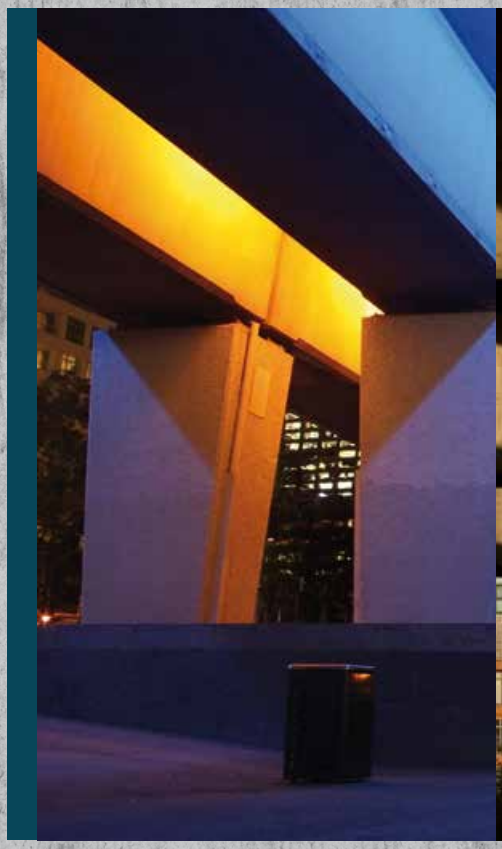
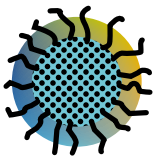
CAS COMPOSITE ANODE SYSTEMS GMBH
TECHNICAL DATA SHEETS CAST^{Q} AND QAP 60



CAS
COMPOSITE - ANODE - SYSTEMS GMBH



CAST^{Q} CARBON QUANTUM DOT MODIFIED COMPOSITE PAINT

PRODUCT DESCRIPTION

The CAST^{Q} Composite-Quantum-Anode-System consists of the electrically conductive CAST^{Q} Composite-Quantum-Anode paint and the QAP 60 Quantum Anode Primer forming a durable composite matrix with the concrete subsurface. The CAST^{Q} Composite-Quantum-Anode-System is formed by applying the QAP 60 Quantum Anode Primer and subsequently the CAST^{Q} Composite-Quantum-Anode Paint on the concrete surface.

CAST^{Q} Composite-Quantum-Anode Paint is a two-component aqueous alkaline alumo -silicate/ polymer composite paint for the active cathodic corrosion protection of reinforcing steel in concrete. The QAP 60 Quantum Anode Primer and the CAST^{Q} Composite Quantum Anode paint are doped with admixed Carbon Quantum Dots (CQD's). The admixed CQD's, due to their versatile surface and superior electron transfer capabilities, lower polarization resistance and increase conductivity especially in dry environments assuring corrosion protection of the steel reinforcement also under ambient dry conditions, e.g. in carbonated concrete and furthermore increase adhesion strength. Therefore, a reliable and durable corrosion protection of the steel reinforcement may be assured also in dry environments or carbonated concrete.

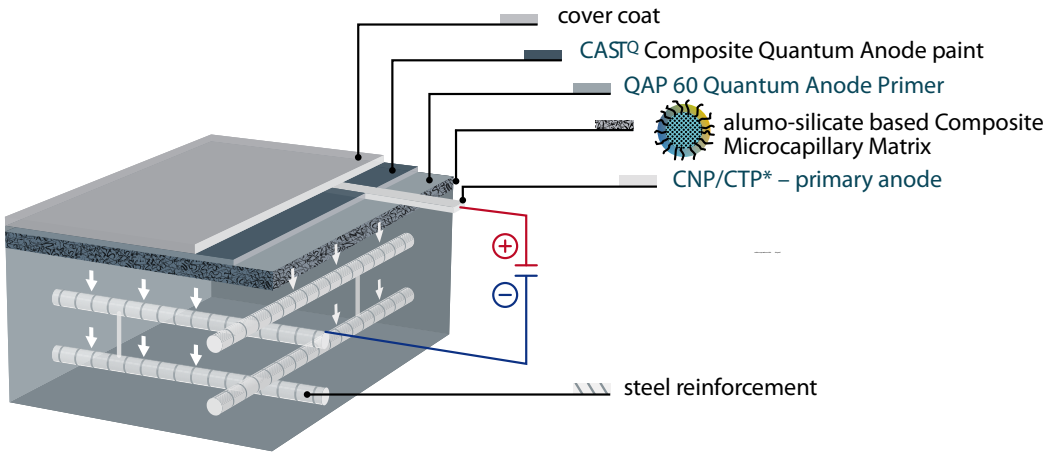
The CAST^{Q} Composite-Quantum-Anode paint and the QAP 60 Quantum Anode Primer contains a soluble alumo-silicate component that infiltrates with the aqueous phase in the upper layer of the concrete overlay (2–5 mm) and, depending on temperature, hardens within 7 to 14 days within the conductive paint layer and in the pore concrete pore-compound to a micro-capillary matrix. The composite micro capillary matrix serves as "sponge" that pulls the concrete pore solution towards the anode/concrete interface neutralizing the anodically formed acid consequently permitting high current loads. This ionic transfer effect is supported by the admixed CQD's allowing higher applied voltages under dry conditions (verified up to 12 Volts) and higher applied currents (120 mA/m^2 short term up to 24 hours) under humid conditions up to 35 mA/m^2

The composite micro capillary matrix forms a durable bond between the concrete cover and the CAST^{Q} Composite-Quantum-Anode paint forming the CAST^{Q} Composite-Quantum-Anode. The CAST^{Q} Composite-Quantum-Anode-System, is based on the CAST^{3+} Composite Anode System, exhibiting high durability, resistance against acids and alkalis, high weathering resistance (UV-resistance, frost resistance, frost-thaw salt resistance if applied on a frost-thaw-salt resistant concrete) and is compatible with most acrylic, polyurethane-, polyurea- and epoxy-based paints and coating systems. A list of compatible cover coats is available from CAS.

Furthermore, the CAST^{Q} Composite-Quantum-Anode paint is temperature resistant up to 120°C. However, CAST^{Q} Composite-Quantum-Anode paint applied to concrete shall not be exposed to temperatures above 90°C in the long term: The electrolytic resistance of concrete exposed to temperatures above 90°C increases significantly and irreversibly.

carbon quantum dot doped

CAST^{Q} Composite Anode System



*CNP: copper/niobium/platinum or
CTP: copper/titanium/platinum

FIELDS OF APPLICATIONS

Cathodic protection according to ISO EN 12 696, NACE SP0408-2019 of steel reinforced concrete members and structures that are endangered or damaged by the corrosion of the steel reinforcement induced by the ingress of de-icing salts, by exposure to sea water and/or by the carbonation of the concrete overlay.

_ Bridges: bridge decks, columns, beams, supporting walls, abutments, cantilevers
_ Parking garages: parking decks, pavements, columns, walls, sockets
_ Apartment buildings: facades, balconies, columns, beams
_ Tunnels: columns in street galleries, portals
_Pools: walls, concrete basin underside,
_ Seaside Concrete Structures: jetties, decks, columns
_ Storage tanks for salty water, e.g. waste water, seawater
_ Concrete structures erected with salt contaminated concrete

ADVANTAGES

_ No intrusion into the structure of the concrete member
_ No increase of concrete cover and no increase of load capacity and usable height
_ High durability, solidification of the concrete surface, strong adhesion to the concrete surface and high current loads (up to 35 mA/m^2) due to the formation of an inorganic alumo-silicate composite matrix between the conductive coating and the concrete overlay
_ High adhesion strength due to the formation of the composite matrix
_ High resistance against weathering
_ Frost-thaw salt resistance if applied on frost-thaw salt resistant concrete
_ High Temperature resistance – up to 120°C
_ High durability in wet environments
_ High chemical resistance against weak acids and alkalis (pH 4–pH 14)
_ High electrolytic conductivity due to the micro-capillarity of the composite matrix and admixed CQD's
_ High electrical conductivity due the high performance electrically conductive fillers and admixed CQD's
_ Simple and easy application
_ Compatible with most alkali-resistant polymer coatings (list of cover coatings available)
_ High sustainability (no or minimum concrete refuse, no fresh concrete required, minimum energy required for the preparation of the concrete surface.
_ Durability and service time > 40 years if applied in combination with Poly-Urea-Coatings (e.g. MasterSeal M 689 as part of MasterSeal® Traffic 2239 or equivalent)

MATERIAL DATA

COLOUR

component A	Anthracite
component B	transparent greenish-yellowish

PACKAGING

Component A	20 litres PP pails à 20 kg net or 5 litres PP pails à 5 kg net
Component B	0,25 litre PP flasks à 0,36 kg net or 0,1 litre PP flasks à 0,1 kg

STORAGE AND SHELF LIFE

Komponente A: Stored in the original packaging in dry conditions, this product will keep for at least one (1) year. Storage Temperature: min. 5°C max. 40°C

Komponente B: Stored in the original packaging in dry conditions, this product will keep one (1) year, discard if a white precipitate is observed. Storage Temperature: min. 0°C, max 40°C

Mixing ratio component A/ B	A: B 50: 1 to 55 : 1
Pot life	approximately one (1) hour (20°C)

DRYING AND SOLIDIFYING BEHAVIOR

temperature	relative humidity	dry after	rainproof after	overcoatable after
+ 10°C	45%–80%	12 h	24 h	14 d
+ 20°C	45%–80%	8 h	12 h	7 d
+ 30°C	45%–80%	4 h	8 h	7 d

Standard climate: 23°C, 75% r.h.

Formation of the microcapillary composite matrix 1–2 weeks after the application of the CAST^{Q} Composite Anode.

CONTENT ON SOLIDS

Solid content in component A:	about 48 Vol.%
Content on CQD's	0,01–0,05 wt.%
Ø CQD	3 nm

OPERATING TEMPERATURE

Max. operating temperature	120°C
Max. operating temperature on concrete	90°C

At operating temperatures below -5°C the Composite Quantum Anode has to be operated strictly in constant voltage mode and precaution has to be taken by voltage and maximum current settings that local exposure to meltwater does not lead to excessive local current loads.

SERVICE TIME/LIFE TIME

Minimum service time (proved by references)	20 years
Expected service time	> 25 years
Expected service time combination with poly-urea-top-coating (e.g. MasterSeal M 689 as part of MasterSeal® Traffic 2239 or equivalent):	> 40 years

PHYSICAL DATA

PHYSICAL DATA

component A	1,19 kg/l
component B	1,45 kg/l
component A + B	1,19 kg/l

VISCOSITY

Viscosity component A	11,7 Pa.s	Measured at a
Viscosity component A +B	8,9 Pa.s	shear rate of 40 s^{-1}
Viscosity comp. A +B + 5% water	7,7 Pa.s	

ADHESIVE TENSILE/PULL OFF STRENGTH

Adhesive tensile strength after 7 days	1,5–3 MPa
Adhesive tensile strength after 14 days	2–5 MPa

WATER ABSORPTION AND DIFFUSION RESISTANCE TO WATER VAPOUR

Water Absorption Coefficient W20	0,04 $kg/m^2.h^{0,5*}$
On a concrete subsurface, W20	0,43 $kg/m^2.h^{0,5*}$
Water vapour diffusion resistance, μH_2O	1.120*

ELECTRIC PROPERTIES

Electric resistance after formation of the composite matrix	0,5 ± 0,1 Ohm.cm
Sheet resistance after formation of the composite matrix	15 ± 2 Ohm/square
Standard current densities (empirical values)	3–10 mA/m^2
Maximum current density	35 mA/m^2
Standard voltages (empirical values)	1,5–5 V
Maximum operating voltage	12 V

_ If average current densities of > 15 mA/m^2 are expected then the technical service of CAS Composite Anode Systems shall be consulted.
_ Average current densities > 20 mA/m^2 shall only be applied at concrete temperatures > 0°C and if the tensile adhesion strength is > 2,0 MPa 14 days after application.
_ The maximum current densities depend on chloride content, and the degree of saturation of the concrete.

WEATHERING RESISTANCE/DURABILITY

EN 13687-1 freeze-thaw cycling with de-icing salt immersion	passed
EN 13687-2 thunder shower cycling/EN 1504-2	passed
Fire Resistance according to DIN EN 11925-2-2020, class D	passed

*Determined for the CAS-T+ paint

APPLICATION INSTRUCTIONS

CONCRETE SURFACE PREPARATION

The concrete surface has to be free of loose or sandy parts. Surface contamination's have to be thoroughly removed, especially oil, fats, wax. The pull-off strength of the concrete should be > 1 MPa, preferentially > 1,5 MPa. The concrete surface may be dry to slightly damp, but absorbing enough that the liquid phase of the paint may penetrate 2–5 mm into the concrete surface. Optimum adhesion of the coating will be obtained by preparing the concrete surface with sandblasting, water jetting 400–800 bars, -ball blasting or grinding. If current densities of >15 mA/m² are expected then the medium roughness according to DIN 4760 should be ≥ 0,2 mm. The temperature of the concrete surface has to be above 8°C and the relative humidity of the ambient air should allow drying and film formation of the composite paint within 6–8 hours – this is usually achieved if 10°C < T < 25°C, 75% < rh. < 85%. Reprofiled surfaces shall be hardened for at least 7 days and cleaned with a rotating steel brush and subsequently with a broom before applying the CAST^{Q} composite paint.

REMARKS

For optimum performance (adhesion, electrical and electrolytic conductivity and durability) of the CAST^{Q} composite paint, especially at high protection current densities, optimum conditions for the formation of the microcapillary composite matrix have to be assured and maintained. The CAST^{Q} composite paint shall be applied preferentially on concrete surfaces impregnated with the QAP 60 Quantum-Anode-Primer that reinforces the formation of the microcapillary matrix. Albeit the strengthening of the concrete surface induced by the formation of the composite matrix, the pull-off strength of the concrete surface should be at least 1,0 MPa, preferentially higher than 1,5 MPa. Free or dissolved calcium hydroxide may interfere with the formation of the composite matrix. For the composite quantum anode system design specifications (primary anode installation, cover coats, etc.) please consult the webpage or CAS Composite Anode Systems GmbH for the installation guideline and list of compatible cover coats.

MIXING OF COMPONENTS

After stirring and homogenizing component A with a mechanical stirrer for about 5 min, CAST^{Q}/B+ hardener is added slowly while stirring (high speed), then mixing is continued for about 2 min at low speed (air should not be mixed in while stirring). The mixed material shall be transferred to another container to prevent mixing errors and to control the homogeneous mixing of the conductive pigment (graphite) into the paint.

MIXING RATIO

Component A : Component B = 50 : 1 to 55 : 1

Remark: Component A may be adjusted to be more fluid by adding max. 5 wt.% of water. The CAST^{Q} composite paint is highly thixotropic, therefore becomes more fluid during mixing.

APPLICATION

The CAST^{Q} composite paint may be applied like a conventional paint either with rollers (short hair) or with airless spray technique.

▷ Application with Paint Rollers

The CAST^{Q} composite paint is applied, undiluted, in minimum two layers. The application shall be rich but not wet. With the first layer, 300–500 g/m² but not more than 500 g/m², with the second layer 200–300 g/m² shall be applied. Higher application amounts may lead to the formation of surface micro-cracking. Subsequent coatings shall be applied on dry paint, preferentially on the next day but not later than 24 hours after application of the previous layer. Formation of micro-cracks in the surface indicates a too-thick coat.

It is strongly recommended to apply the CAST^{Q} composite paint on a concrete surface that has been impregnated with the QAP Quantum 60 primer.

▷ Application with the Airless Spray Guns

With the airless spray guns, 700–900 g/m² CAST^{Q} composite paint may be applied in a single operation. About up to 1000 m²/day may be applied with one airless spray gun.

CONSUMPTION

▷ Application per Roller	1st application:	300–500 g/m²
	2nd application:	200–300 g/m²
	total consumption:	700 ± 100 g/m²
▷ Application per Airless Spray	Single application	700 ± 100 g/m²
	wet film thickness:	500–750 µm
	dry film thickness:	250–350 µm

RECOMMENDED PROCESSING CONDITIONS/LIMITS

concrete substrate temperature	min. 8°C/max. 35°C
air temperature	min. 8°C/max. 35°C
relative humidity	≤ 80%

CLEANING ADVICES

Not hardened material may be washed off with water, shortly after hardening with hot water. Dried and hardened material may only be removed mechanically.

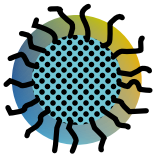
SAFETY ADVICES

Safety and disposal instructions in the MSDS (material safety data sheets) and on the container labels have to be observed and followed. The MSDS for the component A (CAST^{Q}/A) is also valid for the CAST^{Q} composite paint (component A mixed with component B).

The CAST^{Q} composite paint is designed and especially suited for the CAS-Composite Quantum Anode System for the cathodic corrosion protection of reinforcing steel in concrete. The purpose of this product data-sheet is the description of the properties and applications of the CAST^{Q} composite paint.

The described properties and reported values may vary depending on the solicitude and processing on which we do not have any direct influence. Our warranty is therefore limited to the quality of the delivered product. The product data sheet does not contain a complete manual of use and application. Our advice and consultancy are required for the use of CAST^{Q} composite paint in connection with the CAS-Composite Anode System or in connection with any cathodic protection system for reinforcing steel in concrete. The information above is believed to be accurate and represents the best information currently available to us.

The CAST^{Q} composite paint and the CAST^{Q} composite quantum anode system are protected by patents.



QAP 60 QUANTUM ANODE PRIMER

PRODUCT DESCRIPTION

The Quantum Anode Primer QAP 60 is a two-component aqueous alkaline alumo-silicate/polymer composite primer admixed with 0,7 wt.% Carbon Quantum Dots (CQD's). The QAP 60 Quantum-Anode-Primer is applied to concrete surfaces and impregnates the concrete overlay down to a depth of 2–5 mm. It is devised to be applied prior to the application of Carbon Quantum Dots Modified Composite Paint CAST^{Q}.

The alumo-silicate component, supported by the admixed CQD's, induces the formation of a micro-capillary alumo-silicate-matrix in the with QAP 60 Quantum Anode Primer impregnated layer of the concrete overlay that acts like a sponge inducing the transport of the concrete pore solution to the anode/concrete interface and neutralizing the anodically produced acid as outlined in detail in the description in the TDS of the CAST^{Q} Composite Quantum Anode paint.

The QAP 60 Primer is specially designed as a component of the Composite Quantum Anode for the application with the CAST^{Q} Composite Quantum Paint, consolidating the concrete-surface layer, enhancing adhesion of the CAST^{Q} Composite Quantum Paint to the concrete surface and promoting ion transport across the concrete overlay.

MATERIAL DATA

COLOR

Component A	brownish – milky – emulsion
Component B	transparent greenish-yellowish

PACKAGING

Component A	10 liter PP cans à 10 kg net or 5 liter PP cans à 5 kg net
Component B	0,25 liter PP flasks à 0,36 kg net or 0,1 liter flasks à 0,1 kg net

STORAGE AND HANDLING

Component A:	unopened containers may be stored for at least 12 months if stored properly, under dry and cool conditions, free from freezing storage Temperature: min. 5°C, max 40°C
Component B:	unopened containers may be stored for at least 12 months if stored properly, under dry and cool conditions, free from freezing, discard if a white precipitate is observed storage Temperature: min. 0°C, max 40°C

PHYSICAL DATA

SPECIFIC WEIGHT

component A	1,09 kg/l
component B (same as for CAST^{Q})	1,45 kg/l
QAP 60 component A + B	1,08 kg/l

MIXING OF COMPONENTS

mixing ratio of components A: B	25 : 1 to 28 : 1
pot time	approx. 2 hours (20°C)

APPLICATION INSTRUCTIONS

CONCRETE SURFACE PREPARATION

The concrete surface has to be free of loose or sandy parts. Surface contamination's have to be thoroughly removed, especially oil, fats, and wax. The concrete surface may be dry to damp but not wet. The concrete overlay has to be sufficiently absorbent to allow the QAP 60 Quantum Anode Primer to permeate at least 2 mm, preferentially 5 mm into the surface layer. The concrete is preferentially cleaned and prepared by sand-blasting, water-jetting 500–800 bars, ball-blasting, and grinding). The temperature on the concrete surface shall be at least 8°C.

REMARKS

An optimal development of the micro capillary composite matrix is a prerequisite for an optimal functionality (adhesion, electrolytic conductivity, polarizability of the steel reinforcement, current densities up to 35 mA/m^2, long term durability) of the CAST^{Q} Composite Quantum Anode.

MIXING

Transfer the component A into a appropriate 10–20 liter pail. Thoroughly mix component A with a mechanic spiral stirrer. Keep vigorously stirring while adding component B, continue stirring at low speed for at least 2 minutes, without entraining air.

MIXING RATIO

Component A: Component B = 25 : 1 to 28 : 1
Pot life: 2 hours

APPLICATION

The QAP 60 Quantum Anode Primer is applied to clean and prepared concrete surfaces, preferentially by a brush, roller or with a hydraulic sprayer. The application shall be done in such a way that the surface is well soaked with the primer. Usually about 200–300 g are applied per m^2. The QAP 60 primer hardens within 8 hours at 15°C to 25°C, within 24 hours at temperatures at about 10°C, to such a degree that the CAST^Q Composite Quantum Paint may be applied. The CAST^Q Composite Quantum Paint shall not be applied later than 48 hours after the application of the QAP 60 Quantum Anode Primer.

MATERIALS CONSUMPTION

Per application:	200–300 g/m^2

PROCESSING CONDITIONS/LIMITS

concrete substrate temperature	min. 5°C/max. 35°C
air temperature	min. 5°C/max. 35°C

CLEANING ADVICES

Spilled material may be washed off with water

SAFETY ADVICES

Safety and disposal instructions in the MSDS (material safety data sheets) and on the container labels have to be observed and followed. The MSDS for the component is also valid for the QAP 60 Quantum Anode Primer (component A mixed with component B).
The QAP 60 Quantum Anode Primer is designed and especially suited for the CAST^Q Composite-Quantum-Anode-System System for the cathodic corrosion protection of reinforcing steel in concrete. The purpose of this product data sheet is the description of the properties and applications of the QAP 60 Quantum Anode Primer. The described properties and reported values may vary depending on the solicitude and processing on which we do not have any direct influence. Our warranty is therefore limited to the quality of the delivered product. The product data sheet does not contain a complete manual of use and application. Our advice and consultancy are required for the use QAP 60 Quantum Anode Primer in connection with the CAST^Q Composite-Quantum-Anode-System or in connection with any cathodic protection system for reinforcing steel in concrete. The information above is believed to be accurate and represents the best information currently available to us.
The CAST^Q Composite-Quantum-Anode-System is protected by patents.

Technical Data Sheet TDS
CAST^Q & QAP60
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