# Middle Swan Primary School

## Report of the Environmental Protection Authority

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ISSN 1030 - 0120
ISBN 0 7309 1980 3

# MIDDLE SWAN PRIMARY SCHOOL

Complaints of the presence of an "airborne irritant" at the Middle Swan Primary School over the last eighteen months or so have been a cause of concern to Health and Occupational Health and to the EPA. No definite cause has been isolated despite:

. detailed testing of stack emissions at the brickworks and hospital and of air by the Chemistry Centre and EPA;

. detailed examination of the school buildings and surroundings by the Building Management Authority;

. examination of the history of the site;

. surveys of surrounding activities;

. medical examinations of students and teachers;

. epidemilogical surveys of students, teachers and residents.

There is, however, no doubt that some airborne irritant is present from time to time. Not only is there evidence from the students and teachers, but also the effect has been experienced by a technician from Murdoch University and by senior staff from Occupational Health, Safety and Welfare. The symptoms claimed by some teachers may now be also the result of sensitising.

If there is some airborne "irritant" affecting the students and staff at the Middle Swan Primary School, the two most likely sources now appear to be:

. the brickworks;

. the hospital incinerator;

The two major constituents of brickworks kiln flue gases (other than normal combustion products) are hydrogen fluoride (commonly called "fluoride") and hydrogen chloride ""acid gas"). Both gases are driven off when the clay is heated to brick firing temperatures. The hydrogen fluoride derives from fluorine salts and the hydrogen chloride from sodium chloride (common salt).

Fluoride

Fluoride emissions from Midland Brick have been a matter of contention for many years due to the high susceptibility of grape vines to damage by very low levels of fluoride gas. Damage can occur at concentrations as low as $0.3ug/m^3$ (micrograms per cubic meter of air) if exposure is continuous through the growing period. Other vegetation is affected at various levels up to a few $ug/m^3$, however, humans are much less sensitive - the occupational health limit is $2500ug/m^3$. No environmental standards are set for human exposure due to the vastly more stringent requirements needed to protect vegetation. Where no environmental standard exists it is common practice to obtain a 24 hour average standard by dividing the occupational limit by 30, therefore a 24 hour average level of, say $80ug/m^3$ would not be unreasonable as such a standard.

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As part of a general study of fluoride levels in the Swan Valley, EPA has been monitoring one-week average fluoride levels at various locations including the Swan Districts Hospital since July 1988, monitoring commenced at the school on 28 September 1988. The monitoring has shown some disturbingly high levels (from the viewpoint of vegetation damage potential), the highest being 2.83ug/$m^3$ for the week ending 5 October 1988. However, probably as a result of work done by Midland Brick to improve their scrubber efficiencies, there has been a general downward trend.

One week averages will obviously include many hours when no fluoride is present.

More recently measurements over shorter averaging times have been undertaken on behalf of the EPA by Dr Frank Murray of Murdoch University. Levels of up to 7ug/$m^3$ (7½ hour average) have been measured - still well below any level which would be expected to affect any but the most sensitive individual. Most measurements indicate levels below 0.5ug/$m^3$.

Acid Gas

During the firing of the clay, sodium chloride salt present in the clay is converted to acid gas; the gas is also generated in the burning of many plastics and would be expected to be present in the hospital incinerator flue gases. The gas is irritating when inhaled at excessive concentrations. The occupational health limit is 7000ug/$m^3$ - a level which most people would find distasteful.

A monitor was set up at the School in March 1989 to attempt to measure the presence of acid gas. The sensitivity of the monitor and its response to temperature fluctuations have made the data difficult to interpret but there appear to be some 16 occasions when elevated acid gas readings have been made.

Other "Irritants"

The hospital incinerator is fitted with an after-burner designed to raise the temperature of the flue gases to about 800°C. At this temperature most commonly burnt materials will be rendered harmless. The flue gases should be largely water vapour, carbon dioxide and hydrogen chloride. Some specialised materials may need higher temperatures for breakdown but they are likely to be present only in very small quantities.

The operation of the incinerator is a cause for concern. It has been observed on several occasions to be emitting dense black smoke and to be smouldering after the burning cycle. A "burnt plastic" odour can frequently be detected. These conditions could only arise if combustion is not complete. Under such conditions any number of odourous and irritating gases could be formed.

AN "EXPLANATION"

There is little chance that gaseous fluoride could cause the symptoms complained of, however, it can be measured relatively accurately and can therefore be used as a "tracer" for the brickworks emissions. Tests undertaken on behalf of the EPA by Dr Frank Murray of Murdoch University have revealed occasions when fluoride levels in the school grounds and near

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the hospital are as high as 7ug/$m^3$ over a 7½ hour period. Recognising that emissions are not uniformly mixed with the surrounding air as they travel from a source, it is conceivable that very short time episodes (small pockets of gas) could reach 70ug/$m^3$.

Measurements made on the various stacks at Midland Brick have shown a ratio of acid gas to fluoride ranging from 10 to 60. Assuming a near-worst case, acid gas concentrations could conceivably reach 3000ug/$m^3$ at the Middle Swan Primary School or the hospital. If such levels were to occur during periods of high humidity (perhaps enhanced by the steam emissions of the brick dryers) they could be irritating, particularly to sensitive or sensitised individuals.

Coupling the above possibility with a poorly operated hospital incinerator provides potential sources of irritation during almost still, humid conditions under both southerly and northerly air movements.

A SOLUTION

Brickworks: The limestone gravel and crushed limestone scrubbers fitted to the exhausts of the kilns are designed to remove fluoride, they also remove some acid gas. For fluoride they vary between about 50% and 85% efficiency. However, they are not very efficient at removing acid gas (about 35%). Similar scrubbers operating at another brickworks achieve about 95% removal of acid gases.

Differences are that Midland Brick has:

. higher temperature

. smaller limestone volume

. different limestone

. different limestone "regeneration" system

It should be possible to improve the efficiency of acid scrubbing.

Alternatively specific scrubbers could be installed for the purpose. It is not unreasonable to expect a reduction in acid gas emissions from the present total of about 30gram/sec to something less than 0.5grams/sec. Such modifications would take between 3 and 6 months depending upon their complexity.

Incinerator: Ideally the incinerator should be shut down and the waste burnt in a more appropriate facility. Failing this its operation should be much more closely controlled:

. feed rate should be reduced

. feed should be "homogeneous" to avoid slugs of wet material or explosions;

. burning rate should be increased (perhaps by 100%);

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. the hearth should be cleaned after each burn;

. the burning should be continuously supervised:

In addition to the above, the incinerator should be fitted with an acid gas scrubber.