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Office of the Ministerial Inquiry into the Management
of Certain Hazardous Substances in the Workplace.
P.O. Box 3705
Wellington

31/1//003

**Re:** Ministerial Inquiry into the Management of Certain Hazardous Substances in the Workplace.

Thank you for the opportunity to make a submission to this Inquiry. I have noted in the Guidelines for Participation Introduction that this Inquiry is particularly focused on the use of glutaraldehyde, other aldehydes, and solvents.

I am the Technical Manger of the Otago Centre for Electron Microscopy at the University of Otago. The chemicals glutaraldehyde and formaldehyde; and the solvents ethanol, acetone, methanol, propylene oxide and chloroform are used routinely in our Centre and are essential to our work.

The staff of the Otago Centre (6 staff) are very much aware of the dangers of these chemicals. They do everything they can to ensure all users of our facility, who are required to use these chemicals, are also fully informed of the dangers and the correct handling procedures.

In use, these chemicals are handled in small quantities, in the order of 5 to 20 mls, at any one time. All usage is undertaken in the laboratory fume cupboards and while users are wearing appropriate safety equipment.

We also have in place appropriate disposal procedures and spillage control procedures.

It would be fair to say that the level of respect these chemicals are now given in our Centre has not always been the case,. Certainly in the early days of my career there where many researchers who did not give much regard to the safe handling of these chemicals, in fact little regard to all chemical safety issues. These people normally did not have to much respect for those who wanted to be more cautious either.

From my perspective, I have been very conscious of the dangers of the aldehydes in particular, but also solvents, since Marjorie Gordon became very out spoken about the use of glutaraldehyde in x-ray darkrooms in the late 1980's, and the Australian Amanda Warwick become outspoken about the use of glutaraldehyde as a disinfectant in hospitals in the early 1990's.

Glutaldehyde, formaldehyde (made up fresh from paraformaldehyde) and the solvents listed above are essential in all biological research endeavours using electron microscopy, and all undergraduate teaching programmes involving electron microscopy. Without these chemicals there would be no electron microscopy-based biological research or teaching undertaken in New Zealand, or around the world.

Electron microscopy is also used as a diagnostic tool in many hospitals. In these situations the work is normally contracted out to a nearby electron microscope unit.

Biological electron microscopy is undertaken in nearly every university around the world. Each university in New Zealand has an electron microscope unit, as do many Crown Research Institutes.

I would like to outline how these chemicals are used in electron microscopy.

<u>Aldehydes</u>

To study a biological specimen in the electron microscope (there are two basic types of electron microscope, the transmission electron microscope and scanning electron microscopy) the biological specimen must first be removed from its natural environment. This could be from a culture dish for bacteria, a leaf from a plant, sea weed from the ocean, an slice of an organ from an experimental animal, or a biopsy specimen from a human patient.

In all cases the living cells will start to change immediately in response to being removed from their natural environment. This is because of the loss of natural physiological and biochemical factors. The scientist studying an organism, or the pathologist diagnosing a disease, does not want to view the specimen in an altered state, they wish to study the cell in as close to the living state as possible.

The cell therefore needs to be stabilised as quickly as possible after removal from the host so as to minimise these changes. To date the chemicals that have been the most effective at preventing these cellular changes has been glutaraldehyde, and to a lesser degree formaldehyde. The process of stabilising the cells and preventing change is called fixation.

For the last 40 years these two chemicals have been the standard fixative chemicals for electron microscopy all around the world. No better, or safer, alternative has yet been found.

The aldehydes work by penetrating the cells quickly and cross linking proteins within the cell without any significant structural distortion from their original state. The aldehydes essentially become a chemical component of the proteins they cross link.

Solvents

The inside of the electron microscope is under an extremely high vacuum. This is to allow the undeflected path of electrons from the electron source at the top of the microscope to an imaging device lower down. If any air molecules, or other gas molecules, are inside the microscope column the electron beam would be deflected and usable images would not be formed.

A high vacuum is also required to allow the electron gun to generate a stream of electrons.

Unfortunately, all biological, specimens to be examined in the electron microscope contain a high proportion of cell water. In all investigations this water must be removed from the specimen. If the cell water is not removed then when the specimen is placed inside the high vacuum of the microscope the cell water would boil off and the high vacuum compromised.

The removal of the cell water must be gradual to protect the delicate structures inside the cell. To remove cell water we use a graded series of solvent, usually ethanol, followed by propylene oxide. However, for special applications, we sometimes need to use methanol and acetone.

Again these solvents are the standard for electron microscopy all around the world. No better, or safer alternative has been found in this time.

We also use ethanol to clean electron microscope components during service operations. In the past we used freon however, as the environmental concerns with freon usage become better known, we switched to ethanol as the next best chemical to use.

The solvent used in cleaning electron microscope parts must be able to absorb moisture, leave no absolutely residue, be easily and safely disposed of, and be able to be handled in as safe as possible way.

To date, no other chemical has satisfied this criteria.

Chloroform is essential to us for making ultra-thin (approximately 80 nanometre thick) plastic support films which are essential for viewing many biological specimens.

Summary

Glutaraldehyde, formaldehyde, ethanol, methanol , propylene oxide, acetone and chloroform are essential chemicals for the undertaking of electron microscopy related biological research and electron microscopy related undergraduate teaching. These chemicals are the global standard for the tasks they are required for. No better alternative has been found in the last 40 years.

In the electron microscope lab these chemicals are used in small quantities, and with appropriate safety equipment and precautions. There is a high awareness of the hazards involved.

To restrict or ban their use in electron microscopy would have a serious affect on biological research, on undergraduate teaching and on diagnostic evaluation where electron microscopy is used.

I am happy to discuss further, or expand on, any aspect of this submission.

Thank you for taking the time to read this.

Yours sincerely

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