Linking applications and technologies with a global approach:

AALBORG WHITE® to enhance Glass Fiber Reinforced Concrete uses

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Cementir Group

White Cement has been representing a niche in the global cement market, with approx. 18 mln ton current yearly consumption, accounting for less than 1% of the total cement used.

Regarded as high end and value-adding product, its use varies from application with aesthetic requirements to structural ones, for both renovation (decoration, repairs & maintenance work) and new build.

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CALTAGIRONE GROUP

Cementir Group is the global leading player in White Cement with more than 3 mln ton capacity and production facilities strategically located in four continents. Serving White Cement, Cementir Group supports its partners by providing a consistent and high performance product, value-adding services into the customers' supply chain, extensive technical and customer support, and potential cooperation in (co)developing new applications using white cement.

The Group markets its white cements in more than 70 countries worldwide under the global AALBORG WHITE® brand. Production plants are located in Denmark, Egypt, Malaysia, and China, as well as in the US (in partnership with other companies). All sites benefit from large resources of high purity limestone and other key raw materials, which are needed for the special production of white cement. The state-of-the-art plants enable the Group to produce with consistent chemical features, uniform white color and high strengths.

The Management has clearly identified to strengthen its leadership and further develop White Cement as a key strategic pillar in the current 2017-2019 business plan, leveraging on a unique competitive position with its global widespread. "By being directly present in key markets, Cementir benefits from a diversified customer base in terms of size, business, culture, tradition and technological levels. The Group aims at differentiating its value proposition on White Cement globally, by re-defining and developing solutions that will support the growth of our clients' business through customized services, know-how sharing, advisory and strategic partnering", states Michele Di Marino, White Cement Commercial Development & Marketing Director, responsible for global commercial, business development and innovation. "Assessing mega trends in Society and specifically in the construction industry, as well as understanding the <Voice of Customer> and the <Jobs to be Done>, Cementir wants to challenge the traditional way of looking at white cement as mainly an aesthetic and architectural building material. There is an untapped potential to further develop our customers' business with white cement that, as a global leader, we have to make available to our partners".

AALBORG WHITE® cement-based products have a large undiscovered potential giving opportunities to challenge the known and look at new frontiers in applications and related technologies. It is the building material of the future: plastic moldable properties, the true colors of the rainbow or the plain white surface that emphasizes the play of light and shadow, solids and voids.

Pursuing Innovation: InWhite

The Group sees a huge potential to work with customers by a new strategic focus towards the applications in the market to which the customers are supplying their products. Here is the true potential for development of the business by being upfront in developing innovative solutions to challenge existing products and fully exploit White Cement's true potential.

Cementir Group has established a global innovation engine for white cement, InWhite, to develop new solutions for well-known applications, or completely new applications for white cement based products. InWhite benefits from the Group's global knowledge on both well-established and emerging applications for white cement and technical knowhow of its internationally acclaimed R&D center located at Aalborg, Denmark. It is aligned to megatrends detected in the society, such as customization, circular economy and high-energy efficient solutions.

Enhancing Aalborg White® applications with emerging technologies

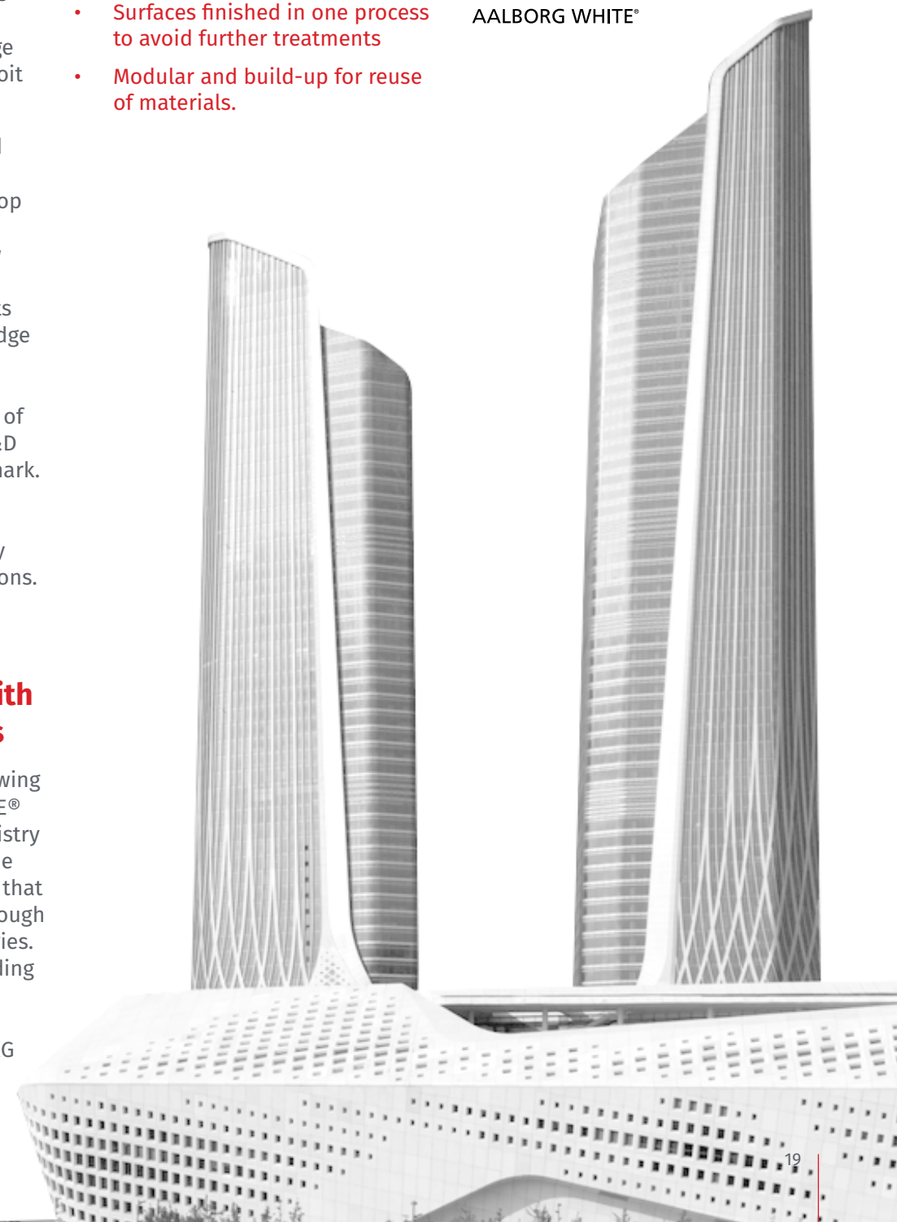
Some emerging and rapidly growing applications for AALBORG WHITE® cement are related to the chemistry and purity of the cement and the superior mechanical properties that can be achieved in concrete through advanced production technologies. Very high strength and outstanding durability can be achieved by manufacturing very thin panels and elements based on AALBORG WHITE® cement.

As an example, this principle can be applied to façade elements to achieve compact, high insulating panels featuring, among others:

- Low weight per m^2
- Total wall thickness significantly reduced to allow for a more efficient use of the inside area of the building
- Surfaces finished in one process to avoid further treatments
- Modular and build-up for reuse of materials.

New solutions based on high value and fast developing technologies like UHPC (ultra high performance concrete) and GRC (glass fiber reinforced concrete) have been identified and are in primary focus in the coming years.

AALBORG WHITE®



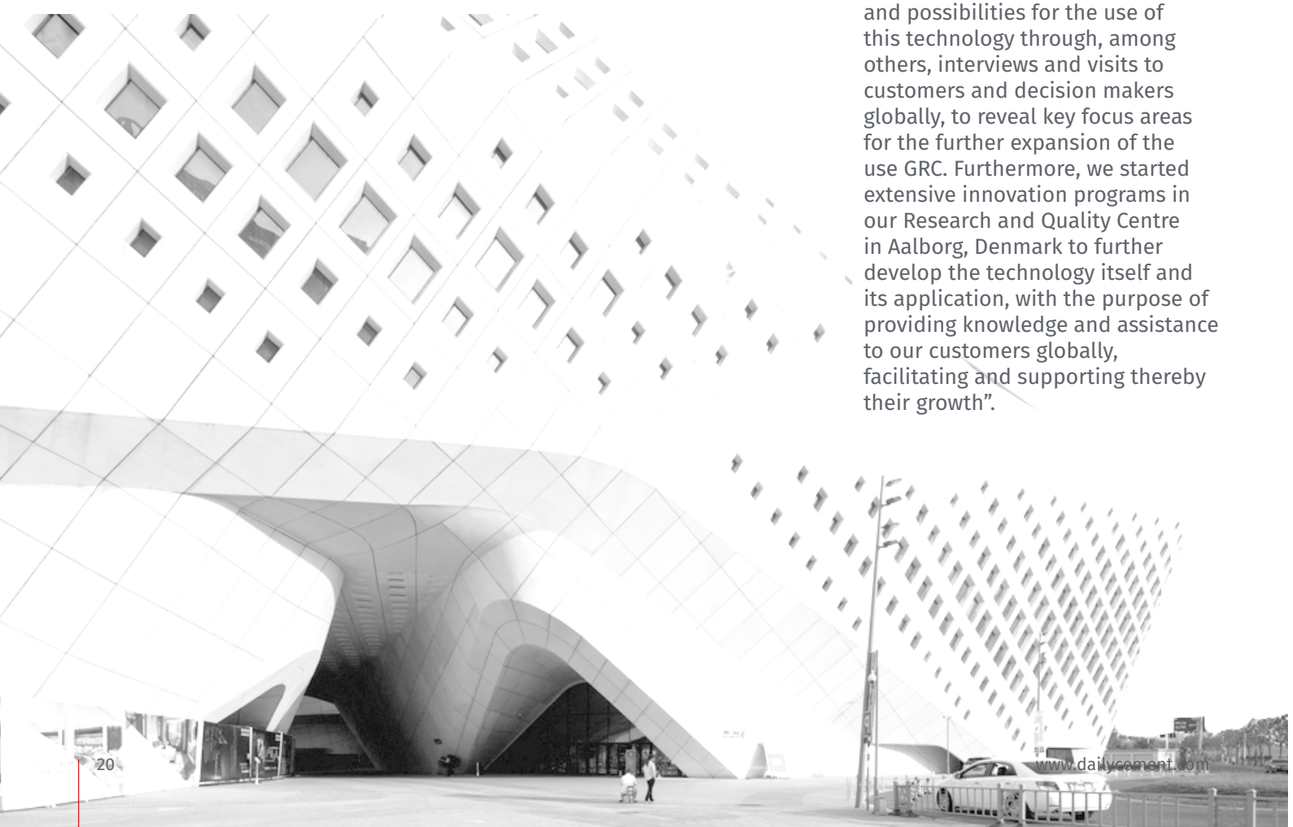
Glass Fiber Reinforced Concrete (GRC)

Glass Fiber Reinforced Concrete is one of the most versatile building materials available to architects and engineers. Composed primarily of cement, sand and special alkali resistant (AR) glass fibers, GRC is a thin (down to 10-15 mm), high strength and environmentally friendly composite with many applications in construction. It has a flexible ability to meet performance, appearance and cost parameters.

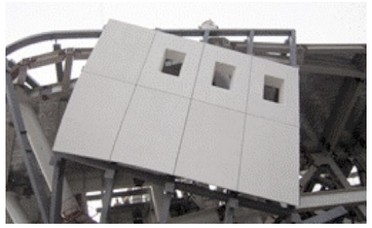
The technology was developed in the 70ies. However, the global low focus on architectonic value of buildings in the period from 1970-2000 limited its use to markets with very low costs of labor. The material and the technology around it, has now matured into a great potential to serve very high and complex requirements in society, that by far outweigh the relatively higher production costs, following the high extent of craftsmanship.

The market of GRC is expected to more than duplicate globally over a period of 3-5 years, and this will be concentrated in regions like Asia, Europe Middle East and USA, which mirror Cementir Group's global production and commercial footprint for white cement. In some specific markets, Cementir has observed for instance consumption growing by a factor 3 to 4 in the last 3 years for innovative facade solutions using this technology.

The Group, among other memberships, has joined the International GRC Association from 2016, to co-lead and play an active role in supporting the future development of this technology. This membership is coherent with the strategic intent to focus on developing market/customer driven technologies and applications for AALBORG WHITE®. "Here, we will not just only be able to follow the development within this production technology, but also to become an important active player in shaping its future development" says Erik Pram Nielsen, Product Innovation & Commercial Development Leader. "During the last year, and as part of an ongoing activity within InWhite, we have initiated an extensive global study on the challenges and possibilities for the use of this technology through, among others, interviews and visits to customers and decision makers globally, to reveal key focus areas for the further expansion of the use GRC. Furthermore, we started extensive innovation programs in our Research and Quality Centre in Aalborg, Denmark to further develop the technology itself and its application, with the purpose of providing knowledge and assistance to our customers globally, facilitating and supporting thereby their growth".



AALBORG WHITE® in action: GRC project in Nanjing, China



Occupying a 5.2 hectares site, the International Youth Cultural Center contains 465,000 square meters of floor space, which includes a hotel, conference center, offices and underground parking, and is part of a larger masterplan by ZAHA.

According to the architects the Culture and Conference Centre masterplan expresses the continuity, fluidity and connectivity between the urban environment of He Xi new Town, the agricultural farmland along the Yangtze River and the rural landscapes of Jiang Xin Zhou Island.

The architects' goal is to leverage the complex to create a gradual transition from the vertical of the urban Central Business District CBD to the horizontal topography of the river. The GRC paneled podium borrows from the fluid language of

the river, while the towers connect to the urban streetscape of the new CBD.

GRC was found to be the most suitable material for the exterior façade and roof system to successfully express flowing geometries of the exterior shape of the podium. A total of 110,000 m^2 GRC panels made by Nanjing Bei Li Da company, using 52.2 high-strength AALBORG WHITE® cement, produced at Cementir's plant in Anqing, were used for the project, and none of them had the same size and shape. Each panel has a unique design with either single-parabolic or double-parabolic to reach the complex curved surface structure.

The GRC panels from the roof system to each of the layers of floors were designed in a unified diagonal line, which increased the difficulty of its installation, considering the partition of the glass windows and connections. Thanks to the latest technologies of BIM (Building Information Modeling) to monitor the process from design and production, this high-precision GRC project became successfully completed in late 2016.

Photo-catalyst paint (Nano TiO2) technology was designed and applied to the surface of the GRC panels of the exterior wall and roof system to facilitate maintenance. Furthermore, this technology added air purifying properties to the building ■