Pool safety depends on proper materials for fasteners and hanging constructions

Jan Heselmans firmly believes that companies who actually build swimming pools should be held accountable for the materials used, as they are responsible for the safety of their buildings, installations and products. A string of incidents in the Netherlands where stainless steel fasteners have given way due to stress corrosion cracking have resulted in the issuance of a guideline, but this does not go far enough to ensure the safety of pool users, says Jan. He spoke to Stainless Steel World about the history of this potentially dangerous problem and his efforts to have firm rules put in place.

By Jan Sint Nicolaas

Jan Heselmans is a materials and inspection expert and owner of the consultancy firm Corrodium in the Netherlands, which carries out asset integrity management on oil & gas platforms, in industry and in the construction sector. He is convinced that the safety of construction in swimming pools depends on adequate inspection. “We had a tragic accident in Tilburg in 2011 where a baby died after being struck by two falling speakers, weighing altogether some 50 kgs.”

Jan emphasizes that inspection of stainless steel fasteners and hanging constructions (such as ceiling hooks) in swimming pool environments must be conducted regularly, not sporadically. In an international context he is working on a standard for material specification and inspection of swimming pools.

“The problem has been known for many years: stainless steel bolts used for suspension systems can succumb due to stress corrosion cracking, with potentially dangerous consequences. During inspections these places are hard to reach because they are often located up high and behind ceilings.” Swimming pool managers and some authorities think that under the current Dutch legislation nobody is specifically responsible for inspections, but with his experience in the oil & gas and other industries Jan does not agree. He concludes: “the first mistake is often made during material specification by architects and contractors.”

The culprit: stress corrosion cracking
Following the accident in Tilburg at least three other incidents of objects falling into swimming pools have occurred in
the Netherlands, fortunately without causing injury. All were caused by stress corrosion cracking. According to Jan, it is practically impossible to prohibit the use of stainless steel mounting materials in swimming pools; however a new NPR (Practical Guidelines in the Netherlands issued by the Dutch Standardization Institute NNI/NEN) of appropriate materials will soon be published.

“It will be prohibited to choose materials other than those in this list, and quotes for materials used in pool environments should refer to the NPR,” he explains. Fortunately there are plenty of alternatives available. “For example, zinc clad galvanized steel lasts between five and thirty years, depending on factors such as humidity.” Also 6% Mo stainless steels such as 1.4529 and 1.4565 (254 SMO) are suitable. Carbon steel clad with duplex coating is even more sustainable and can last three to thirty times longer than galvanized steel. A duplex coating is a combination of galvanization and lacquering. “This is a good solution for locations that are difficult to inspect and for fittings that need to be in place for a long period of time; and also threaded fasteners such as bolts and screws are available with a (very thin) duplex coating.

Turning Point
An accident in Tilburg in 2011 marked a turning point in the use of stainless steel in Dutch swimming pools. In 2014 the city of Tilburg opened sport complex ‘Drieburcht’ and it wants this pool to serve as an example regarding the use of safe mounting materials. Jan is also enthusiastic about the new sports complex “Koning Willem-Alexander” in the city of Hoofddorp, where new materials from offshore practices (duplex coated bolts) have been used instead of the standard stainless steel grades AISI 304 (A2 for bolts) or AISI 316 (A4 for bolts). He admits that such materials for fasteners were not readily available in the Netherlands’ building industry until recently. Jan: “This is a standard metallic zinc coating according to ISO 4042 (>5 micrometer Zinc) covered with an extra organic coating such as epoxy and Teflon. Because of the threading such layers are very thin, however also very effective. Screws with duplex coating are already available in building stores and bolts will be available for the building industry soon (coming from industry and oil & gas). Hanging constructions such as wires, cables and ceiling hooks are readily available, and new products will follow.”

NACE Standard
As far as Jan is concerned, galvanized steel as a minimum and preferably the duplex coatings should become the
new standard in swimming pools, in combination with regular mandatory inspections. With regard to stainless steels the 6% Mo grades 1.4529 and 1.4565 are suitable as well. He is the initiator, author and chairman of Task Group 498 for a world-wide standard that is being developed by NACE, an international organization of specialists in materials and corrosion associated with the United Nations and ISO. The upcoming NACE Standard contains a list of appropriate materials and enforces a mandatory inspection in accordance with common international methods. The standard recommends the risk-based inspection method as a suitable and reliable way of inspection. The Task Group has suggested to convert the NACE standard in a US Building Code. Other countries are also encouraged to do this, such as the Netherlands. Controls regarding the use of materials for swimming pool safety in the Netherlands do not yet have a distinct legal status. The Dutch Parliament asked several questions to the minister about the Tilburg accident. Apart from a letter to the Dutch Parliament and a report from the TNO (Dutch research institute) and the issuance of a guideline in 2004, no further action has yet been taken. The Normalization Institute of the Netherlands (NNI) is still developing a Practical Guideline for the Netherlands (NNP). The need for stronger measures is demonstrated by three recent accidents. In 2013, in the city of Dordrecht, a lamp weighing almost 20 kilos suddenly fell from a height of 14 meters when its stainless steel bolts gave way. As the incident happened at night nobody was affected. “An important point is that this pool had only opened two years before. This is how quickly things can go wrong,” warns Jan.

Last year a stainless steel cable in a lift for disabled people spontaneously broke, causing the occupant to fall into the water and sink to the bottom while still bound to a stretcher. Three guards were able to rescue this person at the last moment. The most recent incident was when a heavy mounting plate fell after the stainless steel bolts holding it in place broke on March 7 of this year, in the city of Waddinxveen. The pool had been completely renovated in 2011 meaning rupture occurred within a short time span. And many incidents and accidents outside Netherlands are known, among others in Russia, Germany, Croatia, USA and France. By far most incidents, in fact near-accidents, have never been reported.

Chlorine plays a role
Stress corrosion cracking of stainless steel objects in swimming pools environments occurs due to the presence of chlorine amine in the air in combination with temperatures over 20°C. Chlorine amine is a volatile gas and a reaction product of free chlorine in water with human waste products containing ammonia, mainly urine. These volatile gases condense on metal parts in the atmosphere and form a very thin layer of aggressive hydrochloric acid on the surface. The fact that the fasteners and ceiling hooks are usually cold formed and that the thread of a bolt is cold-rolled also plays a role because cold-worked materials are far more susceptible to stress corrosion cracking than hot rolled or annealed stainless steels are. Stainless steel is only affected in this way when it is exposed to the indoor swimming pool atmosphere. When the stainless steel is applied under water or frequently becomes wet, no stress corrosion cracking can occur because the hydrochloric acid will be washed away. Galvanized steel is not suitable for use under water or in situations where it will regularly become wet. In the atmosphere with chlorine amine, the zinc layer on galvanized steel resists 5-15 years.

Today the regulations in the Netherlands still remain complex and are not transparent, at least not for swimming pool managers. Jan believes that it’s only a matter of time before the next incident occurs, and that the solution is as effective as it is simple: develop a proper standard (or NPR) and don’t allow the use of any materials other than those listed in this standard. If such materials are discovered during an inspection, the inspector immediately can reject them, referring to this standard. During the building phase, the construction companies are responsible for use of safe construction materials. Jan has appealed to construction companies to issue proper materials specifications for fasteners and hanging constructions in the swimming pool atmosphere. When the NACE Standard is released, they can refer to that for materials selection of such elements. Once the building is in use and unsafe materials are found during an inspection, the owner or operator (the maintenance department) of the swimming pool will be responsible for proper repair. The NACE Standard will solve the problem.

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