

Research-Development and Design

In 2020, the R&D and Design activities were shaped by taking into account Şişecam's strategies, global trends in the industry as well as socio-economic changes caused by the pandemic around the world, and they were supported with national and international collaborations.

In 2020, corporate research-development and design activities were carried out under Şişecam Research and Technological Development Department (RTDD) were undertaken by taking into account the Company's strategies, global trends in the industry as well as socio-economic changes caused by the pandemic around the world, and they were supported with national and international collaborations.

Şişecam Science Technology and Design Centre (STTC) has been carrying out its operations in its new campus since 2014. As one of the most advanced R&D centres in Turkey and one of the largest R&D centres of its kind in Europe, STTC consists of 29 well-equipped expert laboratories as well as a product design centre specialized in glassware and glass packaging. The Centre operates under Law no. 5746 as a government licensed R&D facility and employs 164 full-time researchers including 17 design professionals. 37% of the Centre's staff have a postgraduate degree. R&D and Design activities range from basic scientific research and creation of a laboratory-scale prototype to commercialization of new products and technology with production groups.

R&D activities are conducted on a project basis. Development of each project is monitored within the RTDD project management system. In 2020, various work packages

were conducted under 36 umbrella projects. Of the total, 171 work packages relate to opportunities for cost/efficiency/quality optimization in current production processes and products. Of these work packages, laboratory studies were completed for 54 work packages which were aimed to develop new products and technologies, while 32 work packages completed trial production runs, giving birth to new commercial products. 12 work packages were executed as part of furnace renovation and investment projects in 2020.

As part of intellectual property rights protection efforts, Şişecam filed 4 patent applications, 11 patent registrations, 1 PCT/EPO application and 95 design registration applications in 2020. Şişecam and its subsidiaries have 72 active inventions. Of them, 32 have been registered, while 40 are pending registration. Şişecam has intellectual property protection for 743 design registrations for glassware and 281 design registrations for glass packaging products.

New Products/Technologies

As part of our commitment to contribute to the fight against the global pandemic, the Antimicrobial V-Block Coating Technology which neutralizes virus and bacteria on glass surfaces was developed and commercialized in a short period of time, and a patent application was filed. The V-Block Technology has been proved to be effective against

many different viruses and bacteria, including coronavirus, based on the results of tests performed by accredited laboratories, and official approval processes have been completed for licensing, application and sales of products featuring this technology. These products which feature the antimicrobial V-Block Technology are also the first-ever antimicrobial glassware product group in the world. Additionally, in the Glassware area, the "Recycled" product using 90-95% recycled cullet as raw material was developed. A patent application was filed for this unique product and then the product was passed to mass production in May.

Şişecam started mass production for the high performance windshield with athermic coating developed by the Company to ease the load on air conditioning and gain a defrosting function by providing heat and solar control for use on laminated windshields of vehicles. In addition, a windshield featuring head-up display (HUD) that presents vehicle and driving data without requiring drivers to look away from the road was developed and completed the customer approval process. A patent application was filed for the glass B-pillar developed in 2019. Customer approvals have been received from leading automotive manufacturers for this product, and necessary preparations have been completed to start mass production of the product in 2021.



In 2020, the Company continued the development process of heat and solar control coatings, designed for use in architectural projects, using the sputter deposition technology. Four temperable coatings as well as non-temperable versions of four existing temperable products were developed, and the products were transferred to production.

A new and unique antireflective coating solution was developed for our glass product with antireflective coating for use on solar panels, and a patent application was filed for it. Aging tests were successfully completed according to international standards for these glass products with antireflective coating produced by using this new solution.

Development activities for next-generation ecological water-based mirrors and solar mirrors (called heliostats) which are a key component of tower-type concentrated solar energy plants have been transferred from laboratory scale to production sizes. These products are planned to be transferred to production in 2021.

Three new products for use in glass fibre reinforced composite products were transferred to production and received customer approvals. On the other hand, research and development activities were carried out to transfer three products from laboratory scale to production size, to increase strength of materials with nano additives, and to examine possible use of innovative binding ingredients to get flame retardation, antimicrobial and whitening properties.

In the field of innovative and functional paint systems for glassware, development process of 10 new products was completed. Laboratory studies were also done on electroluminescence, photoluminescence, hydrographic film technology, high reflection and different surface effects.

Glass prototypes have been developed for automotive applications by using 1.1 mm and thinner glasses strengthened with chemical tempering technology.

The Antimicrobial V-Block Coating Technology which neutralizes virus and bacteria on glass surfaces was developed and commercialized in a short period of time, and a patent application was filed.

Research-Development and Design

Modeling and simulation-assisted designs and technological improvements were made in furnace projects to optimize efficiency and energy savings.

Projects were commenced to develop new glass and glasslike materials for use in advanced technological applications and expand Şişecam's product portfolio with such materials. Accordingly, new laboratories were established to melt and prepare such materials. Materials being studied by the Company include infrared transmitting chalcogenide glasses, glass ceramics capable of transmitting different regions of electromagnetic spectrum, laser glasses, high temperature-resistant glasses for general purposes and various optic glasses. Additionally, projects undertaken to develop glass systems offering resistance to different types of attacks, such as ballistic attacks or explosions, for use in security and safety applications continue at full pace.

As part of "Glassware Design" activities, a total of 512 automated production product designs, 543 secondary processing product designs, 292 hand-made product designs and 1,925 packaging designs were created in 2020. Of these, 325 product, accessory and pattern designs have become commercial products. Automated: 157 projects, 512 designs; Hand-made: 78 projects, 292 designs; Embellishment: 85 projects, 543 designs; Packaging: 1,352 projects, 1,925 graphics. Additionally, 81 automated molds, 138 secondary processing products, 106 hand-made molds were created by the Mold Category Group Directorate and commercialized in 2020.

As part of the "Glass Packaging Design" activities, 352 shape designs were created for a total of 191 work packages (100 domestic, 91 abroad) in 2020. Mold ordering process was initiated for 40 out of 191 projects, and 18 of them were commercialized and passed to production. The Company worked on 120 mold projects this year. 19 of them consist of mold set design works. Additionally, 150 structural analyses were performed this year.

Energy, Process Efficiency and Environment

With ongoing Research and Technological Development activities in the field of high-efficiency and low-emission innovative melting technologies on a global scale, Şişecam continues to seek ambitious objectives in this field.

In 2020, the Company continued to work on cold repair design projects for 11 furnaces, commissioned three furnaces upon completion of repairs in Turkey and proceeded with installation of three furnaces. Modeling and simulation-assisted designs and technological improvements were made in completed and ongoing furnace projects to optimize efficiency and energy savings. Original and energy-efficient furnaces were designed for production groups at affordable costs. Technical support was given to the central procurement in material and equipment procurement.

The "Smart Oxy-Boost" project designed to expand production capacity up to 15% with 'smart' combustion technologies by using process integrated sensors

in a flat glass furnace has been successfully completed. Meanwhile, assembly process for the "CleanOx - Preheating via Radiative Heat Exchangers" project designed to enable pre-heating of reactants by radiant heat exchangers in a glassware furnace has been largely completed. Both projects are supported by the EU LIFE fund. The Smart Oxy-Boost and CleanOx projects are two of Şişecam's internationally supported efforts in 2020. Şişecam joined the EU-certified CO2OLHEAT project as a consortium partner. Initiated under the H2020 call, this project is designed to use super critical CO₂ as a process fluid to achieve two times more energy efficiency compared to traditional systems which produces electricity from waste heat. Under the project of monitoring and analyzing the performance of melting furnaces via an integrated database, a user interface was created for the data collected in real-time and analyses were conducted. This project carried out as part of the Group's digitalization and Industry 4.0 efforts has been completed. The entire structure continued to be expanded with integration of auxiliary systems, besides the furnaces, on an equipment/system basis.

Under Energy Efficiency Law No. 5627 and relevant regulations, Şişecam completed energy surveys of 16 different plants in four production areas.

To evaluate the current potential for waste heat recovery, Şişecam conducted planning studies on four new projects (approximately 10 MW electricity and 24 MW absorption cooling). Rooftop type photovoltaic

solar electric plants located at Flat Glass Mersin Plant and at Science, Technology and Design Centre, with 6.2 MW and 87 kW installed capacity respectively, continue to produce energy.

Şişecam established the ENIS-Energy Monitoring System for real-time monitoring and improvement of energy efficiency of energy sources and processes in the production facilities. The ENIS-Energy Monitoring System was fully or partially commissioned in a total of 39 facilities, including 18 plants, 5 businesses and 16 buildings/stores. Monitoring and instantaneous analysis studies of key energy consumption points – electric motors, compressors, fans, pumps, lighting fixtures, and the like – were conducted throughout the year. This effort improved specific energy consumption. In addition, hardware deficiencies for digitalization were identified. Energy bulletins and analysis reports were also generated.

Operational Excellence in Design and Production

Next-generation fully electric and hybrid furnace development activities were continued to reduce consumption of fossil fuels and improve energy efficiency. Efforts to optimize operating conditions of furnaces and production lines for different production demands were supported with the assist of digital simulations. Shaping simulations are utilized to support efforts to reduce weight of glass packaging products. New product development processes were supported with the use of ballistic performance and crash test simulations. Thanks to its modeling capabilities, Şişecam holds "Designer Business Partner" status of leading automobile manufacturers. Studies on designing heating systems in automotive windshields were continued. The Company also gained competency in analyzing and designing head-up display systems. Glass furnace operation and the production process of chemicals such as chromic acid sodium monochromate were optimized with artificial intelligence methods. Classification of glass defects was supported with machine learning methods. Şişecam continues to improve its modeling capabilities for optimization of vacuum coating process as well as process modeling capabilities for the production of soda and chromium components.

In glass technologies, Şişecam has assessed melting and fining performance of 30 alternative raw materials. These were compared with existing raw materials to reduce cost, boost quality and increase efficiency and achieve operational excellence. The Company supported 20 color transitions in flat glass and glass packaging furnaces. Color transition times were shortened. Production efficiency and glass quality were improved.

Şişecam performed analysis studies to improve the cost and quality advantages of its painting systems used for automotive, glassware and glass packaging products. The Company also evaluated six different alternative raw materials for use in glass fiber binding systems.

Quality control processes for electrocast refractories, key materials for the operational life of glass melting furnaces, were improved.

As part of ISO 17025 Laboratory accreditation, necessary preparations were made to adapt to the double-glass standard which received a substantial revision as a result of updated experiment methods. Scope expansion audit conducted by TÜRKAK was successfully completed without any finding of technical non-compliance.

National and International Integration/Intellectual and Industrial Rights and Patents

In 2020, Şişecam carried out research and development activities in collaboration with R&D units of 68 (38 national, 30 international) universities, research institutions and companies. In the design area, joint projects were undertaken with a total of 26 designers, including eight domestic and 18 international designers.

Under TÜBİTAK 1004-Excellence Centre Support Program, the Company accepted Phase 2 applications for the projects carried out in collaboration with Bilkent University UNAM and Middle East Technical University GUNAM. And later, the projects commenced following execution of the respective project contracts.

In 2020, Şişecam executed one ARDEB (Directorate of Research Funding Programs) 1003 - Priority Areas R&D Projects Grant Program and one TEYDEB (Directorate of Technology an Innovation Grand Programs) 1501 - Industry R&D Projects Grant Program. One TEYDEB 1511 - Priority Areas R&D Grant Program was completed. One ERASMUS project is in progress.

Under the TEYDEB 2244-Industry Doctorate Program, in addition to the joint projects undertaken with METU, GTU, Marmara, Sabancı and Özyeğin Universities, the applications jointly submitted with YTU, GTU and Bilkent Universities during the second call of the program were accepted. During the 5 projects undertaken as part of the first call, Şişecam performed studies on specific subjects designated by RTTD with a total 14 doctorate students. The Company plans to work together with 14 more students as part of the second call.

Under the International Support Programs, two EC Life+ projects were executed. Additionally, five HORIZON2020 (two MSCA_ITN, one MSCA COFOUND, one LC-SPIRE, one LOW-CARBON), one EUROSTARS, one EU Ira-SME, one ERA.NET Rus Plus application as well as one bilateral collaboration (TÜBİTAK and Russia) project application were submitted. Three ARDEB 1071-Support Program for Increasing the Capacity to Benefit from International Research Funds and Participation in International R&D Collaborations project applications were also submitted.

Project activities were commenced under one SAGA (Defense Industry's R&D Wide Area Calls) project upon execution of the contracts.

This year, the 35th Glass Symposium was held on digital platform in line with new global trends caused by the pandemic. The symposium took place in four sessions on November 9, 2020 under the theme «Glass in sustainable future: Pandemic and New Ecosystem». It was live broadcast on online platforms and a total of 758 people, including 737 viewers, 14 panelists and seven moderators, from 39 countries across five continents participated in the event.