SIBUR for Clients
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POLYMERS DURING THE CONSTRUCTION BOOM TIMES

Market needs, promising technology and innovation in Russian manufacturing.

SIBUR SEES NEW POLYMER PRODUCTS AND TECHNOLOGY SOLUTIONS FOR CONSTRUCTION AS ITS PRIORITY AREAS. THEIR DEVELOPMENT WILL BE SPEARHEADED BY NIOST, THE COMPANY'S CHEMICAL RESEARCH CENTRE, AND THE POLYMER R&D CENTRE SIBUR POLYLAB

The scientific potential of the construction site

Construction is traditionally seen as a driver of economic growth: investment in the segment stimulates the development of metallurgy, transport, energy, mechanical engineering and a number of other adjacent industries. The construction industry is defined by large-scale investments, technology improvements and a focus on selecting the best materials. It is quite natural for developers of construction technologies and manufacturers of materials to look for ways to cooperate. The Moscow State University of Civil Engineering hosted a meeting between representatives of the university and SIBUR employees in May.

The meeting participants discussed the modern construction industry's polymer needs and the various innovations that Russia's largest petrochemical holding could provide. SIBUR sees new polymer products and technology solutions for construction as its priority areas. Their development will be spearheaded by NIOST, the Company's chemical research centre, and the polymer R&D centre SIBUR PolyLab. According to SIBUR, the most promising areas of partnering with the civil engineering university involve the creation of innovative types of concrete, 3D printing materials, thermal insulation and waterproofing, the use of recycled polymers and non-metallic pipes. The dialogue between scientists and manufacturers allowed us to identify priority areas for our joint efforts and bring together a team for future cooperation on projects.

SIBUR for new builds

The five most exciting areas:

- New technology solutions for concrete, including lightweight concrete, polymer concrete, glass concrete, fibre concrete, sulfur-extended concrete, polystyrene concrete, concrete treated with a sodium silicate (liquid glass), plasticisers for concrete and supplementing or even replacing concrete with plastic and composite structures, including composite reinforcement and void

formers

- 3D-printed buildings, structures and individual elements
- Thermal insulation and waterproofing innovations (PIR and EPS insulation)
- Use of recycled polymers
- Non-metallic pipe for utilities and building utility systems (pipes pre-insulated with PU foam and a review of polymer solutions vs reinforced concrete for non-pressure systems)

One of SIBUR's most promising R&D areas is new technology solutions for concrete.

Pushing innovation forward through experimentation

In 2021, MGSU celebrates its centenary. The university has blossomed into a scientific and technical complex comprised of research institutes, educational centres and scientific laboratories. The academic delegation shared their experience of using polymers on construction sites with their colleagues from SIBUR and discussed trends in different market segments and the potential demand for various technologies.

THE ADDITIVE MANUFACTURING MARKET IS GROWING, AND THE TECHNOLOGY'S SCOPE OF APPLICATION IS FOLLOWING SUIT. FROM 3D PRINTING INDIVIDUAL ELEMENTS AND STREET FURNITURE ITEMS, THE INDUSTRY IS PIVOTING TOWARDS DESIGNING WHOLE BUILDINGS USING THIS METHOD. ACCORDING TO SCIENTISTS' ESTIMATES, 42% OF RESIDENTIAL PROPERTIES IN RUSSIA CAN BE CONSTRUCTED USING 3D PRINTING TECHNOLOGY

Oleg Kornev, Deputy Director at the Science and Research Institute of Experimental Mechanics, gave a presentation on projects that use polymer composite materials. Demand for composites in the construction industry is constantly growing, and consumption in this segment is outpacing the building materials market average. The traditional drivers of demand hold true today: road construction, as well as the production of rebar, roofing materials and structures for sewage-treatment and oil-production facilities. The value of composites lies in their durability, corrosion resistance, lightness, strength, speed of installation and low maintenance costs at facilities. All the same, their market uptake is being held back by their 120 °C maximum operating temperature, low rigidity, lack of uniform quality across the market, high production costs and gaps in the literature on the use of composites alongside traditional building materials. The scientists suggested that manufacturers first develop and test polymer matrix composites with a higher maximum operating temperature in their designs.

Dmitry Korolchenko, Head of the Department of Integrated Safety in Civil Engineering, presented a report on the fire hazard posed by composite materials. A possible solution can be found in chemically and physically modifying the polymers, including by incorporating more heat-resistant binders and phosphorus and halogen-rich oligomers in their production. Experiments that look to yield results are those on high fire-resistant composites and polymer-reinforced concrete structures.

Vadim Solovyov, Head of the Technologies of Cohesive Materials and Concretes Laboratory, explained that polypropylene microfibre, polystyrene concrete and void-forming agents for reinforced concrete are in-demand technologies for concrete production. One obstacle the technology faces is the uneven distribution of polystyrene granules when being mixed with the mortar, something that pre-processing the granules with a surfactant should overcome. It is actually also possible to create a new, modified product for thermal and sound insulating plaster mixes. In addition, a method of manufacturing monolithic floor slabs with void formers of set dimensions is in the pipeline, while the possibility of using void formers to make concrete vertical monolithic structures and hollow formers to produce thin-walled structures made of high-strength concrete is being evaluated.

Road construction drives demand for polymer composite materials.

Vitaly Gladkikh, Head of the MGSU STROY-TEST R&D centre, reviewed the applications for building materials made from industrial sulfur. Sulfur-extended concrete can be used for structures that are operated in tough environments: drainage, well rings, manhole

cover slabs and flooring for livestock farms, to name a few. The technology will be in further demand from road construction and landscaping: reinforcement slabs, drainage, fence posts, signposts, curbs and paving slabs.

Sulfur-extended concrete also finds use cases in hydraulic engineering and ports, including breakwaters and finishing elements for embankments and berths. Sulfur-extended asphalt is a special type of asphalt, where some bitumen is replaced with a sulfur modifier. By using sulfur in road construction, a 40%–45% increase in time between repairs can be secured. Furthermore, sulfur-extended asphalt mixes can be mixed and poured at a temperature 10–15 °C lower than conventional asphalt. The Moscow State University of Civil Engineering is making headway on the use of sulfur in building materials and plans to bring its projects to market.

3D-printed objects look like they are from the future. Aleksey Adamtsevich, Senior Researcher at the Scientific Research Institute of Construction Materials and Technologies, discussed the potential for using additive manufacturing in construction. The market is growing, and the technology's scope of application is following suit. From 3D printing individual elements and street furniture items, the industry is pivoting towards designing whole buildings using this method. According to scientists' estimates, 42% of residential properties in Russia can be constructed using 3D printing technology. A member of MGSU's Department of Architecture has built a unique, 3D-printed, two-storey house in Ufa. Furthermore, the actual materials used in additive manufacturing are another promising field of application for polymers.

Initiatives straight from the university campus

The demands of tomorrow include:

- composites with a maximum operating temperature of 120 °C and strong fire resistance
- polymer-reinforced concrete structures
- a method of pre-processing polystyrene granules with a surfactant, to unlock a more uniform distribution when mixed with mortar
- a method of manufacturing monolithic floor slabs using void formers with set dimensions
- void-forming agents that can be used to make concrete vertical monolithic structures
- the use of hollow formers to produce thin-walled structures made of high-strength concrete
- building materials made from industrial sulfur, whether sulfur-extended concrete or sulfur-extended asphalt
- polymer materials that can be used in 3D printing for construction.