Analytical Report on the Failure of the [redacted] Tanker on [redacted].

On the night of [redacted] was lost due to a tanker failure on a side road off [redacted].

The tanker was of mild steel construction, and had recently been lined with mild steel sheet for extra thickness. The failure occurred by slow corrosion on the underside of the tank, through the liner, then eventually the main body of the tank. The photograph below reveals the nature and eventual extent of the corrosion through both of these layers.

Sections of this tanker were sampled for chemical and metallurgical analyses, so as to ascertain the cause of the failure.

Specifically, two samples were prepared for analysis by Electron Probe Microanalysis using the Energy Dispersive Spectrometry (EDS) system of the JEOL JEM800 microprobe at QUT’s Analytical Electron Microscope Facility.

The first sample was a section of the liner material, cut across a corroded weld joint and sectioning some of the liner material well away from the heat-affected zone. The second sample prepared was from the outer tank.

It was sought to determine if any of the following factors contributed to the failure:

- Compositional differences in liner and tank material causing a galvanic reaction with the contents.
- Difference in liner and weld wire composition causing a galvanic reaction with the contents.
- Reactivity of any of the tank materials towards the tank contents.
- Possible contaminants in the tank contents causing reactivity towards the tank materials.

EDS analyses of all steel samples (including the weld) confirmed that they were all of mild steel with similar compositions, and therefore unlikely to have contributed to any galvanic corrosion.

The corrosion surfaces were then examined by EDS to reveal any signs of reactivity of the tank material towards tank contents or contaminants. The phosphoric acid being carried at the time expected under normal circumstances to form a passivating layer on the steel surface which prevents extensive corrosion.

In the present case, sulphur and phosphorus were identified at both the "inner" and "outer" interfaces of the liner material, consistent with the phosphoric acid cargo being carried at the time. However, significantly, zinc was also found on both surfaces.

This element is a marker for [redacted] material [redacted]. It should be noted here that chloride was not identified in the current analyses, because it would have been lost during the subsequent spill clean-ups, truck wash-down, and the sample removal and preparation procedures. However, the zinc was incorporated in the corrosion products, and its presence suggests that a significant quantity of the chloride was remnant in the tanker at the time of pick-up of the phosphoric-based material.

It is therefore concluded that the chloride had promoted corrosion by interfering with the passivation of the steel. This loss of passivation then allowed the phosphoric acid to corrode the tanker material to failure.

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