ConSensor

Chloride sensor

1. Company information

This application is from 2 SMEs:

ConSensor BV, established in 1998, is specialized in the development, production and sale of sensors for concrete. ConSensor is a 'network company', with one fte, and a team of 8 people that work for ConSensor on an on-demand basis. Flagship product is the ConSensor 3.0 concrete strength sensor that monitors the temperature and electrical conductivity of hardening (fresh) concrete, calculates the strength development from these data, and shows this information on a web platform to the users; mainly contractors and ready-mix producers. By using these data the industry can learn how much cement is really needed for a given structure and in this way reduce the cost and the ecological footprint of the built environment.

The company's start was based on a PhD research on this topic at the TU-Delft. ConSensor is very well connected to the scientific community, building new (sensor) products on research findings. We recently, for instance, participated as management committee member in the EU COST project TU1404, and are working together with different TU's in the Netherlands and abroad on the development of new technologies and products for our customers.

Vitruvius Building Solutions BV was started in 2015 and is specialized in the use of materials in the infrastructure and utility building industry. The main material that is used is concrete. We optimize concrete recipes with the following possible conditions strength at a very early date or minimizing the carbon footprint. The other activity is the durability of concrete constructions and the repair or maintenance of these constructions.

2. Problem

Chloride ingress into concrete causes the reinforcement steel of the concrete to rust. The rusting steel will expand, and the resulting pressure will cause the concrete to crack, which causes further ingress of water and chloride and consequently aggravates the problem. Also chlorides give a special kind of attack on the reinforcement known as well as corrosion. This type of corrosion does not give any warning because there is no expansion but the reinforcement cannot function as designed. Main sources of chloride are sea water (in marine environments / coastal zones) and de-icing salts used on infrastructure when it is freezing. It is therefore very important to monitor the ingress of the chloride in the concrete.

There are, however, to date no satisfactory non-destructive sensors that will last for >50 years that can reliably measure the amount of chloride - and a chloride profile - in the concrete. Some sensors need to be embedded, and will only last up to 10 – 20 years.
Other methods, for existing structures, are destructive in their nature. Samples are taken as cores from the construction and analysed by dissolving the concrete and measuring the chloride in the solution. One existing method is by using laser induced spectroscopy, but still the method needs a core from the construction.
Destructive methods are expensive, time consuming and damage the construction. They can therefore not be repeated too often.

Ideally a sensor is either embedded in the concrete during construction and will remain usable during the whole lifetime of the structure or it is like a 'stethoscope' that is held against the (existing) structure in different places to assess the chloride content. It is also important to determine a depth profile of the chloride: how much chloride is present at what depth? It is no simple task to envision such a sensor.

On the other hand current developments in the areas of physics, electronics and software (AI, big data, …) open up new possible approaches to this problem. It is for that reason that we are inviting the physics community to look at this issue in fresh and open-minded way.

The ideal outcome of the PwI workshop would be for us to have a few approaches that are truly feasible and merit further R&D, and if possible a proof of concept for these methods.

There are only a few conditions for the solution: one has to keep in mind that the sensor needs to be applied / used on site with existing and new buildings and structures. It has to be non-destructive. A sensor that is embedded has to be fairly low cost (say , 100 euro) and last for > 50 years, whereas a 'stethoscope' solution may cost thousands of euro's provided it will be easy to operate (portable!) and quite accurate with repeatable results, and allows to make a depth profile of the chloride in the concrete.