

Tabled at Council Meeting
20 July 2017 → item 4

COMMENTS ON THE EMISSIONS FROM THE
YALDHURST QUARRIES

Deputation

What they are quarrying: Greywacke rock

This is a very common rock type in New Zealand that is used for gravel, aggregate and land fill. The extensive quarries besides the Old West Coast Road quarry greywacke, and crush it and sort it for the Christchurch rebuild. Greywacke contains between 30% and 50% of silica dioxide, a fact that has been known for over hundred years. Although silica dioxide is a common component in many types of rocks, it is relatively harmless in nature (although not always so), but it can become very dangerous when crushed, sawn, worked, run over, or otherwise disrupted by human activities, such as quarrying. When released by human activity from the bound matrix of the greywacke rock, the silica dioxide is in the form of minute, sharp-edged, multicoloured crystals which are so small they are invisible to the naked eye. They can be lifted in to the air and carried by air movements for considerable distances (between 500 m to 1.5 km). While airborne the crystals may be breathed in by quarry workers and by nearby residents. If they are airborne and can be inhaled they are called respirable crystalline silica (RCS). I have attached a photomicrograph taken at very high magnification through a microscope that shows that these respirable crystals are very small and have sharp edges and points. They also refract light beautifully giving a range of colour just like diamonds. They are lovely, but deadly.

Silicosis

When inhaled the RCS can bypass the defences in the larger airways of the lungs of mucus and cilia that line these larger airways of the lung, and pass down into the very smallest airways. Here they may cut into the cells of the lung epithelium, thus causing an inflammatory response which then results in scarring and a non-functional lung cell. Such a scarred cell is unable to transport oxygen to the blood, nor carbon dioxide out. So lung function is impaired, though not lung tidal volume, leading to shortness of breath, and worse conditions - much, much worse.

This lung disease is called silicosis and it has been known for centuries. In fact, it was the first lung disease to be recognised. It can kill if the sufferer loses lung function after prolonged exposure. It is incurable, but can be arrested if the source of the problem, the respirable crystalline silica, is stopped. But RCS can also cause heart disease, cancer (it is classified as a carcinogen in most countries and as a presumptive carcinogen in New Zealand), kidney disease and a number of other diseases depending on the physiology of the patient. All of these conditions can be fatal.

International regulations aimed at reducing silicosis

Most countries have a number of regulations aimed at preventing silicosis. Avoiding quarrying silica-rich rocks close to homes or public areas is a common requirement throughout the world, though not in New Zealand. Setbacks or buffer zones between the quarry and the quarry boundary of between 500 m and 1.5 km are common in other countries, such as India and Australia, but not in New Zealand where setbacks of a mere 25 m have been allowed. However, the ERA in New Zealand now recommends a best practice guideline of a setback of 500 m.

The reasons why such large setback are demanded is because the invisible silica dust travels much further than visible dust.

Another problem in New Zealand practice is the requirement for bunds in quarrying consents aimed at reducing the incidence of dust. But bunds are now known to make the situation worse by forcing an airstream to deflect higher in the air thus causing the finest dust to travel further. In many countries dust fences tend to be favoured; though not in New Zealand.

Other operating requirements are the sealing of every surface where trucks and diggers operate is often mandatory. Other surfaces may be required to be irrigated continuously in order to keep the dust down. High efficiency face masks must be worn by staff. And crushers and other dust-emitting equipment may have to be enclosed. Semi-continuous monitoring may be required and staff examined at regular intervals for signs of silicosis.

New Zealand quarries are a long way behind the rest of the world in these preventative measures for reasons unknown to me. The information about the extremely harmful effects of silica

dust has been known for centuries and modern information is readily available especially since the growing realisation of the dangers has prompted many governments to conduct more and more research into the causes of silicosis. The WHO has is attempting to eradicate silicosis by 2020.

Why isn't silicosis better known in New Zealand

One reason silicosis slips under the radar may be that it is very hard to diagnose in its early stages. And if death does occur then the cause may be ascribed to one of the secondary conditions caused by the silica, such as cancer, without anyone realising that the primary cause was inhaled crystalline silica dust.

The effect of silica dust on quarry neighbours

Traditionally, the focus of regulations was on the health and safety of workers. But of late much more attention is being paid to the effects on non-occupational neighbours of quarries. In 2010 L J Bhagia published a comprehensive review of studies that showed that respirable crystalline silica can seriously affect residents living near to dust emitting industries. Residents may be affected continuously (24/7/52), whereas workers are exposed only during working hours (8/5/48). Bhagia reported three major findings:

- 1, non-occupational residents can be very seriously affected by silica dust discharges from nearby quarries;
- 2, risk is cumulative, not non-cumulative as assumed by regulations; and
- 3, that permissible exposure limits should be a mere 5 μg of respirable crystalline silica per m^3 of air. Below that level people living near quarries are safe. Above that some, or many, will develop silicosis.

After 40 years of prompting by experts and by NIOSH, the US regulatory authority, OSHA has recently lowered the permissible exposure limit to 50 $\mu\text{g}/\text{m}^3$ on a time weighted basis. It has been suggested that resident's exposure should be at least half or less of that (<25 $\mu\text{g}/\text{m}^3$). But if modern research is correct then the permissible exposure limit should be 5 $\mu\text{g}/\text{m}^3$.

ECAN's study – further analysis

In a study conducted by ECAN (Air Quality Investigation: Yaldhurst Quarries. Report Number R16/30) an exposure limit of 150 $\mu\text{g}/\text{m}^3$ was taken as the critical limit. This is fine for non-silicaceous dust, but is totally inappropriate for respirable crystalline silica. Even so, a dangerously frequent number of exceedances was recorded. In most country one such exceedance per annum is enough to trigger cessation of operations until adequate mitigation is instituted.

Although I have not been provided with the original data so that I can conduct analyses, I did manage to show the number of exceedances at the level of 50 $\mu\text{g}/\text{m}^3$. This indicated frequent exceedances. A level of 5 $\mu\text{g}/\text{m}^3$ would indicate nearly continuous exceedances.

Medical conditions shown by residents

The neighbours to this large zone of very active quarrying are showing disturbing medical conditions. They are experiencing wheezing and coughing, bleeding from the nose, eye irritation, shortness of breath, lung inflammation, dental problems, problematic blood chemistry, and general weakness, all of which are listed in the literature as being possible signs of early stage silicosis. The residents have been protesting for many years the development of quarries so close to their homes, but little has been done since dust experts, who didn't know that greywacke is made up of large amounts of silica, assured the Environment Court and Commissioners that the dust nuisance is "less than minor." Well, it isn't. And the amazing belief common in New Zealand regulatory authorities that only visible dust matters is risible.

We all agree we need quarries, that is a given, but like many human activities quarrying must be carried out in ways that do not endanger the health and well being of workers and residents. Other countries manage this; why can't we?

Kelvin Duncan ,PhD

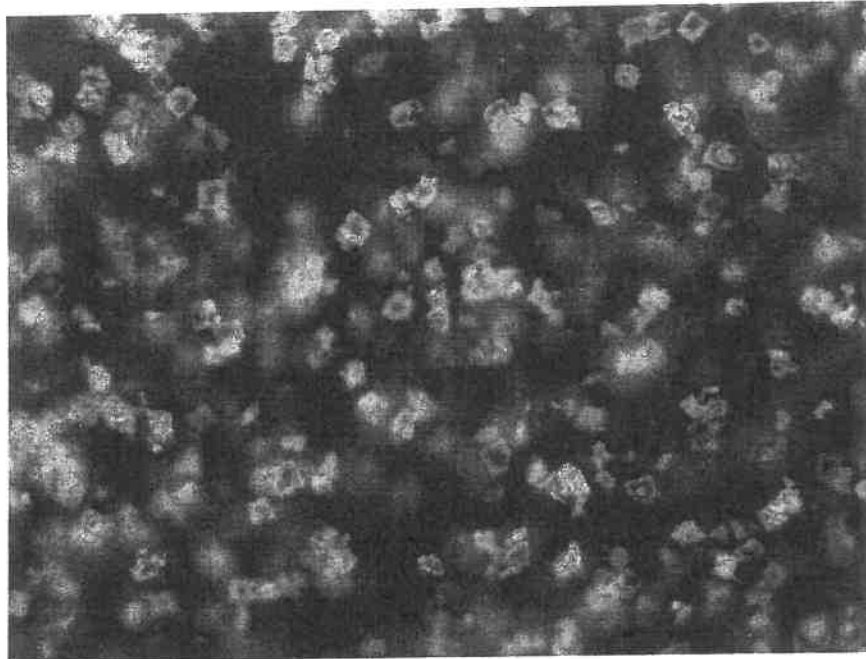


Illustration 1: Yaldhurst quarry dust taken from a resident's home. The average size of the particles is between 2.5 and 5.0 μm which makes them invisible to the naked eye.

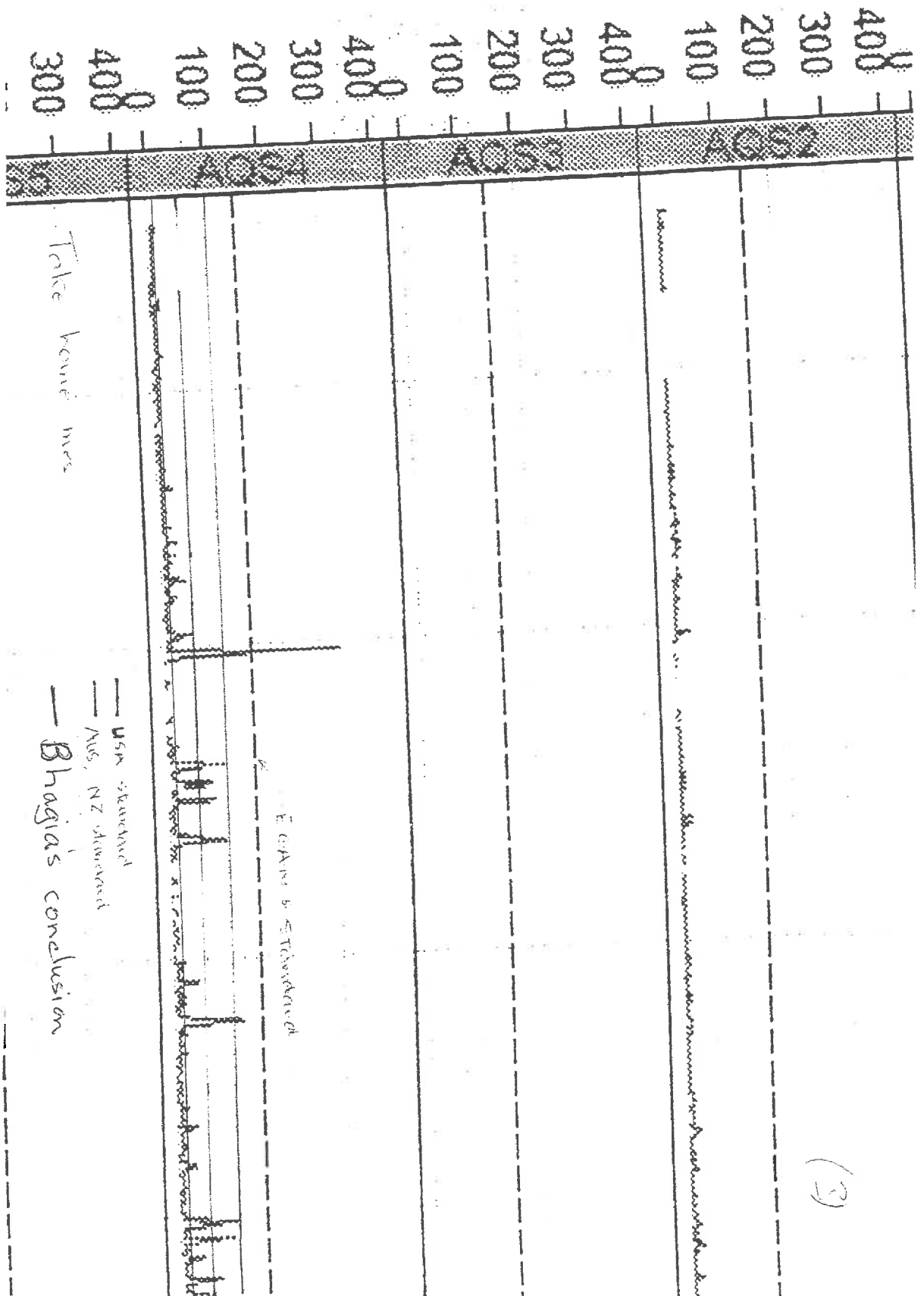


Illustration 2: Reworking of one of ECAN's graphs to show the exceedances with more modern and realistic exposure limits.