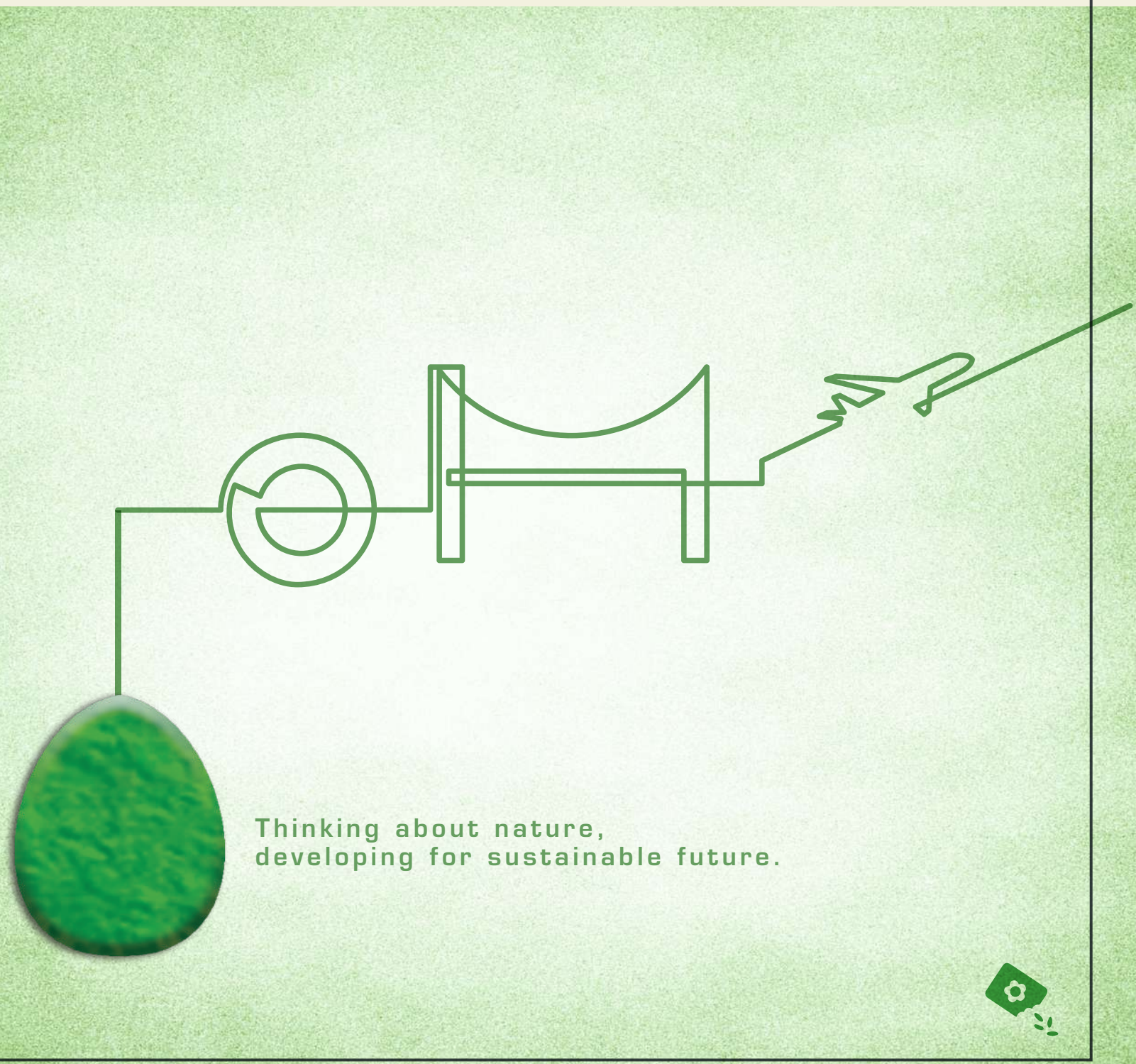
THE REINFORCER

KORDSA | BULLETIN | N.11 | 2019 | TURKEY

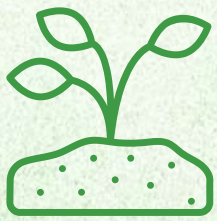
Determined to Create Value

KORDSA



FIND YOUR SEED

At Kordsa, our aim is to make lives both safer and more sustainable
with the mission to “Reinforce Life”.
In order to realize dream of greener world, we placed 3 kinds of seeds on the cover visual.
Find your seed when it meets with the soil.
Is it Blue Pine that adds originality to its environment? Wildflowers that symbolize happiness with their colorful appearance? Or is it a Spruce that lives for 400 years?
For a greener future;
1) Remove the green paper from cover visual
2) Plant it into a flower pot.
3) Put it in a place with sunlight.
4) Give water day by day.
5) Take care of it.



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In the industries we operate, the trends are mostly driven by sustainability. Therefore, as a leading player, our sustainability concerns are manifesting in our product portfolio.

Foreword

ALİ ÇALIŞKAN

CEO

Dear Esteemed Partner,

When we look back, we are excited with the milestones that Kordsa have taken in the first half of the year 2019. With our investments in tire and composite industries, we support our promise promise to reinforce life. During this journey, the response to our "Inspired from life, we reinforce life" campaign, which reveals the essence of Kordsa's main mission, has been incredible. After underlining how we are inspired from the happy moments in life and how we translate this inspiration to new technologies to protect and enhance those moments, on the 2nd phase of our campaign we are now sharing videos of real inspiration stories of Kordsa Reinforcers who reflect this inspiration in their work.

Meanwhile we never compromise our responsibility for the society and for the future, giving the utmost importance to sustainability over the last 46 years. Although Kordsa's sustainability journey began the very first day the company was established, now all these are made by the Sustainability Task Force (STF), a team set up specifically for our sustainability efforts, and with the participation and feedback of our stakeholders, our employees and a number of selected customers. Alongside preparing sustainability trainings and workshops to raise awareness about the global trends in sustainability, STF also made our first 5-year road plan in 2016 to have a clear vision of where we are heading to. This 5 year map included inclusion of our employees to the process, integrating monitoring and evaluating models to all our plants, and improving our policies, and our supply chain by assessing our suppliers. It also included actions about management systems certification, integration of sustainability topics into employee idea platforms.

While striving to produce more efficient and more environment-friendly technologies that make life easier, safer, and more sustainable, we dedicatedly keep on track with our sustainability roadmap. Now we are ready to form our second 5-year road map. This road map will be including some additional inspiring topics, like Kordsa's own sustainable products created by Kordsa's R&D and innovation power and open innovation vision.

After last year's acquisitions of the US companies Fabric Development Inc., Textile Products Inc. and Advanced Honeycomb Technologies, we are now a larger company with recent acquisition of Axiom Materials. These acquisitions not only broadened our field of operation but also widened our product range. A new story in aerospace industry started with Fabric Development, Textile Products providing structural parts, strengthened with Advanced Honeycomb Technologies providing interior parts and now is completed with Axiom providing novelty technologies for aerospace engines. Today we are able to provide advanced composite technologies for the aerospace and automotive industries as well as the next generation industrial and transportation applications. We became the only worldwide qualified manufacturer of Oxide-Oxide ceramic matrix composites which is a promising material with numerous industrial applications including sophisticated aircraft engines and therefore is providing a huge growth potential.

We now seek for opportunities in thin film and printed & flexible electronics. Thin films already have a wide range of applications from TVs to smartphones or notebooks. And applications like foldable display sheet to replace printed newspapers, walls covered with DSSC (dye sensitized solar cell) to recycle electrical energy from the lightning, robots with soft and flexible skin with plenty of flexible sensors to prevent it from injuring people uses this technology which will be in our daily lives in the near future. In line with the importance of the material and its applications, we launched a new R&D platform "Thin Films and Flexible Electronics" in partnership with Sabancı University, and together we have started to work to develop thin films and flexible electronics technologies with an open innovation concept. We are already engaged in a new project in May 2019, Nanosis-1004. Kordsa will be coordinating the project with its partners to develop a new generation of flexible-type wearable healthcare sensors. The new platform is also in contact with some international renowned universities, institutions and companies in Turkey, the US and Europe to extend its partnerships. Other new projects are expected to emerge, once Kordsa has purchased new lab and pilot machines suitable for flexible electronics technology. We are firmly proceeding toward building new success stories.

Outstanding teams have been assembled to deliver significant value for all of our stakeholders and make a difference. This new chapter of our companies will be filled with many opportunities to expand our global reach. We are exceptionally proud.

We are working continuously to introduce more environmentally friendly products in the interests of our employees, society and the environment. Aiming to transform the tire industry with more eco-friendly technology, we have launched our new brand COKOON, a new sustainable adhesive technology standard for bonding textile reinforcing materials with rubber compounds, together with Continental. COKOON enables the bonding activation of textile reinforcing materials without the use of resorcinol and formaldehyde. We offer this new dip technology to all tire manufacturers and the supplier industry as an open source solution via free licensing. You will also be able to read more on this in inner pages.

In the industries we operate, the trends are mostly driven by sustainability. Therefore, as a leading player, our sustainability concerns are manifesting in many products besides COKOON. The technologies that are currently being developed by Kordsa are aiming to reduce the material consumption during tire production like high tensile, high modulus reinforcement materials. Additionally, there are some new products that contribute to longevity of tire with increasing the integrity of fabric and rubber matrix by improved adhesion. Having an expertise of years at fabric production, and not losing the innovative approach, we are also developing several new and game changer concepts, like changing the fabric construction with fundamental know-how. With this new method, significant savings on materials are expected while delivering higher performance.

The last but not the least, we put into operation our USD 18 million worth additional polyester yarn line at İzmit plant in order to meet the increasing demand in the field. After Indonesia, now we are able to provide 7000 tonnes of additional capacity in Turkey as well. With this new line, equipped with the latest technology, in addition to the standard HMLS polyester yarn we will produce a new generation of polyester yarn products with higher resiliency and better dimensional stability.

2019 has much in store for Kordsa. We look forward to walking this path with all our stakeholders. In this edition you will find in detail the subjects I have covered here and many more. I am sure you will find them interesting and useful. Enjoy the read!

Ali Çalışkan

CEO

Digital Transformation

FATİH AKAR

Global IT Manager, Kordsa

In the last five to ten years, digital transformation has entered the agenda of companies in practically every sector.

As long as we are prepared, we can embrace it. The world is changing at a phenomenal rate. Ever since the dawn of the information age, both companies and consumers have been changing the way they operate, to make sense of the fast-changing context. This time, however, digital transformation is bringing with it a change in mindset. It is a radical, systematic change, which is going to influence every aspect of our lives. More than just a technical change that leads organizations to modify their processes and infrastructures, it is a kind of cultural and behavioral change.

Digital transformation has become an absolute necessity for every industry and every company, no matter whether it is small or large, Information Technology (IT)-related or not, newbie, experienced or legendary. It is hard to predict what our digitally-enabled world will look like, and determining the specifics of the digital future will involve an exact definition of what customers want.

Digital transformation is going to blur the line between IT and business. It is enabling businesses to innovate faster, become more agile and gain a competitive advantage in their market. On the other hand, it cannot be denied that it also harbors many unknown risks and the potential for considerable disruption.

At Kordsa, our digital transformation journey started three years ago, when we prepared our digital assessment, and we are continuing to apply the strategy on a global basis. Now it is time to implement the transformation in selected prioritized areas, like Big Data Platforms on which data connected with a field can be assembled, Manufacturing Execution Systems (MES) for increasing Overall Equipment Effectiveness (OEE) and product quality, Supply Chain Optimization, Advanced Data Analytics for extracting greater value from the new gold, data, and the Cyber Security that is required for all these environments.

Amidst all these priorities, here are the elements of our Digital Transformation on which we are currently focussing:

Connected Things Analytics

One of the great benefits of going digital is the potential it brings to track metrics and analyze the data that is gained during production processes. Indeed, by exploiting these insights, businesses can optimize their strategies and processes in order to yield even better results.

In business, two things matter more than most: costs and revenue. It's possible to make massive changes to both by integrating data-based insights into a company's culture.

Using data-driven insights to understand customers better can feed into business strategy and enable hyper-personalization, improved relevancy, heightened flexibility, and real-time feedback. To achieve this, businesses need to make use of structured data (personal customer information) as well as unstructured data (sensors and image-processing metrics); fusing all our data in a Big Data Platform will be the starting point for the transformation journey.

The importance of data in decision-making should not be underestimated. A company that displays the leadership needed to make the whole organization aware of the importance of data will soon find itself advancing smoothly on the road to a higher Return of Investment (ROI) and OEE.

Customer Experience

The world's obsession with the latest technology, social media and applications is rooted in a desire for an easier life. People want effective and fruitful solutions to their problems. More importantly, they want them fast.

The experience of customers lies at the heart of the digital revolution. The digitalized world should bring benefits for everyone, making people's lives easier. For this reason, the primary objective of digital transformation is to use cutting-edge technology to improve the customer experience.

Many companies recognize this, with 90% of leading firms developing mature digital transformation strategies, specifically to enhance the consumer experience.

Cyber Security

The landscape of information security is changing rapidly, and digitization is expanding, resulting in an increase in the frequency and magnitude of cyber attacks. Once attackers infect a company, it can take months to detect the breach, let alone win back territory. Any system-critical infrastructure faces the threat of cyberwar and cyberterrorism, and every firm is a potential target. The worst consequence of an attack might not be the damage incurred directly but the high level of public knowledge of the attack and the loss of trust in the entire system.

At Kordsa, we understand that information security risks constitute major business risks. We appreciate too that, during our Digital Transformation journey, a well-defined strategy can become a powerful competitive advantage.

Organization and Culture

Many people fear change. The thought of the entire organization undergoing a massive digital transformation can be a daunting prospect for the whole workforce, from leadership to entry-level employees. In such a transformation, all processes and strategies need to be addressed, down to the core structure and company culture.

This, however, brings with it the opportunity for unity throughout the workforce. Strong communication is vital for enabling a successful switch to the new digital reality .

With encouragement, employees can overcome age gaps and social divisions, engage in conversation and learn together. Since Kordsa Reinforcers are being mobilized to maximize global collaboration, we are confident that the existing climate will improve the digital intelligence of the workforce.

The foundation for a smooth digital transformation is digital congruence. When all departments are aligned, a strong company culture will emerge, and this will lead on to a successful and confident transition. This is why, at Kordsa, we have set up a Digital Transformation Committee on which the heads of various departments sit. We shall continue the journey of Digital Transformation in the spirit of collaboration.

Only a strong digital workplace can be flexible and adaptable. Such an environment will allow the workforce to remain productive and engaged in the transformation without feeling overwhelmed or disconnected from the process.

Merely having the technology in place is not enough. If a business is to succeed in the future, it has to adopt a company culture that embraces change.

Given that 60% of professionals do not feel equipped for change, a company culture that immerses the workforce in a digital learning environment can only be beneficial. Such a culture will help professionals develop the skills they will need in the years ahead, encouraging them to climb up the ladder and become digital-savvy employees.

Digital transformation allows this to happen by making an impact on leadership and driving culture from the top down. Such is its importance that, by 2020, 90% of large companies are expected to have a Chief Digital Officer on their staff.

We believe that the more stakeholders join in, the higher the benefit will be for all parties and that COKOON can help transform the industry for the sake of a greener future.

The Road to Resorcinol-Formaldehyde-Free Adhesive Dip Technology for Tire Cord Manufacturing

YASİN ŞEN, PhD

Expert Researcher, Chemicals and Materials

Reinforcement of rubber with textile fibers is essential for satisfactory mechanical properties and hence for the performance of many heavy-duty mechanical rubber goods, especially tires. Since it is generally difficult to get reinforcing fibers to adhere to rubber due to the differences in chemical properties, the treatment of the fibers with adhesive coatings is necessary to obtain the desired bonding. Resorcinol-Formaldehyde-Latex (RFL)-based adhesive systems have been used for this purpose since the late 1930s.

The replacement of resorcinol and formaldehyde with more environmentally-friendly alternatives is beneficial not only for the environment but also for tire cord manufacturers. It is worth noting that employees in tire plants and end-consumers are not exposed to these chemicals, which are heated up and react in the textile conversion process; for this reason, resorcinol and formaldehyde can no longer be detected in converted textiles and in ready-to-use tires. It is more of a concern for the tire cord producers. SHE* concerns led the team to initiate a resorcinol and formaldehyde-free dip development project at Kordsa in 2008, and since then many challenges had to be overcome.

The first technical difficulty consisted in finding suitable substitutes. An extensive literature search indicated that many companies had worked over the last 30 years on finding good candidates. Chemicals involved in these studies included epoxides, isocyanates, acrylates, curing agents, alcohols and various latexes. In other words, common thermosetting (crosslinking) chemistries were employed. They were used in different amounts, forms, combinations and processes. Thus, designing an unprecedented formulation constituted a major challenge. Here, a radical approach was adopted: A chemical reasoning had to be put forward for any formulation change proposed. This principle may seem rather naive, considering all the chemical reactions and physical events that take place during the tire cord dipping and curing processes. However, it meant that every team member had to focus on the chemistry and visualize the micro-nano-pico-second chemical/physical events in slow motion. In doing so, statistical methods were also utilized to write plausible chemical scenarios.

The next challenge consisted in understanding and visualizing the physical events taking place, at the same time as considering the chemical reactions. As chemists, the team were inclined to focus on the chemistry at play. However, there were many physical events taking place during the preparation of the dip solution, the dipping process and the subsequent curing step: dispersions were breaking, forming and coagulating; water was evaporating, viscosity was changing, chemicals were migrating and depositing on the cords; and all of these events were happening at different rates and according to a hierarchy that derived from the process conditions. Therefore, the chemical scenarios were heavily dependent on the physical events as well. Analytical tools were used to understand the dynamic polymer physics behind the new technology.

Many other technical challenges had to be overcome. Some needed expertise, others needed additional experimentation. A range of parameters, such as type of fibers, surfactants and green tires, needed to be considered. Hard work and team effort ultimately led to the emergence of a new material that in laboratory tests yielded similar adhesion to the RFL-treated cord.[1-3]

In the meantime, similarly to Kordsa, Continental had been working for several years on the development of a new eco-friendly dip technology in line with its corporate strategy.[4] As the two companies had been collaborating for many years on various topics related to tire textile reinforcements, it was natural that they would join forces on this project. Developers from both companies exchanged the know-how they had acquired, discussed options, created concepts to overcome prior limitations and tested various technologies. This partnership was also complementary thanks to the presence of dipping facilities on both sides, thus enhancing the development's speed and efficiency. The high quality of collaboration eventually paid off with a novel RF-free formulation that yielded similar results to the RFL standard not only in laboratory tests but also in tire tests. This was without compromising on safety or performance criteria.

COKOON

The complex dip technology was given a simple and easily recognizable name: COKOON was born! As one might guess, COKOON is an acronym combining the names of the two companies; "CO" comes from Continental and "KO" from Kordsa. With a small addition, the combined four letters formed the word COKOON, which is pronounced like "cocoon". Indeed, a dip surrounds a textile fiber, just as a cocoon encloses a caterpillar.

COKOON technology utilizes readily available chemicals compliant with the regulations, works at similar 3T (time, temperature, tension) conditions to RFL and does not require any special equipment. Besides, considering the dipping recipe and dipping process, the cost impact of COKOON is anticipated to be neutral compared to RFL technology. Due to the light color of the adhesive, COKOON is suitable for colorizing cord, constituting an additional feature of this technology.

The fact that such a promising alternative has been developed does not mean that it is possible to replace an almost century-old standard, which is an approved, long-tested system with which every tire manufacturer seems to be satisfied.

Currently, several textile suppliers provide only a single adhesion technology (i.e. RFL) to tire manufacturers; but in the case of RF-free, from the tire producers' point of view, the approval process could become much more complex and costly since numerous textile converters are working on alternative adhesion technologies of their

*Safety, Health and Environment (SHE)

own. Given the approval process and the added complexity of legal issues related to IP protection for each adhesion technology, tire manufacturers are likely to become reluctant towards trying alternatives. On the other hand, it is obvious that the industry needs to seek sustainable and responsible solutions with regards to future needs. So far, no one has been able to provide a viable business solution to this issue. In order to overcome such a bottleneck and to lay the foundation for a new industry-wide standard parallel to that of RFL, Kordsa and Continental have decided to make the COKOON technology available for everyone through free licensing, so that all parties can contribute to a greener world by joining this open innovation project.

The basic idea of this licensing concept is that we will allow all interested parties to use our new adhesion system without paying any royalties and/or a technology transfer fee; as a return, we ask for free back-licensing for future improvements, so as to avoid the kinds of selection patents that would block the pool members (including Kordsa and Continental) and undermine the sustainability of this technology.

COKOON was launched in March 2019 in Hannover, Germany at the Tire Technology Expo, and the technology and the details of this concept were described in an oral presentation.[5] The innovation received a very good response both during and after the fair. Currently, more than 30 textile converters and tire manufacturers are willing to test the material before joining the licensing pool. We believe that the more stakeholders join in, the higher the benefit will be for all parties and that COKOON can help transform the industry for the sake of a greener future.

Acknowledgements

The technical guidance of Dr. Nurcin Cevahir (recently retired from Kordsa) and Assoc. Prof. Ersin ACAR from Bogazici University-ISTANBUL/TURKEY throughout this project is greatly appreciated.

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Graphene has great potential to reduce the weight of composites by improving their mechanical, electrical and thermal properties while maintaining integrity of structure.

Graphene: A New Generation Reinforcement in Lightweight Composites

BURCU SANER OKAN, Assos. Prof. PhD

Researcher, Sabancı University

Graphene is the thinnest and strongest material known to possess a two-dimensional carbon network. Its unique electronic, chemical, and mechanical properties have led it to be described as 'The Material of the 21st Century'. The first graphene sheets were obtained in 2004 by extracting monolayer sheets from three-dimensional graphite using a technique called micromechanical cleavage, also named the 'Scotch tape method', which was pioneered by Konstantin Novoselov and Andre Geim from the University of Manchester. In 2010, the Nobel Prize for Physics was awarded for the discovery of graphene. The years since then have seen growing interest in the commercialization of graphene-based products, as graphene has shown great potential as a modifier/reinforcement in polymers and polymeric composites in fields such as energy, aerospace, automotive and construction.

Graphene has a great influence on mechanical performance, on thermal and electrical conductivity, and on the flame retardancy of composites. Its high specific surface area enables stronger interfacial interactions and better load transfer between polymeric matrix and reinforcement particles, making it a suitable candidate for composite fabrication. Just a small amount of graphene (less than 1 wt%) can lead to a significant improvement in the performance of thermoset- and thermoplastic-based composites. However, the main challenge in the graphene market is scaling up and high production cost. There have been several attempts to increase the capacity of graphene and to meet the needs of the market.

Growth of the graphene market: Graphene is currently one of the fastest-growing advanced nanomaterials, with a growth rate of 42.8% since 2015. This rate is expected to remain constant until 2020, thereby creating a market opportunity worth approximately €234 million. The demand for graphene is projected to reach 1,321.1 tons by 2022, and this is set to increase annually, thus expanding the market opportunity to €445 million by 2025.

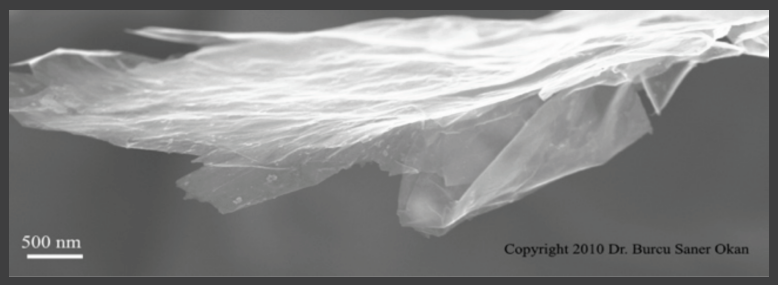

Figure 1. Electron microscopy image of graphene sheets

Demand for lightweight vehicles: The automotive sector accounts for nearly one third of global energy demand, being the major source of pollution and greenhouse gas emissions in urban areas. At this point, lightweight vehicle design is a key to improving fuel efficiency and vehicle performance whilst reducing adverse environmental impacts. Regulatory authorities in the EU aim to shift to a competitive low-carbon economy by decreasing CO2 emissions to 75 g/km by 2050. This has boosted the growth of the global lightweight car market, which is expected to expand between 2018 and 2023 at a CAGR close to 4.9%. As a result, in 2016, the automotive lightweight market was valued at €50.2 billion, and it is projected to grow at a CAGR of 13% between 2016 and 2021.

The use in vehicles of materials such as carbon/glass fiber-reinforced composites results in tremendous weight reduction.

The fiber-reinforced composites currently deployed have been embraced by the automotive industry since they offer advantages such as 50-60% weight reduction in comparison to steel, ease of manufacturing, design flexibility, a reduction in tooling costs and better mechanical and corrosion resistance. In 2013, BMW was the first company to initiate a major change in automotive production by introducing carbon fiber composites to its i3 model, an electric vehicle for city use. However, carbon fiber is very expensive, so vehicle manufactures are still looking for materials that will have the desired impact on cost, safety, risk, weight, market image, and vehicle emission.

Graphene has great potential to reduce the weight of composites by improving their mechanical, electrical and thermal properties while maintaining integrity of structure. Graphene-based polymer composites can be very effective as structural materials at a time when the integration of functionalities within the automotive sector is seen as crucial. Given the anticipated future demand for lightweight vehicles, the automotive industry, with its various automotive applications, is expected to become the highest user of graphene-modified polymeric composite materials in terms of volume. Recently, the automotive giant Ford announced that it would begin using graphene parts in its vehicles, starting with the Mustang and F-150 in 2018.2 Ford and its partners have tested graphene-reinforced foam covers for noisy components such as the fuel rail, pumps, belt-driven pulleys and chain-driven gears on the front of engines. In these tests, graphene-reinforced parts displayed a better performance, being 17% quieter, 20% stronger and 30% more heat-resistant. The deployment of graphene in automotive production is the door to a new era in this sector in that it paves the way for the commercialization of nano-integrated parts. However, there is still growing demand for commodity products (especially for thermoplastic polymers), since so far graphene has proven its potential only in thermoset composites; other uses remain to be explored. Numerous companies and compounders across Europe are seeking new technologies to meet the burgeoning demand from automotive and other consumers.

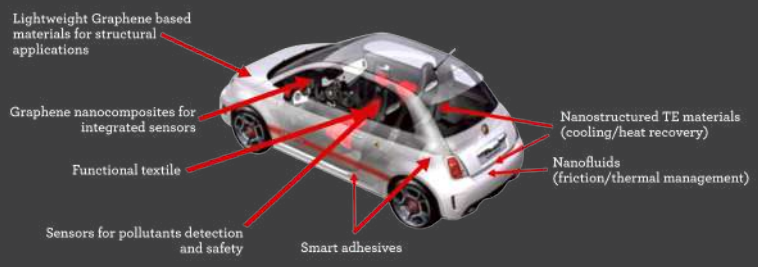

Figure 2. Graphene-based applications in a vehicle[3]

Turkey's automotive plastic compounding market is expected to reach a value of USD 390.8 million by 2025, according to a new report by Grand View Research, Inc. In terms of size, this market was estimated at 102.39 kilo tons in 2015 and is projected to reach 183.80 tons by 2025. Growing environmental concerns and stringent pollution control norms have compelled automotive OEMs to limit emissions by utilizing innovative lightweight materials. In 2013, Turkey was the leading plastics exporter among the EU-27 member nations and was ranked 5th in plastics processing. Turkey's automotive industry is expected to witness tremendous growth in the near future, despite the slowdown and stagnation in the European automotive sector.

Life cycle and circular economy: Light-weighting has a significant impact on the reduction of the automotive sector's carbon footprint. The Life Cycle Assessment (LCA) systematically evaluates the environmental aspects of a product or service system through all stages of its life cycle, from the acquisition of the raw materials, through production, use, final processing and recycling, to its final disposition (cradle to grave). LCA is a helpful instrument for environmental decision support. Furthermore, a comprehensive multi-criteria evaluation tool is still required and is currently being developed for application to the final product. This will be to the benefit of all stakeholders along the value chain, including developers, OEMs, suppliers, recyclers and users. With this kind of method, it will be possible to pinpoint realistic concepts and examine the implementations of a circular economy of technological products.

Other potential applications of graphene: To conclude, reliable and durable composite production is possible through the integration of graphene sheets into the composite matrix. Lightweight graphene-reinforced composites have great promise for use in the bodies of aircraft (especially the wings) since the mechanical properties of graphene are advantageous in terms of flexibility. Graphene is a disruptive technology and, alongside composite applications, can create a new market in various fields such as health, medicine, sensors, energy, electronics and photonics. For instance, graphene-based photovoltaics can be integrated into the aircraft body and thus yield a current directly from the sun's energy. In the field of energy, transparent organic light emitting diodes (OLED) have started to be used in information displays. Furthermore, the use of graphene as an electrode material in batteries will enable higher power density, longer life-time and increased recyclability. All in all, graphene has accelerated the production of niche products in the market, helped greatly by flagship projects. In the near future, we expect to see graphene-based commodity items being produced not just in the lab but on an industrial scale.

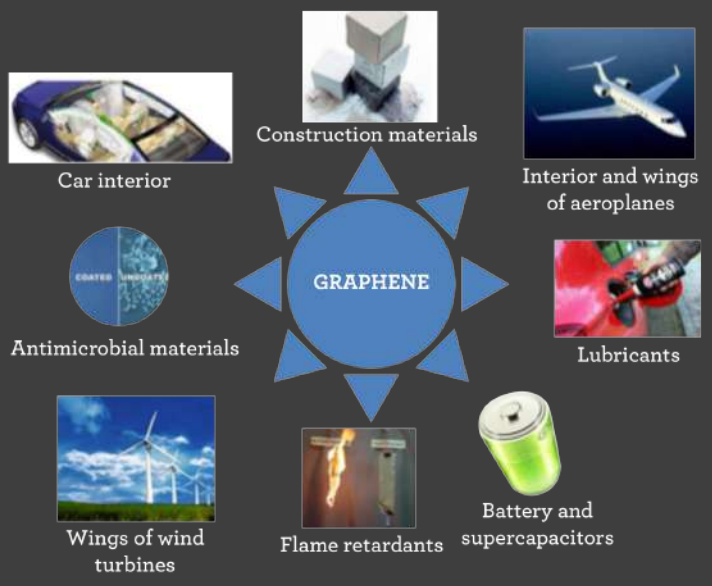

Figure 3. Application fields of graphene

Graphene in Kordsa: Kordsa has been working on the development of graphene reinforced composites and has accelerated graphene research by establishing the Composite Technologies. Center of Excellence which is a first in Turkey from the industry-university-public partnership model in 2016 In the scope of this collaboration, Kordsa and Sabancı University completed a joint project about the design and manufacturing of high performance thermoplastic prepregs by integrating graphene produced from waste tire. This new generation graphene/glass fiber reinforced thermoplastic prepreg shows better mechanical performance than the competitor's products available in the market and also can increase the competence in the composite field and decrease the manufacturing costs by using recycled sources.

Sabancı University - Integrated Manufacturing Technologies Research and Application Center

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Kordsa Launched a New R&D Platform “Thin Films and Flexible Electronics” in Partnership with Sabancı University

Thin Films and Flexible Electronics

DEVRİM ÖZAYDIN

Global Technology Director

Products based on thin films and flexible printed electronics, which are expected to make their way into our homes in the near future, are shown in Figure 1.

As can be seen, a large-screen TV is mounted on the wall. It is lightweight, thin and flexible. The TV panel itself consists of an OLED (organic light emitting diode), with an active matrix back plane composed of organic transistors and metallic nano ink circuits. The person sitting at the table is reading a newspaper, but it is no ordinary newspaper. It is actually a foldable display sheet. The wall behind the TV, with its patterned design, is not simply a wall covered with patterned wallpaper but is actually a DSSC (dye sensitized solar cell) wall that recycles electrical energy from the lighting inside the house. The gadgets on the table –a smartphone, playing cards and notebook PC– are not merely lying there but are being wirelessly charged via the communication sheet on the table. The robot walking in the room possesses soft and flexible skin with plenty of flexible sensors, to prevent it from injuring people or pets or damaging furniture. The floor also has a sensor network beneath the carpet that senses any movement above the floor. The sensor network also needs to be soft. The curtain is not a straightforward piece of cotton fabric. Its outside face is an organic thin film type of solar cell, while its inside face is an OLED lighting panel. The solar cell provides electricity for the internal lighting, and the curtain itself works as a standalone flexible device. On the roof there is, of course, a solar cell module, possibly formed from inorganic thin film. Close inspection of the person sitting at the table reveals that he has some sort of device on his shoulder: a health monitor seal on his shirt. The seal monitors his temperature, blood pressure, pulse, sugar level and other important health parameters and sensors transmit health data to his doctor via a cell phone.

All in all, a variety of flexible and printed electronics products will be a regular feature of our lives in the near future and will add extra ease and comfort to our daily routines. These devices will not be noticeable to people because they will be so thin and lightweight, and they will match the contours of walls, clothes and even skin; they will certainly be energy-efficient and, above all, affordable. [1]

In other words, thin films and flexible electronics are on their way ...

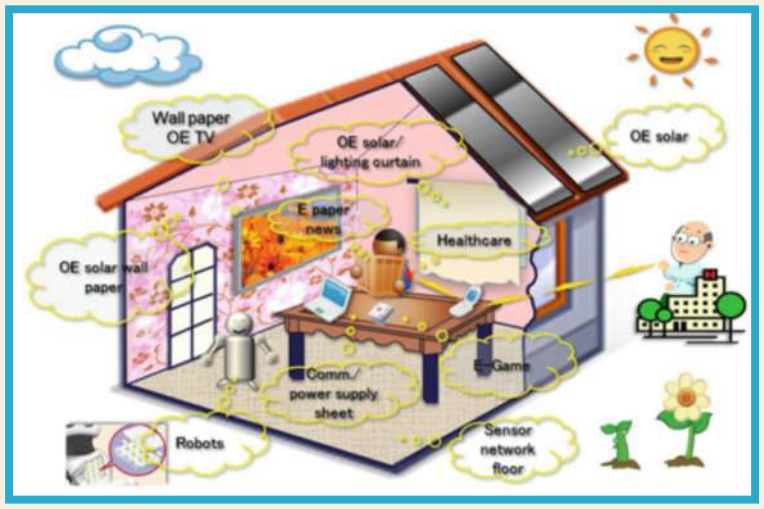

Figure 1: Thin Films and Flexible Electronics in the near future[1]

Kordsa's new R&D Platform: Thin Films and Flexible Electronics

After completing several detailed workshops, in March 2019 Kordsa launched a new R&D platform "Thin Films and Flexible Electronics" in partnership with Sabancı University.

Step by step, Kordsa and Sabanci University Platform members started to understand and develop thin films and flexible electronics technology in line with an open innovation concept. The Platform is now in contact with some universities, institutions and companies in Turkey, the US and Europe, with the aim of developing this new technology and creating potential new business.

The team engaged straight away with a new project in May 2019, Nanosis-1004, funded by the leading Turkish research body, TUBITAK. Kordsa is coordinating the project, and its current partners are İstanbul Technical University, Sabancı University, Yeditepe University, TUBITAK and Arçelik. An additional European institute is due to join. The aim of the project is to develop a new generation of flexible-type wearable healthcare sensors.

Other new projects are expected to emerge, once Kordsa has purchased new lab and pilot machines suitable for flexible electronics technology.

Figure 2: The first flexible sensor prototype developed by Sabanci University and Kordsa in April 2019.

Before we go on to consider more details, the reader may be asking this basic question:

- What are thin film and flexible electronics?

A thin film is a layer of material ranging in thickness from fractions of a nanometer to several micrometers.

Flexible electronics are devices built using conformable or stretchable substrates, generally plastic but also metal foil, paper and flexible glass.

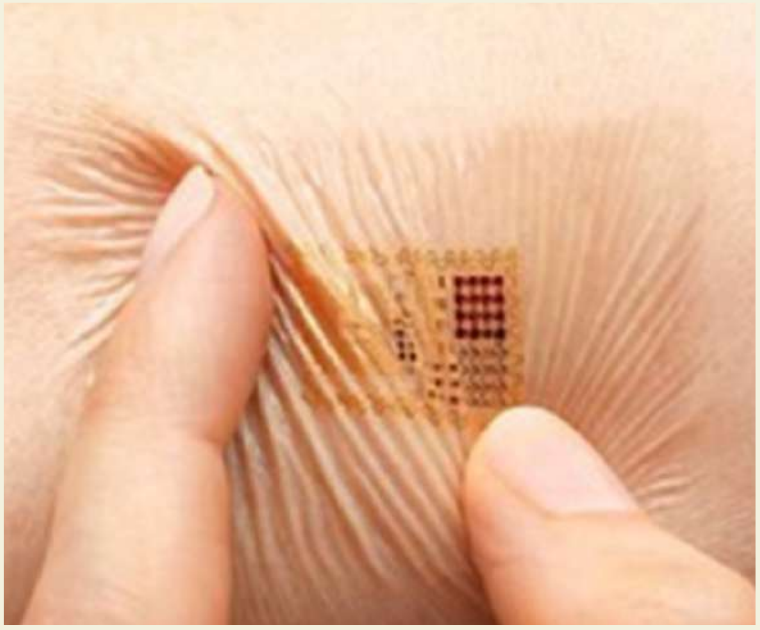

Figure 3: A sample of thin film

Figure 4: A sample of flexible electronics

Thin Films

Thanks to the advances in nanotechnology, thin films and thin film devices have been developed for a vast range of conventional and emerging applications. This has been greatly helped by progress in producing conducting polymers, molecular semiconductors and carbon nanotubes, by exploiting graphene as a raw material, making use of techniques for obtaining high surface area, controlling nanostructure for effective charge transfer and exploiting unique physical and chemical features [2].

The difference between a thin and a thick film is defined rather vaguely in the literature; usually 1 μm (1000 nm) of thickness is said to be the border between thin and thick films. Another approach is to define the type of film according to its surface or bulk-like properties. For instance, surfaces that require to be more than one micrometer thick can still be classified as thin films [3].

With semiconductors, it is vital that some quantity of functional material (organic molecules, polymers, metals, metal oxides or dielectrics) is deposited on very thin films. This is due to the fact that the semiconductor sector has been witnessing constant miniaturization since the 1950s. When the first transistor was made, it was only good for a single use. Today, however, millions of transistors can fit on a small chip capable of running multiple functions, as is particularly evident with cell phones.

When we talk about thin films, the thicknesses of such electronically active films range from a few nanometers –coating just a few atoms with a few more– to a few microns. As such, thin films possess different structural, optical and electrical properties compared to their bulk form. For example, graphite is a bulk form made up of millions of carbon atoms, which gives it its black color and thus renders it non-transparent; in contrast, graphene is transparent when deposited in one atomic layer. When deposited in very thin layers, atoms can be aligned perfectly in three dimensions without the defects demonstrated by their bulk counterparts. This actually enables magnificent electrical conductivities and the charge carrier mobilities required for electronic applications. Another advantage of thin films is that very low resistivity can be obtained by the meticulous alignment of atoms in them. This allows new electronic devices to run on very small voltages, as in the case of electrochromic, light-emitting diodes or sensors.

Coating flexible substrates with very thin layers of functional materials makes it possible for people to produce devices that could not have been made before, such as electronic skin, flexible displays and flexible solar cells. As the amount of functional material is decreased, it can nonetheless adjust well to the substrate, thereby avoiding mechanical brittleness. For this purpose, the deposition methods used have high throughput but are also very precise. Among the technologies deployed to create thin films are vacuum-coating technologies (using chemical vapor or physical vapor deposition) and solution process-based (roll-to-roll) coating.

Flexible Electronics

The term “Flexible electronics”, usually called printed electronics, refers to functional electronics fabricated by laying conductive lines using one of several printing methods. The origin of this technology was to replace conventional silicon electronics with lower cost devices. But there are more benefits now. Companies are now focusing on a wide range of technologies including sensors, smart textiles and flexible displays with the goal of complementing silicon electronics and, in many cases, yielding high value or unique features.

Flexible electronics essentially consist of two layers –substrate and functional materials (eg. conductive inks, dielectrics, etc.). In recent years, plastics (particularly polyimide and polyester) have been the substance of choice in the substrate segment.

Why are flexible electronics preferred?

There are several advantages of flexible electronics compared to conventional silicon electronics. The key advantages of thin films and flexible electronics are as follows:

- Flexibility - stretchability
- Disposability and sustainability
- Increased potential for digitalization
- Light weight
- Low cost processing
- Miniaturization, small and efficient systems
- Scalability, modularity and easier reconfiguration

Flexible electronics technology can be found in the market but is relatively rare. However, there is a huge potential market that will require much time and effort to develop. Major market products are as follows:

- Lighting (OLED)
- Organic and inorganic photovoltaics, solar cells
- Displays
- Integrated smart systems (RFID, sports and healthcare devices, smart cards and smart textiles)
- Electronics and components (memories, antennas, batteries, wiring and interconnects and other components)

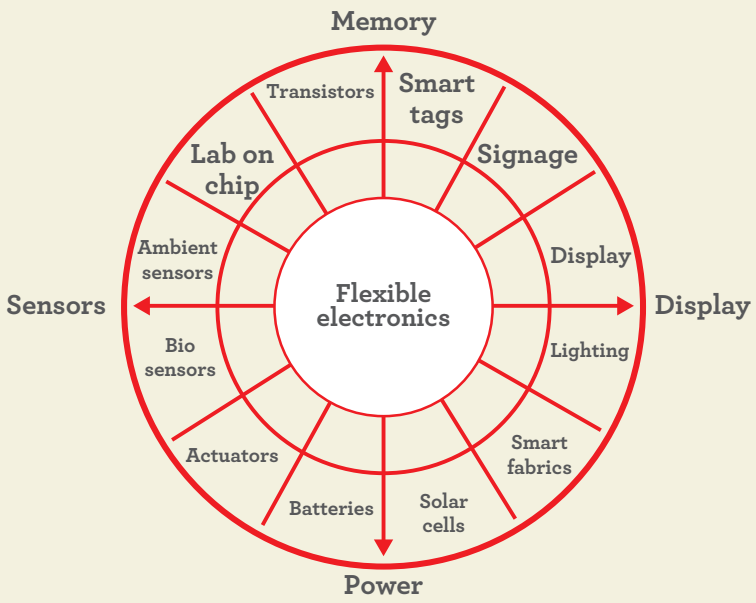

Figure 5: Categories of flexible electronics products

The flexible and printed electronics market is at a relatively early stage of its development. For many years, traditional rigid, fabricated electronic modules dominated the market, after which advancements in 3D printing started to drive the market. Growth in the last decade has been very quick, ranging from USD 3.8 billion in 2009 to USD 31.6 billion in 2018. [4]

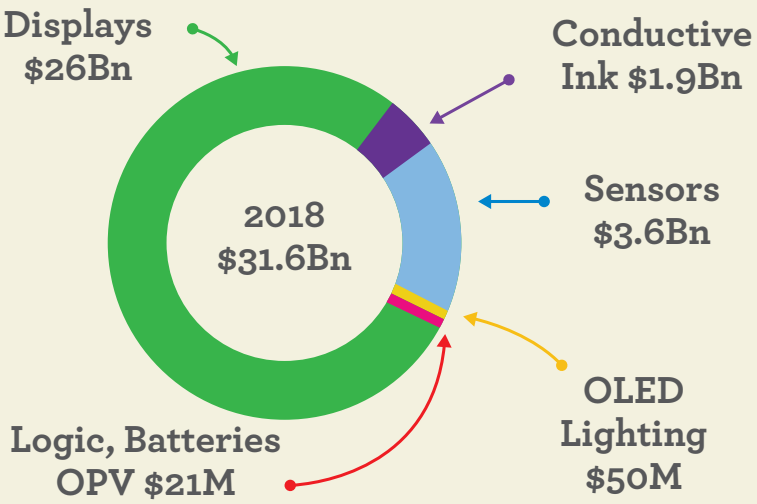

Figure 6: The current flexible electronic market [4]

Technologies for flexible electronics will be major differentiators in the next generation of consumer and computing devices. Some of these devices are expected to be among the fastest growing product categories over the next decade.

Flexible printed electronics can be manufactured using a variety of technologies, which can be categorized into two main groups: Non-Contact and Contact Printing.

Roll-to-Roll Printing is the most convenient, simplest and cheapest printing technology available on the market.

We will discuss these technologies in the following issue of Reinforcer Magazine.

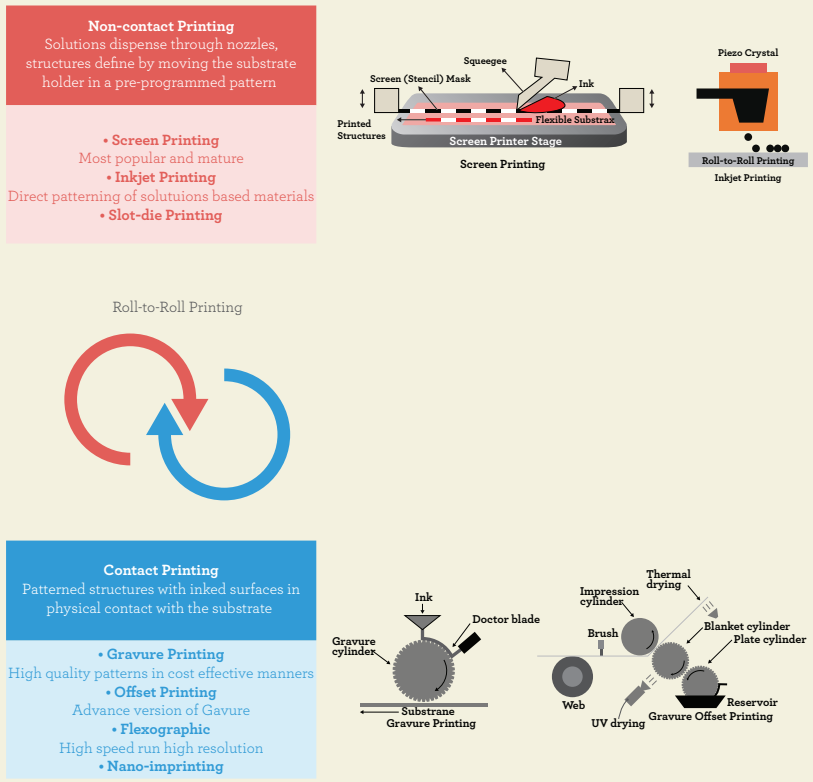

Figure 7: Printing technologies [1]

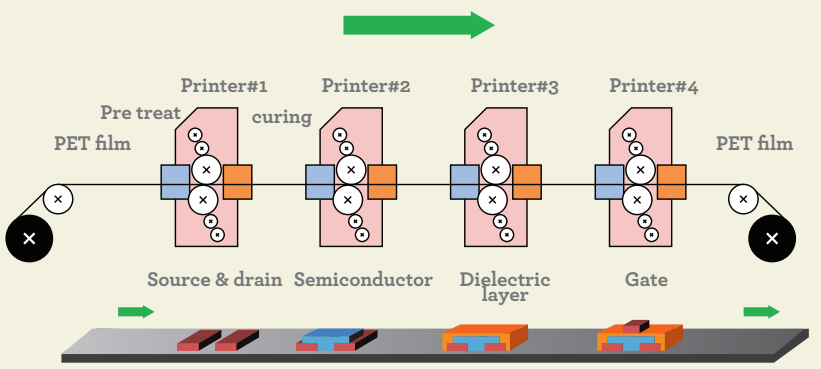

Figure 8: Roll-to-roll printing [1]

Acknowledgements

We greatly appreciate the support of Dr. Unsal KOLDEMIR, Dr. Nazif Uğur KAYA and Mehmet İlker YILMAZ from Kordsa's R&D Team.

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Kordsa is a leader in the global tire cord industry. The research done at Kordsa's R&D center focuses on the improvement of existing products and new product development as well as research on new materials.

An Investigation of Condensation Heat Transfer of Dowtherm-A Fluid in Dow-Box

MERT PATKAVAK, MSc

Global Technology Project Leader, Kordsa

Kordsa is a leader in the global tire cord industry. The research done at Kordsa's R&D center focuses on the improvement of existing products and new product development as well as research on new materials. The construction of a new R&D Experimental Line Machinery Installation Works will be completed in the second half of 2019. This R&D facility will bring various opportunities: the possibility for differentiation between existing NY and PET products with high strength and tenacity; the development of next generation PET, UHT NY, POM and biocomponent yarn and compounding chips with additives; the development of better products at the same cost; the improvement of equipment and the manufacturing of new equipment; enhanced development know-how for yarn production and compounding processes; a decrease in the investment cost for future projects; and an expansion in market share.

The polymer used in tire cord manufacturing is transferred down a jacketed transfer line and heating box to enable thermal stability of the system after the extrusion process. The dow box is heated with vapor phase Dowtherm-A to compensate for the heat loss experienced by the polymer. In order to increase heat transfer on the condensation surfaces, it is essential to reduce the thickness of the condensed fluid film. This study uses steady state analyses to investigate the inlet mass flow rate of Dowtherm-A.

Dowtherm-A Heat Transfer Fluid

Dowtherm-A fluid is utilized in heat transfer processes and is composed of two organic components, namely biphenyl ($C_{12}H_{10}$) and diphenyl oxide ($C_{12}H_{10}O$). Since the vapor pressures of these components are approximately the same, the Dowtherm-A fluid can be considered a single compound fluid. It can be utilized in industrial heat transfer applications in temperatures ranging from 15°C to 400°C, and at pressures between 1 and 10.6 bar. As well as enabling vapor phase heating, Dowtherm-A makes it possible to heat in the liquid phase. Viscosity, stability, freezing point and vapor pressure are four significant specifications of Dowtherm-A fluid that govern its heat transfer behavior. Heating applications that utilize Dowtherm-A in the vapor phase have some benefits over systems involving liquid Dowtherm-A, since they make it possible for natural circulation of the condensed vapor to occur under the effect of gravity without the need for pumping devices. When Dowtherm-A is used at low pressure values, systems that exploit the vapor phase yield a much higher heat transfer rate per unit mass of heat medium. These advantages are the reason why Dowtherm-A heat transfer fluid is used in the polymer line.

Dow-Box System

Polymer is transferred along a jacketed transfer line covered by the heating box, a measure designed to maintain the thermal stability of the system after the extrusion process. In a standard operation, the heat generated by the meter pump is adequate for maintaining an operating temperature. Without the heating jacket, if the meter pump were shut down, the polymer would freeze in the unit. For this reason, the system needs a heat transfer medium that makes it possible to keep the polymer at the preferred temperature.

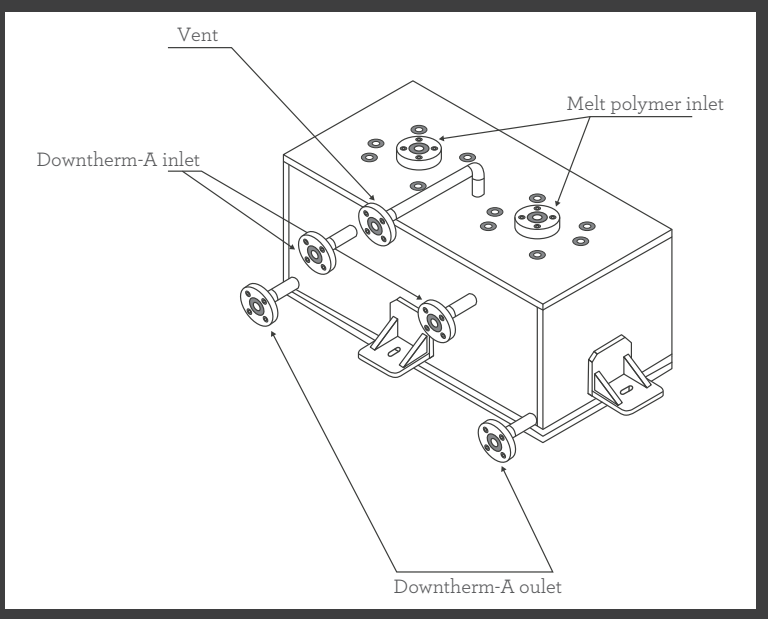


Figure 1: Schematic figure of a heating box (Dow-box)

The heating process is carried out using Dowtherm-A in its vapor phase. As shown in Figure 1, the Dowtherm-A enters through the Dowtherm-A inlet so as to compensate for the heat loss from the polymer. The Dowtherm-A covers the inner volume of the heating box and condenses on the contact solid surfaces. The latent heat of Dowtherm-A is released during condensation and consequently the

polymer temperature is kept at the desired value. The incoming Dowtherm-A in the heating box system condenses entirely and, under the influence of gravity, is ejected from the Dowtherm-A outlet in a liquid form. The heating box also includes a vent line for accidental exceptions. The temperature is controlled by adjusting Dowtherm-A pressure, and a thermocouple measures the temperature of the Dowtherm-A fluid instantly. High and low pressure alarms are integrated into the system. The temperature of the fluid and the levels of pressure are monitored from the control rooms.

CFD & CHT Analysis

CFD & CHT analyses were performed for the heating box system. Star CCM+ was utilized to model the CFD & CHT simulation of the heating box system. In the CFD model, the heating box system is composed of gas phase Dowtherm-A inside the box, polymer in its liquid phase inside the pipes, liquid phase Dowtherm-A on the condensation surfaces as well as in the solid-phase solidification chamber, pipes and insulation material.

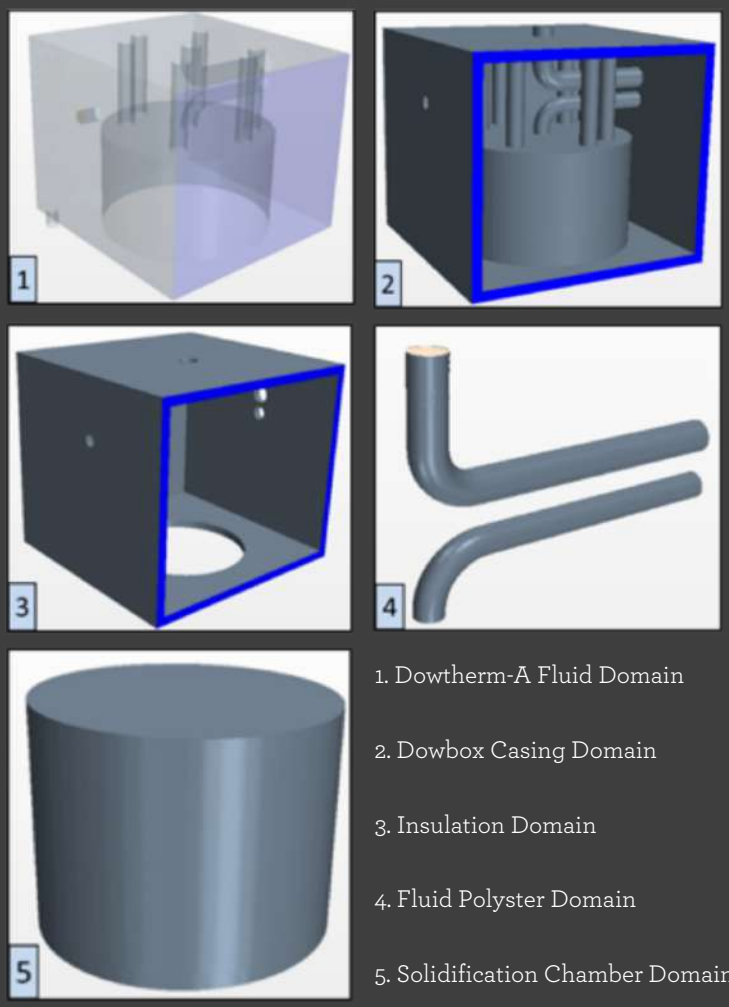
Dowtherm-A enters the system in its gas phase at saturation temperature 300°C. Condensation occurs on the outer surfaces, including on the pipes before and after the pump, in the solidification chamber, and on the inner surface of the insulation, where the temperature is lower than the saturation temperature of the Dowtherm-A. Several assumptions were made in the CFD & CHT analysis. These were as follows:

1) Transient analysis would show that the Dowtherm-A in the heating box system condenses entirely and leaves the box in its liquid phase.

2) Since the velocity of the polymer in the solidification chamber is very low, it was assumed that the advection term would be negligible. Therefore, it was modelled as solid.

3) Temperature change in the pump and pipes outside of the heating box was ignored.

On the basis of these assumptions, a 3D CFD was generated, as presented in Figure 2.



1. Dowtherm-A Fluid Domain
2. Dowbox Casing Domain
3. Insulation Domain
4. Fluid Polyster Domain
5. Solidification Chamber Domain

Figure 2: Heating box system model details

The mass flow inlet is calculated with respect to the heat loss in the dow heating box system. The total heat loss from the heating box is equal to the temperature difference divided by equivalent resistance. Figure 3 shows the points at which heat transfer loss occurs, as well as the resistances due to convection and conduction.

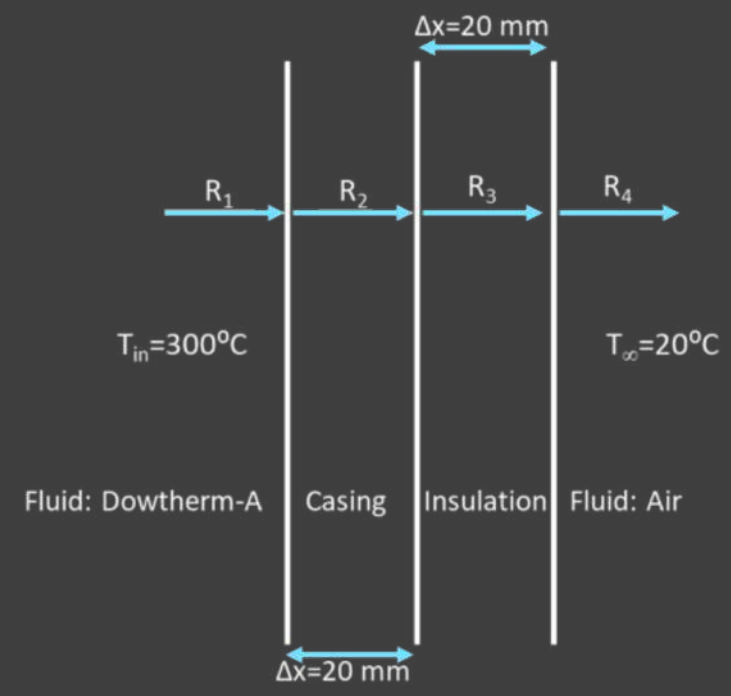


Figure 3: Resistances in the casing and insulation of the heating box system

In Eq. (1), resistances were calculated, taking into account convection and conduction heat transfer:

$$R_1 = 0 \qquad R_2 = \frac{L_{casing}}{k_{casing}A_{casing}} \qquad R_3 = \frac{L_{insulation}}{k_{insulation}A_{insulation}} \qquad R_4 = \frac{1}{h_{air}A_{outer}} \tag{1}$$

$$R_{eq} = R_1 + R_2 + R_3 + R_4 \tag{2}$$

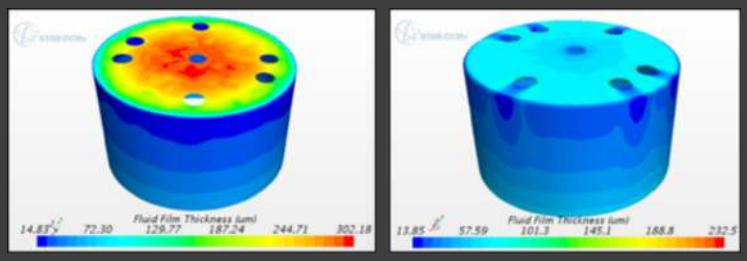
Total heat loss was calculated as Eq(3):

$$\dot{Q} = \frac{\Delta T}{R_{eq}} \tag{3}$$

Required mass flow for heat equilibrium is calculated as 0.0035 kg/s, which is set as the mass flow inlet boundary condition for transient analysis. The model consists of gas and liquid phase Dowtherm-A, liquid phase polymer and solid phase heating box casing, insulation and solidification chamber domains. Liquid phase polymer enters the system through the pre-pump pipe, and a pressure outlet is located at the exit from the pre-pump pipe. Liquid phase polymer re-enters the system via the post-pump pipe at a higher pressure level. A mass flow outlet is located at the exit of the post-pump pipe.

Dowtherm-A condenses on the surfaces and the film thickness increases at higher condensation rates. In order to understand the effect of the fluid film thickness, two different solidification chamber designs were analyzed. Design 1 is the base design, in which the solidification chamber has a flat top. Since previous studies showed that two-phase Dowtherm-A heat transfer performance increased with incline, Design 2 included a solidification chamber with an inclined top

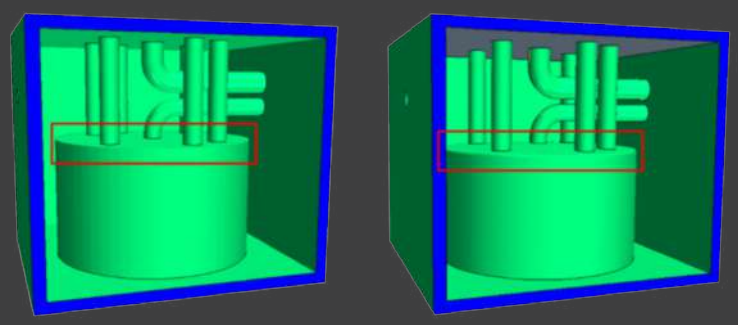
surface, as shown in Figure 4. It was expected that the inclined surface of Design 2 would let the fluid film flow quickly down from the top surface of the solidification chamber and eventually the heat transfer performance would increase.



Design 1 (Flat Top Surface) Design 2 (Inclined Top Surface)

Figure 4: Design 1 & Design 2 geometry models

In Figure 5, the accumulation of the condensed film on the top surface is higher for the flat top design. The incline on the top surface of the solidification chamber evidently made it easier for the accumulated condensed fluid film on the top of the solidification chamber to be extracted. Therefore, the fluid film thickness on the top surface of Design 2 is lower than that in Design 1.



Design 1 (Flat Top Surface) Design 2 (Inclined Top Surface)

Fig 5: Fluid film thickness comparison for Design 1 & Design 2

Figure 6 shows the heat flux distribution over the top surface of the solidification chamber of Design 1 and Design 2. Since the incline increases the rate at which the condensed fluid film is removed from the top surface of the solidification chamber, the fluid film thickness was found to be lower for Design 2. Thus, the heat resistance of the fluid film was lower for Design 2 and consequently heat flux values were higher compared to those in Design 1. Figure 7 shows that approximately half of the total heat transfer took place towards the solidification chamber and polymer pipes, while the other half was lost due to heat transfer in ambient air.

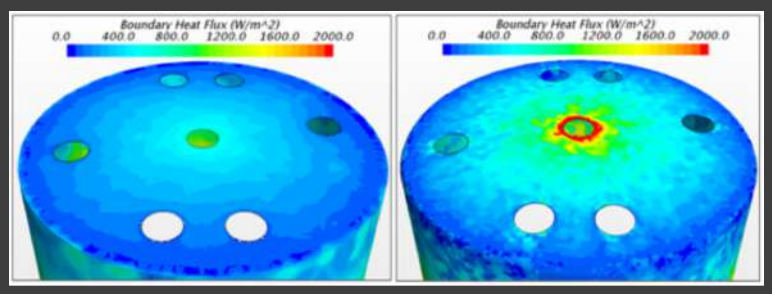
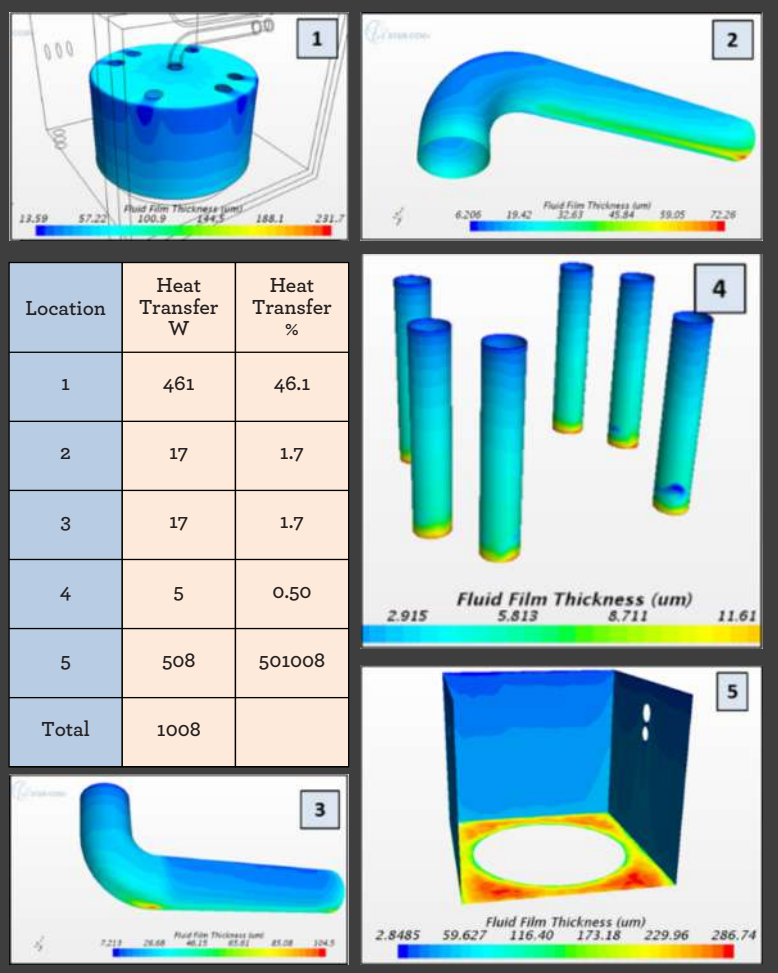


Figure 6: Heat flux distribution comparison of the top surfaces of the solidification chambers in Designs 1 & 2



Location	Heat Transfer W	Heat Transfer %
1	461	46.1
2	17	1.7
3	17	1.7
4	5	0.50
5	508	501008
Total	1008	

Figure 7: Heat transfer rate for components of the heating box (Design 2)

Conclusions

In this study, the effect of inclining the top surface of solidification chambers was investigated using two different dow heating box designs. Results show that an inclined top surface removes more fluid from the top surface and decreases fluid film thickness. Lower fluid film thickness increases the heat transfer rate. Therefore, the heat transfer rate of the solidification chamber of Design 2 was found to be 3.5% higher than that in Design 1. It was also established that approximately 50% of the heat was transferred to the solidification chamber and polymer pipes whereas the rest of the heat was lost due to heat transfer through ambient air. Total heat transfer for the dow heat box was measured at 1008 Watt.

In steady state cases, fluid moves toward the polymer pipe, at a high energy in the case of higher inlet mass flow rate. However, it then loses its energy and flows towards/ the solidification chamber.

For this system, the required Dowtherm-A mass flow for heat equilibrium was calculated at 0.0035 kg/s. It was defined as the mass flow inlet for transient analysis. Therefore, transient analysis reveals that the heating box reaches a steady state equilibrium at approximately 300^{0}C.

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Humans have been living with ceramics for 25,000 years. We've been using them for cups, pipes, pottery and many other handy everyday objects. Ceramics are known for their incredible strength and superior heat resistance.

Ceramics-Beyond Your Coffee Cup

MARY P. SHAFER

General Manager, Fabric Development Inc.

Humans have been living with ceramics for 25,000 years. We've been using them for cups, pipes, pottery and many other handy everyday objects. Ceramics are known for their incredible strength and superior heat resistance. But the light, strong, and heat resistant material has one fatal flaw, it is brittle. Ceramics they fracture easily under mechanical or thermo-mechanical loads because of cracks initiated by small defects or scratches. To overcome this deficiency, Ceramic Matrix Composites (CMCs) have been developed.

Ceramic Matrix Composite (CMC) materials are made of coated ceramic fibers surrounded by a ceramic matrix. They are tough, lightweight and capable of withstanding temperatures 300–400 degrees F hotter than metal alloys can endure. A ceramic matrix composite is different than almost all other composites because the matrix is ceramic and the fiber is ceramic. Typically, combining two brittle materials yields a brittle material. But altering the bond between fiber and matrix enhances the toughness of the composite. Cracks don't propagate into the fibers from the matrix around them. The fibers hold the material together and carry the load while slowly pulling from the matrix.

Initially, to increase the crack resistance or fracture toughness, monocrystalline whiskers or platelets were embedded into the matrix. However, the improvement was limited, and the products have found application only in some ceramic cutting tools.

The use of long multi-strand fibers has drastically increased the crack resistance, elongation and thermal shock resistance. The reinforcements used in CMC to enhance the fracture toughness of the combined material system while still taking advantage of the inherent high strength and Young's modulus of the ceramic matrix. The most common reinforcement embodiment is a continuous-length ceramic fiber, with an elastic modulus that is typically somewhat higher than the matrix. The functional role of this fiber is to increase the CMC stress for progress of micro-cracks through the matrix, thereby increasing the energy expended during crack propagation; and then when thru-thickness cracks begin to form across the CMC at a higher stress, to bridge these cracks without fracturing, thereby providing the CMC with a high ultimate tensile strength. In this way, ceramic fiber reinforcements not only increase the composite structure's initial resistance to crack propagation, but also allow the CMC to avoid abrupt brittle failure that is characteristic of monolithic ceramics. This behavior is distinct from the behavior of ceramic fibers in Polymer Matrix Composites (PMC) and Metal Matrix Composites (MMCs), where the fibers typically fracture prior to the matrix due to the higher failure strain capabilities of these matrices.

Ceramic fibers are made by super-heating chemical like silica until they are molten, and then spinning into a fiber form. 3M developed this technology and has developed a family of fibers known as Nextel.

Nextel is an oxide ceramic fiber, mainly based on alumina Al_2O_3 and Silica SiO_2. This chemistry is favorable because of high stability of alumina at high temperatures. 3M produces Nextel in several grades: 312, 440, 550, 610, and 720. These fibers can be readily converted into textile structures of various fabrics, braids and tapes.

Nextel ceramic fibers 312 and 440 are aluminoborosilicate based and primarily used in heat and flameshielding applications in the aircraft and aerospace industries. Flexible and durable Nextel ceramic textiles remain flexible even after being exposed to high temperatures and harsh conditions over long periods of time, meaning fewer repairs and replacements. Primary applications are heat shields, curtains, linings, insulation, blankets and seals.

Initially used to protect NASA Space Shuttles against the heat of reentry, today Nextel 312/440 textiles and fibers are used for both high temperature and load-bearing applications in outer space. For example, blankets sewn from Nextel textiles protect the Delta II rocket engine from the plume of the solid boosters, and whipple shields made with Nextel fabrics defend the International Space Station and satellites against impact by micrometeorites and space debris.

With Nextel's success in space flight, it only seems natural that the fabric be used in the aviation industry. The high temperature insulation performance makes it perfect for lining and protection surfaces through airplane compartments. It offers lightweight, flexible and durable alternatives to metal shields for protecting aircraft engine struts and composite fan cowls.

Nextel ceramic fibers 610 (alumina) and 720 (aluminosilica) are used in ceramic, polymer and metal matrix composites. Nextel ceramic fiber 610 is noted for its outstanding single filament tensile properties. Nextel ceramic fiber 720 finds applications in ceramic matrix composites because of its high creep resistance. Applications using these fibers have been successfully demonstrated in both military and commercial jet engine applications.

CMCs have now allowed engineers to build jet engines that could take planes farther and burn less fuel. That's because the material has two hugely winning attributes for aviation: it's one-third the weight of metal and it doesn't need to be air-cooled, which allows designers to build lighter and more efficient engines. There are many components were CMCs could replace metal alloys in turbine engines of aircraft and power plants. The result is the engines could operate more efficiently at higher temperatures, combusting fuel more completely and emitting fewer pollutants.

GE Aviation began developing Ox-Ox in the late 1980s as part of its CMC research efforts. Ox-Ox was introduced on F414 exhaust seals in 2011 to improve durability. The Passport engine will be the first non-military engine to use Oxide-Oxide (Ox-Ox) CMCs. For the Passport engine, the Ox-Ox CMC material will be used on three parts: exhaust mixer, centerbody and core cowls. The lightweight material is resistant to high temperatures found in the exhaust area. These advantages will enhance the engine's durability and lower fuel consumption.

Both Fabric Development Inc (FDI) and Textile Products Inc (TPI) reinforce the ceramics market. FDI is currently supporting the aircraft insulation activities. TPI is a leader is weaving fabrics for CMCs and is sole source for the Passport engine program.

Kordsa produces innovative tire reinforcement, composites and construction reinforcement technologies. It touches every corner of life, making lives both safer and more sustainable.

Kordsa's Sustainability Road Map 2020

ELİF ÖZKUL GÖKMEN

General Manager, Senior Consultant, Sercom Sustainability Consulting

I like inspiring stories. If you do too, keep on reading...

What makes Kordsa remarkable in terms of sustainability management is the vision and strategy that have become part of the company's genes over the last 45 years. My journey with Kordsa started when I was asked to prepare a sustainability report, but Kordsa's own sustainability journey began the very day the company was established. This became clear to me as soon as I joined the Kordsa team.

It was no coincidence that I had met the former Safety, Health and Environment (SHE) Manager of Kordsa several times at small conferences, especially at the meetings of the Turkish Business Council of Sustainable Development, of which Kordsa is a member. This was many years ago, when I was one of the fewer than 50 business people from various companies who would meet together to brainstorm on what we could do for a sustainable world.

I was very happy when I received my first call from the Kordsa SHE manager. After we prepared our first sustainability report, which took about 6 months, we had a clear picture of Kordsa's sustainability performance. While working on this report, we followed the Global Reporting Initiative's reporting guidelines, backed up with its content and quality principles.

First Moves Towards Sustainability

One of our first moves towards reporting was to set up a Sustainability Task Force (STF), the members of which were referred by the Executive Leadership Team (ELT). We organized a sustainability training and workshop to raise awareness about the global trends in sustainability and to discuss Kordsa's impacts in more detail with the STF members.

The next step was to prepare a sustainability strategy survey, with the participation of ELT and STF Members. Later we had private meetings with all the ELT members to discuss the results of the survey and to elicit their feedback with respect to our key stakeholders and their relationship to Kordsa's most important material sustainability topics. Finally we met with the CEO to get his approval on the material topics.

Engaging stakeholders was also a crucial way of investigating these material issues. So, we decided to talk to the employees and a number of selected customers. The more than 300 employees who replied to our sustainability survey and the Brisa Supply Chain Manager and the Michelin Global Textile Category Manager who answered our questions enabled us to get a better idea of employee and customer priorities regarding Kordsa's sustainability impacts.

Although the first report was a learning process for the company, collecting the data and formulating best practices regarding the impact areas were not hard at all. Kordsa was already a sustainable company. It just needed an opportunity to tell its story. And now it had this opportunity!

Indeed, the report's brief and concise style, its meaningful content and reader-friendly design were such that the report won Kordsa its first sustainability award from the LACP (League of American Communication Professionals).

The New Era in Sustainability Management at Kordsa

Having laid this strong foundation, the next year (towards the end of 2016) the SHE Manager and I easily mustered the courage to propose to the ELT to move with a five-year plan. My indispensable collaborator, Dr. Yoga Mardiyansyah, invested a significant amount of his time into helping me design the content of the road map. Together we decided on the actions for the 5 years up to 2020 that would help us to improve Kordsa's sustainability performance.

All the management systems and data we required were in place, at the mother factory at Izmit. We just needed to systemize the data collection for reporting and to disseminate this among Kordsa's global sites. The new roadmap included actions like management systems certification, integration of sustainability topics into employee idea platforms and setting up a system for environmental and social impact assessment of our suppliers.

Prompted by our engagement with two of our key customers, we added this last topic to our material issues list. In addition, we determined smart targets, aiming to improve our performance by reducing our probable impacts on people and the environment. We are proud and happy to have met our targets on the roadmap up until today.

As you can see from this part of the story, the visionary ELT of Kordsa approved our well-prepared plan without any hesitation. We have always felt the support of the CEO, starting with Mr. Cenk Alper and continuing with Mr. Ali Çalışkan.

In 2017, our third report collected first-place awards on three continents:

1- Asia-Pacific Excellence Awards - Annual and CR Report Category Winner

2- Sustainable Business Awards - Sustainability Report Category Winner (Turkey)

3- LACP Inspire Awards - Annual Report for Customer Category Winner (USA)

Currently we are working on Kordsa's 5th sustainability report. Today we are talking about some additional inspiring topics, like Kordsa's own sustainable products. Kordsa's incredible R&D Department and Laboratory play an important role in creating and refining these products in close collaboration with our customers.

Kordsa produces innovative tire reinforcement, composites and construction reinforcement technologies. It touches every corner of life, making lives both safer and more sustainable. This is through its environmentally-friendly products that reduce fuel consumption in tire reinforcement technologies, though composite technologies that make vehicles lighter and thus enable them to perform with less fuel and lower carbon emissions, and by enabling the building of durable concrete structures using construction reinforcement technologies.

All I need to do in the coming report is to keep on sharing my enthusiasm about these great products and performances. I am privileged to have served the giant global reinforcer for the last five years, and I would like to thank the esteemed ELT members, Kordsa SHE and former Sustainability Manager Dr. Yoga Mardiyansyah, and all the members of the Kordsa Sustainability Task Force for giving me the chance to be a part of this great journey.

Circular Economy: Why/How/What

BURAK İLGÜN

Market Development Project Manager

The given root cause of megatrends

Industry is busy with the clarification of the future of mobility elements like autonomous cars, sharing economy and EV vehicles. Let's take step backward and focus the main reason why we are discussing the future more than ever.

The Paris Agreement signed in December 2015 was the first time as many as 195 countries adopted a universal climate deal. The challenging target they set themselves was to keep global warming lower than 2°C. If no measures were taken, warming would reach ~4.8°C by the end of this century.[1]

Although the 2°C increase limitation seems tough to meet, even this precaution will not be able to prevent a 56cm increase in sea levels and may affect 800M people worldwide. The executive summary, then, is that the world is sinking. The consequences will cost ¨14 trillion USD with lots of complicated social impacts.[2,3]

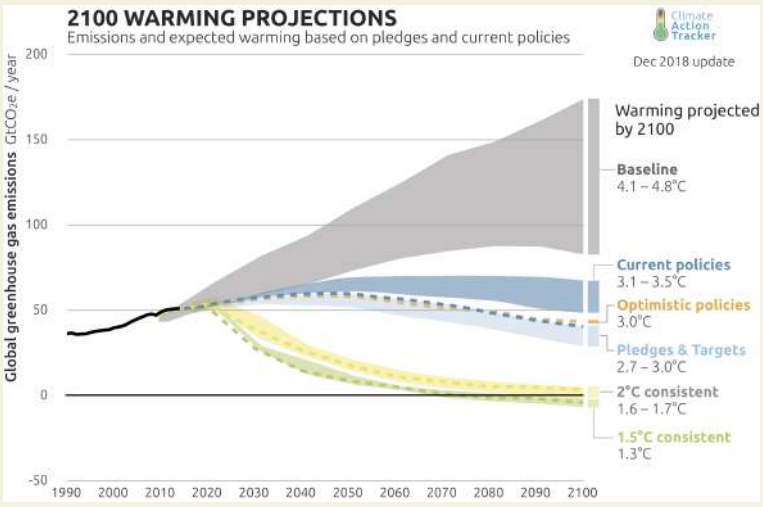

Illustration https://climateactiontracker.org/media/images/-CAT-2100WarmingProjections-2018.12.original.png

Desing thinking for global warming: circular economy

In order to achieve low emission levels globally, holistic approach is highly required. If we would like to start design thinking for emission reduction, circular economy will be the emerging answer.

According to a report published by the World Economic Forum, here is the definition: "A circular economy is an industrial system that is restorative or regenerative by intention and design. It replaces the end-of-life concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse and return to the biosphere, and aims for the elimination of waste through the superior design of materials, products, systems and business models"[4]

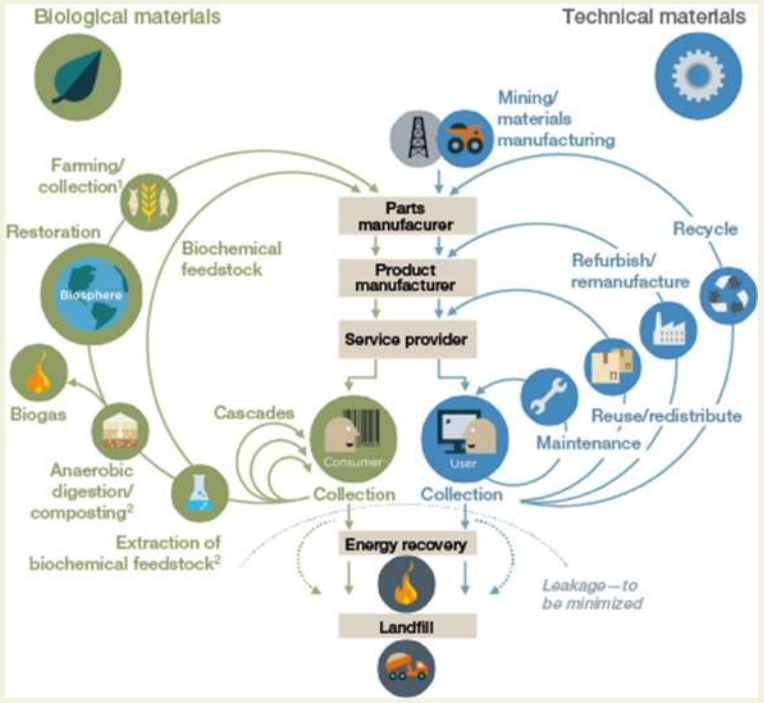

Illustration: https://www.ellenmacarthurfoundation.org/circular-economy/infographic

As was declared in January 2019, the current size of the world's circular economy is only around 9%. This means that 91% of generated economic value will become useless after its product life. Unfortunately, the world is still dominated by a linear economy, leading to the misuse of truly scarce resources.

The sophisticated circular economy requires re-cycle, re-use and re-duce of materials that are within either the production, usage or disposal phase. As soon as this approach is deployed, less usage of resources will limit emissions.

The new premium

Although the perception was previously widespread that products with a "re-"prefix were "low cost" and "low quality", this will soon change as people see that the circular economy is vital for the future of the planet.

Surveys and events have indicated that people, especially the younger generation, regard global warming as a personal issue. This awareness will be a kind of game changer and is sure to affect consumer behaviour. The same shift in mentality may also be valid for B2B companies.

Accepting the notions of the "circular economy" and the "sharing economy" constitutes a disruptive change in mentality that can reshape the world from bottom to top. When we start to assign importance to the Life Cycle Assessment (LCA) of products, we may find that recycled or reused materials come to be positioned at the same price. Products that lead to a "reduction" in material use may even end up being classified as premium products.

Tough decisions for the future

It is obvious that any innovation should include the best practices for environmental issues at first. people are challenged by the LCA of their products. If the LCA of the new technology worse than the older technology there will be always a request to change it.

Whenever discussion turns to electric vehicles (EVs), the argument arises that a non-renewable source of electricity is of limited use in preventing global warming. EVs reduce carbon emissions significantly, but they do not represent a perfect solution yet.

This is why hydrogen power has been the hot topic of the automotive industry for the last 3 years. [5]

Due to the current limitations, hydrogen power does have its drawbacks, but the expectations for the upcoming years are all positive, and it is predicted that a switch to hydrogen fuel cell EVs will occur. In this way, automakers will be able to come close to their carbon-neutral targets.

Having said this, since the "future of mobility" is becoming an ever more complex notion, shaped by constantly increasing factors, it is becoming ever harder to solve this equation. Innovating within the framework of the circular economy calls for open collaboration practices which will make it easier to deliver solutions.

Reinforcement solutions for the circular economy

Today's tires need to possess a range of features: to facilitate shared mobility, be suitable for cars with heavier chassis, possess superior durability and require minimal maintenance. Kordsa offers new products that can reduce the reinforcement usage in tires (high modulus nylon, high tenacity PET) or prolong tire life (high adhesion retention), while abiding by the principles of the circular economy. These solutions are increasing the flexibility of car designs for the future that make use of various powertrain applications.

End of life tire are still in the linear economy phase which is a common problem for stakeholders. Although there is not a proven feasible solution for recovery of textiles from ELT, with open collaboration and acceleration of circular economy eco system, let's be positive that there may several solutions may come true....

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What lies at the root of our success story, our decisions that we take and the relations that we build to reinforce life is trust.

Cocoon That Encompasses Life

PELİN KURT

Brand and Corporate Communication Specialist, Kordsa

Kordsa's motto "Inspired From Life, We Reinforce Life" has been at the heart of Kordsa's campaigns for a long time. We asked ourselves what it would be like to make our technologies which reinforce all aspects of life without being in the limelight more visible with Arzu Kaprol's artistic perspective. And we were truly excited. We talked about Kordsa; Kaprol designed; and from this process was born a cocoon. The cocoon of Kordsa; where all the inventions and innovations are created with Kordsa's most fundamental value; trust.

Our roads crossed with the world-famous fashion designer Arzu Kaprol at the Sustainable Brands Conference in 2018. Besides being a world-renowned designer, Arzu Kaprol is someone who follows the latest technological developments and searches for ways to turn them into wearable products. She is so successful at doing it that she has made a mark with her wearable technology designs as she does with her designs at Paris Fashion Week. So, what was it that brought Kordsa and Arzu Kaprol together?

It all started with the following idea: Just as Kordsa transforms the transportation of the future with the technologies it develops in tire reinforcement and composite technologies businesses, so does Kaprol follow technological advances closely, interprets them from the eyes of an artist, turning them into fashion designs, thereby shaping the future of fashion. Our panel on "Transforming the Future Through Technology" based on this idea created a big buzz and made an impression on the conference attendees. This was the first step in our cooperation with Kaprol, which continued with a series of meetings and gave rise to the process resulting in the design of Kordsa's cocoon that encompasses life.

During our meetings we talked with Kaprol about Kordsa. We said, although not seen or felt, we are here to reinforce life and all the aspects of it. We reinforce the tires of cars and aircrafts with our tire reinforcement technologies, reinforce landing tracks of those aircrafts with our construction reinforcement technologies, and aircraft fuselage, engine and wings with our composite technologies. What lies at the root of our success story, our decisions that we take and the relations that we build to reinforce life is trust. And one of the reasons that makes us a global player across all the markets we operate is the "trust" we instill in our customers as we work towards boosting the safety of vehicles on the road. That's why we can safely say that what lies at the heart of Kordsa is trust, which reinforces and adds value to life, and makes those precious moments last.

With this idea in mind, Kaprol designed a cocoon for Kordsa which could hold a person. The cocoon surrounding you like a mother's womb now stood as the most beautiful way to express and experience trust, the most fundamental value of Kordsa. To tell of Kordsa's journey that originates from trust, Kaprol added a Virtual Reality (VR) experience to the cocoon. Thanks to that the vehicles reinforced by Kordsa, as well as Kordsa's inspirations and global power are told through the video as a part of the VR.

We are the developer of tire reinforcement technology which keeps tires flawlessly continue their road as you and your children travel safely in your vehicle. Not only that but we also strive to make the technology of the future more sustainable by reducing rolling resistance of tires, thereby decreasing fuel consumption. Due to our know-how in the tire industry, and its unyielding determination to understand and offer customized solutions to its customers, Kordsa currently reinforces one out of every three automobile tires, and two out of every three aircraft tires globally, and we are the market leader for nylon cord fabric and polyester cord fabric production in the Europe-Middle East-Africa region. We are the second biggest producer of nylon cord fabric and polyester cord fabric in Asia Pacific region, the sole polyester and cord fabric producer in South America, and the leading nylon cord fabric producer in North America.

We believe that the biggest source of inspiration in life is children. On the VR video, this is depicted by the image of a child who holds his mother's hand for safety while learning to ride a bike so that he can ride in a firm and stable way. Just like us, the invisible hand that makes it possible to manufacture lighter and more robust vehicles thanks to our composite technologies...

At Kordsa, we develop innovative and unique byproducts and applications for the composite technologies market where we leverage our in-depth know-how and experience used chiefly in aviation and automotive markets, as well as in others such as sports and maritime. To become an important player in commercial aviation and aviation technologies we make investments and grow in the composites market by acquisitions. For sustainable mobility in the future, it is important to lighten not just tires but the entire vehicles and aircraft, thereby reducing fuel consumption. This makes composites the indispensable technology of tomorrow.

At Kordsa, we will keep all-encompassing and indispensable "trust" as our most fundamental value while we keep reinforcing our position in the market as a stronger global player. We will continue to reinforce life with the inspiration we get from the happiest and most joyful moments in life and use our experience and competencies to enable a better way of life. We will continue to reinforce life by feeling what we feel inside the cocoon in all fields of mobility... on floorings, in the tires of the vehicles which ride on those floors, in the tunnels through which those vehicles pass, in the tires, the fuselage, the wings and the interior of the planes flying over those tunnels...

For a Short Time We Owned a Hotel!

VAHE HANAMİRİAN

Consultant
Former Global Accounts and Marketing Director, Kordsa

It was the beginning of winter, and the first snow had fallen. We were on a trip to a small city in Eastern Europe. The region was familiar to us, and everything had been arranged – or so we thought...

Just before it got dark, four of us arrived by car at the "usual" hotel, following a difficult drive down snowy highways. The "usual" hotel was actually the only one we knew and probably the biggest and best hotel in town. However, at the reception we were shocked to discover that, due to a communication problem, no rooms had been reserved for us. What was worse, there were no other rooms available. We asked the kind lady at the reception for help. It was a small city and people knew each other, so the lady checked all the other hotels and informed us that, unfortunately, there were no rooms in other hotels either. It being so late, we started to get quite desperate. We asked the lady to look into hotels in nearby cities, but at the same time we were not thrilled about the prospect of driving around on such a cold, snowy night when we were already quite tired.

The lady was really very helpful and consulted her friends to try and find a solution. Finally, the manager came up with a proposal. The hotel actually owned another smaller hotel on a nearby mountain, which was due to be opening very soon, when the skiing season came. This, in fact, was imminent and the hotel was ready for guests, but they did not yet have any personnel. The manager told us that they would be willing to give us the key for the hotel and some instructions on how to work the heating, electricity etc. All in all, for the same price that we would be paying for our rooms in a downtown hotel, we were being given the opportunity to stay in a completely empty hotel, in any room of our choice. A good offer – indeed, the only offer...

I guess that, now we had found a good solution we had become rather spoiled and asked arrogantly, "What about dinner?" They had a solution to that as well and gave us the menu for the restaurant in their downtown hotel. The deal was that we would select and order our food and drinks and, within an hour, they would send them to us by car, accompanied by an experienced waiter. An excellent solution. What customer service!

We reached the hotel. Since none of the surrounding hotels were functioning yet, the area was a bit scary. We opened the electronic garden gate, parked the car in front of the main entrance and entered. Once we had turned on the electricity and heating, the two ladies in our group urged us men to go around and make sure that we were alone and safe. Evidently, we had all been affected by the many horror movies set in similar environments. But this didn't really bother us. We selected the best rooms of course and waited at the restaurant.

As promised, the waiter arrived with all the pre-ordered food. He was very kind and served us until we had finished dinner. Then, though, he left. We had to make our own entertainment as well. There was a billiard room and table tennis facilities, and we even managed to find some way of playing music.

Next morning, as promised, we turned off all the heating, electricity etc. and carefully locked the door before exiting. For just one night, we had owned a swish hotel; from them on, though, we would own at least one interesting memory.

WE REINFORCE LIFE

News

Kordsa Acquires Axiom Materials With an Investment Of USD 181 Million

Kordsa, acquired US-based Axiom Materials. This acquisition of USD 181 million paved the way for Kordsa to be the only worldwide qualified manufacturer of Oxide-Oxide ceramic matrix composites.

Kordsa has stepped into the advanced composite materials industry with Composite Technologies Center of Excellence, conjointly established with Sabancı University. Kordsa has expanded its area of operations and competencies with its 2018's acquisitions of Fabric Development, Textile Products and Advanced Honeycomb Technologies providing advanced composite materials to the aerospace industry. With the acquisition of Axiom Materials, Kordsa has completed the first phase of its goal to build a second Kordsa in composite technologies. Widely used in aircraft engines, the value-added materials produced by Axiom Materials have different applications in various industries and are considered as the material of the future. This acquisition, which is critical to develop Kordsa's competencies in strategic and high growth areas, strengthens Kordsa's potential to develop new products.

Composite Manufacturing Plant Visit in USA

Sabancı Holding Chairman Güler Sabancı visited Kordsa's new composite manufacturing facility in the United States. Within the scope of the visit, she was informed about the advanced composite materials that Kordsa has provided to the aerospace sector. The visit was completed with a tour of the production site.

At its İzmit Plant, Kordsa Puts into Operation Additional Polyester Yarn Line Worth USD 18 Million

In 2016, Kordsa announced polyester yarn investments in both Indonesia and Turkey, which would enable 7000 tons of additional capacity in each plant. Recently, Kordsa's investment in İzmit, worth USD 18 million, came into operation. This new line, equipped with the latest technology, will make it possible to produce a new generation of polyester yarn products with higher resiliency and better dimensional stability, as well as standard HMLS polyester yarn.

Kordsa Among Best Performers According to Evaluation of the Carbon Disclosure Project (CDP)

In an evaluation of the CDP (Carbon Disclosure Project) Turkey Climate Change Program, Kordsa raised its score in Climate Change and Water Security and attained one of the highest scores in Turkey. Kordsa continues its efforts to increase its score in line with its Sustainability Roadmap.

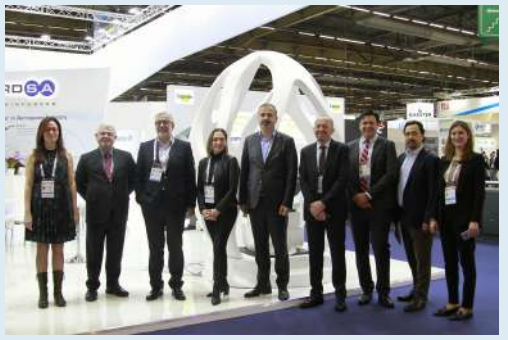
Kordsa and Continental Join Forces to Present Cokoon, a New Eco-friendly Adhesion System for Textile Reinforcing Materials, as an Open Source Technology

Continental and Kordsa have together developed a new sustainable adhesive technology standard for bonding textile reinforcing materials with rubber compounds. Reinforcing materials of this kind are used in the tire industry, as well as in the production of mechanical rubber goods like hoses and conveyor belts. The new technology enables the bonding activation of textile reinforcing materials without the use of resorcinol and formaldehyde. Continental intends to manufacture the first series-produced tires using this technology in 2019.

The two development partners are offering the new bonding system technology to all other tire manufacturers and the supplier industry as an open source solution under the brand name 'Cokoon'. Free licensing will be handled by the independent law firm Advinno. Continental and Kordsa have chosen to waive development or licensing fees. In return, they expect licensees to make their patents concerning the further enhancement of this technology available to the other partners free of charge via a licensing pool. Interested companies can request first lab samples now.

New Light Weighting Technology in Heavy Duty Vehicle Chassis System

Kordsa introduced its new light weighting technology in heavy duty vehicle chassis system including structural health monitoring systems, developed together with Ford Otosan at Jec World 2019. Among all the products and technologies showcased by Kordsa during the Expo, the light weighting technology in heavy duty vehicle chassis system, developed in co-operation with Ford Otosan, caught the most attention. Kordsa and Ford Otosan also presented this new light weighting technology at "Composites Exchange" conference on March 13th within the "Automotive & Transportation" track.

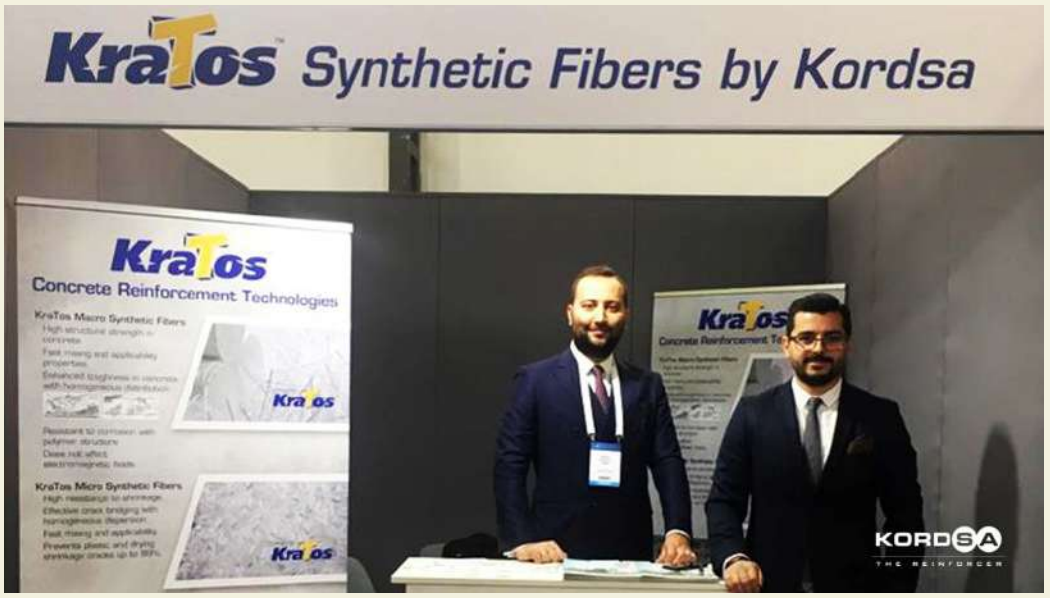


At the Sustainable Brands Conference, Kordsa Shares its Latest Technologies that Redesign the Good Life

Kordsa took part in the Sustainable Brands Conference 2019, the main theme of which was "Redesigning the Good Life". As part of the Conference, Kordsa CEO Ali Çalışkan participated in a chat session with Sustainability Academy Board Member Semra Sevinç on the subject "Redesigning the Good Life". Çalışkan said: "To make transportation more efficient, sustainable and safe, we develop eco-friendly products that reduce fuel consumption due to the better road grip provided by tire reinforcement technologies; meanwhile, we lighten vehicles, enabling them to perform with less fuel and lower carbon emissions in the composite industry. Although Kordsa are invisible, we exist in every corner of life, and we always strive for better. You may not feel the presence of these technologies but you definitely notice their absence."

Kordsa Participates in World Tunnel Congress 2019

Kordsa participated in the World Tunnel Congress held in Italy on May 6-8 2019, showcasing its innovative concrete reinforcement product, KraTos Synthetic Fiber Reinforcements. Kordsa informed visitors to the fair about the technological features and advantages of KraTos. The fair is attended by leading engineering and technology development companies from the tunneling and infrastructure sector.

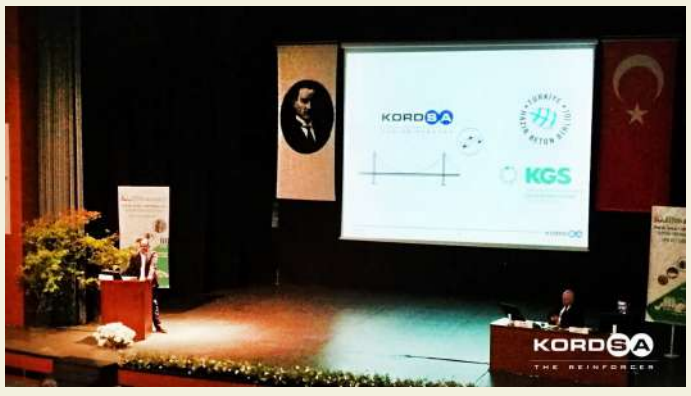


Kordsa Chattanooga Receives ISO 14001: 2015 Environmental Management System Certificate

Kordsa successfully completed the environmental management system audits at its tire reinforcement facilities in Chattanooga and received ISO 14001: 2015 certification. The environmental management system certification includes commitments related to the efficient use of energy and natural resources, conservation of biodiversity, and the fight against climate change.

Kordsa at Industry Workshop

Kordsa attended the 2nd Industrial Workshop organized by Sabancı University's Data Analytics Research and Application Center. In a panel on the latest developments in science and technology related to data analytics, Kordsa shared its research on digitalization and advanced data analytics.



Kordsa at the 10th International Concrete Congress

Kordsa participated in the 10th International Concrete Congress. With a presentation on "Use of Synthetic Fibers in Permeable Concrete", Kordsa informed about its efforts to extend the life of environmentally-friendly waterproof concrete through its KraTos synthetic reinforcement fibers.

Boeing Visits Composite Technologies Center of Excellence

Representatives from Boeing visited the Center of Excellence in Composite Technologies which is a joint work between Kordsa and Sabancı University. Within the scope of the visit, information was given about the thermoplastic prepreg operations performed at the Center.

Kordsa R&D Center Visit by Public University-Industry Cooperation Working Group

The Public University-Industry Cooperation Working Group, which was established by the Ministry of Industry and Technology with the aim of producing technology through effective collaboration between public universities and industry, visited Kordsa's R&D center in İzmit. Visitors were informed about the reinforcement technologies that Kordsa exports from Turkey to the whole world.

Wearable Sensor Technologies Workshop at Kordsa

A workshop on wearable sensors in the health sector was held at Sabancı University's Nanotechnology Research and Application Center, led by Kordsa's new R&D platform, "Thin Films and Flexible Electronics Technologies". Participants exchanged information and opinions on different products and joint project opportunities while discussing next generation technologies.

Kordsa Joins TÜSİAD's Digital Industry Accelerator Program for the Second Time

Kordsa has joined TÜSİAD's Digital Transformation Accelerator Program for the second time. This year, Kordsa aims to reduce operator downtime and increase productivity by integrating an automatic product extraction system and the use of IoT into twisting machines.

Kordsa at Smart Production Technologies and Digitalization Conference

Kordsa was one of the speakers at the 2nd Smart Production Technologies and Digitalization Conference. A representative from Kordsa informed participants about Kordsa's use of digitalization and robots according to its industry 4.0 roadmap. The presentation also covered sensor technologies and advanced data analytics.

Automotive Quality Management System Trainings Continue

IATF 16949: 2016 Automotive Quality Management System trainings continue at Kordsa. The quality management system, framing globally-valid technical requirements for the automotive industry, aims to increase profitability by reducing problems and risks in the supply chain.

Quality Day at Kordsa

In Turkey, Kordsa quality teams organized a day to discuss customer complaints and analyze supplier quality-development projects. Within the scope of the event, presentations were given on improvement projects that could be realized with the aim of eliminating quality problems and preventing the recurrence of all kinds of failures.

Kordsa Attended TÜBİTAK's Patent Week

Kordsa, one of the world leaders in terms of patent applications, gave a presentation at TÜBİTAK's "30 April Patent Week". Within the scope of the event, Kordsa made a presentation on "Management of Intellectual Property Rights in Technology Companies" and shared its success story.

Kordsa Joins the Additive Producers Association

Kordsa has become a member of the Additive Producers Association (KÜB), a pioneer in sectoral coordination and developments, where concrete, mortar and cement admixture producers come together under one roof. The Kordsa Construction Reinforcement Business Unit aims to contribute to the KÜB's sector development activities with respect to concrete reinforcement applications.

Kordsa to Support TÜBİTAK 2244 Industrial Doctorate Program

Kordsa will support 9 students with 3 projects in cooperation with Sabancı University within the scope of the TÜBİTAK 2244 Industrial Doctorate Program. The program aims to use university-industry cooperation to train qualified human resources up to the doctoral degree required in the industry, to encourage the employment of doctoral researchers in the industry and to develop universities' research infrastructure.

Kordsa Reaches Target of Accident-free Working Days in Thailand

At its facilities in Thailand, Kordsa has managed to reach the target it set itself of 4500 working hours without a work accident. Reinforcers got together to celebrate having met their objectives by bringing working practices in line with standards for work safety and occupational health.

WE REINFORCE LIFE

CSR Projects

Indo Kordsa Comes Together with Students at National Career Fair

Indo Kordsa participated in the National Career Fair organized by the Indonesian Ministry of Labor. During the fair, Kordsa Reinforcers came together with high school and university students and informed the participants about the tire reinforcement sector and business opportunities at Kordsa.

Kordsa Runs at Runatolia Marathon

In the 14th International Antalya Marathon Runatolia held in March 2019, Kordsa Reinforcers ran on behalf of the Koruncuk Foundation, to reinforce the lives of children in need of protection. Supporting social responsibility projects with the mission of reinforcing the future, Kordsa has been participating in the Runatolia Marathon since 2015.

Kordsa Brazil Produces Furniture for Mini Reinforcers

Kordsa Brazil Reinforcers produced furniture for the little children at the school which they support within the scope of their social responsibility project. Kordsa reinforces the society in which it operates and continues its social responsibility projects in all regions.

Kordsa Gets Together with Dupont Elementary School Students

Kordsa Reinforcers got together with the students of Dupont Elementary School in the USA, which they had declared their sister school. Within the scope of the company's social responsibility project, Kordsa Reinforcers spent the day doing various games and activities with the little students of the school, enjoying a very pleasant time with the children.

Kordsa Reinforcers Participate in "Read Across America" Project

Kordsa Reinforcers participated in the "Read Across America" awareness project, which was initiated by the National Education Agency of America with the aim of motivating children to read. The Reinforcers organized reading sessions in four classes at the Dupont Elementary School, which they had chosen to be their sister school.

Kordsa Continues to Reinforce the Future in the USA

Kordsa sponsors many university projects, to encourage young people to be involved in technology, innovation, R&D and engineering. Fabric Development Inc., one of Kordsa's composite companies in the United States, provides composite material support to Temple University's Formula Racing Team.

WE REINFORCE LIFE

Awards

Kordsa Once Again among the Top 100 Fastest Growing Companies in Indonesia

For the third consecutive year, Kordsa has been listed among the “100 Fastest Growing Companies" in Indonesia. The list, prepared by Info Bank, recognizes the outstanding performances of the top 100 companies among the 355 public-listed companies on the Indonesian Stock Exchange. The top 100 were those companies that managed to record the fastest growth over the last five years, with double-digit profit growth for the financial year 2018. Kordsa received the award at an event held at the Main Hall of the Jakarta Stock exchange.

Sustainable Business Award for Kordsa Sustainability Report

Kordsa among the Leaders in Exports

Kordsa received a platinum award at a ceremony that paid tribute to the successful performances of exporting companies that are manufacturers belonging to the Istanbul Textile and Raw Materials Exporters' Association (İTHİB). Kordsa won an award for being among the leaders in exports, exporting reinforcement technologies from Turkey to countries around the world.

Kordsa Brazil among Best Employer Brands for the Fourth Consecutive Year

For the fourth consecutive year, Kordsa has been listed among the best employers in the Bahia region of Brazil within the “Great Place to Work” competition. The fact that Kordsa has won this award for the fourth year in a row proves how important employees are to Kordsa, how Kordsa reinforces relationships and values its people.

Kordsa Receives Certificate of Achievement for its Energy Efficiency Practices

Kordsa has been awarded a Certificate of Achievement by the Ministry of Energy and Natural Resources for its energy efficiency practices. Kordsa received its achievement certificate from Murat Kalsın, President of the Energy Efficiency Association, at the award ceremony held within the scope of the 10th Energy Efficiency Forum and Fair held in Istanbul.

Kordsa's "All Stars Awards" Rewarded for the 13th Time

Every year since 2006, high-performance facilities, projects and employees who have contributed to Kordsa's success have been nominated for "All Stars Awards", and the 2018 "All Stars Awards" were no different. During the ceremony, the results of the competition between 117 projects and 990 candidates were announced and awards were given based on best cost performance, best financial performance and best work safety performance.

Kordsa's CFO Volkan Özkan among 50 Most Influential CFOs

The results of a survey to find "Turkey's 50 Most Effective Finance Managers", conducted through cooperation between Fortune Turkey and DataExpert, have been announced. Kordsa CFO Volkan Özkan was chosen among Turkey's 50 most influential CFOs and received the award at the ceremony.

Kordsa Receives "Corporate Awareness" Award for the Third Time

For the third time, Kordsa has been recognized in the category "Corporate Awareness" at the Awareness Award Ceremony organized by the Institute of Internal Auditors. This year, Kordsa received the award for its work "airplane model", which promotes awareness in the areas of strategy, innovation and creativity.

Kordsa Receives Local Quality Award from Izmir KalDer

Kordsa participated in the 20th Excellence Symposium organized by KalDer Izmir. It received the bronze award in the private sector category of the "Most Successful Team Awards of the Year" section, which was taking place for the 19th time.

Kordsa Receives Award from Sabancı University

Kordsa has received an award for projects developed within the scope of Sabancı University's "Industry-Oriented Projects Program". Kordsa participated in the program with two projects —"Image Classification with Deep Learning" and "Analysis of Hysteresis Curves of Fiber and Cords" — both of which had been developed by undergraduate students under the supervision of Sabancı University.

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“I enjoy spending time in nature and observing it. For example, without any interference from outside, the stem on which the leaf attaches to the branch carries dozen times of its own weight and that leaf remains on that tree throughout its life. This perfect design inspires me. I am developing tire reinforcement technologies at Kordsa, taking the unique mechanism of nature as an example.”

Mert Patkavak, MSc
Tire Technologies, R&D Project Leader

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