The uses of Ammonia, Nitric Acid and Sulphuric Acid in the manufacture of inorganic fertilisers Why are they required, are there any problems with their use, e.g pollution, if so, how are they overcome?

By Laura Bateman

Fertilisers are compounds given to plants to promote growth, they are usually applied either through the soil for uptake by plant roots, or by foliar feeding for uptake through leaves. Fertilizers can be organic (composed of organic matter), or inorganic (made of simple, inorganic chemicals or minerals). They can be naturally occurring compounds such as peat or mineral deposits, or manufactured through natural processes (such as composting) or chemical processes (such as the Haber process). They typically provide, in varying proportions, the three major plant nutrients- nitrogen, phosphorus, Potassium (N-P-K), the secondary plant nutrients- calcium, sulphur, magnesium (Ca-S-Mg) and sometimes trace elements or micronutrients with a role in plant nutrition (Boron-B, Chlorine-Cl, Manganese-Mn, Iron-Fe, Zinc-Zn, Copper-Cu and Molybdenum-Mo). Both organic and inorganic fertilisers are called manures, derived from the French expression for manual tillage, but this term is now mostly restricted to organic manure.

Inorganic or artificial fertilisers are formulated in appropriate concentrations and combinations for various crops and growing conditions. The most popular inorganic fertilisers include: anhydrous ammonia, a gas that is 82% nitrogen; urea, a solid compound containing 46% nitrogen and diammonium phosphate, containing 18% nitrogen and 46% phosphate. Ammonia is most commonly used as a fertiliser and applied directly to the soil from tanks containing the liquefied gas. Agricultural industries are the major users of ammonia, as it is a very valuable source of nitrogen that is essential for plant growth. The most important single use of ammonia is the production of nitric acid. A mixture of one part ammonia to nine parts air is passed over a platinum gauze catalyst at 700 ºC - 850ºC, ~9 atm, whereupon the ammonia is oxidised to nitric acid.

There are many problems associated to using these inorganic fertilisers, here are to name a few. Inorganic fertilisers sometimes do not replace trace mineral elements in the soil which become gradually depleted by crops grown there. This has been linked

to studies which have shown a marked fall (up to 75%) in the quantities of such minerals present in fruit and vegetables. The problem of over fertilisation is primarily associated with the use of artificial fertilisers, because of the massive quantities applied and the destructive nature of chemical fertilisers on soil nutrient holding structures. The high solubility's of chemical fertilisers also exuberate their tendency to degrade ecosystems. Storage and application of some nitrogen fertilisers in some weather or soil conditions can cause emissions of the greenhouse gas nitrious oxide (N2O). Ammonia gas (NH3) may be emitted following application of inorganic fertilisers, or manure or slurry. Besides supplying nitrogen, ammonia can also increase soil acidity (lower pH, or "souring"). Excessive nitrogen fertiliser applications can also lead to pest problems by increasing birth rate, longevity and overall fitness of certain pests. For these reasons, it is recommended that knowledge of the nutrient content of the soil and nutrient requirements of the crop are carefully balanced with application of nutrients in inorganic fertiliser especially. This process is called nutrient budgeting. By careful monitoring of soil conditions, farmers can avoid wasting expensive fertilisers, and avoids the potential costs of cleaning up any pollution created as a by-product of their farming. Also, inorganic fertilisers are presently produced in ways which cannot be continued indefinitely. The application of sulphuric acid may result in the charring of the soil and reduction of pH in soil and water. The effect of an application that is not so large leads to a reduction of about 0.2 pH points. The compound is not persistent and the buffering capacity of the soil and water is likely to return the pH to an acceptable level within a relatively short period. Sulphuric acid is known to break down relatively quickly, reducing the possibilities with long tem effects on the environment.

The growth of the worlds population to its current figure has only been possible through intensification of agriculture associated with the use of fertilisers. There is an impact on the sustainable consumption of other global resources as a consequence. The use of fertilisers on a global scale emits significant quantities of greenhouse gas into the atmosphere. Emissions come about through the use of fertilisers that use nitric acid or ammonium bicarbonate, the production and application of which results in emissions of nitrogen oxides, nitrous oxide, ammonia and carbon dioxide into the atmosphere. By changing processes and procedure, it is possible to mitigate some, but not all, of these effects on anthropogenic climate change.