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1 *Typical site of operation.*
2 *Installed transponder.*

# PASSIVE SENSOR FOR CORROSION DETECTION


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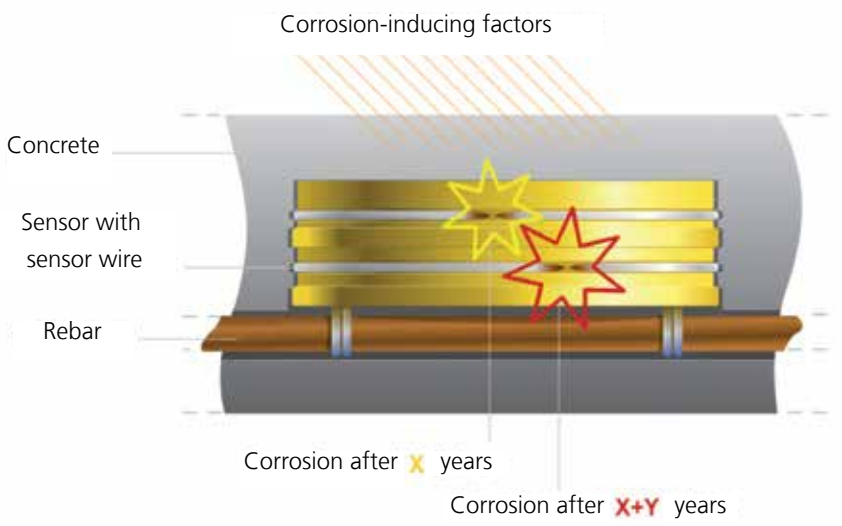
## Effects of Corrosion

Concrete bridges have to withstand a lot: Frost, heavy traffic, and exhaust fumes affect the constructions badly – just as road salt used by winter services for the control of black ice. Sodium chloride – the most common de-icing salt – is used in large quantities nationwide. When the thaw sets in, the salt disintegrates into ions, which penetrates into the concrete and affects its five centimeter thick protective alkaline layer. If the dissolved salts reach the embedded steel rebar, it starts to rust damaging the construction's basic. In consequence cracks appear and pieces of concrete may break off. At worst this leads to an early failure of reinforced or prestressed concrete constructions. Until now there are only cost intensive or destructive tests to determine to what extent the ions have already penetrated the concrete and what damage has already been done. At present, construction workers typically check out the reinforced concrete for cavities – a sign of corrosion damage – manually with a hammer. This is a time-consuming and error-prone method. With a new sensor transponder and regular maintenance it is possible to measure to what extent the ions have penetrated the concrete – contactless and non-destructive.

## Functions

The sensor itself consists of a special wire, which is wound around the housing (Fig. 3). If the dissolved salts reach this mesh, its wires start to rust and finally break. This corrosion process can be captured measuring of the impedance of one sensor wire or better several sensor wires positioned in different depths to the concrete's surface. Based on the state and number of affected sensor wires it is possible to determine the degree of the corrosion and how many centimeters of the protective layer are affected.

Therefore it is possible to set a due date for next repair. In combination with a transponder frontend the sensor turns into a




wireless-readable sensor-transponder; with that it is possible to fit the sensor into the construction without »harming« the surface. The energy required for the measuring is harvested from an electromagnetic field, thus batteries and their exchange are unnecessary – the transponder can remain permanently inside the construction, while the measured data is transmitted via radio to a reading device.

**Advantages**

- Immediate information concerning the state of the sensor wire in the moment of detecting or scanning the corrosion sensor (via hand-held or mobile reader)
- No direct surface contact necessary
- Possibility of integration into remotely controlled network systems
- More flexible application options (larger surface effect, specific geometry, etc.)
- Possibility to calculate the remaining life expectancy of the construction

**Expertise of Fraunhofer IMS**

The expertise of Fraunhofer IMS in the field of multi-functional transponder systems ranges from ASIC development, electromagnetic field simulation, antenna design and measurement, energy harvesting, implementation of hardware – i.e. ultra-low-power design – and software components for sensor transponder tags and reader units to adaptation of application-specific requirements.

**Technical Data**

| | |
|---|---|
| Diameter | 80 mm |
| Height | 50 mm |
| Energy supply | passive (by the RF field of the reader) |
| Antenna | LC resonator (integrated in the transponder) |
| Operating temperature | -20 °C – +85 °C |
| Carrier frequency | 133 kHz |
| Read-out distance | up to 50 cm (depending on reader unit) |

**Cooperation Partners:**

Gefördert durch:
Bundesministerium für Wirtschaft und Technologie
aufgrund eines Beschlusses des Deutschen Bundestages
BS2 Sicherheitssysteme
BAUSTOFF ÜBERWACHUNG

3 *Principle of operation.*