INTESA SANPAOLO
INNOVATION CENTER

INDUSTRY TRENDS REPORT
CHEMICALS & MATERIALS

TOWARDS A SUSTAINABLE CHEMICAL INDUSTRY

FROST & SULLIVAN

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EXECUTIVE SUMMARY

Across the **Chemicals & Materials** space, market participants are increasingly looking to reconcile the often competing demands of providing high performance at low costs whilst, at the same time, reducing their ecological footprint.

It is against this backdrop that technologies are enabling the delivery of new products in areas such as Buildings & Construction, Fashion & Textiles and Aerospace & Defense and allowing the deployment of more efficient and successful R&D pipelines.

Self-healing Material is a good example of a cross-cutting area where these two themes are converging. Here, increased innovation promises the development of solutions which are effective, economic and environmentally friendly.

In **Buildings & Construction**, energy consumption is a particular concern with the sector accounting for 36% of global demand. Suppliers and end-users in the space are therefore turning to sustainable materials to mitigate their contribution to climate change. For insulation, solutions using aerogel and nanotechnology are emerging as greener alternatives to mineral wool and plastic foam whilst market participants are launching new adhesives and sealants that are both more environmentally-friendly themselves and designed to address emerging and sustainable applications such a prefabricated construction.

The situation in **Fabrics & Textiles** is similar although here the focus is more on delivering improved quality. Water repellent hydrophobic and superhydrophobic materials are one area of R&D focus offering vendors the possibility of enhancing personal protective equipment while the advent of thermochromic and photochromic solutions are enabling the launch of smart fabrics that react to external stimulus. Overall, however, much of the innovation activity in the textiles sector has been centered on antimicrobial technologies, such as metallic ions, which improve both health and safety.

Source: Frost & Sullivan

In **Aerospace & Defense**, the market is at an inflexion point with the way in which it recovers from the pandemic to be shaped by the roll-out of disruptive technologies and the financial and efficiency benefits that they can bring. Advanced materials, high-tech coatings and additive manufacturing will all have a significant and immediate role to play in production and maintenance whilst electrification – enabled by next generation battery chemistries, such as metal-air, nanowire, liquid metal, proton and flexible – are expected to reshape power production, storage and management in land, sea and air vehicles.

More generally, **Digital Technologies** are transforming many functions in the chemicals & materials industry and having a particular impact on R&D. Algorithms can, for example, be used to simulate innovation processes, artificial intelligence and machine learning can improve scale and speed and big data analytics can help maximise both internal and external collaboration. Here, the venture capital arms of tier 1 chemical companies as well as government departments are funding start-ups with innovation also stemming from direct market players, technology vendors and academia.

This paper examines each of these areas in turn with a focus on the role of technology in developing and delivering innovative solutions. More broadly, it provides a guide as to how the **Chemicals & Materials** industry is looking redefine itself by providing new products and protecting its margins in a period of turbulence defined by climate change.

Source: Frost & Sullivan

BUILDINGS AND **CONSTRUCTION**

According to the UN, the global building and construction industry accounts for 36% of energy consumption, 40% of CO_2 emissions and 25% of water usage

Continued industrialization and urbanization will increase the negative impact of the sector on the environment while the ongoing improper disposal of hazardous and demolition waste into the environment is often to the detriment of the health of people living in areas surrounding building and construction sites.

It is therefore necessary to adopt techniques which will enable a reduction in demand for natural resources, including energy and water, and minimize the contribution of the building and construction sector to climate change. In parallel, industry stakeholders need to make use of innovative technologies which will ensure greater reuse and recycling.

The building blocks which are needed to achieve carbon neutrality are ecological sourcing, resource efficiency and material circularity.

The deployment of sustainable materials is one of several key overlapping approaches that is urgently required to reduce this footprint

Net-zero energy and water buildings are intended to improve efficiency by leveraging building automation, smart sensor and energy management solutions. They also look to use energy generation and storage technologies such as rooftop and Building Integrated Photovoltaic (BIPV) solar power and micro-wind turbines coupled with batteries or ice- and molten-salt based solutions.

Here, geothermal power is increasingly being used as heat source.

Biomimicry and biophilic design is deployed to benefit from the convergence of architecture and biological sciences to develop nature-inspired building structures. Adopting such an approach to constructing buildings looks to promote health and well-being by incorporating nature elements indoor, providing good daylight distribution and using green roofs and/or outdoor spaces.

Sustainable building materials are designed to reduce the carbon embodied in conventional construction solutions by adopting carbon capture and mineralization processes or using alternative cementitious materials such as slag, fly ash and silica fume during cement production. The approach also includes introducing sustainable and eco-friendly substitutes by drawing on raw materials such as straw bales, bamboo, recycled plastic, wood, timbercrete, hempcrete and mycelium amongst others.

Research and development activity in this context is broad but there is a specific focus on insulation materials as well as adhesive and sealant technologies

Overall, the insulation materials market in Europe was valued at $7.7b in 2020 and is growing at 3.3% per annum with mineral wool the largest segment

Glass and stone are the two most common types of mineral wool insulation material.

Glass wool is extremely cost-effective and is deployed widely in the residential sector for its strong fire safety and insulation properties as well as its good compatibility with a variety of structural products developed for thermal insulation.

36% of global energy consumption

40% of global GHG emissions

25% of global water consumption

Source: Frost & Sullivan

Moreover, glass wool is manufactured from natural and non-depleting sources and offers high sustainable credentials and a reduced carbon footprint.

Its use has therefore increased in Europe in correlation with new building codes that push for the use of environmentally friendly building products.

Growth of the **stone wool** segment is attributed to the increasingly stringent fire-retardant mandates in buildings. Stone wool has, over the years, proven to be the best material to buy occupants time during a fire. In addition, the solution is highly recyclable which brings benefits to both manufacturers and end-users with more than 500 KT of inorganic or combustible residue materials from other industries are used in the manufacturing of stone wool products in Europe. This enables significant cost reduction from the feedstock point of view, sparing customers from frequent price variations.

From a form perspective, batts and roll products will continue to dominate the mineral wool segment moving forwards, owing to their cost-effectiveness and insulation effectiveness.

Plastic foam solutions are slowly gaining ground and winning share

Mineral fiber-based sandwich panels are expected to face stiff competition from Expanded and Extruded Polystyrene (EPS/XPS) insulation as well as Polyurethane (PU) and Polyisocyanurate (PIR) materials as customers increasingly opt for product solutions that provide higher R-values together with lower thickness.

EPS insulation offers cost-effectiveness, high thermal resistance, moisture protection, breathability, flexibility and good recyclability. It is the preferred choice of material for external wall insulation.

XPS, on the other hand, is used for constructing foundation configurations such as Frost Protected Shallow Foundations (FPSFs). Expanded Polystyrene can withstand high compressive loads and a substantial amount of moisture and is therefore ideal for insulating below-ground building.

PU/PIR insulation materials offer excellent fire resistance, low density and flexibility so are largely used in Europe for retrofitting works. This segment is expected to witness growth owing to stricter energy code regulations and increasing financial support from governments for energy-efficient refurbishment projects in the region.

Source: Frost & Sullivan

However, the real interest stems from value-added and advanced insulation materials with aerogel and nanotechnology emerging as greener alternatives

Conventional insulation systems in the building and construction industry are in fibrous, granular and cellular forms.

There has been keen interest in manufacturing EPS and PU materials in Europe and Asia Pacific with stakeholders such as BASF (Germany) and Honeywell (Japan) looking to introduce more environmentally-friendly approaches by reducing carbon emissions stemming from the fabrication processes and by applying closed cell polyurethane which does not require blowing agent.

In the longer term, studies here and elsewhere have been focusing on the adoption of bio-based insulation system such as those leveraging rice and wheat husks, wood fibers and nano-cellulose aerogel. In addition, market participants are exploring sustainable substitute materials like aluminum foil-polyester composites and vermiculite boards.

Authorities are supporting this green innovation with the US Department of Energy having introduced the ASHRAE 90.1-2007 and IECC 2006 regulations which require buildings to have minimum thicknesses of insulation as part of a drive to set best practices in developing energy efficiency constructions.

In 2018, the European Union similarly amended its Directive on Energy Efficiency (2018/2002) which is a key part of the region's policy framework to 2030 and beyond. The EU has been funding several projects in regards to enhancing the development of energy-efficient building through the deployment of next-gen insulation technology.

Here, there are a number of cross-industry collaborative programs

ICECLAY brings together Active Space Technologies Actividades Aeroespaciais (Portugal), Devan Chemicals (Belgium), Brunel University (UK) and Ecoterra Desarrollo Sostenible (Spain) to develop ultra-lightweight clay-aerogel for building insulation together with low cost nanoscale minerals and polymers through freeze-drying.

NANOFOAM partners Dow Europe (Switzerland) with the Centre Scientifique et Technique du Bâtiment (France) and Caba-Blind Antriebsaggregate (Germany) for the development of energy efficient nanotechnology-based foam insulation systems in buildings using the low Global Warming Potential (GWP) blowing agents such as carbon dioxide.

NANOINSULATE features Kingspan Research and Developments (Ireland), Koc University (Turkey), Acciona (Spain) and BASF (Germany) to develop nanotechnology-based opaque and transparent insulation system for low energy buildings.

AEROCOINS teams up Fundacion Tecnalia Research & Innovation (Spain) with Separex (France) and Politechnika Lodza (Poland) for the development of cost-efficient and high performance insulation systems made from silica-based aerogel composite. Their crosslinking with nanofiber strengthen their structure and thermal resistance.

ADAPTIWALL combines Isodal (Belgium), Prochimir (France) and Sioen Industries (Belgium) to develop insulation and nanomaterials for lightweight wall panels.

Source: Frost & Sullivan

PRINCIPAL ABBREVIATIONS

AI	*Artificial Intelligence*
B	*Billion*
C	*Centigrade*
CFRP	*Carbon Fiber Reinforced Polymer*
CMC	*Ceramic Matrix Composite*
CMU	*Concrete Masonry Unit*
CNT	*Carbon Nanotube*
CO2	*Carbon Dioxide*
EPS	*Expanded Polystyrene*
FML	*Fiber Metal Laminate*
FPSF	*Frost Protected Shallow Foundation*
GWP	*Global Warming Potential*
IIoT	*Industrial Internet of Things*
IoT	*Internet of Things*
IP	*Intellectual Property*
KT	*Thousand Tons*
ML	*Machine Learning*
M&A	*Merger and Acquisition*
ML	*Machine Learning*

OEM	*Original Equipment Manufacturer*
ONN	*Optimized Neural Network*
PBAT	*Poly Butylene Adipate-co-Terephthalate*
PIR	*Polyisocyanurate*
PLA	*Poly Lactic Acid*
PoC	*Proof of Concept*
PPE	*Personal Protective Equipment*
PU	*Polyurethane*
R&D	*Research & Development*
RoI	*Return on Investment*
SaaS	*Software as a Service*
UAS	*Unmanned Aerial System*
UK	*United Kingdom*
US	*United States*
UV	*Ultraviolet*
VOC	*Volatile Organic Compound*
XPS	*Extruded Polystyrene*
US	*United States*
VNA	*Vendor Neutral Archive*

Source: Frost & Sullivan

ABOUT INTESA SANPAOLO INNOVATION CENTER:

Intesa Sanpaolo Innovation Center is the company of Intesa Sanpaolo Group dedicated to innovation: it explores and learns new business and research models and acts as a stimulus and engine for the new economy in Italy. The company invests in applied research projects and high potential start-ups, to foster the competitiveness of the Group and its customers and accelerate the development of the circular economy in Italy.

Based in the Turin skyscraper designed by Renzo Piano, with its national and international network of hubs and laboratories, the Innovation Center is an enabler of relations with other stakeholders of the innovation ecosystem - such as tech companies, start-ups, incubators, research centres and universities - and a promoter of new forms of entrepreneurship in accessing venture capital. Intesa Sanpaolo Innovation Center focuses mainly on circular economy, development of the most promising start-ups, venture capital investments of the management company Neva SGR and applied research

For further detail on Intesa Sanpaolo Innovation Center products and services, please contact businessdevelopment@intesasanpaoloinnovationcenter.com

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