GFRP

INSULATION COMPONENTS ALLOW REVISIONS TO TRANSFORMER DESIGN

How Durostone® CR contributes to compact design and resilient transformers

One of the megatrends is urbanization: Urban living is the dominant lifestyle of the future. By 2050, two thirds of the world population will live in cities. This leads to an increasing demand for energy in the same space. Therefore, transformers with the same or smaller dimensions, but with higher capacity, are needed. Additionally, the need for mobile transformers is increasing while aged transformers are replaced.
Both developments require transformers to be compact and more resilient. This leads to higher requirements for the construction insulation materials in the active part of the transformer. The new Durostone® CR materials' mechanical properties provide the ability to revisit the overall design.

Shield end ring made of Durostone® CR: Close tolerances because of no shrinkage leading to high dimensional stability

Glass fiber reinforced plastic (GFRP) is a material that has so far only played a subordinate role in the construction of oil-filled transformers, but it has the potential to boost the construction of compact and high-performance designs.

The current construction elements inside the transformer are steel and wood-based materials like laminated press-board (LP) and laminated densified wood (LDW). But a material that has so far only played a subordinate role in the construction of oil-filled transformers has the potential to boost the cons-truction of compact and high-performance designs: glass fiber reinforced plastic (GFRP).

Compared to steel, the electrical properties of GFRP provide advantages in terms of stray losses and smaller transformer design.

Compared to wood-based materials, GFRP provides better mechanical properties. In addition, the operating temperature of GFRP is higher, since wood-based materials are normally used at a maximum operating temperature of 105°C. On the contrary, the critical property for fiber-reinforced plastics are the electrical properties in point of partial discharge. GFRP does not absorb any oil. Therefore, the manufacturer must ensure that the material is free of air bubbles. A special know-how is required in the production process and special resin systems to fully utilize the advantages of GFRP.

Durostone® CR was specifically developed for oil-filled power transformers with the highest requirements.

Photo: Röchling

Platform made of Durostone® CR: improved mechanical properties and reduced clamping ring thickness

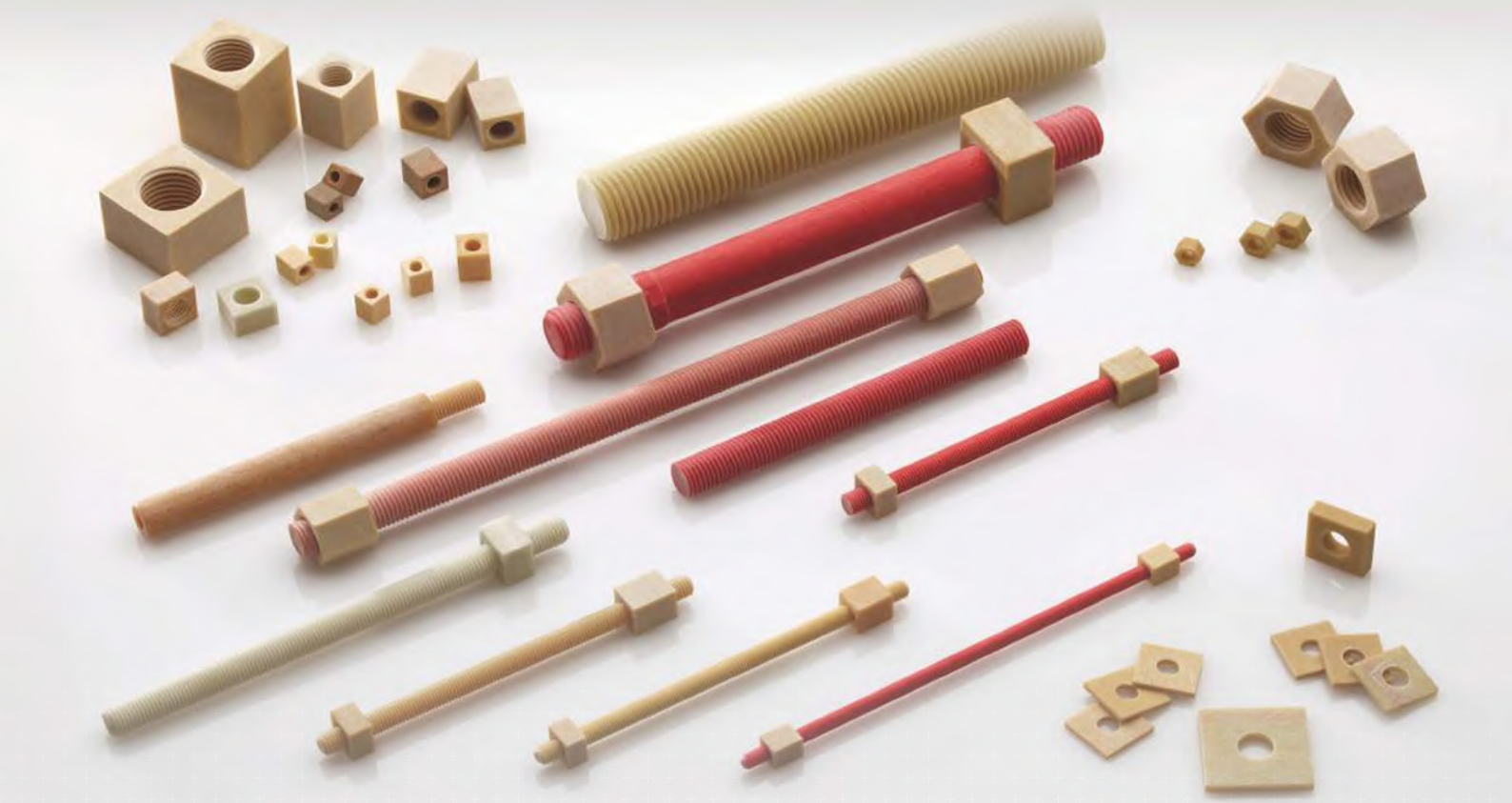
Durostone® CR provides higher performance, more compact design with a higher capacity and higher operating temperatures, thus supporting a new design for modern transformers performing at the highest requirements.

Röchling Industrial, a world-leading plastics and composites manufacturer, has more than 60 years of experience in the production of high-power insulating materials. Röchling has been challenged to develop GFRP grades for transformer construction. The new materials are combined in the Durostone® CR (CR = Compact & Resilient) product family. Durostone® CR was specifically developed for oil-filled power transformers with the highest requirements.

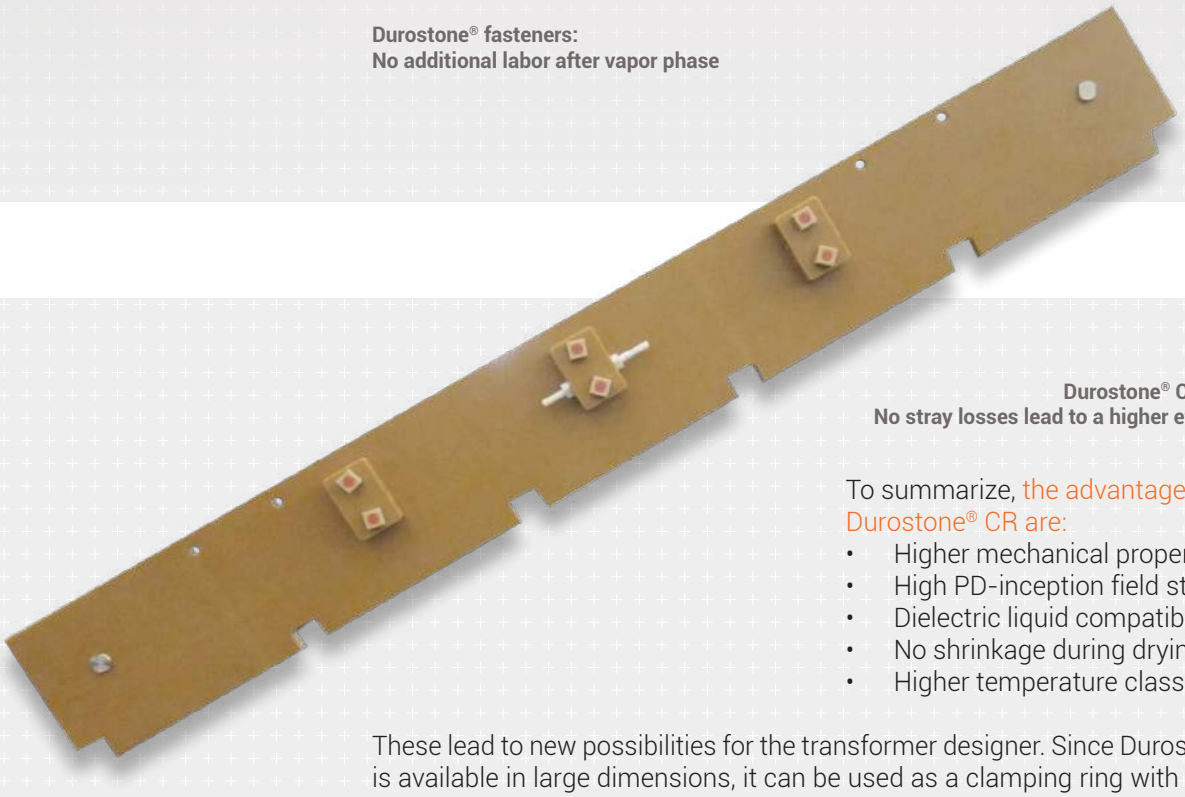
The difference to common composites is the high dielectric strength without onset of partial discharge, which is much lower for typical fiber-reinforced plastic compared to laminated pressboard (LP) and laminated densified wood (LDW). With Durostone® CR dielectrical properties of up to 10 kV/mm without onset of partial discharge are possible, which is on the same level with LP. Highest reliability for the electrical insulation properties is crucial for the construction elements in the active part of the transformer.

For the development of Durostone® CR, Röchling made use of the broad experience with LDW and LP. The Röchling brand Lignostone® Transfomerwood® has been used in transformers for over 60 years. In 2009 Röchling expanded with Trafoboard® HD-PH, a laminated pressboard with excellent dielectrical properties.

The electrical properties of Durostone® CR in point of onset of partial discharge are approved from well-known institutes in the industry which have the highest standard with a measuring sensitivity for partial discharge of <1 pC. The compatibility with dielectric liquid has been tested by Doble with no negative influence. Furthermore, Durostone® CR has the advantage of no shrinkage during the drying process because it is not hygroscopic. This provides closer tolerances and a more stable design. Additionally, it can be advantageous for threaded rods since there is no need for reassembling after the drying process.



Durostone® fasteners:
No additional labor after vapor phase



Durostone® CR beam:
No stray losses lead to a higher efficiency

To summarize, the advantages of Durostone® CR are:

- Higher mechanical properties
- High PD-inception field strength
- Dielectric liquid compatibility
- No shrinkage during drying
- Higher temperature class

These lead to new possibilities for the transformer designer. Since Durostone® CR is available in large dimensions, it can be used as a clamping ring with a diameter of up to three meters, for very high mechanical requirements. Beams and fasteners with a length of more than 5 meters are available. It can replace steel beams due to its very high stiffness of up to 30 GPa, which reduce eddy currents in the beam and gives more freedom in the HV-Design.

All these factors support a new design for modern transformers performing at the highest requirements. Durostone® CR provides higher performance, more compact design with a higher capacity and higher operating temperatures.

Photo: Röchling