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STATEMENT – 21 JUNE 2010

DOES THE NFI ANALYSIS CONFIRM THE PRESENCE OF HYDROGEN SULPHIDE IN THE PROBO KOALA'S SLOPS?

As stated previously, it is the opinion of Minton, Treharne and Davies Ltd. that, on a complete and accurate reading of the NFI Report, hydrogen sulphide could simply not have existed in its molecular form in the Probo Koala's slops.

To interpret the NFI Report as meaning that the slops contained 0.5% hydrogen sulphide is simply not correct and demonstrates a fundamental misunderstanding of the position and a serious misinterpretation of the NFI Report itself.

Background to this public statement

Certain elements of the media as well as other parties continue to misinterpret and misrepresent the Netherlands Forensic Institute's report on the composition of the Probo Koala's slops (the NFI Report).

In this public statement Minton, Treharne and Davies Ltd seeks to provide a clear explanation as to the nature of the tests carried out on the samples taken from the slop tanks of the Probo Koala as well as what the resulting analyses detailed in the NFI report actually means.

To do this, Minton, Treharne and Davies Ltd has undertaken a detailed review of the NFI Report in the context of:

1. the chemistry of the slops; and
2. the nature of the tests undertaken by the Netherlands Forensic Institute.

Hydrogen sulphide and its chemistry in alkaline solutions

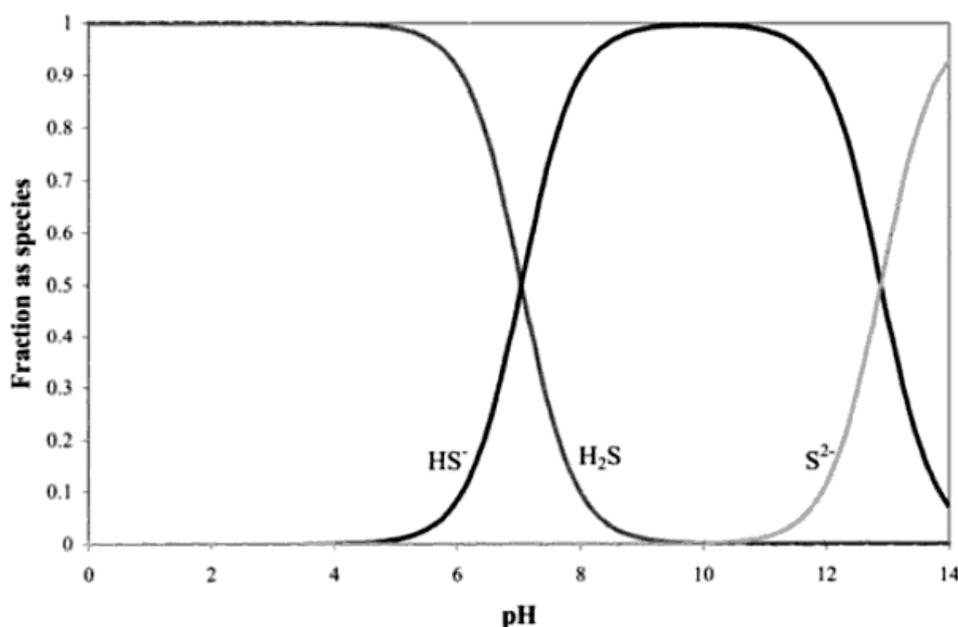
Hydrogen sulphide is a colourless, flammable gas at room temperature with a characteristic odour of rotten eggs. The odour of hydrogen sulphide is detectable at very low concentrations in air, ranging from 0.0005 to 0.3 ppm.

Hydrogen sulphide is an acute toxicant – namely the risk it poses is directly linked to both concentration and the duration of a single exposure event.

Hydrogen sulphide is produced both naturally and as a result of human activity. For example, hydrogen sulphide is found naturally in some crude petroleum, natural gas, volcanic gases and hot springs. It is also sometimes released from stagnant or polluted waters, manure and coal mines.

Importantly hydrogen sulphide is soluble in alkaline solutions. Its behaviour once dissolved will be dependent upon the pH of the solution into which it is dissolved.

As the diagram below illustrates, in highly alkaline conditions, any hydrogen sulphide (H₂S) will dissociate into its ionic forms (i.e. bisulphide (HS⁻) and sulphide (S²⁻)).



Source: 'Odours in wastewater treatment: measurement, modelling and control', By Richard Stuetz, Franz-Bernd Frechen, IWA Publishing, 2001

Did the slops contain hydrogen sulphide?

The Probo Koala's slops comprised of two phases, an alkaline aqueous phase and a hydrocarbon phase. Hydrogen sulphide, if present, would be far more soluble in the alkaline aqueous phase than in the hydrocarbon phase. Hence, any hydrogen sulphide would have partitioned into the aqueous phase rather than remaining in the hydrocarbon phase (i.e. all of it would have actively transferred into the aqueous phase).

As clearly stated in the NFI Report, the aqueous phase of the slops was highly alkaline (pH of 14) due to the presence of sodium hydroxide (NaOH). As explained above, due to this high alkalinity (pH 14), hydrogen sulphide in its molecular form simply could not have been present in the aqueous phase – it would have dissociated into its ionic forms.

In order for hydrogen sulphide to have then been generated and, as a result, released from the slops (i.e. for the bisulphide (HS^-) and sulphide (S^{2-}) to have been converted into hydrogen sulphide) in quantities sufficient to have caused the alleged deaths and serious injuries, a very significant amount of acid would need to have been added to the slops. To put this in context, based on the NFI Report and taking a conservative approach, it is our opinion that approximately 200 litres of concentrated hydrochloric acid would have been required to neutralise 1m³ of the aqueous phase of the slops to generate and, as a result, permit the release of hydrogen sulphide in any concentration that might be harmful to human health. From the evidence we have seen, there is absolutely no evidence of any such acidification taking place in respect of the slops in Abidjan.

So what does the 0.5% hydrogen sulphide figure actually mean?

There were two types of test carried out by the NFI to determine the presence and concentration of sulphides in the slops.

The first, a qualitative test (i.e. confirming the presence of a substance – e.g. there is sugar in a cup of tea), was carried out by the NFI using headspace gas-chromatograph mass spectrometry (GCMS).

As explained above, hydrogen sulphide would not have been present in its molecular form in the slops due to the high alkalinity. However, in order to carry out the qualitative testing exercise, referred to in the NFI Report, first it would have been necessary to change the

chemical composition of the slops. Accordingly, the laboratory acidified the slops by adding large quantities of hydrochloric acid. It was only under these conditions (i.e. following acidification) that the bisulphide and sulphide present in the slops would have been converted into hydrogen sulphide. For the avoidance of doubt, hydrogen sulphide was not present in its molecular form until the chemical nature of the slops had been materially altered via an additional process.

The second, a quantitative analysis (i.e. calculating the quantity of a substance – e.g. there are 4g of sugar in a 150ml cup of tea), was commissioned by the NFI and carried out by a third party laboratory.

The hydrogen sulphide figure was derived using the UOP (Universal Oil Product) test method 163.¹ Crucially, this method does not differentiate between the forms of sulphide present; any sulphide detected is reported as hydrogen sulphide (even where no hydrogen sulphide is actually present in the unaltered sample – as is the case with the slops).

Accordingly, the figure of 0.5% reported by the NFI represents the *total sulphide* present in the slops (not actual hydrogen sulphide).

In conclusion, it is the opinion of Minton, Treharne and Davies Ltd. that, on a complete and accurate reading of the NFI Report, it is clear that the alkaline slops did not contain hydrogen sulphide and therefore, hydrogen sulphide would not have been released.

¹ Entitled 'Hydrogen Sulphide and Mercaptan Sulfur in Liquid Hydrocarbons by Potentiometric Titration'.