity demand in all regions
- Meeting short lead times
- Handling a large variety of products
- Building highly innovative products
- Achieving a high service level
- Handling supply uncertainty

Our priorities in terms of supplier management are creating an ecosystem with highly competent suppliers, and establishing and sustaining long term strategical alliances with them with the help of new technologies.

The main supply chain approach we adopt is understanding the demand clearly, fulfilling the demand proactively using an integrated information system.

Digitalization helps us to achieve more effective, more transparent and more agile supply chain management. Among our tools which enhance value creation are the Supply Chain Optimization model, forecasting with leading and lagging indicators, e-procurement, a style-based inventory and integrated procurement platforms.

To face tomorrow's business climate, we will be focusing on;

- Supply Chain Resilience and Sustainability
- Postponement
- The Long Tail

The next generation of transportation vehicles will be required to be fuel efficient, low emission, low maintenance vehicles that are designed for safety.





Lightweighting For Heavy Trucks

İSMAİL ERHAN EYOL

**Functional Manager; Chassis Engineering
- Ford Otosan**

The title of this article inevitably creates a sense of oxymoron, like an excerpt from Shakespeare's *Romeo and Juliet*; but the concept of "lightweighting", now seen as a megatrend, is at the center of Ford Otosan's product development of heavy trucks. As such, the collaborative work with Kordsa in the field of composites is of great importance. However, rather than skipping straight to the details of the work, let us first clarify the concept of lightweighting and the motivation behind it.

An effective lightweighting strategy is about much more than simply replacing a few steel parts with aluminum or composites; it is about using the correct material for the correct part in the correct place. Ford's portfolio extends from the Ka+ city car to heavy-duty trucks. With such a broad range, it would be impossible for an OEM of this size to introduce a group-wide material-specific lightweighting policy. Instead, Ford concentrates on design optimization and the use of application-specific materials.

Lightweighting has become a holistic concept, improving not only fuel economy and emissions but also vehicle performance and handling. The next generation of transportation vehicles will be required to be fuel efficient, low emission, low maintenance vehicles that are designed for safety. They will possess an extraordinary range of sensors and electronics. Weight reductions will therefore be vital to satisfying the increased demands on performance, while also complying with far stricter regulations on fuel economy and emissions. Incidentally, a survey made among members of SAE reveals that the top choice for best fuel economy should be lightweighting (Fig. 1).

TOP TECHNOLOGY TRENDS TO MEET FUEL ECONOMY TARGETS

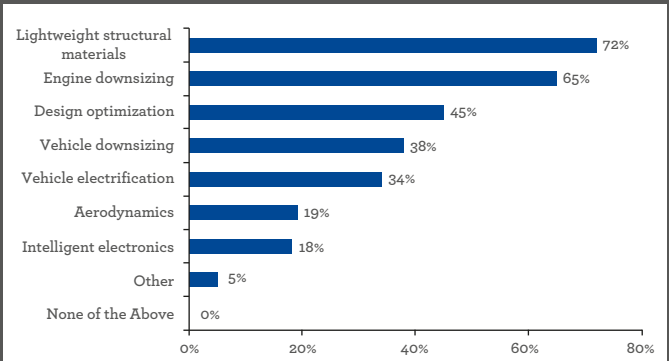


Figure 1. (source: SAE.org)

In our line of work, heavy-duty vehicles are those with more than 16,000 kilograms of gross vehicle mass. These include highway tractors, construction trucks (e.g. cement mixers, concrete pumps), road trucks, etc. Reducing CO₂ emissions in line with ever-changing regulations and cutting fuel consumption requires a decrease in vehicle weight. In ground transportation, the motivation to reduce weight differs according to the industry. For the on-highway trucking business, there is a weight restriction for each class, so the lightweighting effort is often focused on maximizing payload. Great efforts are being made to reduce the weight of heavy trucks that reach the allowable weight limit during service, and this sector that has been an early adopter of new technologies to achieve this aim. Diesel-powered trucks and tractors have become hundreds of kilos heavier over the last decade due to pollution-control equipment, heavier radiators etc. Reducing the curb weight of these trucks is the best way to make up for this.

Composites for Lightweighting

The aforementioned SAE survey also looked at the lightweight materials of the future, and composites came out as the top contenders (Fig. 2). Compared to conventional automotive materials such as steel, magnesium and aluminum, advanced composite materials can offer the following benefits:

- Superior stiffness-to-weight and strength-to-weight ratios
- Higher specific damage tolerance and energy absorption properties, providing improved crash-worthiness
- Higher fatigue and corrosion resistance for better long-term durability (reducing warranty costs)
- High-energy absorption for reduced noise and vibration (NVH)
- Highly tailorable mechanical properties for specific applications
- More flexibility for the design of complex shapes to provide improved styling
- Ability to provide multi-functional, integrated systems and components, thereby reducing part count and assembly time
- Good surface quality for use in exterior body panels
- Ease of embedding sensors for continuous monitoring of reliability

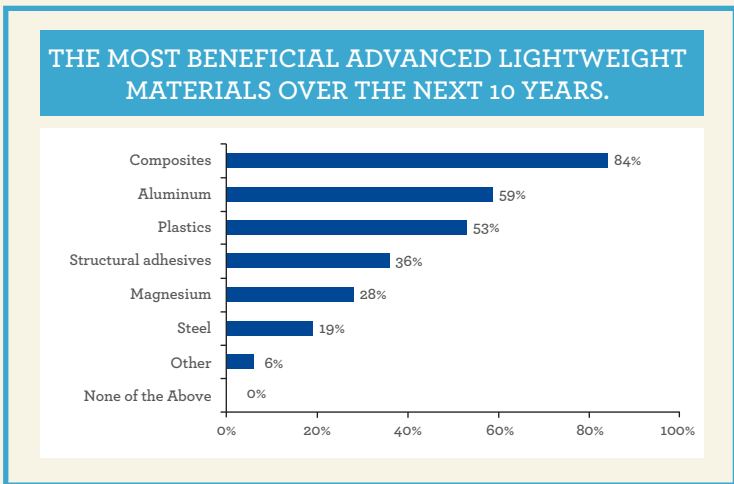


Figure 2. (source: SAE.org)

The Work at Ford Otosan

Ford's efforts to reduce vehicle weight have been well publicized: the GT, launched in 2005, was the first all-aluminum Ford. In 2014, Ford unveiled the Multi-Material Lightweight Vehicle concept and the aluminum-bodied F-150, followed by the carbon fiber-bodied GT supercar in 2015.

The reflection of this vision on heavy trucks is inevitable, and we in the department of Chassis Engineering have been looking at every vehicle part for lightweighting, including critical structural components bearing high loads, such as air reservoirs, wheels, cross-members, pedal boxes, battery trays etc. Chassis Engineering deals with suspension, brakes, steering, frames, wheels and tires; all critical in every attribute of the vehicle. As an example, below is a depiction of a project carried out in collaboration with Kordsa, and with the support of the Scientific and Technological Research Council of Turkey (Fig. 3). Even a leaf spring subjected to many tons of weight at the rear of an HDV can be redesigned as a composite part.



Figure 3

Computer-Aided Analysis (CAA) can help validate the design of composite components. The diagram above shows the initial stage carried out during this project, where significant know-how was acquired as to how a composite structure carrying such high loads can be attached to steel structures (in this case, to the trunnion system via u-bolts). The next step will be the assessment of the correlation of results versus physical tests.

When designing with composites, it is imperative to utilize methods of contemporary engineering to maximize production, quality, and mechanical properties. Since the manufacturing process can significantly affect all of these properties, it is important to develop the process during design. The primary manufacturing method reviewed and chosen during the design process for this part is capable of producing high quality parts in a scalable process.

Autonomous Trucks and Lightweighting

The global autonomous heavy-duty truck market is gaining momentum, with most major heavy truck manufacturers, including Ford Otosan, trying to make their mark in this competitive field. There are discussions as to whether this could result in reduced demand for passive safety features, as such vehicles aim to nullify accidents, hence requiring fewer parts or parts with lessened strength. However, predictions suggest that 15% of vehicles on the road in 2030 will have some form of autonomous drive technology. This means that safety regulations may change, but are unlikely to relax. A significant impact on the choice of materials is therefore not expected from this perspective.

CONCLUSION AND FUTURE WORK

Despite the challenges, lightweighting and material selection will continue to be a megatrend for many equipment manufacturers striving to meet increasing attribute expectations while also maintaining productivity and payload capabilities. The use of structural composites is a critical component for technological progress in the automotive industry. In order to speed up the adoption of these materials, we need a fuller understanding of their physical properties and processing behavior. These factors have an impact on the durability, reliability, and affordability of structural composites, and this impact needs to be assessed correctly to obtain the best possible balance between all these elements. The collaboration between Ford Otosan and Kordsa, initiated by the composite leaf spring work, will maintain its importance, with plans for the findings of the project to be transferred to use on other chassis parts, from wheels to cross-members.



He is coming again!

VAHE HANAMIRIAN

Global Accounts and Marketing Director

Even minor mistakes in the sales process can cause the customer a great deal of annoyance. Well, these were annoying at the time but a funny story years later...

In the 1990s, Kordsa had a considerable amount of business making material for covering conveyor belts. In those days, conveyor belt production in Europe was at its peak and deliveries were quite intense. Trucks from our factory went out to customers all over Europe each week. We had customers in Yugoslavia, Italy, Denmark, France, and the UK.

Many of our customers in the UK had production sites around the Manchester area but head offices in London.

We had one such customer, with a head office building in the middle of a big, beautiful, typical English garden. To imagine it, let us think of Hyde Park or St. James's Park. To visit them was a joy, as we would spend time in London and sit in this verdant park after the negotiations.

Like many others, their factory was near Manchester, so there were two different addresses on the shipment documents. The invoice address was the one in London and the shipment address near Manchester. Although the documents were prepared correctly, the driver made a mistake. Instead of driving to the factory, he took the big container truck to the head office. First driving into London, he then began driving over the green grass of the beautiful park area. We got a written complaint from the lady in charge of buying, because the truck had destroyed much of the garden. She was really annoyed, for understandable reasons.

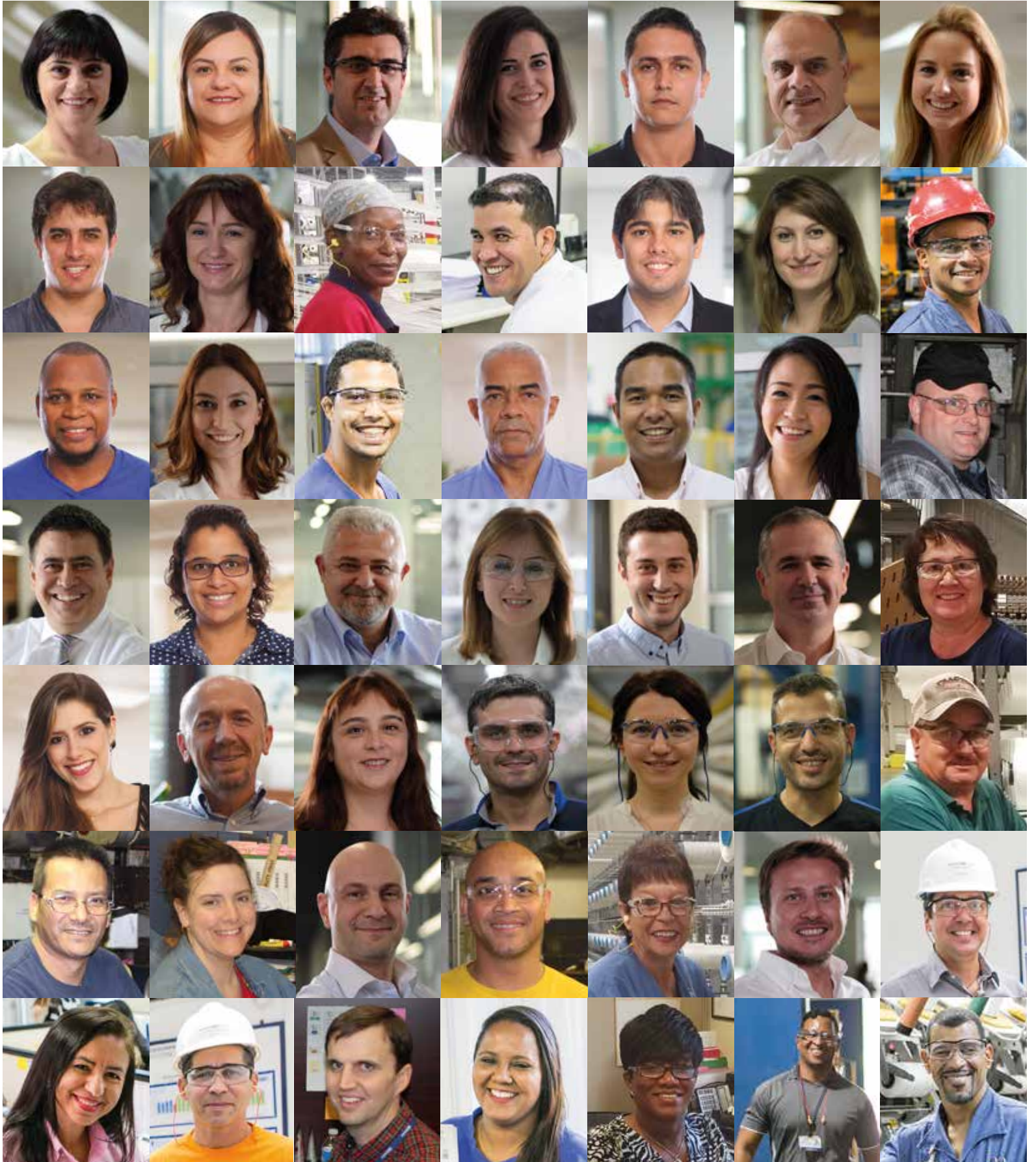
We sent an official reply, but wanted to calm her down by talking to her personally on the phone and decided to call her. We were apologizing and promising that this would not happen again.

The lady's office must have had a window facing the park area and suddenly she stopped talking. We just heard:



Oh my god! There he is, coming again!

We felt like we were in a 'Terminator' movie. A big truck driving at full speed towards the building, destroying all the nature on the way.



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