

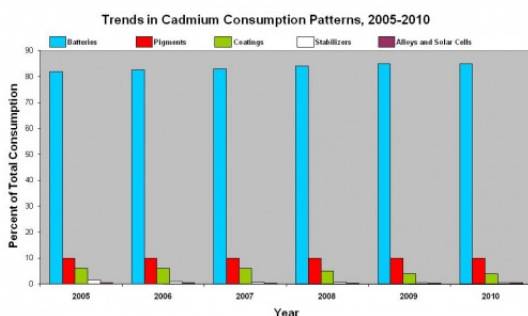


The following article was written by Soiltech Soil Scientist, Dave McKie MAgSc (Hons)

CADMIUM

What is Cadmium?

Cadmium (Cd) is a widespread, naturally occurring, element that is present in soils, rocks, waters, plants and animals. The chemical symbol for cadmium is Cd. It occurs naturally with deposits of zinc and phosphorus but, unlike these nutrients, it is not currently considered to be essential for life.



What is Cadmium Used For?

Predominant use is the manufacture of nickel-cadmium batteries, paint pigments.

Why is Cadmium Important? Cadmium is toxic to humans and other animal species. It can accumulate in humans, with high levels affecting human health, particularly bone disease and kidney damage. Therefore, it is crucial to limit our long-term exposure.

How do Humans Intake Cadmium?

Through food and water consumption, smoking and occupational (workplace) exposure. Recommended guidelines for safe intake of cadmium are 1ug/kg body weight. World Health Organisation data from June 2010 suggest that Cd intake levels for men and women (averaged across the globe) have declined from a monthly intake of 15ugCd/kg of body weight in 1960 to a level of 5ugCd/kg of body weight by 2000.

Sources of Cadmium

Natural levels in NZ soils range from less than 0.1 to 0.5 milligrams per kilogram, or about 0.1 to 0.7 kg cadmium per hectare in the top 10 centimetres of soil. This reflects levels found in the earth's crust. Levels of cadmium in NZ soils:

Average of all soils	0.16mgCd/kg soil
Agriculture/horticulture soils	0.35mgCd/kg soil
High superphosphate use	Up to 2.5mgCd/kg soil (Dairy - Taranaki 0.66; Waikato 0.60)

Superphosphate and other fertilisers

Superphosphate (super) is manufactured by attacking a rock phosphate rock source material with sulphuric acid. If the source material includes Cd as a significant contaminant, then Cd (which was not removed during the manufacturing process) is applied to the soil as a by-product of superphosphate application.

Since 1997, NZ fertiliser manufacturers have voluntarily limited the cadmium content in super to 280mgCd/kg P in the fertiliser (this is audited as part of the Fertmark process). Earlier superphosphate was made from rock phosphate from Nauru which had high levels of Cd contamination i.e. 600mgCd/kg P in the superphosphate. Some rock phosphate sources contain only trace amounts of cadmium e.g. guano. Other P fertilisers not derived from rock phosphate rock (DAP, MAP) generally contain low levels of Cd contamination. RPR fertilisers contain the same amount of cadmium as is found in the source material.

Rain and irrigation water generally have very low cadmium concentrations. Some sewage sludges (biosolids) may contain a significant amount of cadmium as an impurity. Other organic wastes and manures may also contain cadmium. Cadmium in the atmosphere may be high in the vicinity of industrial activities such as smelting. In most agricultural regions the amounts added to the soil from the atmosphere are minimal.

Cadmium Sources

Phosphate Fertilisers	41.3 %
Fossil Fuel Combustion	22.0 %
Iron & Steel Production	16.7 %
Natural Sources	8.0 %
Non-ferrous Metals	6.3 %
Cement Production	2.5 %
Cadmium Products	2.5 %
Incineration	1.0 %

Soil Properties and Cadmium Availability

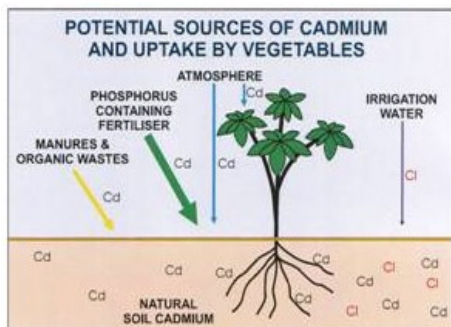
Cadmium availability is influenced by several soil properties. Plants uptake cadmium through their roots, but uptake is lowest when soil pH is higher (6.2); organic carbon (organic matter) levels are higher and levels of soil calcium (Ca), iron (Fe) and zinc (Zn) are adequate. High levels of chloride (Muriate of potash) can increase cadmium uptake. Sandy soils (low clay and organic matter) are generally worse than soils with a higher cation exchange capacity (CEC) in terms of problems of cadmium availability.

Soil organisms are negatively impacted by excessive cadmium exposure. Thus using superphosphate with high cadmium contamination is a double negative i.e. the biology is “naked” by very acidic levels that result during granule assimilation. Soil biota not killed at assimilation are then impacted by high cadmium levels.

Cadmium is removed from the soil by: plant uptake, erosion processes and leaching – especially from sandy soils. (Erosion and leaching simply move the cadmium somewhere else).

Plant Uptake of Cadmium

Cadmium is concentrated in particular parts of plants. As a general rule, leaves contain the most Cd, followed by storage roots and tubers, and then seeds or grain and fleshy fruits. Fleshy leaf crops (lettuce, spinach) tend to have higher levels than pumpkin, cucumber etc. Storage root crops (garlic, parsnip, carrot, beetroot, onion, potato) can also all contain significant levels of cadmium, depending on levels present in the soil.



Note: Diets low in Ca, Fe and Zn can be problematic for both humans and animals, particularly in humans for females of child bearing age with a tendency to anaemia.

What Can I Do If My Soil Cadmium Levels are High?

1. Reduce superphosphate fertiliser additions i.e. only apply the phosphorus you need, or better yet, use a phosphorus fertiliser with low cadmium contamination (guano, DAP etc).
2. Don't apply high levels of chloride in either fertiliser (KCl) or irrigation waters.
3. Maintain pH > 6.0 and ensure levels of plant available Ca, Fe and Zn are adequate.
4. Maintain or increase levels of soil organic matter.

Fertiliser Management Where Cadmium Levels are High

There is a cadmium management group in NZ. They have proposed the following guidelines related to cadmium. Proposals also include testing farms for cadmium every 5 years.

1. Tier 1 No limit on P fertiliser application where soil Cd levels < 0.6mgCd/kg soil
2. Tier 2 Restriction on P fertiliser products & application rates where Cd < 1.0mgCd/kg soil
3. Tier 3 P fertiliser products & application rates to be managed where Cd < 1.4mgCd/kg soil
4. Tier 4 No further accumulation of Cd permitted when Cd > 1.8mgCd/kg soil

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