



# CADMIUM IN FERTILISERS

**Cadmium is a naturally occurring element, a metal that is present at trace levels in the earth's crust, in water and in the air. In its pure form, it has a melting point of 321°C. It is used in a range of everyday objects, most notably in NiCd batteries. It is also found in yellow, red and orange pigments that are used to colour plastics, ceramics, glasses and enamels. It has excellent resistance to corrosion, and is often used in coatings for materials that will be exposed to alkaline or salt-water conditions.**

## How does cadmium get into fertilisers?

Phosphate fertiliser is normally made by reacting specific types of phosphate rock with acid. The rock used for this may be either igneous or sedimentary. Igneous rocks (formed by the cooling and solidification of magma) tend to have a relatively low amount of cadmium. However, they also have relatively low levels of phosphate. An exception is the Kola igneous deposit, found in Russia, which has a 17% phosphorus content.

However, more than 80% of the world's production of phosphate rock comes from sedimentary rock. Sedimentary rocks are formed by the compaction and cementation of sediments – the slow settling of the remains of phosphate-rich bones of prehistoric fishes and other marine life in what was (millions of years ago) a shallow sea.

This can be imagined as a sort of soup, with phosphate molecules floating through it. These molecules react with calcium (also floating in the soup) to make apatite –  $\text{Ca}_5(\text{PO}_4)_3$ . This binds to other compounds to make different types of apatite, e.g. fluorine to make fluorapatite, or hydroxyl groups ( $\text{OH}^-$ ) to make hydroxyapatite.

However, other elements may also be floating in this soup, including cadmium. The cadmium reacts with phosphate groups, forming an insoluble compound that gets distributed

through the sedimentary material. The cadmium complexes do not cluster together, but are dispersed through the sediment, much the same way that sugar is dispersed through a cake.

As the formation of these phosphate rocks is a natural process, it means that any impurities (such as cadmium) that were present when the rock was created, are trapped in the fabric of the rock. They are still there when the rock is mined for use in phosphate fertiliser manufacture.

## Can cadmium be removed from phosphate rock?

With current methods of manufacturing superphosphate, it is not possible to economically remove cadmium from the end product.

Cadmium can be partially removed by heating the rock to extremely high temperatures, but this has a side effect. It calcines the phosphate, meaning that it cannot be used to make superphosphate. Cadmium is removed from phosphate rock during the manufacture of phosphoric acid (which is used to make DAP and triple super), but this cadmium ends up in a phosphogypsum sludge waste product, giving rise to disposal issues.



Phosphoric acid is used to make products such as DAP and triple super. Its lower cadmium content effectively dilutes the concentration of cadmium in the phosphate fertiliser, which is why DAP and triple super are lower in cadmium, on a per kg phosphorus basis.

### Reducing cadmium in phosphate fertilisers

During the manufacture of superphosphates, no loss of product occurs. In other words, all of the phosphate and cadmium that is present in the rock is retained in the final product. As a result, the most effective way to minimise the level of cadmium in superphosphate is to select raw materials that naturally have relatively low levels of this material. This is a balancing act, since it is also important that the raw material contains sufficiently high levels of phosphate, low odour and good reactivity and granulation properties, so that the final product is acceptable economically and agronomically.

At Ballance, Superten is made with rock from a number of different deposits. Depending on the individual characteristics of the rock available for manufacturing purposes, the rocks may be blended together to produce a final product that contains the required level of phosphorus for the fertiliser, and also restricts cadmium content to the lowest practicable level.

The New Zealand fertiliser industry has put in place a voluntary standard that means all phosphate fertilisers supplied by companies that are members of the Fertiliser Association of New Zealand contain less than 280 mg cadmium per kg phosphorus. The industry has had a cadmium reduction strategy in place since the mid 1990s.

### Levels of cadmium in phosphate fertilisers

Ballance regularly tests its fertiliser to ensure product quality control is effective and to protect the interests of its customers. The following table details the typical cadmium content of some common phosphate fertilisers.

The cadmium content of RPRs varies depending on the source of the product. The range given here is representative of RPR products that have been imported into New Zealand in the past. RPR must also have acceptable physical and agronomic qualities in order to perform as a satisfactory phosphate fertiliser.

When assessing the impact of the cadmium content of a

fertiliser, it is important to take into account the amount of phosphate also present. Imagine two products have the same amount of cadmium (e.g. 20 ppm) but one product contains 10% phosphorus and the other 20%. In order to apply the required amount of fertiliser phosphorus, a farmer would need to use half as much of the more concentrated phosphorus fertiliser, so reducing the cadmium load being applied to the land. Reporting cadmium content levels in mg/kg phosphorus helps to make the comparison between different products easier.

In a cadmium-sensitive environment, more refined fertilisers such as DAP or triple super may be preferable. If this is the case, other nutrients may need to be blended in, e.g. sulphur. Choice of phosphate fertiliser should also take into account the agronomic needs of the property, e.g. readily available phosphate versus a slowly released phosphate.

Fertiliser	Phosphorus content (%)	Cadmium content (mg/kg P)
Superten	9.0	150-280
Pasturezeal G2 5K	5.9	150-280
Sulphurgain 30S	7.0	150-280
Pasturemag	5.8	150-280
Serpentine super	6.8	150-280
Triple super	20.5	3-100
RPR	12.5	56-280
DAP	20.1	3-150
YaraMila Complex	5.2	<50

**TABLE 1**

Typical cadmium contents of some common phosphate fertilisers. Note that DAP and triple super usually have very low cadmium levels (<20 mg/kg P), but on rare occasions a shipment may have higher levels

