The purpose and limitations of Silver Nitrate Testing

Sodium chloride found in seawater and as used to de-ice roadways is corrosive to steel. Silver nitrate testing of higher value steel cargos at the time of loading will detect chlorides present pre-shipment and can enable the Master to clause bills of lading as may be appropriate.

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Written by Adrian Scales

Steel products such as coils of rolled steel sheet, billets, tubes and steel plate are routinely presented for shipment at sea. The hot rolled steel products can at times be transported to outside shore storage and transit sheds without the provision of a covering or protection from the elements.

Steel products can be high value cargo that is susceptible to contamination from chlorides which are corrosive. Contamination from chlorides can occur at any stage of the transportation and storage process following production. Unfortunately, it is generally only during sea transportation that claims will be brought forward for alleged “seawater wetting” as it is an easy allegation that the contamination has been caused by undue exposure to the sodium chloride in seawater while the products are in the care of the Master on the ship.

Preliminary testing for the presence of chlorides can be carried out at any stage of the transportation process using an acidified silver nitrate solution. Silver nitrate ($AgNO_3$) in its pure form is a crystalline salt which has many commercial uses particularly in the pharmaceutical industry. For use in the marine industry, particularly when used for checking for chloride contaminants on steel products, a test solution is generally prepared in the form of two parts $AgNO_3$, two parts nitric acid (chloride-free) and 96 parts distilled water. The solution should be stored in a dark bottle. For use on site, the most common method is to utilise small dark bottles with dropper-type applicator.

The test for the presence of chlorides is simple. Using the dropper bottle, a small quantity of the silver nitrate solution is applied to exposed surfaces of any accessible steel products. If there are chlorides present, the solution will react and turn milky in colour. In our experience, the results obtained from a silver nitrate test on steel are as follows: Negative (no reaction), Brackish (limited reaction) or Positive (strong reaction).

Example of "positive reaction"

Example of a "negative reaction"

The key point to remember is that the test using the silver nitrate solution only gives an "indication" of the presence of chlorides, it does not give any indication of the source of these chlorides, nor of the level of chlorides. Silver nitrate is very sensitive and hence may give a positive reaction even with incidental traces of chloride. While it can be useful to confirm chlorides in a matter where there is clear evidence of an ingress on a vessel, for situations where the products are tested pre or post shipment, the results can be less conclusive.

Contamination of steel products with chlorides can occur from a multitude of sources as follows:

- during road transportation from manufacturers premises.
- during open storage within a port while awaiting transhipment.
- during a sea passage.
- during storage at a port post discharge.
- during road transportation to the receiver's premises.

With respect to pre-loading contamination, a source can be from the carriage of the products on the back of flat-bed open lorries during inclement weather or over the winter. During the winter, roads liable to icing are routinely salted using rock salt to try and help prevent the build-up of ice. By association, this potentially salt laden water will be disturbed by the movement of traffic and can result in a fine spray that

will cover the vehicles, and any unprotected steel products or equipment being carried on same. How often do you have to clean your car in winter? Think of the same deposits on uncovered steel products.

Similarly, while in storage at a port or terminal, there is the possibility that sea and/or dock water spray can be generated during periods of adverse weather. This water spray and/or mist can contaminate cargos in storage and in particular any uncovered products. Similar to the road transportation, dock/seawater wetted quaysides have the same potential for generating splash and spray over the products as products are moved around and placed near a vessel for shipment.

It is therefore recommended that where steel products are assigned for shipment by sea, it is good practice for comprehensive preload surveys to be conducted and fully documented. During these surveys, the steel products should be inspected and checked for the presence of chlorides, and this should be in addition to checking and recording the overall condition of the steel products and any packaging. On discovering the presence of chlorides it is important that a shipper's representative be made aware of the finding. If that item of cargo is subsequently shipped, the mates receipt should show the test finding and the relevant bills of lading should be claused with:

A positive result to a silver nitrate test at discharge does not mean that the cargo has suffered sea water contamination or been wetted during the sea passage. A positive result can also be obtained from condensation wetting that may have generated on internal hold surfaces. This condensation water can absorb salt residues from previous hold washing activities, or from the atmosphere, which can result in some light contamination and brackish results on the surface of the steel products within the space.

Positive results are regularly used to challenge the carriage conditions on the vessel, which, as highlighted above, may well be inaccurately alleged, and can create unnecessary complications during the offloading operations.

In summary, the silver nitrate test should be seen only as a means of establishing the presence of chlorides. If there are any doubt as to the origins of those chlorides, then further chemical analysis and testing would be necessary.