Ammonia: Teacher Notes

Desulfurisation of natural gas

Strong-smelling sulfur compounds such as ethyl mercaptan (thioethanol) are added to natural gas as it is brought ashore. These are added to make leak detection easier; they are called odorisers or stenching agents. To prevent the catalysts being poisoned, they have to be removed, along with naturally-occurring sulfur compounds in the gas. The essential chemistry is:

$$[S] + H_2 \rightarrow H_2S$$

$$H_2S + ZnO \rightarrow ZnS + H_2O$$

where [S] represents the sulfur in the compounds.

Even if the natural gas were supplied without the stenching agent, desulfurisation would still be needed to remove the naturally-occurring sulfur compounds.

Carbon dioxide removal

This occurs in the two tall towers shown on the video clip. In the left hand tower, carbon dioxide is absorbed in an aqueous solution of potassium carbonate, forming potassium hydrogencarbonate:

$$CO_2(g) + K_2CO_3(aq) + H_2O(l) \rightarrow 2KHCO_3(aq)$$

In the second tower, the potassium hydrogencarbonate is decomposed by heat to form carbon dioxide (for sale) and to regenerate the potassium carbonate, which is reused. Most of the carbon dioxide is sold as a liquid.

Conversion

The degree of conversion of 15% is not the equilibrium conversion under the conditions of temperature and pressure that are used in the plant; the gases pass through the converter too quickly for equilibrium to be reached. The figure below shows the equilibrium conversion of nitrogen and hydrogen to ammonia under different conditions of temperature and pressure.

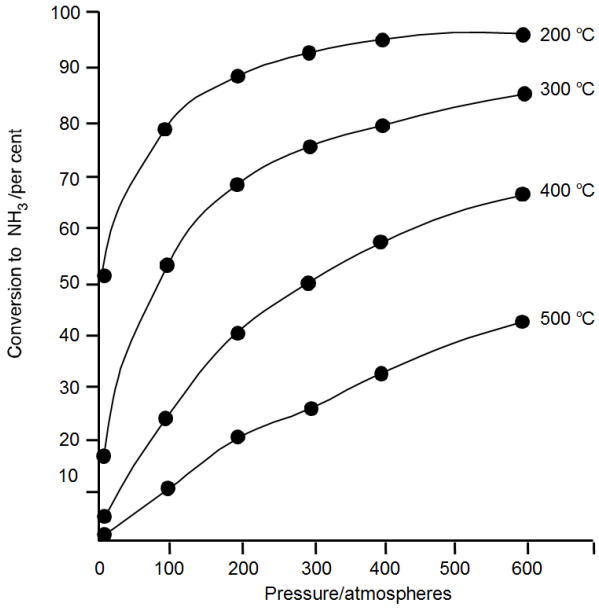

Figure: The equilibrium conversion to ammonia under different conditions.