TG11:20

Stress Corrosion Cracking in High Tensile and Alloy Steels

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Stress Corrosion Cracking (SCC) is the formation and growth of cracks through certain materials when subjected to tensile stress and specific corrosive environments (see Figure 1) and can lead to unexpected sudden failure of normally ductile metals. This process can especially occur at elevated temperatures. SCC is highly chemically specific in that certain alloys are likely to undergo SCC only when exposed to a small number of chemical environments. The chemical environment that causes SCC for a given alloy is often one which is only otherwise mildly corrosive to the metal.

SCC can occur in many different types of materials, including aluminium, high tensile, stainless, carbon and low alloy steels, each affected by a number of different environments.

Fine cracks can penetrate into the material, whilst most of the surface remains un-attacked. (See Figure 2). Such fine cracks can be very difficult to detect. Hence, metal parts with severe SCC can appear relatively corrosion free, whilst being filled with internal microscopic cracks. Mechanical failure can therefore occur unexpectedly, with minimal material loss.

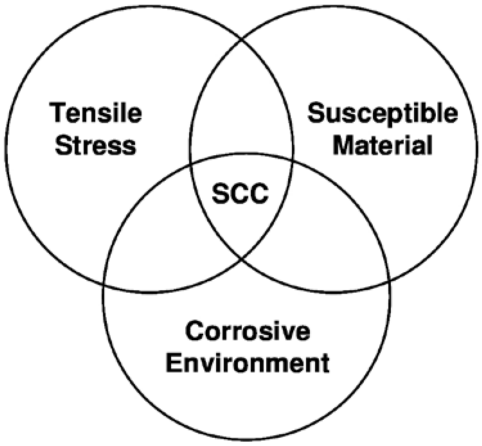

Figure 1
(Conditions Required to Induce SCC)

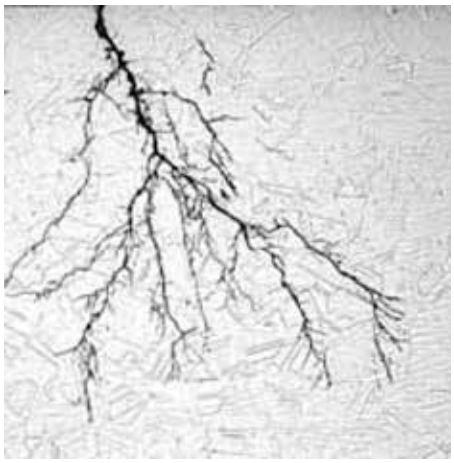

Figure 2
(Microstructure of Metal Displaying SCC)

SCC often progresses rapidly and is more common among alloys than pure metals. The specific environment is of crucial importance, and only very small concentrations of certain highly active chemicals are needed to produce catastrophic cracking, often leading to devastating and unexpected failure.

Some products which in normal use give satisfactory service, but can be affected by this phenomenon, are pipes, high tensile bolts, rivets, hollow rivets, anchor bolts, couplers and other types of fasteners which have 'locked in' stresses resulting from the manufacturing process. The stresses can be the result of the crevice loads due to stress concentration or can be caused by the type of assembly or residual stresses from fabrication or cold working.

Not all metal-environmental combinations are susceptible to SCC. In other words, the environment where SCC may occur is specific to each type of metal or alloy. This relationship is complex, so if there is any doubt regarding the material being used or the environment to which it may be subjected, the advice of a metallurgist or corrosion specialist should always be sought.

The client or site owner should also be consulted in order that the recorded behaviour of similar metals on the same site may also be taken into account.

NASC, 4th Floor, 12 Bridewell Place, London EC4V 6AP
Tel: 020 7822 7400 Fax: 020 7822 7401
enquiries@nasc.org.uk www.nasc.org.uk