Carbon Concrete Composite

Fact Sheet

Quality and test specification RAL-RG 351

Publisher: C³Verband (C³Association)
Dresden, September 2022

Motivation

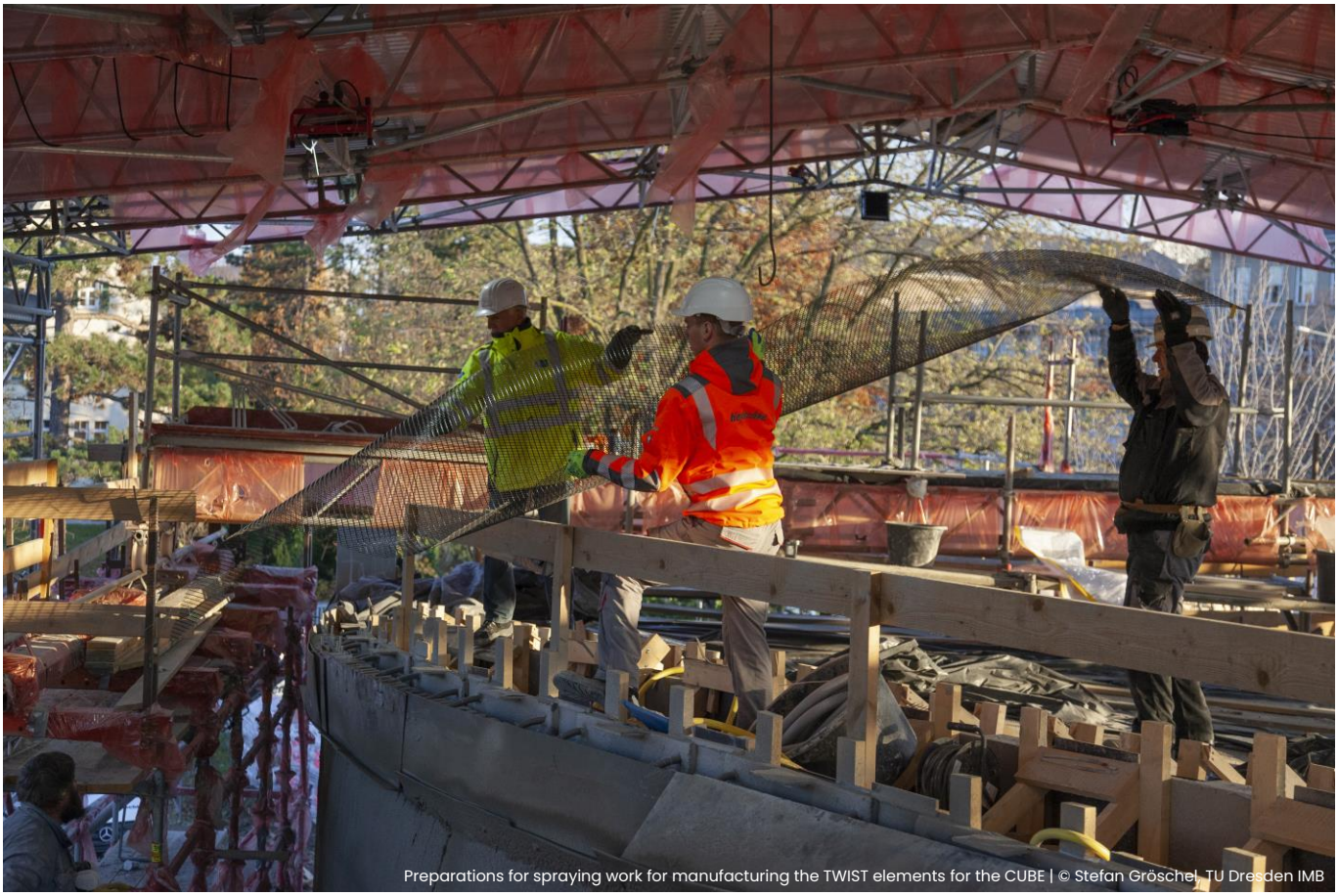
Carbon concrete offers many advantages over reinforced concrete construction which are in line with the goals of sustainable development. However, it must be ensured that no unacceptable risks for people and the environment can occur during use. The necessary occupational health and safety measures should also not be more complex than with reinforced concrete construction.

The fact that carbon fibres with different characteristics are already being offered, sold and in use on the market is particularly challenging. Particularly as in some cases the mechanical and/or thermal processing of products containing carbon fibres, exposure to respirable fibre dusts hazardous to health have been measured.

For this reason, the C³Association initiated the registration RAL-RG 351 published by the RAL Deutsches Institut für Gütesicherung und Kennzeichnung (German Institute for Quality Assurance and Marking (RAL)) for the prevention of hazards from non-biodegradable respirable fibre dusts in carbon concrete construction. The regulations ensure that no mat- or bar-shaped reinforcements made of carbon fibres which could lead to the release of health-relevant dusts are used anywhere in the entire supply chain of the construction industry.

It serves as a guide to ensure that, according to the current state of knowledge and applicable regulations, no special occupational health and safety precautions beyond those already customary need to be taken into account when using carbon concrete. The regulations cover new construction as well as reinforcement and repair.

With regard to the required test procedures, you will also receive a recommended course of action compiled by the C³Association through the fact sheet series.



Preparations for spraying work for manufacturing the TWIST elements for the CUBE | © Stefan Gröschel, TU Dresden IMB

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Verhinderung von Gefährdungen durch biobeständige, lungengängige Faserstäube bei der Carbonbetonbauweise

Güte- und Prüfbestimmungen

RAL-Registrierung
RAL-RG 351

Ausgabe Dezember 2021

RAL

DEUTSCHES INSTITUT FÜR GÜTESICHERUNG UND KENNZEICHNUNG E. V.

Bildnachweis: U1 und U4

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Preisgruppe 7

Zu beziehen durch:

Beuth-Verlag GmbH · Burggrafenstraße 6 · D-10787 Berlin
Tel.: (0 30) 26 01-0 · Fax: (0 30) 26 01-12 60 · E-Mail: info@beuth.de
Internet: www.beuth.de · www.mybeuth.de

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VERHINDERUNG VON GEFÄHRDUNGEN DURCH BIOBESTÄNDIGE, LUNGENGÄNGIGE FASERSTÄUBE BEU DER CARBONBETONBAUWEISE (PREVENTING HAZARDS FROM NON-BIODEGRADABLE, RESPIRABLE FIBRE DUSTS IN CARBON CONCRETE CONSTRUCTION)

GÜTE- UND PRÜFBESTIMMUNGEN (QUALITY AND TEST SPECIFICATIONS)

RAL-REGISTRIERUNG (RAL REGISTRATION)

RAL-RG 351

PUBLISHED DECEMBER 2021

PREAMBLE

Carbon concrete offers many advantages over reinforced concrete construction which are in line with the goals of sustainable development. However, it must be ensured that no unacceptable risks for people and the environment can occur during use. The necessary occupational health and safety measures should also not be more complex than with reinforced concrete construction. Particular attention should be paid to the selection of mat and bar-shaped reinforcements made of carbon fibre used for new construction and for reinforcement or repair. For example, during the mechanical processing of plastics with certain pitch-based carbon fibres, health-hazardous exposures to respirable fibre dusts have been measured[1]. A potential for the release of hazardous fibre dusts cannot currently be ruled out for carbon fibres from thermal recycling processes (rCF) either.

Carbon fibres with different characteristics are offered, sold and in use on the market. The registration serves as a communication measure in the industry in order not to have to make specific regulations on occupational health and safety when using carbon concrete according to applicable labour law. It ensures in the customer-supplier relationship that no mat or bar-shaped reinforcements made of carbon fibre types which, due to their fibre

[1] Bäger D., Simonow B., Kehren D., Dziurowitz N., Wenzlaff D., Thim C., Meyer-Plath A., Plitzko S.: Pechbasierte Carbonfasern als Quelle alveolengängiger Fasern bei mechanischer Bearbeitung von carbonfaserverstärkten Kunststoffen (CFK). VDI Fachmedien & Co KG (Hrsg.): Gefahrstoffe – Reinhaltung der Luft. Band 79. Heft 1 / 2. 2019. S. 13–16.

morphology or their fracture behaviour in their life cycle, can lead to a health-relevant release of alveolar and non-biodegradable fibrous dusts which meet the WHO counting criteria for fibres (d < 3 µm, l > 5 µm, l / d > 3) are used anywhere in the entire supply chain for products used in concrete construction. For such fibres which are referred to as critical below, the validity of the fibre-toxicological principle[2] is to be assumed, according to which the elongated form of the alveolar and non-biodegradable fibres represents a carcinogenic active principle.

Initiated by C3 – Carbon Concrete Composite e. V. (C³Association).

1 AREA OF APPLICATION

These quality and test specifications define requirements for the use of mat- and bar-shaped reinforcements made of carbon fibres in concrete construction in the fields of new construction as well as reinforcement or repairs for the respective manufacturing, processing and recycling processes.

They are not applicable for other carbon fibre products, nano-scale carbon fibres or applications outside concrete construction. Concrete construction where short fibres are used or mixed in is also excluded.

1.1 Terms

Carbon fibre: carbon fibres within the meaning of this registration are industrially manufactured fibres made from raw materials containing carbon, which are converted into graphite-like carbon by pyrolysis. The individual filaments are combined into bundles (fibres or rovings).

Reinforcements made of carbon fibres: mat- or bar-shaped reinforcements in the context of the registration result from the rovings which are processed in textile-technological processes and thereby impregnated with a plastic matrix.

Carbon concrete: in the context of the registration, carbon concrete is a composite material made of concrete and a mat- or bar-shaped reinforcement made of carbon fibres. Areas of application are both new construction as well as reinforcement and repairs.

[2] Pott F., Friedrichs K. H.: Tumoren der Ratte nach ip.-Injektion faserförmiger Stäube. Naturwissenschaften. Volume 59. 1972. 318 p.

1.2 Normative references

The application of this registration is not an exemption from the observance and implementation of legal requirements in the latest version for the placing on the market and use of the products concerned.

2 QUALITY REQUIREMENTS

2.1 Requirements on the material

For manufacturers, processors, users and recyclers of components made of carbon fibres and carbon concrete structures, the following requirements are derived from the requirements of hazardous substances legislation and the state of the art:

1. No use of carbon fibres that are prone to splinter fracture or reduction in diameter during manufacture and use when subjected to mechanical, thermal or oxidation stresses that may result in a relevant release of fibre dusts that meet the WHO counting criteria. This includes carbon fibres that already contain fibre dusts before processing.
2. No use of carbon fibres that contain filaments with a nominal diameter smaller than 4 µm during manufacture and use.
3. No use of carbon fibres that form a relevant release of alveolar fibre dusts during manufacture and use when subjected to mechanical stress. Particularly prone to this are
    - fibre materials with an apparent density greater than 1.95 g/cm³ and
    - mesophase pitch-based carbon fibres.

2.2 Occupational safety

For activities using carbon fibres for the uses mentioned in section 1.1, no further measures for substitution within the meaning of hazardous substances legislation need to be observed, taking section 2.1 into account.

3 TEST SPECIFICATIONS

As a rule, proof of compliance with the material requirements in accordance with section 2.1 is to be provided in accordance with the requirements of hazardous substances legislation for the determination of information and risk assessment by means of a certificate from the upstream supplier (product information sheet based on safety data sheet). The proof must

also be communicated between those responsible in the manufacturing process of the building and the demolition and recycling of the construction materials. This also implies the direct obligation to pass on this information within the circular material flow.

If the carbon fibres are processed, the processing institution must also provide such proof.

The reason for this is that the fracture behaviour changes between an unsized and uncoated carbon fibre compared to a sized and coated carbon fibre.

If, in individual cases, no certification is available from the upstream supplier, proof of compliance with the material properties can be provided in accordance with the requirements of this registration by means of own or commissioned tests.

The documents for the verification shall be assigned to the respective contract documents. The duration of storage is linked to the respective agreement on legal certainty and guarantee.

4 MARKING

Products that have been manufactured in accordance with the quality and test specifications can be marked with the reference RAL-RG 351.

5 CHANGES

Changes to this RAL registration, including editorial changes, require the prior written consent of RAL.

HISTORIE

Die deutsche Privatwirtschaft und die damalige deutsche Regierung gründeten 1925 als gemeinsame Initiative den Reichs-Ausschuss für Lieferbedingungen (RAL). Das gemeinsame Ziel lag in der Vereinheitlichung und Präzisierung von technischen Lieferbedingungen. Hierzu brauchte man festgelegte Qualitätsanforderungen und deren Kontrolle – das System der Gütesicherung entstand. Zu ihrer Durchführung war die Schaffung einer neutralen Institution als Selbstverwaltungsorgan aller im Markt Beteiligten notwendig. Damit schlug die Geburtsstunde von RAL. Seitdem liegt die Kompetenz zur Schaffung von Gütezeichen bei RAL.

RAL HEUTE

RAL agiert mit seinen Tätigkeitsbereichen als unabhängiger Dienstleister. RAL ist als gemeinnützige Institution anerkannt und führt die Rechtsform des eingetragenen Vereins. Seine Organe sind das Präsidium, das Kuratorium, die Mitgliederversammlung sowie die Geschäftsführung.

Als Ausdruck seiner Unabhängigkeit und Interessensneutralität werden die Richtlinien der RAL Aktivitäten durch das Kuratorium bestimmt, das von Vertretern der Spitzenorganisationen der Wirtschaft, der Verbraucher, der Landwirtschaft, von Bundesministerien und weiteren Bundesorganisationen gebildet wird. Sie haben dauerhaft Sitz und Stimme in diesem Gremium, dem weiterhin vier Gütegemeinschaften als Vertreter der RAL Mitglieder von der Mitgliederversammlung hinzugewählt werden.

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- RAL schafft Gütezeichen
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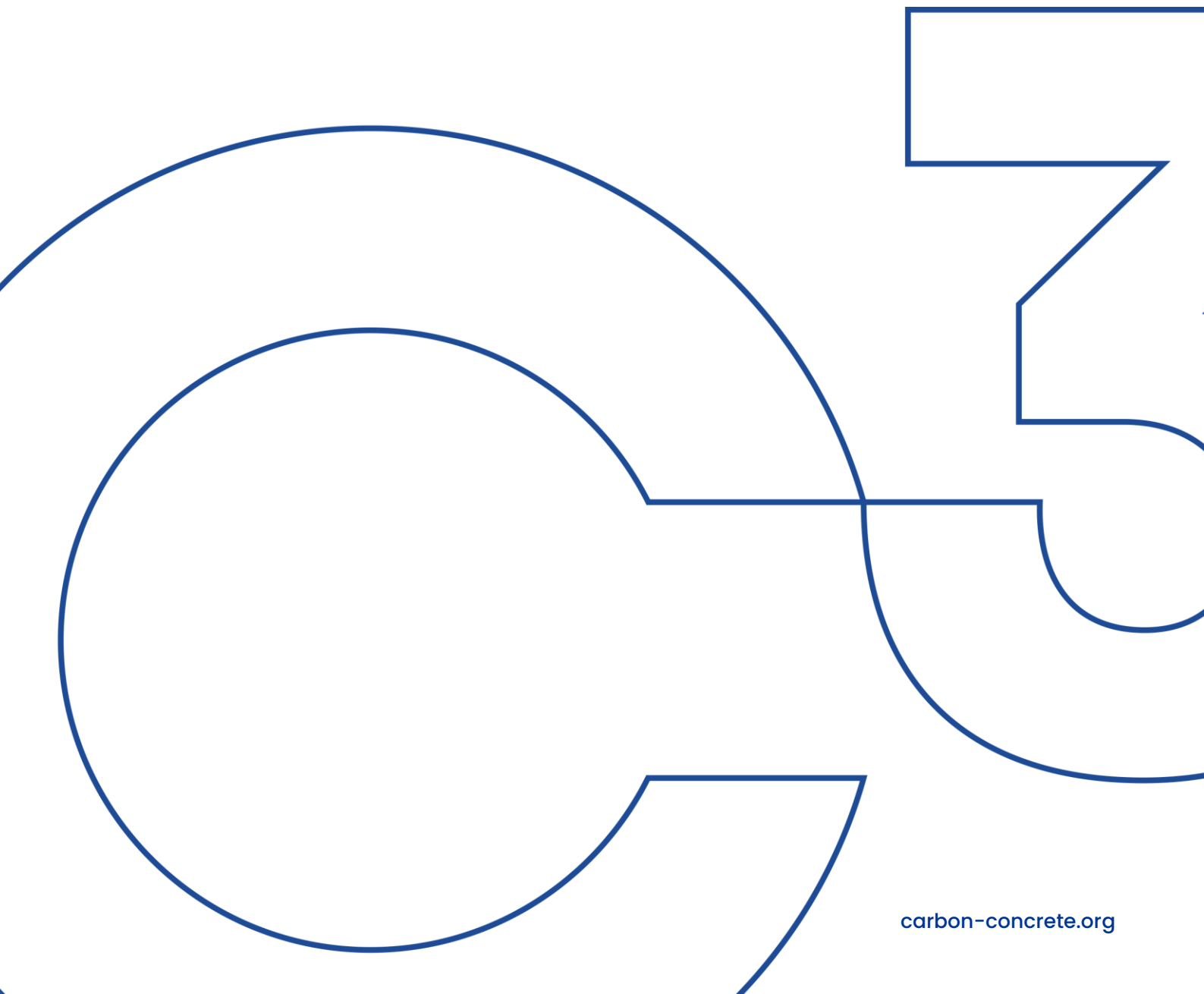

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