Measurements in Cracked Ammonia

When measuring the percentage dissociation of ammonia it is important to understand what your instrument is reading, because definitions vary with the industry in which the measurement is being carried out.

This note discusses the methods used and how to get the best level of accuracy for your measurements.

When ammonia dissociates it does so according to the following chemical equation:

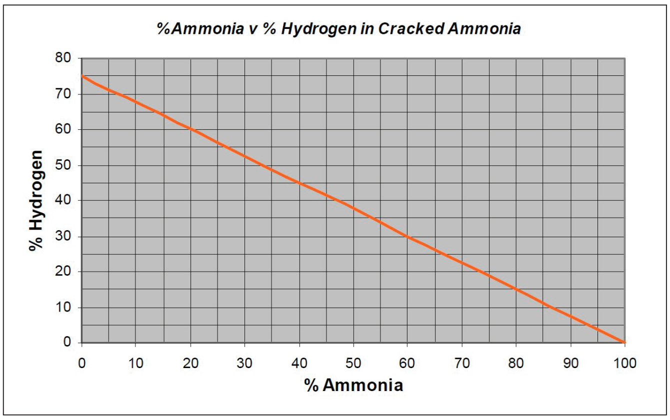
$$2NH_3 = N_2 + 3H_2$$

For a partially dissociated situation (proportion x) it can be written:

$$NH_3 = 0.5 \times N_2 + 1.5 \times H_2 + (1\text{-}x)\ NH_3$$

So hydrogen, ammonia and nitrogen will be present in precise proportions depending on the degree of dissociation.

Hydrogen has a significantly different thermal conductivity to ammonia and nitrogen, which means that a measurement of the mixture's thermal conductivity allows the amount of hydrogen and hence the amount of ammonia to be calculated. The graph above shows this relationship.



Instruments are available scaled in %Hydrogen, %Ammonia or %Dissociation.

Definition of %Dissociation

It can be seen from the equation above that when ammonia dissociates to form nitrogen and hydrogen, the volume of gas produced is greater than the original volume of ammonia. If 100 volumes of NH_3 fully dissociates it produces 50 volumes of N_2 and 150 volumes of H_2.

If only half the original volume of NH_3 is dissociated and the other half remains unchanged, then the mixture produced comprises 50 volumes NH_3, 25 volumes N_2 and 75 volumes H_2, a total of 150 volumes of which the ammonia is 1/3 or 33%. Because only half of the original ammonia has dissociated then in normal chemical terms it would be referred to as 50% dissociated. However, it is the practice in the metal treatment industry to calculate the '% of Dissociated Ammonia' by measuring the percentage of ammonia remaining in the dissociated mixture and subtracting it from 100%.

This approach does not take into account the volume change that takes place and in the above example this would give a result of 66.7%. When Eaton scales its instruments in '% Dissociation' for this application it uses the 'metals-industry' definition and not the 'true' chemical one.

The MTL katharometer based thermal conductivity analysers are ideal for making measurements of these mixtures. They are very stable devices, and six monthly calibration or verification periods are more than adequate. For this procedure only hydrogen and air are required, both of which are easily obtained.

Note: The MTL Z1550 model is used in this type of application.

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