

Ballance











HOME ABOUT BALLANCE PRODUCTS PUBLICATIONS NEWS EVENTS IN THE COMMUNITY IN YOUR REGION YOUR FARM TYPE EDUCATION LINKS

FERTILISER BASICS

Manufacture of
Superten

FERTILISERS IN THE

FERTILISERS AND PLANTS

FERTILISERS AND ANIMALS

NEW ZEALAND GRASS GRUB

NITRIFICATION INHIBITORS

Manufacture of superten

Superten is Ballance's single superphosphate. The manufacture of superten follows the same processes as the manufacture of any single superphosphate, i.e. it is achieved by reacting phosphate rock with acid.

Raw materials

The first step in manufacturing superten is the acquisition of raw materials. There are two main raw materials used in superten – phosphate rock and sulphuric acid.

The phosphate rock used in making superten comes from several different countries around the world.



This rock was formed millions of years ago, when the land where it is found was still a shallow sea. The remains of prehistoric fishes and other marine life settled on the bed of the sea, along with layers of precipitated phosphates. The layers of phosphate-rich material grew over time, until they were metres thick. Over the ages, geological activity of the earth's crust raised the seabed, until eventually the shallow seas became land.

At one mine, in North Africa, the layer of phosphate-rich rock is 2 to 4 metres thick, 50 kilometres long and 8 kilometres wide. This makes it relatively easy to mine, although the scale of the operation is enormous.

The first step in mining is to blast away the overburden – the layer of material sitting on top of the phosphate rock layer. This overburden material is then pulled away by the use of a drag chain and transferred to other areas that have already been mined.

Once exposed the phosphate rock layer is mined and transported on a series of open conveyor belts to a processing plant, some 100 kilometres away.





Processing, also called beneficiation, of phosphate rock primarily involves washing it to remove waste material and increase the phosphate content. The rock is washed first with seawater and then with fresh water, which is produced locally in desalination plants. After the rock has been dried it is transported to the end of a 3 kilometre-long wharf, specially built to enable the loading of bulk cargo ships.

The rock is transported to New Zealand and is off-loaded at Mount Maunganui, Whangarei or Bluff, and is transported from the wharves to Ballance's manufacturing plants.

The other raw ingredient in superten manufacture is sulphur, which is used to make sulphuric acid. Sulphur is purchased by Ballance from several sources. At Whangarei, molten sulphur is bought from the Marsden Point oil refinery, where it is recovered for environmental benefits by extracting it from the crude oils. The other main source of sulphur is the natural gas industry, where it is a by-product. Sour gas wells contain hydrogen sulphide (H_2S) , which can be removed by reacting it with sulphur dioxide (SO_2) .

2H₂S + SO₂ » 3S + 2H₂O

This is known as the Claus reaction.



Preparation of sulphuric acid

Ballance manufactures sulphuric acid at both its Mount and Whangarei plants. At Awarua, the sulphuric acid is bought in ready-made.

The process starts with the melting of elemental sulphur. The resulting product is filtered to clean it up, then pumped through a nozzle into a burner. At the same time, air is forced in from a blower, which oxidises the sulphur, yielding SO₂ and some unreacted O₂ gas.

After cooling and filtration, these gases are passed through a multi-stage catalytic converter containing vanadium pentoxide, forming ${\rm SO}_3$. The gases are cooled once more, and the ${\rm SO}_3$ is adsorbed into 98.5% sulphuric acid (${\rm H_2SO}_4$). This produces sulphuric acid with a concentration greater than 98.5%, and this acid is then diluted back to 98.5% strength, and stored in steel tanks. At this strength, the acid is chemically unreactive.

All of the steps involved in the manufacture of sulphuric acid are exothermic, that is, they give out heat energy. This heat is not allowed to go to waste. It is removed throughout the process by heat exchangers, and is used to generate steam. The steam is fed to a turbine and used to generate electricity, which is used by the plant.

The electricity produced as a by-product of sulphuric acid manufacture is sufficient to meet nearly all of the site's needs. In fact, at times there is an excess, which is fed into the National Grid.



Before the sulphuric acid can be used in the manufacture of superten, it needs to be diluted, so that it becomes reactive. This is done in one of two ways - either by diluting it with hydrofluosilicic acid (which is created during the manufacture of superten), or by first diluting it with water and then diluting it further with hydrofluosilicic acid. Both methods are exothermic, but the second process results in the production of much less steam, and is the method of choice at Ballance's Mount Maunganui site.

Preparation of phosphate rock

Compared to the manufacture of sulphuric acid, the preparation of phosphate rock is quite simple. Essentially, coarse rock is passed through a mill to grind it to finer particles. The smaller the particle size, the more efficient the subsequent manufacturing process. The grinding process has a feedback loop in it, so that any material that has not been ground fine enough the first time through is fed back to the mill for further processing. The process does create rock dust, but this is captured by a dust collector and added to the material to be turned into superten.

In order to get the final concentration of phosphate in superten, it's important that the starting concentration of phosphate in the rock is correct. If the main rock being used in the process has too much phosphate in it, this is diluted out by adding some rock with a lower phosphate content.

Manufacture of superten



In the first step of the superten manufacturing process, sulphuric acid (usually diluted to 70% concentration) is added to a mixer, along with the phosphate rock. Paddles in the mixer help ensure the material is thoroughly mixed, a process that takes less than one minute.

After this the material drops into a box known as the den, which is where the curing process starts. The acid continues to react with the rock, but at a slower rate than in the mixer. The slurry moves slowly along a conveyor, sitting in the den for anywhere between 20 and 40 minutes.

By the time the material gets to the end of the den it has formed into a damp, porous cake. Knives at the end of the den shave product from this cake, and it enters the conditioner, where other substances may be added to make specific superbased products.

Material only stays in the conditioner for around 20 seconds, then it enters the granulation drum, where the rotating movement helps in the formation of dense granules.

This step is important, because it increases the stability of the product and produces a fertiliser that spreads easily when applied by machine.

Any oversized particles are removed by a screen and fed to a pulveriser, where they are broken down to a smaller size and returned for further granulation and screening. As superten granules are formed that meet the quality requirements for the product, they fall onto a conveyor belt and are moved to storage.