

NEW ZEALAND NZAS ALUMINIUM SMELTERS LIMITED

INTERDEPARTMENTAL COMMITTEE REPORT

1991

REPORT TO THE INTERDEPARTMENTAL COMMITTEE ON ENVIRONMENTAL EFFECTS OF THE TIWAI ALUMINIUM SMELTER FOR THE YEAR ENDED 31 DECEMBER 1991

MEETING AT TIWAI 12th JUNE, 1992

THE INFORMATION CONTAINED IN THIS REPORT IS CONFIDENTIAL TO THE MEMBERS OF THE INTERDEPARTMENTAL COMMITTEE

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SUMMARY

The enactment of the Resource Management Act 1991 significantly changed the way in which New Zealand's resources will be managed. At NZAS the main impact was the transfer of accountability to the Southland Regional Council for all statutory environmental aspects of the smelter.

The overall effect of the smelter on the environment was relatively stable and at a similar level to previous years. The Grazing Monitor Project continued to indicate very little impact on the surrounding area and the Tiwai Experimental Farm Project was continued to study the effects closer to the smelter.

Some difficulties were experienced in particular areas of the operation and resources were allocated to deal with these as effectively and efficiently as possible. The work undertaken was:

A major paraclone replacement programme was initiated to restore the multicyclone dust collection system efficiencies. This was necessary due to an unpredictable increase in paraclone wear rate which overran the normal planned maintenance in the multicyclones and led to higher stack particulate emissions.

A detailed investigation into the sources of variation in the concentration of fluoride in the north drain continued. The focus of the work is to determine the underlying causes so that options for remedial action can be developed.

A total plant audit of oil handling, transport and containment systems was completed after leaks occurred due to pipe corrosion. The first instance, a heavy fuel oil leak, was cleaned up immediately with no residual effect on the environment. Work continues to remove the diesel fuel spill in the second instance and when complete a full soil clean up programme will be undertaken.

At NZAS each Manager directly holds the accountability for the effect of area operations on the environment. Work continues to be carried out by each Manager to continuously improve the systems to minimise these effects.

REPORT TO THE INTERDEPARTMENTAL COMMITTEE ON ENVIRONMENTAL EFFECTS OF THE TIWAI ALUMINIUM SMELTER FOR THE YEAR ENDING 31 DECEMBER, 1991

1. INTRODUCTION

The 1991 year was characterised by significant change. The enactment of the Resource Management Act 1991 resulted in significant changes to how New Zealand's resources are managed.

The Resource Management Act brought to an end the long association of NZAS and the Department of Health with respect to emissions to air and their effects. The accountability for these aspects is now vested with the Southland Regional Council. NZAS have assisted wherever possible with this transition. Continued attention will be given to establishing agreed practices and relationships in accordance with the new Act.

At NZAS the Process Improvement Team convened in late 1990 continued with the investigation into the stack gaseous fluoride concentrations. An Atmospheric Emissions Control MRU was established in mid 1991. The role of this MRU is to study the generation mechanisms for atmospheric emissions from the aluminium reduction process and to develop options for their control.

The accountabilities for the waste streams at NZAS have been reviewed and resulting changes have more closely linked the accountabilities to those managing the operations which generate the waste. In addition, Process Improvement Teams are working on minimising waste streams.

The format of this 1991 year's report has also changed. This report concentrates more on trends and environmental effects. Less emphasis has been placed on reporting compliance with numerical standards as this is subject to another reporting system recently developed for the Regional Council.

NZAS MONITORING SITES



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2: EMISSIONS TO AIR

The emissions to air from the smelter were subject to Discharge Permit No HD/19/0006/88. The following sections give details of the emission trends.



2.1 MAIN STACK EMISSIONS

The 1991 average stack total particulate concentration of 179 mg/Sm³ was significantly higher than the 1990 average of 141 mg/Sm³ and marginally exceeded the Permit Condition maximum. The concentrations were constant during the first 6 months and decreased in July and August when the alumina injection system was not operated. The concentration increased in September when the alumina injection system was restarted but continued to increase above the previous operating concentrations.

Accelerated wear of the paraclones in the Lines 2B, 3A and 3B multicyclones was identified as the cause. A paraclone replacement programme was initiated but more wear was detected than was originally indicated. The replacement programme will be completed by mid 1992, and paraclones will be regularly replaced in future to prevent a reoccurance.

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The 1991 average stack particulate fluoride concentration was 41 mg/Sm³ compared to 37 mg/Sm³ in 1990. This increase was also due to the accelerated wear to the paraclones in the Lines 2B, 3A and 3B multicyclones.

The annual average concentrations have increased in past years as a result of process optimisation activities. Additional comment is made in Section 2.1.3.



The 1991 average stack gaseous fluoride concentration of 63 mg/Sm³ was similar to the 1990 average concentration of 62 mg/Sm³. The alumina injection system on Lines 2B, 3A and 3B was improved during 1991 and the benefits are indicated by the lower concentrations during the spring and early summer.

The cumulative effect of the many changes to the aluminium reduction process parameters and operations since the mid 1980s has resulted in an overall increase in fluoride emissions. A Process Improvement Team and the Atmospheric Emissions Control Project MRU have, and are continuing to investigate the mechanisms causing fluoride generation. As a result some process operating improvements have been made to maintain the stack gaseous fluoride concentrations within the Permit Conditions.

2.1.4 Sulphur Dioxide Concentration

The 1991 average stack sulphur dioxide concentration of 171 mg/Sm³ was slightly lower than the 1990 average concentration of 174 mg/Sm³.

2.1.5 Ringelmann Smoke Density Number

The 1991 median stack Ringelmann smoke density number was 1.75 with a maximum observation of 3.0

2.2 POTROOMS ROOF LOUVRE EMISSIONS

2.2.1 Total Particulate Concentrations

1991 Monthly Averages





The 1991 average Potroom roof louvre total particulate concentration of 1.8 mg/Sm³ was similar to the 1990 average concentration of 1.7 mg/Sm³.

2.2.2 Particulate Fluoride Concentration

The 1991 average Potroom roof louvre particulate fluoride concentration of 0.38 mg/Sm³ was slightly higher than the 1990 average concentration of 0.35 mg/Sm³.



The 1991 average Potroom roof louvre gaseous fluoride concentration of 0.47 mg/Sm³ was an increase on the 1990 average concentration of 0.38 mg/Sm³. An abnormally high concentration was measured in December with no absolute cause being established.

The annual average concentrations have been increasing as a result of the changes to the aluminium reduction process parameters and operations. (Section 2.1.3.)

2.2.4 Sulphur Dioxide Concentration

The 1991 average Potroom roof louvre sulphur dioxide concentration of 0.97 mg/Sm³ was an increase on the 1990 average concentration of 0.85 mg/Sm³.

2.2.5 Pot Hooding Containment

The 1991 average Pot hooding containment was 96.6%, lower than the 1990 average of 97.1% Several alternative Pot hood designs are being trialled to improve the sealing above the Pot.

2.3 BAGHOUSE EMISSIONS

The regular visual inspection of baghouse emissions was continued. These inspections supported the on-going operational surveillance of this equipment which ensured the required standards were maintained.

3: DISPERSION AND EFFECTS OF EMISSIONS TO AIR

3.1 METEOROLOGICAL CONDITIONS

The mean wind frequency diagram shown on the following page indicates the typical Tiwai wind pattern with the predominant westerly wind components. There were less south-westerly and more north-westerly winds in 1991 when compared to the previous year.

Unfortunately only 10 months wind data are available from the Tiwai meteorological station for 1991 due to equipment failures. No wind data is available for June and December.

January and February were characterised by a high frequency of strong westerly winds. March and April were relatively calm. The strong westerlies prevailed in May but July and August were relatively calm. The strong westerlies returned in September and October but were of less strength in November.

TIWAI POINT MEAN WIND FREQUENCY (%) OF SURFACE WIND DIRECTIONS FOR THE YEAR 1991

(No data for June or December)



3.2 AMBIENT AIR GASEOUS FLUORIDE



The 1991 mean gaseous fluoride concentration at the 1km hut was 0.08 μ g/m3, and lower than the 1990 average of 0.14 μ g/m³. This site was introduced in 1987 as part of the project to incorporate computer based predictive dispersion modelling into the NZAS monitoring programme. The site was chosen so that the fluoride concentration was high enough to be measured by a real time continuous fluoride analyser. This will allow validation of the modelling predictions. The status of this project is that an automatic meteorological station was commissioned in 1990 and currently NZAS meteorological and emission data is being uploaded into the Bouyant Line Plume (BLP) model by our Brisbane-based consultant.



The 1991 mean gaseous fluoride concentration of $0.07 \,\mu\text{g/m}^3$ was higher than the 1990 mean concentration of $0.06 \,\mu\text{g/m}^3$. This site is at the outer extremities of the area likely to be affected by the Potrooms roof louvre emissions. The concentrations are still well below the documented limits for protection of sensitive vegetation species.



The 1991 mean gaseous fluoride concentration of 0.05 μ g/m³ was significantly lower than the 1990 mean concentration of 0.08 μ g/m³. The annual averages indicate higher concentrations in recent years.



The 1991 mean gaseous fluoride concentration of $0.09 \,\mu\text{g/m}^3$ is slightly higher than the 1990 mean concentration of $0.08 \,\mu\text{g/m}^3$ but there is insufficient data to establish whether a trend is emerging.





The Bluff site was established at the reservoir in 1987 but was moved to the works yard in late 1989. This move was to monitor closer to the residential area as well as attempting to eliminate regular loss of power to the equipment.

The 1991 mean gaseous fluoride concentration of $0.02 \,\mu\text{g/m}^3$ indicates a continuation of the very low concentrations in Bluff.

3.3 Ungrazed Grasses

The ungrazed grasses 1991 mean concentrations are shown in the map on the next page. Comparison with the 1990 mean concentrations indicates similar concentrations to the east but lower concentrations to the north and west.

UNGRAZED GRASS FLUORIDE CONCENTRATIONS

1991 MEAN CONCENTRATIONS



3.4 GRAZING MONITOR PROJECT

The Grazing Monitor Project was established in 1969, prior to smelter comissioning, to provide a method of assessing the effects on the livestock on productive farms. The Project has continued, with minor modifications, as part of the NZAS environmental monitoring programme.

3.4.1 Farm No 1 Pasture Fluoride Concentrations 1991 Monthly Averages











This farm is east of the smelter at Green Point. The annual mean pasture fluoride and urinary fluoride concentrations continue to be low. The high pasture fluoride concentration in July is not supported by the ungrazed grass monitoring at nearby sites and is unlikely to be due to smelter emissions.

Cattle bone biopsies were conducted on this farm and these indicated concentrations well below the recommended limits. The dental condition was assessed by the NZAS veterinary consultant and no change was indicated.



3.4.2 Farm No 2

Pasture Fluoride Concentrations



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This farm is 6 km north of the smelter. 1991 cattle urine samples were collected in April and the abnormally high urinary fluoride concentration of 24.1 mg/litre coincides with a high pasture fluoride concentration of 67 mg/kg for the previous month's sampling. The ungrazed grass monitoring does not indicate an increase in fluoride in the area during this period, although the deposit gauge indicated an increase in fluoride in April, but normal deposition in March. There was a relatively high frequency of low strength winds towards this farm in March compared with the rest of 1991. The data is inconsistent with an increase caused by smelter emissions, and it appears that top-dressing is the likely cause.

Cattle bone biopsies were conducted and the bone fluoride concentrations were lower than recent years' samples. The dental condition was inspected by the NZAS veterinary consultant and no change was indicated.



3.4.3 Farm No 3

Pasture Fluoride Concentrations

1991 Monthly Averages



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This farm is 18 km north east of the smelter. The pasture fluoride concentrations on this farm continue to be low.





Pasture Fluoride Concentrations





This farm is on the north coast of Awarua Bay, 7 km west of the smelter. The annual mean pasture fluoride concentrations continue to be relatively low although the monthly samples indicated higher concentrations in the spring of 1991. The meteorological data does not indicated an abnormally high incidence of wind towards this farm in the spring. This increase coincides with increased stack particulate emissions (Section 2.1.2) which may be a contributing factor.

The cattle urine samples were collected in March and higher than normal fluoride concentrations were measured. Bone biopsies were also conducted with the concentrations in the normal range for this farm, with no abnormal increase being detected. However deterioration in the dental condition was detected by the NZAS veterinary consultant.





This farm is 12 km north of the smelter and close to the Southland Cooperative Phosphate Co Ltd plant. The cattle urinary fluoride concentrations were normal for this farm.

This farm was removed from the project in September 1991 due to ownership and farm practice changes.





This farm is 13 km north of the smelter and is unlikely to be affected by the emissions. The pasture and cattle urinary fluoride concentrations continue to be low.

3.4.7 Farm No 9 Cattle Urinary Fluoride 1991 Monthly Averages





This farm is 15.5 km north-west of the smelter and is unlikely to be affected by the emissions. The cattle urinary fluoride concentrations remain low.









This farm is 25 km east-north-east of the smelter. The 1991 farm pasture fluoride concentrations were normal apart from an increase in December. This increase is also indicated by a nearby ungrazed grass monitoring site but not the deposit gauge.

The annual pasture fluoride concentrations were normal with no trends evident.









This farm is 5 km north-east of the smelter. The 1991 pasture fluoride concentrations were normal apart from a high concentration in April. The high concentration was not supported by nearby ungrazed grass monitoring sites. This farm is under the same management as Farm No. 2 which also indicated high concentrations about this time in 1991. Although unconfirmed, it appears topdressing is a likely cause.

The annual farm pasture concentrations are indicating a slight downward trend.





This farm is on the north coast of Awarua Bay, 9.5 km east-north-east of the smelter. The 1991 pasture fluoride concentrations indicate high concentrations in May and October. These are generally supported by ungrazed grass and other farm pasture monitoring, as well as occurring after periods of strong winds in the general direction of the farm. Smelter emissions are likely to be the main contributor to the high pasture fluoride concentrations.

The annual pasture fluoride concentrations do not indicate any trends.





Pasture Fluoride Concentrations



This farm is 15 km east-north-east of the smelter. No abnormal concentrations or trends were indicated.

3.5 TIWAI EXPERIMENTAL FARM

This project was established to support the Grazing Monitor Project. Its aim was to expose livestock to smelter emissions and to study the effects. It would also provide local veterinary officers with experience in diagnosing fluorosis.

The No 1 Farm is on the Tiwai Peninsula, 3.5 km downwind of the smelter. It was established in 1971. The No 2 Farm is at the eastern end of the the Tiwai Peninsula, 10km downwind of the smelter, and was established in 1973.







Jan

Feb

Mar

Apr

May



Jul

Aug

Sep

Oct

Nov

Dec



Jun

The monthly pasture fluoride and ewe urinary fluoride concentrations indicated considerable variation, similar to previous years. The annual concentration reflect the higher fluoride emissions since the mid-1980s (Section 2.1.2 and 2.1.3), but there is no evidence of a trend.

Bone biopsies were conducted and no increasing trend in bone fluoride concentrations was indicated. The dental condition of the sheep were assessed by the NZAS veterinary consultant and there is no indication of a trend of more severe dental abnormalities.











Ewes were grazed on this farm until 1986 when the project operation was changed to graze weaned lambs.

The 1991 monthly pasture and lamb urinary fluoride concentrations indicate considerable variation. The annual concentrations indicate higher concentrations since the mid 1980s, similar to the No 1 Farm concentrations.

4: DISCHARGES TO WATER AND THEIR EFFECTS

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The smelter's liquid discharges were subject to five Coastal Permits. The following sections give details of the trends for each Permit.





The 1991 annual average drain discharge fluoride concentration was similar to the previous year but the receiving water fluoride concentrations have increased. Preliminary work on characterising the dispersion of the drain discharge was conducted and this indicated very little dispersion in tidal conditions. The decision on conducting further dispersion investigations is dependent on the outcomes of the drain fluoride source investigation.

4.2 COASTAL PERMIT No 90058 - WEST DRAIN Discharge Fluoride Concentrations



Discharge Fluoride Concentrations



Discharge Suspended Solids Concentrations





significant trends.

An oil spill into this drain occurred on 30th June, 1991. Heavy fuel oil was released from a small hole in a reticulation pipe and some of this oil entered the west drain system through an inspection hatch. When the spill was detected the NZAS oil spill procedure was initiated. This involved isolating the source and installing additional oil collection equipment at the drain outlet.

The drain oil trap and the additional collection equipment retained almost all the spill. A small amount of oil required removal from the gravels at the drain outlet. Oil contamination on rocks and gravels in a small cove 0.6 km away from the drain was discovered several days after **Page 37** the spill. An on-site meeting between staff from the Southland Regional Council, Department of Conservation and NZAS decided that natural degradation was the best remedial action.

A review of the condition of all fuel pipes on the site was initiated as a result of this incident. NZAS continues to review the oil and fuel handling systems to identify and remedy system weaknesses.

4.3 COASTAL PERMIT No 90059 - SOUTH DRAIN





The south drain discharge suspended solids and fluoride concentrations, and the receiving water fluoride concentrations do not indicate any trends.

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4.4 COASTAL PERMIT No 90060 - SEWAGE PLANT Flow Rates







The sewage flow rate was reduced in late 1991 as a result of adjustment to the automatic cisterns. These adjustments will be more frequent in future.

The treatment plant continues to provide the required discharge quality and no trends were evident.

4.5 COASTAL PERMIT No 90061 - SPENT CATHODE LEACHATE











4.5.4 Receiving Water Total Cyanide Concentrations

Occasional high discharge suspended solids concentrations occurred in 1991 despite the use of flocculants and a field test to assess the quality before discharge. On most discharges the concentrations were very low.

No trends were evident in the discharge free cyanide concentrations which remained low.

Occasional high receiving water fluoride and intermittent high total cyanide concentrations occurred. A diffuser was installed on the outfall pipe in September but broke away later in the year. It was modified and reinstated in early 1992.

Past actions of changing the time of discharge and installing the diffuser have not eliminated the high receiving water concentrations. A Process Improvement Team was established to recommend options for eliminating the high concentrations. As a result of this team's work, two groups of consultants have been engaged to establish the ground and seawater movements near the spent cathode storage area.

No trends are evident in the receiving water fluoride and total cyanide concentrations.

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5: GROUNDWATER

A leak of diesel fuel into the ground on NZAS property was detected on 15 July 1991. The leak originated from obsolete buried pipework supplying heating fuel to one of the smelter buildings.

The obsolete pipework was removed and a programme initiated to recover the leaked diesel. Woodward Clyde (NZ) Ltd were engaged and a network of recovery bores were installed. This programme is ongoing and bioremediation will be used to remove the diesel residues when the recovery operation is completed.



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