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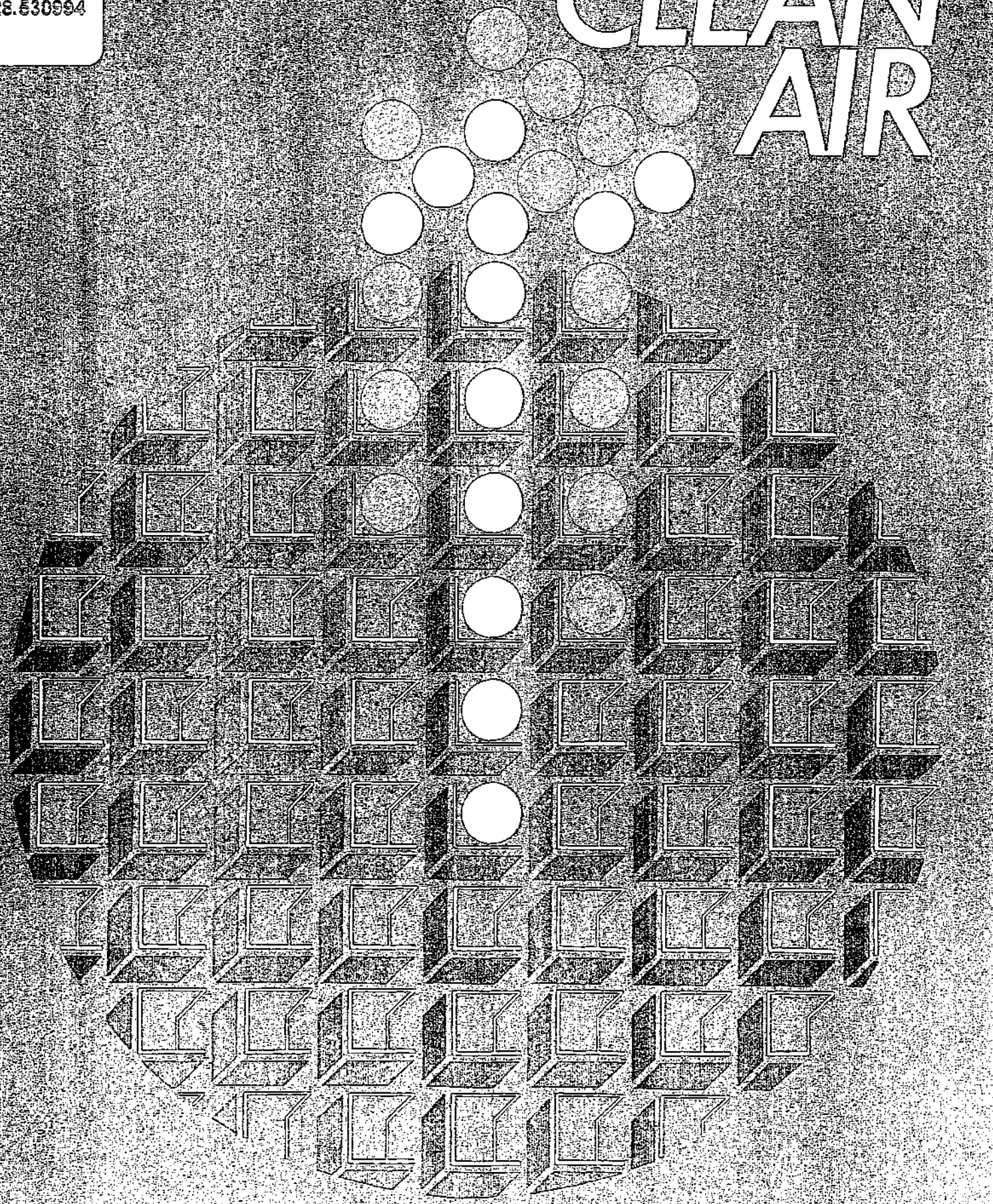

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The Clean Air Society of Australia & New Zealand has produced a number of publications ranging from Training Manuals to Conference Proceedings. These publications are available for purchase by Society members and others. The following publications can be obtained by forwarding the order form with payment to the Executive Officer, Geoff Angus. Prices include packaging and postage.

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AIR POLLUTION CONTROL MANUAL, 2nd Edition, 1990.	$90	☐
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CONFERENCE PROCEEDINGS		
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CLEAN AIR CONGRESS, SYDNEY, July 1986. (5 volumes)	$75	☐
8th INTERNATIONAL CLEAN AIR CONFERENCE OF THE CLEAN AIR SOCIETY OF AUSTRALIA & NEW ZEALAND, MELBOURNE, 1984. (2 volumes)	$20	☐
ECOLOGICAL RISK ASSESSMENT - From Theory to Practice, MELBOURNE, October, 1993.	$120	☐
LEGISLATION SUMMARY		
A SUMMARY OF AIR POLLUTION PREVENTION REGULATIONS IN EFFECT IN AUSTRALIA & NEW ZEALAND IN JUNE 1990.	$10	☐

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Clean Air Society of Australia & New Zealand,
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CLEAN AIR is the journal of the Clean Air Society of Australia and New Zealand
P.O. Box 191, Eastwood, N.S.W. 2122.
Telephone: (02) 325 5625
Fax: (02) 858 3854

ISSN 0009 - 8647

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SUBSCRIPTIONS
Annual Subscription rates (Inc. postage) for non-members and libraries:

Australia and New Zealand $A50.00

Elsewhere $A50.00
Single copies $A13.00
Enquiries about subscriptions, payment of invoices, and requests for back numbers should be directed to the Circulation Manager.

PUBLICATION DATES
Quarterly in February, May, August and November.
CLEAN AIR is listed in *Current Contents*

DEADLINES FOR COPY
Closing date for editorial material is 15th day of month prior to month of issue. Refereed articles should be submitted 3 months prior to date of issue.

The opinions expressed by authors and contributors are their own and do not necessarily represent the view of the Society.

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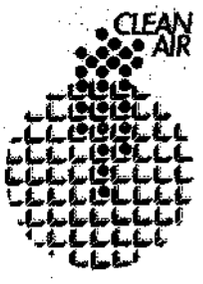

Editorial

ARE WE TRAINING THE RIGHT PEOPLE?

In many cases governments fail to adequately prepare people for the impact of new legislation, or educational programs are pitched at the wrong people. Consequently the best intended efforts do not necessarily have the desired effect.

Those of you who have been involved in air pollution for some time will recall the introduction of motor vehicle emission controls during the 1970s and particularly Australian Design Rule 27a which was introduced in 1976. I have always looked on this design rule as the greatest set-back for air pollution control that has occurred in this country. It was a case of ill conceived control devices being forced on a public who hated them and were unconvinced of their necessity. The result is of course history, the public's perception was reinforced by the motor mechanics and controls were removed at significant cost to owners.

I would like to compare what happened with motor vehicles with the current control of CFCs and halons. In the latter case it was recognised that the tradesman had an important role to play if these gases were not to be released during servicing. The decision was made to send these tradesmen back to school where they learned about the importance of the ozone layer and their own importance in the success or failure of the programm. The system was also tightened to keep the incompetent person out of the industry. From my viewpoint it was a rewarding experience. I found myself with several thousand inspectors who would ring me and demand action whenever their boss or some other person stepped out of line. But more importantly, in my conversations with these people it became apparent that they clearly felt good about playing an active role in an issue they recognised as important.

I compare the warm feelings I received from refrigeration and air conditioning mechanics in particular, with my experience over the years working in the potentially polluting industries registered under the Clean Air Act. I ask the question: how much more successful would we have been if the tradesmen and process operators working in these activities had been committed to clean air?

This was brought home to me a short while ago as I was performing an environmental audit for an organisation for which I have a high regard and whose management has always been conscious of its environmental responsibilities. The technology for emission control was very good, the control room with its closed circuit TV, very impressive. But as I strolled about the works I saw many instances of careless behaviour leading to fugative emissions; emissions that did not appear on the TV screen and of which management was oblivious. It was also clear that the workers saw nothing irregular in their behaviour.

This Society puts a great deal of effort into teaching mainly those who have responsibilities for mitigation of air pollution. Seldom do we have the opportunity to convince those whose actions are often directly responsible for a discharge and whose goodwill, like that of the refrigeration mechanic, could make a world of difference.

I suggest that all process workers and tradesmen working in potential polluting industries should be required to attend a course and sit a test on their knowledge of the consequences of air pollution from their industry. They should also be taught the fundamentals of air pollution control associated with that industry. They should be convinced of their importance in the environmental scheme of things.

I have no doubt that this approach would be opposed by some managments so ! offer another suggestion; it would be of great benefit to have the company bean counters sit an environmental awareness test so that they could truly understand their environmental responsibilities.

Alec Smith is President of the South Australia Branch of the Clean Air Society.

PRESIDENTS COLUMN

As I mentioned in the November 1993 issue, Special Interest Groups (SIG's) are proposed in a number of areas to promote the exchange of information and networking amongst Society members. Two further SIG's have now been established covering odour and indoor air quality.

Contact details for the Group Chairpersons are as follows:

- Modelling - Dr. Peter Manins
  CSIRO Division of Atmospheric Research Tel: (03) 586 7666 Fax: (03) 586 7600
  Private Bag No. 1, Mordialloc, Vic. 3195
- Odour - Mr. John Court Tel: (02) 804 7827
  JD Court & Associates Fax: (02) 858 3854
  PO Box 289, Eastwood, NSW 2122
- Indoor Air Quality-
  Mr. Dale Gilbert Tel: (07) 224 5070
  Q-Build Project Services Fax: (07) 224 6151
  Administrative Services Department
  GPO Box 2457, Brisbane Qld 4001

John Court has circulated a form enabling members to register their interest in the Special Interest Group - Odour. Thirty three members have responded to date. If any member has not received the circular, please contact John. The first meeting of the Group is planned for March 1994 in Sydney.

I would encourage any members with particular expertise in the above areas to become involved in the SIG's. The long term benefits both to individuals, and to the Society, will be considerable.

A review of the Clean Air Journal content and presentation has been undertaken by a Sub-Committee established following the Strategic Planning Workshop. The recommendations of that Committee are to be presented to the Society Executive in March. If anyone has suggestions or comments regarding the journal please contact the Committee Chairperson David Collins (Alcoa of Australia Ltd.) on (052) 451 534, or the Editor Jack O'Heare on (03) 807 1942.

Geoff Angus, Society Executive Officer, is currently drafting a questionnaire to members to enable a comprehensive member data base to be established.

The next meeting of the Society Executive will be in Auckland on the 27th March 1994. I look forward to meeting with the New Zealand members at technical meetings proposed in Auckland, Wellington and Christchurch following the Executive meeting.

The Honours & Awards Sub-Committee have prepared draft guidelines on criteria for granting the Clean Air Medal and the Distinguished Service Medal. I am'pleased to announce the awarding of Distinguished Service Medals to Stewart McFarlane and John Harry. Both Stewart and John have devoted considerable time and effort in promoting and advancing the Society over a long period of time, and are worthy recipients of the awards. I would offer my personal congratulations to them both.

Plans for the Society's major events for 1994, the 12th International Clean Air Conference and the Indoor Air Workshop are progressing well, with enthusiastic Organising Committees in both instances. Members are encouraged to note the following dates in their diaries:
12th International Clean Air Conference Perth, Western Australia 23rd - 28th October, 11994.
Indoor Air Workshop, Gold Coast, Queensland
27th November -1 st October, 1994.

Frank Fleer
President

NOTES FROM SOUTH AUSTRALIA

In the past year South Australia has seen the introduction of the Environment Protection Authority and a change of government, both of which may be expected to impact sharply on the way things are environmentally handled in this state.

The office of the EPA was established to incorporate sections of five departments and statutory bodies to create a one stop shop for pollution and waste management. A new EPA Act has been passed but not yet promulgated. It replaces six pollution and waste management Acts and establishes the SA-EPA.

In a recent address to the Society Mr. Rob Thomas the Executive Director emphasised the single licence and more collaborative approach between government and industries. More effective pollution and waste management would result from the client focus of the four operational branches of the EPA office.

The office of the EPA has developed new policies and programs which include negotiation of environmental improvement programs with key industries and the implementation of a cleaner production program.

The EPA will be encouraging industry to undertake voluntary environmental audits and follow-up action. To provide a stimulus the Act gives statutory protection for relevant information so that it cannot be used in legal proceedings.

The EPA has launched a cleaner industries demonstration scheme as part of its cleaner production program. The aim of the scheme is to demonstrate how industry can improve production, minimise environmental impact and save money through cleaner production techniques. It is intended primarily to attract small and medium industries into this scheme through provision of ten year interest free loans for 50% of the cost of new technology, up to a maximum of $100,000. It also offers payment of consultant's fees up to $15,000 to study an industry's operations for improvements in practices and technology that will reduce costs and prevent pollution and waste.

With a new government is this situation likely to change? If the Liberal Environment Protection Policy is anything to go by, not much. There are however some differences, most notable of which is in the area of the "voluntary" audit. The Liberal policy unequivocally states that the new Government "will require industries with a high potential to pollute to provide the EPA with an environmental audit prepared by an independent organisation, so that the public can be informed on the environmental impact of such industries".

From the Society's viewpoint however it is the statement that a Liberal Government will "provide for pollution control courses" and "require industry personnel responsible for pollution control to be properly trained" that is of particular interest. This is a step in the right direction and is similar to the successful training required in CFC legislation. As Mr. Thomas said in explaining the need for stringent penalties, "despite the emphasis on collaboration and negotiation with industry there will be a small number of deliberate offenders and careless operators" - a good training program would certainly reduce these numbers.

Alec Smith
President SA Branch

INDONESIAN EXPERIENCE

(A summary of a talk given by Len Ferrari at the October NSW Branch Meeting after his return from a one year's consultancy in Indonesia.)

Duri, in the jungle of Sumatra, is just one degree above the equator. I was stationed there for one year and Carmel spent half that time with me.

The Duri oil field, operated by Caltex Pacific Indonesia is about 45 square kilometres in area. The oil is low in sulfur but is so viscous that only about 5 - 15% of the known reserves, of six billion barrels, can be recovered by normal means. However a steam flooding injection technique gives a five-fold increase in recovery, and the field is currently producing some 250,000 barrels a day. This makes it by far the largest steam flood oil field in the world. The steam is produced with the burning of some 50,000 barrels of oil a day. The heat, pressure and steam injected into the oil sands cause the oil to migrate to one of 3000 wells where it is pumped to the surface, accompanied by steam and vapour. The use of steam produces air pollution directly with combustion products and by way of volatile emisions and hydrogen sulfide from the venting of well gases.

The main purpose of my consultancy was to reactivate an ambient air quality station that was operational in 1983/84, and to train the staff to continue its operation after my departure. The station was perched on the top of a slope within the CPI Community, some 27 metres above the plains where the oil wells are located and I commissioned the equipment in October 1992. The air quality station is believed to be the most comprehensive in Indonesia and possibiy the most picturesque anywhere, complete with extensive gardens and a large waterfall.

The station measures all norma! pollutants and meteorological paramaters together with hydrogen sulfide. The air quality is normally excellent with some elevated levels of hydrocarbons and hydrogen sulfide. The station performed well and was on line for 99% of the time - quite an achievement under the difficult conditions experienced in developing countries. I present the data at the Society of Petroleum Engineers International Conference, Jakarta, in January 1994.

During the year awareness of air pollution increased substantially and equipment has been ordered for a new mobile station and acid rain stations, which are expected to be commissioned very early in 1994. More stations are likely and remote sensing devices are also receiving favourable consideration. It is acknowledged that there is a requirement for for increasing external assistance in the foreseeable future.

Len Ferrari,
Immediate Past President, NSW.

COMPANY AND GENERAL NEWS

New NSW Guidelines for Contaminated Water Storage

Following the 1990 Chemical Inquiry, the Hazardous Materials Policy Co-ordinating Committee was formed by the NSW Government and chaired by the Department of Planning to address, among other issues, any contaminated water from fighting chemical fires.

A draft document, "Guidelines for Contaminated Water Retention and Treatment Systems", has been released for industry comment. The Guideline's main objective is to "ensure that the likelihood of significant adverse impact on the environment from contaminated water discharges is acceptably low."

The Guideline's procedures, including a risk assessment for contaminated water storage and treatment, apply to: chemical and petrochemical manufacturers, contaminated sites, demolition and construction works, food manufacturers, electroplating works; service stations, waste storage, transfer and treatment facilities.

A seminar and discussion on the Guidelines was held on 8 December at 5.30 pm, 2nd Floor, Bowlers Club, 95-99 York Street, Sydney.
(Source ACM Bulletin Vol.38, No.22)

Revision of Sydney's Trade Waste Policy

The Sydney Water Board has invited industry input to form a new Trade Waste Policy by July 1994. The new policy will be based on the 1994 standards. It will attempt to simplify the current system, which is based on a complex monitoring and charging arrangement.

At the Sydney Water Board's Industry Customer Council on 24 November, two options for charging trade waste were proposed. Both required companies entering an agreement to complete an Improvement Program.

Option 1: The Trade Waste charge is proportional to the concentration.

Option 2: The Trade Waste charges are based on the total mass of each waste.

Both options require users of the system to conduct regular tests of their output, and to measure their flow rates. In all cases, there will be a maximum allowable mass discharge per day.

Both options offer a lower cost monitoring program and a five-year agreement life.
(Source ACM Bulletin Vo.38, No. 23)

EPA CLEANER PRODUCTION GRANTS AND AIR POLLUTION

EPA Vic. launched a scheme to assist small/medium size business commercialise new waste reducing technologies in Victoria in 1988/89. This scheme provides an interest free loan of up to $100,000 for 10 years and has to date assisted in financing projects for 37 companies.

The spread of successful applicants ranges across the broad spectrum of industry but some of the projects have positive effects on air pollution. Unfortunately only about 20% of the potential winners can be financed but EPA seeks to encourage and support all projects assessed to be environmentally advantageous.

Some of the projects have direct reduction effects on air pollution; others have indirect effects, eg. energy reduction systems which lower the pollution from power generation or transport reduction projects which have obvious and positive effects.

A number of the relevant projects will be mentioned here for consideration and possibly encouragement for others to apply for the 1994 scheme.

Note that not all of the projects listed were given loans, but all were deemed environmentally beneficial and technically sound. Only those projects that have some relevance to air pollution are mentioned here.

For further information contact:
Darrell Reeve, Acting Director - Cleaner Production
(Editor's note: We hope to run a regular feature based on the activities of the Australian Centre of Cleaner Production.)

YEAR	COMPANY	PROJECT	EFFECT
1988/89	Wattyl Ltd	Solvent recovery in paint manufacture	Less solvents to atmosphere
	Techdry	Aqueous protective coat for concrete	Less solvents to atmosphere
	Rothfaze	Recycling CFC's in air conditioners	Less CFC's to atmosphere
	Williamstown Central Motors	Recycling CFC's in automotive air conditioners	Less CFC's to atmosphere
	Bailey Motors	Recovery of solvent thinners	Less solvent to atmosphere
	Fildes P/L	Recovery of printing ink solvents for re-use	Less solvent to atmosphere
	Melbourne Mushrooms	Tunnel composting	Less odour
1989/90	Charles IFE	Cogeneration of Pig Waste to electricity	Excess power sold to SEC Removal of odour problem
	Intrepid Industries	Furnace stripping of paint	Replaces solvent systems
	Exclusive Fleece	Closed system sheep skin dry cleaning	Replaces open bath solvent system
1991	MRT	Mercury recovery systems	Prevents mercury vapourisation
	Trade Waste & Environmental Services	UV oxidation of organics in water	Enables greater solvent recovery and reduces incineration
	William Angliss Hospital	Vacuum sterilisation of infectious wastes	Recplaces incineration
1992	Oilclean	Recovery of lubricating and cutting oils	Prevents incineration
	Plastiblast	Paint stripping by blasting with recycled acrylic grit	Replaces solvent stripping
1993	ERG Research	Non-absorbent refrigeration compressor oil	Less halon escape and lower energy
	Trico	Electrostatic rotary atomiser paint application	Prevents paint overspray
	Coal Corporation	Recovery of coal dust	Prevents dust to atmosphere
	Jancassco	Base catalysed declorination of PCB's	Enables destruction without pollution

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31 Agincourt Road, Marsfield NSW 2122
Telephone: (02) 868 8244
Fax: (02) 869 0516
Len Ferrari BSc.
Categories 1,2,3,4,6
(Refer to May 1990 issue for category listing)

NSW Load Based Licensing of Emissions - Update

At the NSW EPA's Peak Industry Meeting held on 25 November, Neil Shepherd, Director General, EPA, made it clear that Load Based Licensing is only one option being investigated as a future licensing system. A joint Treasury, Sydney Water Board and EPA committee is investigating the use of Load Based Licensing (LBL), with a discussion paper expected in 6 to 8 months. LBL, if introduced, would combine water, air and possibly waste emissions.

Neil Shepherd also indicated that diffuse sources of pollution would not be subject to the LBL system. The EPA prefers to use Best Practice Management methods to address non-point sources, such as stormwater and air pollution.
(Source ACM Bulletin Vol.38, No. 23)

Disposal of Halons - The Halon Bank

Halons, the volatile liquids used in fire extinguishers, may be 3 to 16 times more damaging to the ozone layer than CFCs. Australia has stopped importing halons, and begun to withdraw halon from service, for storage and, ultimately, for destruction.

The Department of Administrative Services Centre for Environmental Management has set up the Dascem Halon Bank.

If you have halon to dispose of, there is a Halon Bank Depot in each capital city. Deposits may be made, for a fee, although domestic depositors and small businesses will not be charged. Depositors will then be issued with a certificate of safe disposal.
(Source ACM Bulletin Vol.38, No.24)

Air Quality Goals for Ozone

A discussion document for public comment has been released by the National Health and Medical Research Council, as part of its review of the national air quality goal for ozone, currently 0.12 pppm, (averaged over one hour). This new document, "Air Quality Goals for Ozone, Environmental, Economic and Social Impact Assessment", follows an earlier project report "Options for Revised Air Quality Goals for Ozone (Photochemical Oxidants)".

Both papers were produced by the University of Adelaide's Department of Community Medicine.
(Source ACM Bulletin Vol.38, No.24)

A Wasted Resource

Australian coal-fired power stations produce over 8 million tonnes of flyash every year. Approximately 10% of this is incorporated into cement and concrete: the rest ends up in unsightly ash dams.

Flyash particles, carried out of the boiler by the exhaust gases, are extremely variable but have some characteristics of interest. The particles are generally less than 250 micrometres in size, spheroidal, have a high mechanical strength, a range of densities from 3 to less than 0.6, a melting point above 1000°C, low thermal conductivity and are mostly chemically inert.

"It is the cenospheres - literally 'round, hollow balls' - which offer the most exciting possibilities,' says Peter Mullins. These have a density of less than 1.0 and hence float on the surface of ash dams. They are light but very strong.'

Recently a Melbourne firm announced their intention

to use cenospheres as composites in light metals. They can also be used in epoxies.

Mr. Muilins, in conjunction with industry representatives, is looking into further specialist, high-value uses for this waste product. The challenge is in developing a cost-effective process to separate the cenospheres from the rest of the ash and then to incorporate them into products such as light, stiff, structural materials, insulation and high-temperature cements,' says Mr. Mullins.

For further information contact: Peter Muilins, CSIRO Coal and Energy Technology, Tel: (02) 887 8772 Fax: (02) 887 8909.

20,000 to 40,000 Tons Per year Reduction in Fine Particles

Scrubbers being installed in the USA to reduce acid rain will also reduce fine particulate air pollution by 20,000 to 40,000 tons per year. These conclusions are contained in a new report issued by the McIlvaine Company entitled "Heavy Metal Removal from Coal-Fired Boilers".

There is renewed concern that fine particles are the most serious air pollution problem. The utility industry is the largest stationary source emitter. The old coal-fired plants are not regulated as to particle emissions by any federal laws. The new SO_2reduction requirements for these plants allow either fuel switching or scrubbers. Scrubbers capture 80% of the fine particles (not captured by the precipitators) along with the SO_2.

If scrubbers rather than fuel switching become the primary method for SO_2 reduction, there would be more than 60,000 MW of scrubbers added by the year 2000. This would reduce fine particulate emissions by-75,000 to 150,000 tons per year.

Scrubbers have the further benefit of removing air toxics. 60,000 MW of SO_2 scrubbers would also remove 20,000 to 60,000 tons per year of chlorine and 7000 to 8000 tons per year of fluorine. The scrubbers would also remove the toxic heavy metals which are measured in lbs. per year instead of tons per year. The scrubbers would remove 12,000 to 36,000 !bs./yr. of mercury and 13,000 to 42,000 lbs./yr. of chromium. Even greater quantities of lead and manganese would be captured. Equal or smaller quantities of arsenic, selenium, cadmium and other toxics would also be removed.

The removal of fine particulate and air toxics in SO_2 scrubbers is very significant and should be recognized in future decision making. Further information on this subject is available in the McIlvaine report "Heavy Metal Removal from Coal-Fired Boilers".

For more information contact: The McIlvaine Company, 2970 Maria Avenue, Northbrook, Il 60062 USA, Telephone: 708/272-0010, Fax: 708/272-9673.

Continued on page 20

COMPANY PROFILE

ICl Australia - environmental improvement by design

ICl Australia traces its history back to 1874 when Jones, Scott& Co began manufacturing explosives at Deer Park in Victoria. A year later this company was purchased by one of ICI's forebears, Nobel (Australasia) Pty Ltd. Other ICl forebears - Brunner Mond and Co Ltd, United Alkali Company Ltd and British Dyestuffs Corporation Ltd - also began production late in the 19th century.

In 1918, British Australian Lead Manufacturers (later to become Balm Paints Pty Ltd and then Dulux Paints) was formed. Imperial Chemical Industries of Australia arid New Zealand was incorporated on 31 May, 1928, to acquire and coordinate all of ICI's Australasian interests. ICI's first plants included Yarraville chemical plant in Victoria, which was bought from Commonwealth Fertilisers and Chemicals Ltd in 1936, and a soda ash operation built at Osborne, South Australia, in 1940.

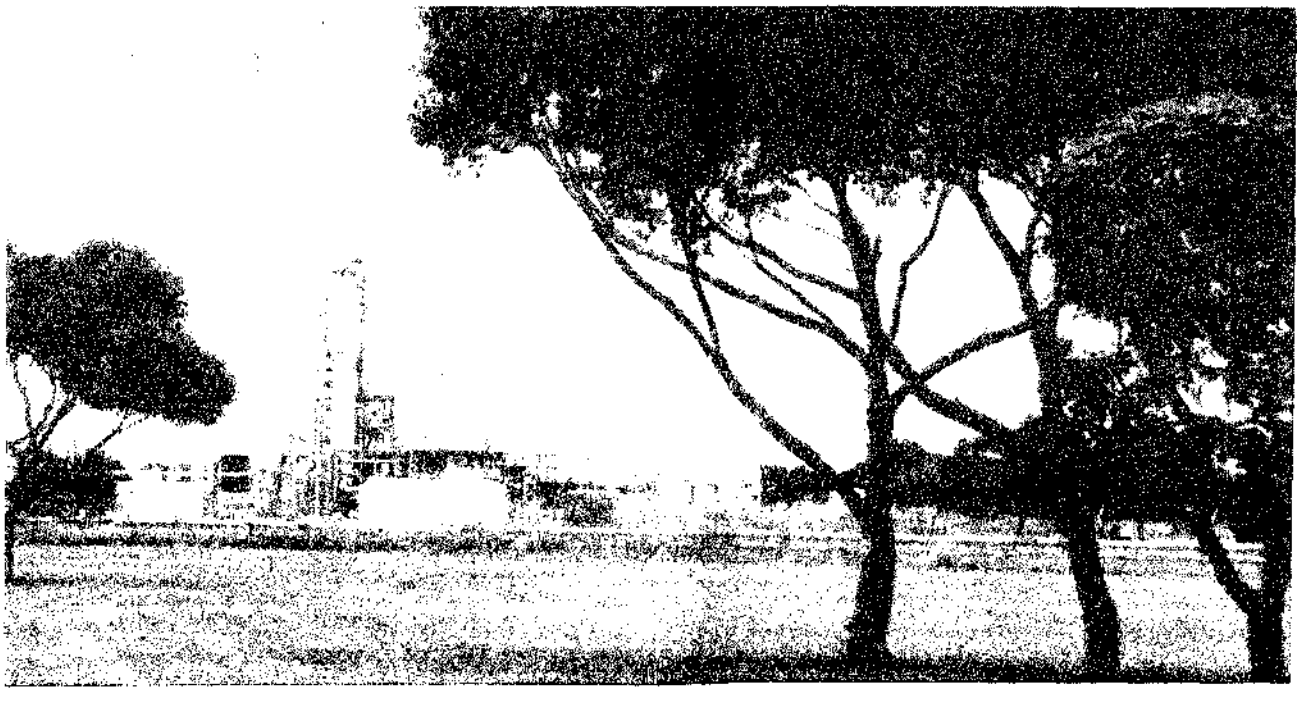
In 1942, ICI's chemical plant at Botany, New South Wales, began operation to meet the demands created by the Second World War. Its first product was carbon bisulphide. In 1971, Imperial Chemicals Industries of Australia and New Zealand changed its name to ICl Australia and, more than two decades later, the company continues to grow and prosper under this banner.

It is not by accident that iCl places environmental protection high on its list of values - but on the understanding that future success is inextricably linked with environmental improvements to existing plants and the constant pursuit of cleaner production through better plant design. ICl Group executive director and ICl Australia director Chris Hampson describes environmental performance as a "key factor" in the future development of the chemical industry. "Without the trust of the public we face a difficult future. However, by gaining that trust we can look forward with confidence."

Just one of the company's four worldwide environmental objectives is to reduce wastes by 50 per cent by 1995, with 1990 being used as the baseline year. Special attention is given to waste considered hazardous. ICl Australia, like the ICl Group worldwide, has embraced this environmental commitment in Australia to the tune of around $50 million a year. As part of the Australian Chemical Industry Council's Responsible Care program, IC! Australia is committed to a continuous and voluntary process of communications on health, safety and environmental matters with interested parties and the general public.

Deer Park (Vic) site was the first to make an environmental disclosure. In December 1992 this site, which has been manufacturing chemicals, plastics and explosives for 120 years, declared it had halved its emissions to air, water and land in two years. In December 1993 Deer Park made its second environmental disclosure and reported further progress.

The emissions to air give an example of the progress made so far. The major gaseous compound emitted to the atmosphere in 1993 was carbon dioxide, a by-product of the burning of natural gas to produce the steam for the site's manufacturing processes. Emission levels had gone from 9400 tonnes in 1990 to 4900 tonnes in 1992 and 4060 tonnes in 1993. These results were achieved with some significant changes at the site. In 1989 Deer Park installed gas-fired boilers at



ICI's state-of-the-art $20 million formaldehyde plant has also substantially reduced emissions at Deer Park.

EMISSIONS TO AIR AT DEER PARK

	1990 tonnes	1992 tonnes	1993 tonnes
Carbon dioxide	9400	4900	4060
Nitrogen oxides	19	7	7
Dimethyl Ether	24	24	35
3Formaldehyde	2	1	1
Other VOCs *	3	3	3

"Volatile Organic Compounds.

a cost of $2 million which enabled the site to move from burning coal to the much cleaner natural gas. This halved carbon dioxide emissions. A further reduction was achieved in 1993 by improving efficiencies.

Installation of a new state-of-the art $20 million formaldehyde plant in 1989 also substantially reduced emissions of formaldehyde. Further modernisation of the Resins operations has reduced emissions to about one tonne. Dimethyl ether, a by-product of formaldehyde manufacture, is well below Victoria's Environment Protection Authority licence limits.

Yarraville (Vic) was the next site to report on its environmental performance. A chemical manufacturing site since 1972, its main products today are chlorine, caustic soda, hydrochloric acid, sodium hypochlorite, hydrogen gas and the plastics additive cereclor. It operates a wharf that discharges fertilisers and soda ash, and also has a battery acid plant. The site recorded major improvements in the areas of recycling and reclamation of waste streams, and atmospheric discharges such as vapour from mercury, hydrochloric acid and chlorine compounds were well below licence limits.

Villawood (NSW) followed shortly afterwards, reporting 100 per cent compliance with NSW Environmental Protection Authority's air, noise and water quality regulations. The site spent more than $3.5 million on environmental upgrades which included replacement of the existing steam boiier with two small, energy efficient boilers this halved the consumption of natural gas and reduced carbon dioxide emission by 55 per cent.

Now Botany (NSW) site, ICI's Australia's $1 billion petro- chemical complex, is about to release details of its environmental performance to the community. Dating back to 1942, today's site now boasts Alkathene, chlorine, surfactants, olefines, site utilities, Propathene, vinyls and Alkatuff plants. Botany has spent over $50 million on environmental measures and new plants such as the Alkatuff plant have been designed very much with the environment in mind.

Cleaner production is part and parcel of all processes these days and ICI Engineering made that a "not-negotiable" feature of the Yarwun site near Gladstone (Qld). At present it has designed and built sodium cyanide, chlorine and the recently-opened ammonium nitrate plants. The ammonium nitrate plants provides a good example of just what ICI has achieved on the environmental front. The prill tower is the third in the world to feature total recycling of process air and the first to combine this with ICI's advanced prilling technology. As a result, atmospheric emissions normally produced by this type of equipment have been reduced to almost nothing. At Yarwun, they say you have to look twice to see if the plant is running!

LEADING BY EXAMPLE

Australia's Prime Minister Paul Keating was one of the first to convert his car to ICI's ozone-friendly air-conditioning gas KLEA 134a. The world's first commercially available CFC replacement gas makes it possible to convert existing car air-conditioning systems such those used by the Prime Minister and Environment minister Ros Kelly to an alternative that has significant environmental benefits.

KLEA 134a is suitable for domestic and commercial refrigeration and air conditioning for factories, offices and cars. As a chlorine-free alternative it has a minimal effect on the ozone layer. It is also produced by a chemical process that reuses much of its own waste.

Woolworths supermarket in Penrith (NSW) changed its refrigeration system over to the gas recently in what is believed to be "a world first", winning a prestigious United States Environment Protection Authority award for its efforts.

In addition, the IC! Group project team which designed the product in the first place carried off a prestigious award of their own - the 50,000 pound MacRobert engineering award for, among other things, squeezing what would ordinarily have been a 10 to 15-year development project into five years.

ICI Australia's KLEA marketing manager John Bresnahan checks the changeover of the air conditioning gas in the Prime Minister's car to KLEA 134a.

CONFERENCES AND COURSES

CLEAN AIR '94

12th INTERNATIONAL CLEAN AIR CONFERENCE

at Burswood Convention Centre, Perth, Western Australia 23 - 28 October 1994.

Provisional Programme

A broad programme content has been established.
The main subject areas to be discussed are —

- Air Pollution Control
- Air Quality Management
- Waste Management Issues
- Industrial Safety
- Combustion and Control Technology
- Developments in Remote Sensing
- International and Regional Issues
- Environmental Auditing

Plenary Sessions will be devoted to the main subjects and workshops will be organised to explore the themes in greater detail.

International Speakers will be supported by speakers from Australia and New Zealand.

A Trade Exhibition will support the conference showing the latest in equipment and services for testing purposes and air pollution control.

Conference organisers: Promaco Conventions Pty Ltd, Tel: (09) 364 8311 (09) 364 5380 Fax: (09) 316 1453.

First North American Conference & Exhibition

Emerging Clean Air Technologies & Business Opportunities

September 26-30,1994
Regal Constellation Hotel
Toronto, Ontario, Canada.

Introduction
The United States, Canada and Mexico jointly represent one of the world's largest clean air technology (CAT) markets - $15 billion in annual sales and projected to grow 5% annually. Furthermore, with the rapid growth of the CAT markets in Eastern Europe, the Pacific Rim and Latin America, the global market is expected to reach $50 billion by the year 2000. Equipment manufacturers, service companies, and consultants are among the main stakeholders who stand to benefit.

This event is being organized to foster increased North-South dialogue and stronger partnerships among Canadian, American and Mexican stakeholders on emerging technologies that address global air issues. Strong networks between the business and technical stakeholders will enable North American industry to successfully compete for the global clean air technology market.

Conference Program

The papers will focus on either business or technical themes pertaining to clean air technologies and will be presented in several concurrent sessions over a three-day period.

Business themes:

- Market Identification
- Market Development & Access
- International Financial Institutions
- Government Funding Programs
- Partnerships/Networks
- Overcoming Barriers & Seizing Opportunities
- Accessing Venture Funds
- Emission Trading & Marketable Permits
- Taxation
- Technical Themes
- Air Toxics: trace organics, trace metals, VOC, POP.
- Acid Rain: SO_2, NO_x, HCl, HF.
- Global Warming: CO_2, CH_4, N_2O.
- Smog, Ground Level Ozone: NO_x, VOC.
- Stratospheric Ozone: CFC, HCFC, Halons, Other ODS.
- Odour: VOC, HC.
- PM-10: Respirable fine particulates.
- Other Issues or Themes.

Posters, panel discussions, related courses and technical tours will complement the overall program.

For further information please fax to either:
Raymond Klicius, Environment Canada, Fax: 819-953-4705 or Blair Martin, United States EPA Fax: 919-541 -5227.

Open Learning Graduate Courses

A range of graduate university award courses - with many concentrated on business and management studies - will be introduced next year across Australia through Open Learning.

"We are pleased we can introduce a range of graduate courses next year to add to our delivery of 81 undergraduate units," said Mr. Tony Pritchard, Executive Director of the Open Learning Agency of Australia.

"The new graduate courses, including Masters degrees, are in response to the clearly expressed desire by many people to continue their education at the post-graduate level through Open Learning," Mr. Pritchard continued.

"Open Learning delivery already has proved a boon to those people who would find undertaking an 'on-campus' course difficult or impossible. The same flexibility of study pattern and ease of access which are features of undergraduate programs will now be available to those men and women of Australia who seek to study at the graduate level to expand their knowledge or obtain qualifications to enhance their career paths.

Students undertaking graduate courses will be expected to have appropriate undergraduate qualifications or equivalent and will need to clarify eligibility for any course with the provider university.

Costs per unit range from $450 for a Graduate Certificate in Addiction Studies (Curtin University) to $1417 in Master of Letters, Philosophy (University of New England in conjunction with Monash University and La Trobe University.

The 19 Graduate courses on offer through Open Learning in 1994 include:
Graduate Diploma in Applied Computing (University of Central Queensland);
Master of Information Systems (University of Southern Queensland);
Occupational Health and Safety Management; and Graduate Certificate in Health Promotion (Curtin University);
Graduate Certificate in Environmental Management (UNE-Armidale);
Master of Letters in Philosophy (provided jointly by UNE, Monash and LaTrobe Universities);
Masters in Practising Accounting (Monash University)
Graduate Diploma in Marketing (Monash University).

For further information contact:

Tony Pritchard	(03) 655 8944
Jane Randall	(03) 655 8929
Dick Wood	(03) 655 8994

COMING CONFERENCES IN BRIEF

Resource Technology '94, an international symposium on Resource Technology in Natural Resource Management, Melbourne Australia 26-30 September 1994. Contact Ian Bishop ph +61 3 344 7500 fax +61 3 347 2916 email Ian Bishop[¢] mac.unimelb.edu.au

10th World Clean Air Congress and exhibition, Espoo Finland 28 May - 2 June 1995. Contact Ms Merja Tolvanen fax +358 0 4567022.

7th IUAPPA Regional Conference for. Pacific Rim on Air Pollution and Waste Issues, Taipei Taiwan 2-4 November 1994. Contact Dr Che-Ming Chang, fax +886 3 4253204, email cheming*twncu865.ncu.edu.tw

The 5th ASEAN Conference on Energy Technology, Bangkok, Thailand 25-27 April 1994. Contact Prof. Prida Wibulswas fax +66 2 427902 / 4278077.

2nd National Hazardous & Solid Waste Convention and Trade Exhibition, World Congress Centre Melbourne Australia 8-11 May 1994. Contact Margaret Bates ph +61 2 413 1047, fax+61 2 413 1047.

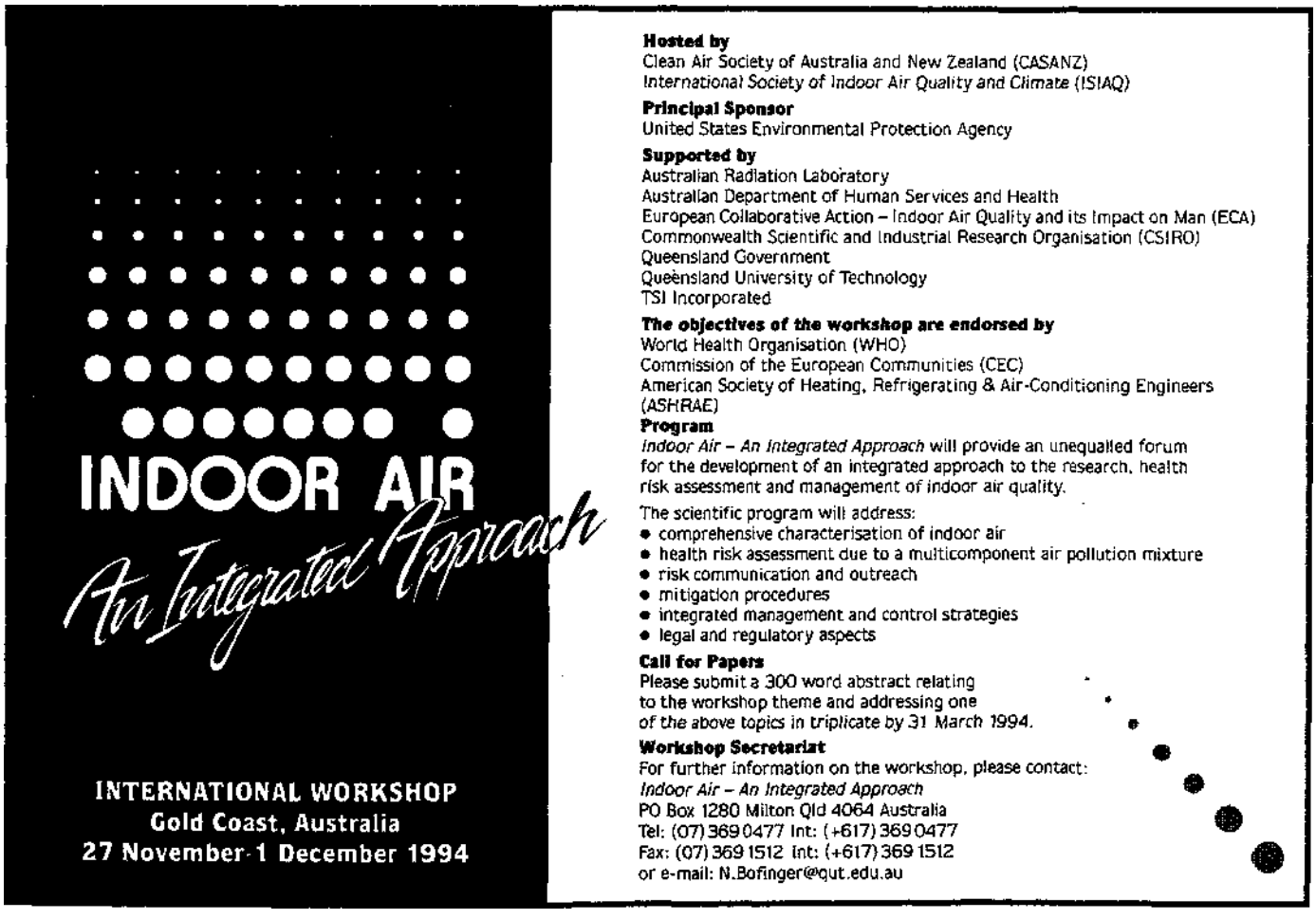
Indoor Air, An Integrated Approach - International Workshop, Gold Coast Australia 27 November-1 December 1994. Contact Dr Lidia Morawska ph +61 7 864 2616 fax +61 7 864 1521, email LMorawska^quteduau. (Seet notice this page).

Global Climate Change, Science, Policy and Mitigation Strategies, Phoenix Arizona USA, 5-8 April 1994. Contact Air & Waste Management Association PO Box 2861 Pittsburgh PA 15230 USA.

4th International Conference on Atmospheric Sciences and Applications to Air Quality, (focussed on global air quality), Seoul Korea, 30 May - 2 June 1994. Contact Prof. Y S Chung fax +82 431 275 1100.

Lead Abatement and Remediation Conference '94, Newcastle, Australia, 1-3 June 1994. Contact Dr John Stephenson ph +61 49 29 1292 fax +61 49 29 4037.

Energy and the Environment: Transitions in East Central Europe, Prague, Czech Republic, 1-5 November 1944. Contact Frank Beaver, Energy and Environmental Research Centre, University of North Dakotta, PO Box 9018, Grand Forks, ND, USA 58202-9018.



LEGAL WATCH
The Environment and Development - the Australian Approach

PETER MITCHELL, Freehill Hollingdale & Page

INTRODUCTION

This is the first article of my regular column. I thought I would start by explaining the constitutional and legal basis of environment protection laws in Australia, focussing on project and other development, to indicate the approach taken by government in Australia and how various laws fit in to the overall structure. In future articles I will concentrate on particular issues of a legal flavour that will be of interest to readers of this journal. If there are any particular topics that readers would like to have addressed I would welcome any suggestions.

REGULATING THE ENVIRONMENT

Around the world issues of environmental planning and management are becoming increasingly complex. Since the release of the Brundtland Commission's report, *Our Common Future,* the integration of economics and the environment has been widely recognised, at least in principle, as providing the necessary basis for all decisions relating to resource use and development.

The principle of intergenerational equity has been adopted in Australia by the Commonwealth, State and Territory governments and the Australia Local Government Association under the Intergovernmental Agreement on the Environment. The parties to the IGAE agreed that environmental considerations would be integrated into government decision making processes at all levels.

However, since well before the Brundtland Commission's report government at all levels in Australia has been involved in environmental planning and management in some way, the greatest involvement usually being at the State level.

CONSTITUTIONAL FRAMEWORK

Australia has a federal system of government, under which laws are enacted by the Commonwealth and the States. The Federal Constitution defines the areas of Commonwealth responsibility and allocates residual legislative powers to the States. Few powers are given to the Commonwealth exclusively - most of its powers are concurrent with those of the States. The States are able to legislate with respect to areas within Federal competence when there are no Federal laws covering these areas. When legislation is enacted at both the Commonwealth and State level on the same subject matter, the Constitution provides that Federal law prevails to the extent of any inconsistency.

The Federal government has no specific power to make laws with respect to the "environment". Jurisdiction over land and natural resources generally belongs to the States and so environmental regulation has traditionally been left to the States. However, in recent times the Commonwealth has been seeking an increased role and a national approach to environmental management to unify the diverse regulatory regime that exists in Australia. Currently, a complex web of State and Federal regulations relating to environmental issues exists, often resulting in duplication of requirements.

Although State legislation still plays the dominant role, local government plays a limited but potentially important role. The focus of local government in this area has traditionally been on public health and iand use planning issues and certain aspects of waste management. However, these days there seems to be a greater recognition that local government should have a broader environmental responsibility.

COMMONWEALTH ENVIRONMENTAL REGULATORY FRAMEWORK

A broad legislative framework exists at the Federal level to protect Australia's environment and heritage. This legislation restricts and in some cases may prohibit development.

The Commonwealth legislation relates predominantly to conservation and environmental impact assessment. Apart from limited cases, such as regulation of the import and export of hazardous waste and ozone protection, the Commonwealth government plays almost no role in the other main area of environmental regulation - waste management and pollution control. This is primarily an area for State regulation. Nevertheless, there is a wide range of Commonwealth legislation which can impact upon an investment proposal. Acts such as the Endangered Species Protection Act 1992, the Australia Heritage Commission Act 1975 and the National Parks and Wildlife Act 1975 establish a framework for protecting and managing areas of land and plant and animal communities. However, State laws also regulate these areas and Commonwealth law is generally limited in its application to:

- areas owned, occupied or otherwise controlled by the Commonwealth; and
- projects which require the decision or approval of a Commonwealth minister, department or authority.

In the context of major project and infrastructure development, one of the Commonwealth's major roles is in the environmental impact assessment process. The Commonwealth Environment Protection (Impact of Proposals) Act 1974 applies generally where works or decisions which affect the environment "to a significant extent" are carried out by or on behalf of the Commonwealth government or a Commonwealth department or institution. The Act also applies where a Commonwealth approval or decision is required, such as the granting of a licence to export woodchips, the approval of a foreign investment proposal or the approval to mine in a national park. If the particular Commonwealth Minister involved believes that the proposal may affect the environment "to a significant

extent", that Minister must inform the Commonwealth Environment Protection Agency of the proposal and this may in turn trigger the environmental impact assessment process. The procedure itself is quite complex and involves requirements for public notice and opportunity for public participation.

STATE ENVIRONMENTAL REGULATORY FRAMEWORK

Laws from State to State tend to differ, sometimes significantly. However, in broad terms there are many similarities. For the purposes of this article let us look at the State of Victoria as an example.

Victoria has extensive laws dealing with environment protection. The responsibility for administering this legislation generally lies with State bodies, and the role of local government, (except in land use planning) is relatively limited.

The Environment Protection Act 1970 is the major source of law relating to pollution control and waste management in Victoria. Administered by the Victorian Environment Protection Authority, the Act amongst other things regulates:

- The discharge of waste to air, land and water by means of a licensing and works approval system applied to "scheduled premises".
- The storage, treatment, reprocessing and disposal of certain types of industrial waste in the same way.
- The discharge of waste to air, land and water from premises outside the licensing and works approval system by means of a series of enforcement measures such as pollution abatement notices.
- The emission of noise.
- The recycling and disposal of solid waste.
- The transportation of certain types of waste.

The provisions of the Act are supplemented by State environment protection policies and industrial waste management policies. These are standards for environmental quality made under the legislation. They are technical documents intended to provide both a policy framework and technical guidance and standards for the discharge of waste and industrial waste management. They have legal force.

Provisions for the protection of flora and fauna are primarily contained in the Flora and Fauna Guarantee Act 1988. This Act may require certain measures to be taken before a project can commence to ensure the protection of a species or habitat listed under the Act. A development can in special circumstances be stopped if any flora or fauna are adversely affected by the development. However, this is regarded as a measure of last resort and so far has not been used. Victoria also has a complex system of laws to protect its heritage. For example:

- Heritage controls are integral to the planning process. Most planning ordinances contain extensive areas and specific controls to protect land or buildings of architectural or historic significance.
- Independently of the land use planning process, the Historic Buildings Act 1981 establishes a register of historic buildings and no works of any significance can be carried out on a building on this register without a special permit.
- Archaeological and aboriginal relics are also protected by special legislation.

Environmental issues in the context of major projects in each State are primarily regulated through the environmental impact assessment process and planning laws. The Victorian environmental impact legislation applies to a broad range of proposals which are capable of having a "significant effect upon the environment". The Act itself is very short and is administered through departmental guidelines which set out the procedures. Those procedures are complex.

There are many ways in which the environmental impact assessment process can be triggered. For example:

- The proponent of a development proposal might have made application to a government agency or municipal council for an approval for the development. The legislation requires any person or body who is required to make a decision which could have a significant effect upon the environment to seek the advice and assistance of the Minister for Planning and they must do so if requested by the Minister.
- The proponent might notify the Minister for Planning directly of the proposal (which might happen in circumstances where the proponent is uncertain as to whether or not the proposal will be subject to the legislation).
- Any person or group can request the Minister to consider a proposal.

The procedures contemplate various public notice requirements and opportunities for public participation.

Independently of the environmental impact assessment process, land use planning legislation (which varies from State to State) generally requires environmental effects to be taken into account in considering certain development approval applications. For example, in Victoria it is mandatory that the relevant authority takes into account any significant effects which it considers a proposal might have on the environment when considering any application for planning approval. As a result, land use planning legislation can provide plenty of opportunity for the environmental impact of proposals to be considered even if formal environmental impact assessment procedures are not triggered.

CONCLUSION

This article outlines in very general terms the extent and complexity of environmental planning and management laws in Australia. More complex development or investment proposals may require a number of quite independent approvals from Commonwealth or State authorities or both. However, in most cases these requirements should not be a hindrance to a proposal provided they are addressed as early as possible and taken into account in the investment or development program.

PETER MITCHELL

Peter is a senior partner in the Melbourne office of Freehill Hollingdale & Page and has extensive experience in environmental law. His recent experience has included advising a number of manufacturing and industrial companies in relation to site clean-ups, advising a chemical storage company in relation to a major fire which occurred in Melbourne

and conducting a review of forestry operations. He is a member of a number of Australian and overseas organisations and has studied extensively environmental regulation and practice in the United States, the European Community and South East Asia. He is also a member of the Environment Council.

Editor's Note.

Freehill Hollingdale & Page has a large and well established environmental law group which operates at an international, national and State level. The group was established some years ago and is one of the largest in Australia. It focuses on all aspects of commercial environmental law. Freehills' involvement in the field includes advising manufacturing and industrial clients in relation to establishment of operations and legal compliance, negotiating with regulatory authorities, establishing environmental compliance and management programs and conducting audits as part of mergers and acquisitions.

PERSPECTIVES ON POLLUTION

PUBLIC AWARENESS OF CHEMISTRY - CHEMICALS AND PUBUC POLICY *

B. Robinson, Environment Protection Authority of Victoria.

Chemistry - the Stuff of Life

Whether life arrived on Earth on meteorites, as suggested by Fred Hoyle, or evolved from condensing galactic gases, chemistry was involved. When ancient peoples sought cures for their ailments, colour for their clothing and poison to tip their hunting arrows, chemicals were involved. When in the Middle Ages alchemists attempted to change base metals into gold, chemistry was involved. When, after the industrial revolution changed the whole basis of national economies and new processes and products were sought, chemistry was involved. When Perkin developed his dyes, when a cure for malarial meningitis was sought, when new fabrics were developed, when electrical systems needed new coolants, when transistors revolutionized communications, when crops were protected from the massive losses caused by insects, chemistry was involved. When the thinning of their eggshells threatened the existence of the larger birds of prey, when the forests of Vietnam were devastated, when thousands died at Bhopal, when the basements of houses at Love Canal were invaded by solvent vapours, when Coode Island erupted in flames, chemicals were involved.

Chemists - the Image Problem

In the 1950s it seemed like a pretty good idea to become a chemist. Chemists had status, they were in demand, they had interesting jobs and there were few areas of human endeavour from which chemists were excluded. The rapidly growing range of new polymers, giving rise to new products, cheaper and more accessible consumer goods, materials for the space race and the kitchen, put chemistry at the very centre of modern consumer economics. Governments and communities alike were anxious to attract chemical plants, upstream and downstream. The economic and technological spin-offs were much sought after. The chemical industry had become a centra! pillar of modern economies, of the consumer society, of the new agriculture and of modern medicine. It was a great feeling being one of the good guys.

Then a relatively unknown American journalist published a little book with an evocative title full of foreboding: "Silent Spring". Rachel Carson's book became a best seller. It struck a chord with a new generation seeking to break out of the self-satisfied, materialistic society that itself emerged in the 1950s in reaction to the deprivation of the second world war and seeking distractions from the threat of the cold war.

The irreverence of the Beatles and their music, the protest songs of Bob Dylan and Joan Baez sent out similar signals. Student unrest showed the younger generation's great feeling of unease with the world order their parents had created and accepted. Then came the great symbolic focus - the Vietnam war. This war seemed to crystallize for so many the previously unformed feeling of unease with society. "Silent Spring" became reality on our television screens, as massive quantities of defoliants were dumped on the jungles of Vietnam. The Agent Orange controversy was surely the major catalyst for the change in public perception about chemicals and the chemical industry. The chemophobia epidemic was born.

Chemicals, that had provided so much for society, became the focus of suspicion and fear. Places such as Love Canal, Seveso, Bhopal and, here in Victoria, Yarram appeared from obscurity to feature in the international news media. The chemical industry was no longer wanted in local communities and the status of chemists and chemistry plummeted. Yet chemists continued to give us new drugs, provided the basis for understanding more about the human body, gave us the tools to investigate our environmental problems. To the profession itself, chemists were still the good guys.

The Profession Reacts

This mismatch in perception was something the chemical industry had difficulty coming to grips with, but so did individual chemists. There were three reasons for this:

- science is about truth, but people react according to perception
- chemists, like other professions, are inherently arrogant about their knowledge and have difficulty appreciating that there may be another perspective
- scientific reductionism.

The industry did not help matters, reflecting as it did this inherent arrogance, but also by being excessively secretive. Once under attack it adopted a bunker mentality while the profession as a whole almost disappeared from view. At a time when chemicals and chemistry were becoming major political and public issues, those with the greatest responsibility left the stage. The result was the development of myth and deception that reinforced the growing negative perceptions among the community at large.

Chemicals Under Scrutiny - Real and Imaginary Problems

This all occurred at a time of rapid political change, and of greater direct involvement of the community in

the formal decision making processes. Public policy was being shaped in an atmosphere of great volatility, with major pressure groups growing in strength and sophistication and with a great desire to jettison icons of the past. But the industry and the profession kept their heads down.

And so we entered an era when regulation of chemicals became a major growth industry. Regulation that was often driven by political imperatives based on public perception. Chemicals were described either as "toxic" or "hazardous". The concept of no safe limit became commonplace. But if chemicals themselves were unwelcome, wastes from chemical processes were totally unacceptable.

Waste storage, transport, treatment and disposal came under much more stringent control regimes than the parent chemicals, even though the wastes were often dilute and much less toxic. The first shipment of PCBs from the Port of Melbourne for overseas destruction was accompanied by police cars with flashing lights and a fire tender. One would not expect PCBs to burst into flames and, if a spill occurred, hosing them down the drain is not a recommended option. Meanwhile petrol tankers travelled freely around the suburbs with little more than their UN hazard placards.

While the development of regulatory controls tended to be driven by community priorities leading at times to over- regulation and additional cost, a greater danger was that real problems were being overlooked. These fall into a number of categories:

- long term problems arising from chronic impact of chemicals
- increasing exposure of the community to chemicals through increased use outside the workplace
- the performance of ancillary industries
- concentration on classical chemistry in industry
- failure to recognize the need for community understanding.

Chronic Impacts

Media treatment of reports on the so-called hole in the ozone layer, and the prospects of climate change arising from increasing greenhouse gas concentrations, catapulted environmental concern to the number one spot in the late 1980s. In spite of the complexities and uncertainties associated with these phenomena, they became a standard talking point throughout the community. They added a new dimension to the basis of public perception about chemicals and the chemical industry.

People also began to realize that the impact of chemicals need not be immediate or obvious. Little attention was paid or credit given to the efforts of the CFC industry over a number of years to phase down CFC use in aerosols as a precautionary measure.

Meanwhile the chronic build up of dieldrin and cadmium in agricultural soils had gone unnoticed and uncontemplated by most. That is until our export beef failed to pass residue tests. Farms were quarantined. Farmers lost their livelihood. The export market was damaged, but a new awareness grew. Since the same scrutiny does not apply to beef for the local market, we can assume that some of the contaminated beef was consumed locally. Whether that is a problem or not we do not know. We do know that levels of dieldrin in human breast milk is higher in some farming communities than elsewhere. Whether this has given rise to actual problems, once again, we do not know. Not unreasonably, when such information emerges belatedly, communities become concerned about what else might emerge. Chemophobia increases and the vicious circle spins faster.

In the 1970s questions were raised about the impact of lead on the intellectual development of young children. These were largely dismissed on the grounds of flawed data. They have now re-emerged with more rigour behind them and growing acceptance. Most States in Australia did nothing to reduce lead levels in super grade petrol until recently. Victoria took the precaution of reducing the. level to 0.3 grams per litre from 1 January 1983. This has still not been matched in any other State. The arguments are complex, involving economic and other social impacts, but by and large the public has not been exposed to them.

The gradual contamination of our groundwater and soils by chemicals from industrial, mining, agricultural and waste disposal activities was largely ignored for many years. It has now come back to haunt us. In most cases only a financial loss has been incurred in the form of a devalued asset, but for some residents their peace of mind and possibly their health, as well as the value of their property, has been affected. While Rachel Carson's prophecies have not entirely come to pass, there is concern about the impact of chemicals on wildlife, particularly aquatic wildlife, around the world. We know there have been some impacts, we surmise about others, but overall, especially in this country, we know so little about what might already have happened and what might still be happening to our unique flora and fauna. At a time when international conventions on the protection of biodiversity are being signed, our knowledge about long term chemical impacts is woefully inadequate.

Community Exposure

While most of the public concern about, and indeed the regulation of, chemicals has focussed on the chemical manufacturers and on the waste industry, the community has been increasingly exposed to chemicals in and around the home. Not only are the obvious garden chemicals used with less than the desired amount of care (after all, you buy them off the supermarket shelf so they must be safe), but a wide range of household products potentially exposes users to much higher concentrations of chemicals than they would ever be likely to experience outdoors. Is this a problem? It certainly is when the tragic poisoning of young children continues and in isolated cases where people are sensitive or allergic to particular chemicals.

It is worth noting that some of the alternative "natural" products are more dangerous than the products they are intended to replace. Bruce Ames, among others, has recently drawn attention to the relative risk associated with "natural" and synthetic chemicals. Once again the perception does not line up with reality. I do not imagine that the storage of a few tonnes of aflatoxin contaminated peanut butter would arouse anything like the controversy over a much smaller amount of PCBs.

Ancillary Industries

Any facility where chemical reactions take place is

potentially unsafe and needs to be managed with special care. This applies equally to a research laboratory or a petrochemical complex. Indeed my experience suggests that research laboratories are a good deal less safe than a major chemical plant. Safety audits and strict safety rules are an integral part of the operation of any major chemical plant. This has been so for many years.

In keeping with the culture of the industry that activity was largely directed inside the plant. Little attention was paid to the operating practices of downstream users, of transporters or of external chemical warehouses and storages. This has improved in recent years with the provision of safety data sheets to customers and transporters. The industry's Responsible Care programme takes it much further, and the concepts of total product liability and life cycle analysis are being introduced.

The fact remains that most chemical incidents do not involve the major manufacturer. The Butler and United Transport fires were warehouse fires. The Coode Island fire was in a storage terminal. Other incidents occurring daily around Australia involve pool chemical wholesalers, small scale users of TDI and, most of all, transporters.

But to the public chemicals are chemicals, and the names associated with them are those of the major companies. A major effort is needed to ensure that the upstream and downstream responsibilities implied by Responsible Care are carried out. This becomes more complicated in the case of imported chemicals since GATT and various bilateral trade issues become involved. This should not be an excuse, however, and I feel that governments and the industry need to work a bit harder on this one.

Changing the Culture

Classical Chemistry

Up to this point I have focussed a good deal on the chemical industry because that is largely the public face of chemistry. It is also, along with agriculture, the area on which public policy is largely focussed. I now want to turn more directly to the problem of chemistry and chemists.

Chemists seem to work very hard at fulfilling the stereotype of the introverted professional. Not wanting to become too involved. Perpetuating the myth of value-free science. Is it any wonder that they have a status problem? Yet how can practical public policy be developed if those with the expertise stay out of the debate? RAG has a much lower profile with government than the Institution of Engineers, the AMA or even the Institute of Environmental Health Surveyors. Rarely do news or current affairs programs feature a spokesperson from RACI even on issues relating to chemicals or chemistry. This is clearly linked to the standing of the profession with the public as well as professional introversion. Each, however, is related to the other. There are some obvious exceptions to this general situation, and what a great contribution they have made to public understanding and confidence.

Let me briefly run through three examples before I draw these threads together into some kind of coherent statement about future directions. About two years ago a Melbourne chemical company was accused of threatening public health and the ecosystem of Port Phillip Bay by discharging polychlorinated dioxins and furans into the sewer. The claims were extreme but were made at the height of community concern about the environment. Neither the company nor the then Board of Works had any data to confirm or deny the claims. The company made 2,4-D and had previously made 2,4,5-T. Claims about its involvement in agent orange manufacture were not difficult to generate.

In the face of a major crisis in public confidence in the Board of Works and EPA, and in the Government's ability to control the activities of the chemical industry, a major investigation was undertaken. This included a site and plant audit, a health and safety audit for workers, a study of the sewer discharge and related discharges, the sewage inflow to the Werribee farm, the farm itself, its discharge to Port Phillip Bay and sediments and biota in the Bay. Reference samples were collected from other parts of the city. Results of the study showed that dioxins were being discharged to the sewer, but that no significant threat to public health or the environment existed. While the investigation was fairly straightforward technically, it did represent the most comprehensive study of its kind involving dioxins carried out anywhere in the world. This and the cloud which the media, on behalf of the public, placed over the Board of Works, EPA and the company, as the investigation participants, posed a major credibility problem.

in the midst of the media hysteria, one independent voice was prepared to stand up and be heard. Ian Rae, Dean of Science at Monash University intervened with some sound scientific common sense. The media, sensing that all might not be as they had been portraying, toned down their reporting. Stories were transferred from front pages to less prominent positions. Professor Rae was subsequently appointed to head up a scientific peer review panel for the investigation. His willingness to explain to the media and the public the significance of scientific peer review and the need to wait until the information was gathered and checked brought everyone down to earth. The investigation report, when complete, was published with the report from the Rae Panel. The results were accepted by the media and the public, even though the original accusers attempted to discredit them. Public policy was able to be restored to an even keel and when subsequent issues involving dioxins arose, the views and opinions of the authorities were given much more credibility by both media and the community.

Another issue that emerged from this incident was the influence of classical chemistry on the thinking not only of chemists but of industry as well. Reactions, whether in the laboratory or in the manufacturing plant, are viewed in terms of product yield. By-products are only of significance if produced in significant quantities, and are only given attention if predicted by classical chemistry. This is reasonable in both commercial and scientific terms unless there is a concern about ultra-trace constituents. In the case of 2,3,7,8-tetrachloro-dibenzo-p-dioxin, concern in some quarters extends to sub parts per quadrillion. While arguments can be made for a threshold of concern several orders of magnitude higher, we are still dealing with very low concentrations. Although the jury is still out on the significance of dioxins for human and ecological impact, there is broad agreement on the need for a high level

of caution to be adopted towards them.

This being so, we need to look not just at the predicted by-products but also at those few molecules with enough energy to do something different and unconventional, based on a very low probability. We might call this chaos chemistry. The recognition that the products of such processes are important suggests that we perhaps need to question the way we teach chemistry. The focus on the "reactants to products" approach is also important in the commercial world. It drives the culture, the mindset, the plant design and even the approach to management. If we take a different perspective and manage for optimization of the total system we might be pleasantly surprised by some of the results.

This is the basis for the philosophy behind cleaner production. Cleaner production involves looking at the total system. Until recently the focus has been on waste treatment and control of discharges. But conventional regulation is not suitable. To try and regulate chemical processes in the conventional way would be ineffectual. Innovation would be stifled, improvements would be hindered and management would feel increasingly impotent.

We need, therefore, to create a new approach based on awareness and a sense of responsibility so that the company is still in control. This will need chemists and chemical engineers of particular talent, innovative, holistic but with their feet firmly on the ground of commercial reality. The United Nations Environment Program is co-ordinating activities in this area, but the chemical industry is already heavily involved. Smart chemistry, such as reducing the number of steps in a synthesis, albeit with lower yield at each step, can increase the overall yield, reduce the amount of waste produced and eliminate much of the complexity in waste management. Long investment cycles mean, however, that such approaches are not always applicable. Changes to the management of existing processes through waste audits, changes to raw material specifications, minor process changes and improved materials handling can pay handsome dividends.

My second example follows on and relates to waste management-the management of so-called intractable waste. It is interesting to note that the term was first used in Australia in the 1970s to remove the emotive aura of "hazardous" and "toxic", and to clearly indicate that the problem with these wastes was not necessarily their toxicity but lack of acceptable treatment facilities. More recently a name change has been proposed - to Schedule X wastes - because of the emotive aura surrounding the term "intractable".

The saga of attempts over the past 20 years to establish treatment and disposal facilities for highly chlorinated organics and other problem wastes such as arsenicals is weli known and does not need retelling here. Suffice it to say that the many failed attempts to deal with this problem failed to gain the explicit involvement of chemists other than those with vested interests. RACI-sponsored seminars were based around pre-determined solutions. Since chemistry is about asking questions, this was further evidence of the traditional product-oriented mindset. Enter Dr Ben Selinger, chair of an independent panel set up by the NSW, Victorian and Commonwealth Governments to rescue the public policy issues from the disaster of Corowa, the last failed attempt to deal with these wastes through conventional means. Dr Selinger has established a reputation over many years of communicating with the public on chemical issues. He had a better understanding than most of where such communication fall down. More importantly, like a good chemist, he asked questions and was prepared to put his scientific reputation on the line. The result of the panel's investigations took us back 20 years to the point where a range of quite disparate wastes were collected together in a single category looking for a single solution - an engineering approach.

The approach proposed by the panel, and given credibility by Dr Selinger's ability and inclination to communicate, was to seek a range of solutions to match the various waste streams. Many of these solutions already existed or were at some stage of development, held back by the single-minded, concentration on engineering approaches which had applied for so long. We now have an approach which can be tailored to Australia's particular needs and to the various waste streams. This represents a major shift in public policy, gives every indication of gaining public acceptability and may well reduce the level of chemophobia in the community.

My third example is of a different nature. It illustrates not "the power of one", as do the others, but the power of working together. Photochemical smog is a significant problem in many major cities around the world. Melbourne and Sydney are no exceptions. The chemistry is very complex, involving in excess of 100 reactions. At its simplest, however, it involves the reaction of nitrogen oxides and certain hydrocarbons in sunlight. These reactions can be duplicated to some extent and studied in smog chambers. Atmospheric measurements at ground level and aloft using aircraft provide further information. The amount of data involved is huge. Because of the large number of reactions involved, modelling requires some simplification and the inclusion of certain assumptions. Supercomputers can reduce the uncertainties due to these, and of course reduce the time involved. Outputs from models are, however, only as good as the inputs, and with the high cost of such modelling exercises and the large costs of smog control options that arise from them, good input data are essential.

Over a number of years the atmospheric chemists at CSIRO and EPA have toiled away on their atmospheric studies. EPA chemists have also produced a highly representative means of preparing emissions inventories. Working with our meteorologists and mathematical modellers, they have produced authenticated models of world class. These will enable EPA to test various control options to identify those that are most cost effective. However, all such options do involve costs, and often costs directly to, or restrictions on, the individual. This makes them not only cost sensitive but politically sensitive. Community understanding of the issues is a prerequisite to their acceptance. The complex chemistry of smog has been modelled and simplified and represented on an animated video model. This can be broadcast by television stations, shown at public meetings, workshops and so on. The issues can then be addressed in a more informed way by community representatives, politicians and evenpolicy officers who might have little interest in the actual chemistry or its complexities.

The Future

We have entered an era where the environment, the economy and chemical issues are subject to major international influences. Where public debate and local political decisions must have regard to international conventions and national policies. The "Earth Summit" in Rio de Janeiro earlier this year has set a new agenda for world development. The importance of environmental and ecological issues has been placed squarely alongside development.

The Climate Change Convention, the Biological Diversity Convention, along with Agenda 21 raise many opportunities and many questions for chemists and chemistry. Add to this the Basel Convention on the transfrontier movement of hazardous waste and the revised Montreal Protocol on ozone depleting substances. These are measures that could profoundly affect our lives and those of our children. Agenda 21 has four chapters of distinct relevance to chemists, covering atmosphere, "toxic chemicals" and wastes. At the national level we see the evolution of complementary measures, and in particular of greater direct participation of the community in the policy process. Ecologically Sustainable Development (ESD) has been the subject of one of the most extensive public and intergovernmental consultation processes this country has ever seen. If followed through, it will represent the process by which many of our international obligations arising from Agenda 21 will be met. The InterGovernmental agreement on the Environment (IGAE), a political compact that came into effect on 1 May 1992, will provide a major mechanism for giving effect to many of these policies.

The IGAE deals with:

- compatibility of databases
- setting national standards, protocols, etc.

Common to all these measures is the need for comparable and reliable data and a means of assessing the risks and benefits of policy options. The traditional engineering risk assessments inadequate for the sophistication with which we need to deal with these issues. The impact of CFCs on the ozone layer is a good example of what we have been lacking.

There is a major need for chemists to become more engaged in the public debate and for chemistry to be more devoted to providing the tools needed for better decision making. We also need more Ian Raes and Ben Selingers interested in bringing the community into their profession.

Most of all we need chemists who will ask questions about the fundamentals. Perhaps we even need more chemists who are prepared to take their training outside their profession and look at the world differently. James Lovelock may be thought somewhat eccentric by many of his fellow chemists, but in posing his Gaia theory to the world he has challenged conventional wisdom. It is from such actions that new insights often spring. If chemists remain the introverted profession, and fail to make available their wisdom and knowledge while they are providing their chemicals, the solutions to many of our problems will be left to others and the world and the future will be poorer for it.

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Sydney's Trade Waste Targeted

The draft report from the Joint Select Committee Upon The Sydney Water Board, asserts that the trade waste limits on industry are not low enough.

The Committee's report cites increases in the levels of mercury, organochlorines, and phenolic compounds, ACM believes that the reported changes are statistical variations and do not necessarily indicate significant increases. The concentration levels are very low, in the 10 to 100 ppb range for mercury and organochlorines in the effluent.

Water Board reports have also been cited in the media, calling for the tightening of the trade waste policy. One report claims that the deep ocean outfalls are significant sources of lead, silver, chlorine and HCBs. This evidence is based on bio-accumulating those substances in mussels.

ACM considers further tightening will do nothing to improve the quantities discharged into the ocean off Sydney. A number of Water Board reports clearly show that discharges from Sydney Harbour are far larger sources of contaminants than are the ocean outfalls. Contamination from Sydney Harbour is largely attributable to stormwater, which is linked to urban development, not to industrial activities.
(Source: ACM Bulletin Vol. 38, No. 22)

MERCURY

An evaluation of the roie and distribution of mercury in ecosystems with special emphasis on tropical regions

The Minamata catastrophe in Japan in the 1950's revealed the serious health hazards of alkyl mercury released to the environment. Other catastrophies, notably in Iraq in the 1970's from consumption of grains treated with alky! mercury, further illustrated the toxic effects of organic mercury on humans and animals. The toxicological significance of methyl mercury in the environment was further emphasized by the demonstration that metallic and inorganic mercury is methylated by aquatic microorganisms and methyl mercury is accumulating at higher trophic levels, such as predatory fishes, used as food by animals, including humans.

On the basis of about 140 cases of the "Minamata disease" in Japan, the lowest toxic level of methyl mercury in humans was estimated. However, these early calculations could not take into account subclinical neurological effects from the exposure of the foetus, which were disclosed many years later, showing extreme sensitivity of the foetus to methyl mercury.

Health hazards from mercury in the environment have caused restrictions in the use of mercury and a stricter control of the release of mercury from industrial and other uses. But at the same time these sources of mercury have been subjected to regulation, new sources have appeared. One such source of current concern is the use of mercury in gold panning. Although this method of gold panning has been practiced since long ago, it has recently been revived in many countries. Notable in this respect is the use of this method in the Amazonas in Brazil, but this same application of mercury in gold panning occurs in several Latin American countries, in Africa, in Southeast Asia and elsewhere. This method calls for gold to be amalgamated, whereupon the mercury is evaporated into the air by heating, leaving the gold in the pan. The handling and evaporation of mercury will cause high levels of contamination in rivers and an increase in atmospheric circulation of mercury.

Another source of mercury contamination of the environment, which has been pointed out in later years, emanates from artificial dams and irrigation projects. The importance of this source of mercury contamination has been emphasized by Russian scientists.

The SCOPE project launched in 1993 should concentrate on these two sources of environmental mercury contamination in the first instance, focussing on the following aspects:

* geographical distribution and level of mercury contamination from the use of mercury in gold panning;
* occurrence and level of mercury contamination from dams and irrigation;
* transport, distribution and chemical transformation of mercury in the water and air of tropical as compared to temperate regions; effects of environmental factors such as temperature, pH and humus on these processes;
* binding of mercury in organisms and accumulation in the food chain in tropical areas;
* epidemiological and ecotoxicological data from contaminated areas;
* analytical problems of mercury compounds.

During preliminary discussions of the project in Sweden, it was emphasized that the study would benefit by concentrating on ecotoxicological aspects of mercury contamination from gold panning and from artificial dams and irrigation projects. This focus is also justified by the fact that WHO is launching an international programme on human health aspects of mercury and mercury compounds. It is important that the two activities by SCOPE and by WHO be implemented in coordination. Contact was therefore established with the Division of Environmental Health at WHO. A first meeting within the WHO programme will be held on October 1993 in Minamataa (Japan) at the collaborative WHO centre for mercury.

In addition WHO is also responsible for the HEAL project (Human Exposure Assessment Location), which aims to make a global measurement of environmental contamination by mercury.

The first step in launching the present SCOPE project will be the organization of a small international meeting in Stockholm. This planning meeting should be composed of experts on different aspects of mercury problems and of representatives from relevant developing countries. This meeting was scheduled for October 1993 in Stockholm.

The further development of the project will be based on workshops. Regional experts, as well as scientific experts on basic problems concerning mercury, will be invited to these workshops. Considering the fact that mercury contamination of relevance to the project has such a widespread occurrence, workshops are planned to be held in different regions - South America, Asia and Africa. At this point the following three workshops have been suggested:

Brazil, 1994. The documented and severe mercury contamination of rivers and air from gold panning in Brazil, notably the Amazonas, makes it advantageous to start the project with a workshop in this region. Although particular attention has been paid to the situation in Brazil in this respect, similar mercury contamination problems are not restricted to that country, but occur in several other Latin American countries. An overview of the situation in Latin America in general, will be aimed at. Among other questions to be dealt with are transformation and fate of mercury under tropical conditions and analytical chemical problems.

Japan, 1995. This workshop will deal with contamination problems in Asian countries such as Indonesia and the Philippines, where problems from gold mining have been reported. Another purpose of this workshop will be to gather available information on mercury release in connection with dam building and irrigation.

Kenya, 1995. The use of mercury in gold panning has been reported at least from Zaire, but the actual situation concerning mercury contamination in Africa is unclear and one purpose of this workshop will be to obtain better information on the African situation. The location of UNEP in Nairobi, where a great deal of experience

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CONTROLLING AIR EMISSIONS - FROM POLICY TO PRACTICALITY

David Collins and John Lippelgoes, Alcoa of Australia Limited.

ABSTRACT

This paper describes the historical development and implementation of an environmental management system at Alcoa of Australia's aluminium smelters and the impact on air emissions. Alcoa of Australia's first aluminium smelter started production in 1963. Since this time, many improvements have been made to the air emission control equipment and monitoring systems in an effort to minimise environmental impact. One of the most interesting changes has been the evolution of the organization towards Best Practice Environmental Management such that the responsibility for environmental management is increasingly devolved to all employees.

THE EVOLUTION OF ENVIRONMENTAL POLICY AT ALCOA

In the late 1960's, Alcoa of Australia reviewed the generally developing concern for the future quality of the environment, the imminent legislation, and its own potential impact on the environment, and decided to formulate an Environmental Policy to recognize formally its environmental responsibility. It was felt that only with a policy, stated publicly and promulgated throughout the organization, couid the many decision makers, at all levels, have a common standard. It is likely that, without this stated policy, much of the environment protection activity currently going on in Alcoa's mining, refining, power generation, smelting and rolling areas would have developed much more slowly. Considerable assistance in the formuiation and implementation of the policy was given by the Aluminum Company of America, which has continued to give technical assistance based on a wealth of experience in the USA and elsewhere. This first Environmental Policy, drafted and adopted in the late 1960s, (Willoughby 1976) is as follows:

- Take all practical and necessary steps to prevent or abate air and water pollution resulting from the mining, refining, smelting and fabricating of aluminium.
- Conserve and effectively use natural resources, such as bauxite, coal and water, and where possible recycle products produced from those resources.
- Restore mined areas by cultivation and reforestation, and carry out research to improve the methods of restoration.
- Protect wildlife from injury which may result from the Company's operations should the air, water or ground become contaminated.
- Train and make available at operating locations qualified people whose accountability is to bring and keep pollution under control.
- Develop improved ways of controlling the quality of air and water in cooperation with other organizations where appropriate and implement these methods throughout the Company so that it always complies with statutory and accepted community standards.
- Work and cooperate with local, state and national governmental agencies charged with environmental control and assist those agencies in the development of sound, equitable and realistic standards.
- Communicate the environmental program effectively and frankly to employees, government bodies and the public.

In the light of these policies, in 1971, at Point Henry, a separate section was established within the laboratory to focus on emission monitoring and development. The part-time position of Plant Environmental Engineer was created. This was consolidated into a full-time position in 1973 with the function of coordinating the environmental monitoring and corrective engineering activity consistent with legislative requirements and company policy.

In the early 1980s, the Portland Smelter was established based on this policy. BACT (Best Available Control Technology) was used throughout the plant. The organization was structured in a way which recognized the importance of environmental issues, with a full-time environmental manager and a substantial part of its laboratory devoted to environmental monitoring.

The Environmental Policy for Alcoa was modified as follows in 1990, to reflect the increasing emphasis placed on environmental issues within Alcoa and the wider community. This policy was adopted at all of Alcoa's facilities around the world.

Alcoa's Current Worldwide Policy

It is Alcoa's policy to operate worldwide in a manner which protects the environment and the health of our employees and of the citizens of the communities where we have an impact.

- We will comply with all applicable environmental laws, regulations, and permits, and will employ more restrictive interna! standards where necessary to conform with the above policy.
- We will anticipate environmental issues and take appropriate actions which may precede laws or regulations.
- We will work with government and others at all levels to develop responsible and effective environmental laws, regulations and standards.
- All Alcoans are expected to understand, promote and assist in the implementation of this policy.

Fundamental to Alcoa's Environmental Policy is a requirement to comply with all legislation. There is also a requirement to make input into new legislation and any existing legislation which is not soundly based on good science and risk analysis principles.

ORGANIZATION EVOLUTION

Alcoa of Australia supports what the Australian Manufacturing Council (AMC) describes as "Best Practice Environmental Management". The changes in Alcoa of Australia's

organizational culture needed to achieve "Best Practice Environmental Management" are best illustrated by way of a slightly modified form of AMC's "Paradigm Shift", (AMC, 1992).

FEATURE	OLD CULTURE	NEW CULTURE
SUPERORDINATE GOAL	Efficiency	Excellence
STYLE	Formal • Command & control • Environment low priority for CEO.	Committed • CEO vision, personal commitment & leadership. • Demonstrated priority for senior management.
STRUCTURE	Rigid • Steeply hierarchical • Weak environmental link between environmental and production management	Flexible • Devolution of environmental responsibility. • Flatter, team oriented approach • Strong integrated environmental management.
STRATEGY	Reactive • Meet regulations, focus on end-of-pipe issues. • No specific environmental policy • Closed door to community	Proactive • Clear link between environmental performance and competitiveness • Emphasis on continual improvement. • "Open Door" to community.
SYSTEMS	Environmentally Exclusive • Minimum necessary to meet regulations	Environmentally Inclusive • Comprehensive Management Plan. • Formalized communication links with community.
SKILLS	Functional • Production directed. • Poorly coordinated, "ad hoc" approach to training.	Problem Solving • Integrated approach to improvement. • Innovation, problem solving skills highly regarded. • Competency based training.
STAFF	Directed • Performance measured by cost. • Little sense of ownership.	Empowered • Environmental criteria in performance appraisal. • Pride in activities of the firm.

To achieve "Best Practice Environmental Management" requires a very honest and open appraisal of the organization and its performance and capabilities with a commitment by all management to the principles of Total Quality Management.

The responsibility for environmental management is being devolved to each employee. The ultimate goal is to develop all employees as environmentalists, rather than relying on a few environmental officers.

ENVIRONMENTAL TOOLS

Environmental Management and Improvement Plans

Comprehensive environmental management plans were compiled for Point Henry and Portland Smelters in August 1991. These plans integrated the existing environmental activities into cohesive summaries and highlighted a number of gaps which needed to be filled.

The various components of these environmental management plans are summarized below;

- Environment Policy
- Environment Management Principles;
  - Line management is accountable for assuring conformance with the environmental policy with technical guidance and support from the environmental staff.
  - Line management will maintain and implement a formal plan of corrective or improvement actions for all situations where facts demonstrate actual or potential non-conformance with the environmental policy.
  - Line management and environmental staff will communicate the environmental policy and any significant environmental developments to all employees and to all others involved in or affected by the operations.
  - Line management and environmental staff will ensure that there is full communication to all levels on significant environmental issues affecting the operations and will respond openly and promptly to any public inquiries on significant environmental issues affecting the operations.
  - Line management will utilize quality tools, waste minimization techniques and energy conservation practices to achieve never ending improvement in resource utilization, pollution prevention and the minimization of environmental impacts.
  - Line, management will ensure that all wastes are managed "from the cradle to the grave" by implementing one or several of the following strategies in order of preference:
    1) Waste avoidance through "Cleaner Production"' practices
    2) Waste minimization
    3) Waste reuse
    4) Waste recycling
    5) Waste disposal in an environmentally responsible manner.

Environment Management Organization

Environmental issues Action Plans - air, water and land management issues are addressed.

Audits

Environmental audits can take many forms; management audit, compliance audit, policy implementation audit, monitoring systems and procedures audit, data management audit, communication audit, process audit, energy audit, etc. They can be directed at a specific receiving environment, e.g., soil, ground water, storm water drains, waste water drains, landfill, stack emissions,' fugitive emissions, etc. They can be applied to a particular process section, an entire site or to many sites. These audits can be in-depth or superficial. They can be managed and conducted by site personnel, corporate personnel, consultants, regulatory authorities or a combination of these. They can be initiated within the organization or by external authorities, such as the Statutory Audit initiated by the EPA in Victoria. They can be conducted regularly, or

as needed.

Brief (two days on site), but intensive internal "walk-through" audits were first conducted in October 1989 for the whole of both the Point Henry and Portland smelters. The audit team consisted of three senior Environmental Managers; one from Alcoa's Pittsburgh head office, one from Alcoa's Tennessee Smelter and one from Alcoa's Western Australia refineries. Many potential problems were identified during this audit and have been acted on.

Since 1989, the Alcoa audit process has been developed into a more comprehensive, 5 days onsite format. These audits are scheduled to be conducted approximately every three years.

Following the final commissioning of Stage 1 of the Portland Smelter in June 1987, a number of complaints were received about airborne emissions from the smelter. Offensive odours were reported from fishermen, surfers and divers. In response to concerns by these groups within the local community, Portland Aluminium engaged a consultant to conduct an external audit of the environmental effects of air and water discharges from the site in 1990.

The specific objective of this audit was to investigate the cause(s) of the complaints and rectify them by:

- Seeking input from the local community groups on the current monitoring plans and if necessary input in drawing up and conducting monitoring programs.
- Reviewing site meteorology.
- Conducting a monitoring program to determine the concentration of gaseous air emissions at the surface of the water nearby the smelter.
- Carrying out mathematical modeling of pollution dispersion in the surface air over the ocean.
- Carrying out measurements of the source emissions.
- Assessing the performance of the smelter's air emission control equipment.
- Reporting the findings to the company, the community groups and the general community.

The overall approach and presentation of the report's findings have been extremely beneficial to the company in developing a greater appreciation of community concerns towards the plant, in understanding the emissions and their impact on the environment and users of adjacent areas, and in developing community confidence in environmental controls and performance.

Emission Monitoring

Extensive source monitoring, well in excess of the minimum requirements required by the EPA, is conducted at each plant to ensure that EPA discharge licence limits are complied with. Alcoa of Australia insists on the highest level of integrity with respect to self monitoring and is a strong supporter of the view that self monitoring is the most cost effective monitoring system.

The monitoring of emissions and environmental impact at Point Henry over many years helped to form a basis for establishing the specification, design and EPA Works Approval Application for the Portland Smelter. Other critical inputs included the joint assessment of US smelters by Alcoa of Australia and the EPA together with Alcoa of Australia's Environmental Policy.

Ambient Monitoring

Ambient HF and SO_2 measurements together with comprehensive meteorological data are collected continuously at a single site at each smelter. The meteorological instruments include a sophisticated three directional acoustic sounder at each smelter. This instrument is used to measure wind speed and wind direction as a function of height, which are needed to characterize accurately the air pollution dispersion from each smelter.

A mobile monitoring van has been commissioned at each smelter to conduct continuous source and ambient monitoring at other sites.

Forage samples are collected monthly from many sites nearby each smelter to assist in this process. The concentrations at ail locations are well below the recommended limits for forage animals.

At Portland Smelter, because of the proximity to agricultural land, cattle grazing nearby are regularly biomonitored for fluoride buildup.

Wiidlife surveys are conducted regularly in the adjacent land and water environments at both smelters to help assess any environmental impact at the earliest stage of development.

Air Emissions

The priority air emission from aluminium reduction cells is fluoride.

Other Emissions

- CFCs

Alcoa has maintained a position ahead of legislation with requirements for CFC-free propellants established as a purchasing requirement in 1989. A detailed inventory of CFCs in 1989 revealed that the largest emission (1000 kg p.a.) of CFCs was electrical contact cleaner, which is 100% R113. This product was replaced by isopropanol (which is relatively more flammable) for most applications and 1,1,1-trichloroethane (which is relatively more toxic and damaging to some plastics) for flammable applications. Both of these products are purchased in bulk and dispensed into refillabie bottles with compressed air propellant. The risks and difficulties of managing these more hazardous alternative solvents have generally been accepted in order to avoid the environmentally damaging effects of the CFC.

- MINOR EMISSIONS

Detailed analyses of air emission sources are being conducted to;
- define all trace emission character, emission rate and ground level concentration,
- assist in establishing appropriate waste minimization strategies and
- provide a basis for understanding any environmental impact through rigorous risk analyses.

For example, efforts to quantify any PAH, ingot furnace fluxing, oily scrap and rolling mill emissions are being made along these lines.

CONTROL TECHNOLOGY DESCRIPTION

- TECHNOLOGY SELECTION AND MANAGEMENT GUIDELINES

There are a number of guidelines which can assist in selection and operation of equipment to achieve Best Practice Environmental Management.

- Industry in general should ensure the use of latest process and control technologies. This may include Best Available Control Technology (BACT) where it has been proven and provides benefits sufficient to offset the costs. What ever equipment used, it should not only achieve today's standards but also

any foreseeable regulation changes.

- Management of industrial plants should recognize that emissions from modern industry can only be kept low while operating personnel are well trained and motivated. Training should be initiated prior to start-up and continue to be reinforced as an integral part of employee's jobs.
- Emission control and process equipment must be maintained to high standards under strict maintenance programs in order to achieve optimum levels of performance. Regular internal assessments should be carried out to ensure the effectiveness of both the maintenance program and the operation of the emission control equipment and procedures.
- The company needs to have a highly dedicated and well trained environment group capable of carrying out or managing testing, assessing equipment performance and capabilities, and conducting internal reviews of the company's environmental performance and reporting back to management.

• ALUMINIUM REDUCTION POT SCRUBBING

At Point Henry and Portland the majority (typically 97%) of the fluoride fumes emitted by the aluminium reduction cells are collected for reuse by an Alcoa patented, "A398" fluoride recovery, dry scrubbing system. This process is a good example of waste minimization on a large scale. The A398 process, in which >99.5% of the collected fluoride is adsorbed onto alumina and then recycled back into the process, replaces an earlier process which adsorbed the fluoride onto lime, all of which was then discarded as a waste.

• ANODE BAKE FURNACE SCRUBBING

Emissions from anode bake furnaces include hydrocarbons and fluorides. Historically, unburned hydrocarbons emitted from the anode bake have caused a visible emission problem. Control methods for anode bake furnace emissions can be divided into three main categories:

- Enhanced process control of the combustion conditions in the furnace to minimize visible emissions.
- Installation of wet scrubbers in series with an electrostatic precipitator which gives good control on visible emissions. This method removes approximately 90% of the fluorides and particulate. Further treatment of fluoride and particulate are necessary before disposal.
- Installation of dry scrubbing devices which employ alumina as a scrubbing medium and a baghouse to capture particles. This system is the current state of the art for scrubbing of fluoride emissions and is in use at Point Henry and Portland.

• ALUMINA FEED SYSTEMS

Alumina feed to the pots in most earlier designs of smelter is by ore buckets supplying open hoppers on the top of the pot. This practice results in spillage of alumina which contributes to elevated particulate emission and to poor house keeping standards within the potrooms. In the early 1980s, a pneumatic conveying system for alumina was developed by the industry to reduce significantly this major source of particulate emissions from the potrooms. Automated alumina feed systems have been installed at both Point Henry and Portland.

CONTROL TECHNOLOGY EVOLUTION

Although the basic elements of aluminium smelting are common to both smelters, the detailed engineering is quite different. Point Henry represents a complex mixture of equipment which mirrors the evolving technology during the growth of the smelter, whereas Portland was established using a common modern technology. Therefore, the relative contribution to total emissions from the various sources within each plant is quite different, and as such, is treated differently.

POINT HENRY SMELTER

The first potline at the Point Henry facility was installed with a simple lime injection system and a baghouse dust collector to col lect and treat the fumes extracted from the pots. This system had a fluoride scrubbing efficiency of 75%. The Alcoa research centre in the US developed an improved scrubber with a fluidized bed of alumina combined with a baghouse, known as the A398 fluoride recovery system (refer to Figure 1). The second potline installed at Point Henry in 1970 was one of the first smelters in the world to be fitted with this design. The lime injection system for the first potline was replaced with this technology at the same time. These scrubbers remove approximately 99.5% of the fluoride from the captured fume. The third and final potline expansion in 1980 was also fitted with these scrubbers. With the captured fume effectively recovered, attention shifted to the 3% of fugitive reduction cell fumes which are not captured by the fume extraction system and the carbon bake furnace fumes, which were untreated. In 1991 a scrubber was fitted to the carbon bake furnace which removed 99% of the fluoride from the bake emissions. The major source of fluoride is now the fugitive emissions which escape from the reduction cell fume extraction system. A substantial effort is being made to identify the causes of the fugitive emissions. A summary of these developments in control technology is shown below;

Since commissioning of the Point Henry Plant in 1963, the ongoing introduction of new technology and improved processes has resulted in significant steady improvements in the reduction of emissions from the plant as summarized below;

— 1963 Line 1
90% pot hooding efficiency
75% removal of captured emissions through the original A173 gas scrubbing system.
— 1970 Line 2
90% pot hooding efficiency
99.5% recovery in A398 fluoride recovery system.
— 1981 Line 3
95% pot hooding efficiency
99.5% recovery in A398 fluoride recovery system.
— 1981-1990 95+% pot hooding efficiency on all pots
99.5+%recovery in A398 fluoride recovery system.
— 1988-1991
Dense-phase alumina feed system retrofitted to all potlines. This technology reduces particulate emissions from the potrooms and reduces the chances of material spillage. In addition, improved mechanization of crust breaking, dense phase alumina distribution and improved control over pot operations were introduced to reduce roof emissions further.
— 1991
A fluoride scrubber was installed on the anode bake furnace exhaust and commissioned in December 1991 at a cost of $6M.
— 1992

Replacement of kerosene based rolling mill lubricants by more highly refined lubricants to minimize volatile hydrocarbon (VOC) emissions.

Ongoing additional actions to reduce fluoride air emissions include:

— improved hooding by improving the condition of the pot covers and ensuring careful placement,
— increased average draft per pot by limiting the use of high draft only to those pots requiring high draft,
— improved housekeeping and minimization of dust from all sources,
— ongoing fume capture and A398 fluoride recovery system performance improvements.

PORTLAND SMELTER

Prior to agreeing to the construction of the Portland Smelter, Alcoa of Australia and the Victorian Environment Protection Authority (EPA), in conjunction with the NSW SPCC, embarked on a study tour of North American smelting facilities, control agencies and research institutes. The main purpose of the visits was to investigate the performance of emission control equipment at some of the most recently commissioned aluminium smelters in the United States at that time to provide guidance for the emission controls that would be required at Portland. The results of this tour were implemented at the Portland Smelter as discussed below.

• SELECTION OF POTLINE DESIGN

The preferred method of control by the aluminium industry in the US for new smelters was the use of centre worked pre-baked pots with high hooding efficiencies, primary scrubbing of captured pot emissions and scrubbing of anode emissions.
Application to the EPA for fluoride emission limits was made based upon the known achievable performance levels together with the proven technology and processes used at other Alcoa locations as of 1981.

• POT HOODING

Significant hooding design improvements have taken place since the installation of pots pre 1970's. The new pot technology for Portland was designed to a hooding capture efficiency of 97%. Today the smelter operates with a hooding efficiency of greater than 98%.
These emissions are passed through the A398 fluoride recovery system which captures more than 99% of the fluoride for return to the smelting process.

• POT FEEDING

Portland was originally designed to have covered air slides which carry alumina to a totally enclosed hopper on top of each pot. During the delay in construction of the smelter from 1980 to 1983, a pneumatic conveying system for alumina was developed and subsequently installed. This feed system significantly reduces a major source of particles in the potrooms.

• ANODE BUTT HANDLING

Fluoride evolution from spent anode butts left to cool in the potrooms can be a source of fluoride to the internal (workplace) and external environment. Because of the large anode size used at Portland, and the relatively slower cooling rate, the fluoride from cooling butts represents a significant proportion of the plant's fluoride emission. Consequently, Portland is currently installing a purpose built anode cooling station to reduce emissions to the workplace and to the external environments and allow evolved fluorides to be recycled back into the process via the existing A398 fluoride recovery system.

• ANODE BAKE FURNACE SCRUBBER

Dry scrubbing systems for anode bake emissions have been shown to meet the US New Source Performance Standards. All new smelters in the USA since 1976 have been required to meet this standard.
At the time of installation at Portland, very few dry scrubbing systems had been installed on anode bake furnaces anywhere in the world. Consequently, a number of commissioning and operational difficulties were experienced and have been rectified since plant start-up. Care must be taken in selection to ensure that the specific equipment chosen is proven and practicable.

CONCLUSIONS

This paper has presented an integrated comprehensive approach to air emission management.

Alcoa believes that economic development and sound environmental practices are compatible and can be achieved by taking the initiative, demonstrating environmental leadership and using every opportunity to make constructive input into the regulatory process.

Emerging issues which need to be addressed by all industries include carbon dioxide generation and trace contaminants.

Aluminium's high strength to weight ratio and ease of recycling result in a substantial net reduction of carbon dioxide when compared against alternative materials over the life cycle of aluminium products.

Traditionally, large companies have focused on major emissions, with less emphasis being placed on trace emissions. With improvements in analytical techniques and the desire for "cleaner production", the profile of trace contaminants is being raised. Industry needs to take a lead role to quantify trace emission constituents, flow rates and any associated environmental risks to ensure that these issues are managed effectively.

The high standards being achieved by the aluminium industry are the result of a process of continuous improvement and the implementation of quality tools. This process will continue into the future.

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Australian Air Quality Criteria, Guidelines, Standards and Objectives for the Protection of Human Health and the Environment

K.W. BENTLEY, P.W. CALLAN

ABSTRACT

This presentation examines the basis of ambient air quality criteria development in Australia, through the philosophy and aims behind criteria development and the scientific review procedure. It also identifies the relationships between Australian air criteria development and that of other international, multinational and national legislatures. Finally, in view of the establishment of a National Environment Protection Agency through the aegis of the Intergovernmental Agreement on the Environment the paper proposes possible future directions in air criteria development.

INTRODUCTION

Pollution of air affects the quality of life of most Australians. Increasingly, our population is focused on a relatively small number of centres. Rural to urban migration is resulting in increasingly localised organic and inorganic air pollution burdens. The inevitable results of such population shifts is an increasing air pollutant burden which, unless amelioration measures are introduced, may result in increased community health and environmental degradation. One thing is abundantly clear; in the Australian socio-political climate of the 1990's public demand and expectations at all levels, national, State and Territory, and local government will be towards implementation of stricter controls over pollution, including air. Fortuitously, the technology for the control of air pollutants is already available albeit at costs which have to be borne.

Criteria, based on exposure-response health information, form the basis of air, water and land quality objectives, standards and regulations throughout the world.

Goals, guidelines are promulgated and codes of practice, standards and regulations are legislated and enforced to protect public health and the environment from deleterious effects. While some national legislatures have developed guidelines based on other considerations, (e.g. fluoride and ozone are widely recognised for its toxicity in sensitive plant species), environmental databases are often inadequate and primary standards are usually human health based. For comprehensive public health and environmental protection, a cocktail of indicative guidelines and regulatory standards are required covering all potential exposure regimes arising from emission sources, occupational environments and indoors and ambient situations. No country has to date established controls for all of these circumstances. In particular, indoor atmospheres where abatement and mitigation relies heavily upon public co-operation engendered through education programs, gives the most outstanding challenges for the future.

Although the States and Territories historically have retained sovereign rights with respect to the regulation of air in Australia, the development of criteria, as guidelines for national air quality has largely become the responsibility of forums at which both the Commonwealth and state interests can be considered. The Commonwealth organisations with primary responsibilities in this area include the National Health and Medical Research Council (NHMRC) and the Australian and New Zealand Environment and Conservation Council (ANZECC) and in the occupational sphere, Worksafe Australia.

THE ROLE OF THE NHMRC IN SETTING STANDARDS AND CRITERIA

Within Australia health guidelines using a single contaminants approach have been promulgated by the NHMRC for many years. The then Australian Environmental Council recommended environmental guidelines for a few pollutants using similar and parallel approaches. While no formal co-ordination existed between the two Councils, common membership of many subsidiary committees existed with supplementary 'health' representation where considered appropriate. Since 1987, and particularly since 1990, both Councils have appreciated that with the increasing complexity of guidelines development and the need for 'human health and well being" to be integrated within a broader ecological and developmental framework.

The NHMRC through its Committees and Expert Panels includes, in addition to government officials, scientific experts, medical specialists and industry and consumer group representatives. A broad public consultative mechanism has been established which assists in developing a consensus reflecting national concerns. The Environmental Health Standing Committee of the NHMRC is responsible for:

- providing assessments of existing information on the relationship between exposure to environmental pollutants and human health;
- advancing guidelines for setting limits consistent with the protection of human health;
- the identification of new or potential pollutants; and
- the identification of gaps in knowledge for present or potential pollutants and the promotion of research where information is lacking.

Two key areas of concern to the establishment of criteria have been identified. Firstly there is uncertainty in the information used by air quality organisations due to inadequate data and methodologies by which the degree of hazard is defined and assessed. Not infrequently, essentially identical information on the health effects of pollutants may be interpreted quite differently by different organisations. The second concern relates to how social, political, economic and

cultural factors are to be considered. While these factors ought essentially not influence the available scientific database, they are necessary if air quality guidelines and standards of broad societal acceptability are to be developed.

The NHMRC has more recently broadened its involvement beyond its traditional role in ambient and emission guideline formulation to develop both industry and community networks to participate in the development of guidance. The many advantages of maintaining close collaborative networks for development of national contaminated land guidelines and standards rather than purpose designed individual goals are clear.

The establishment of the Commonwealth Environment Protection Agency (CEPA) as a implementation mechanism for the recently concluded Intergovernmental Agreement on the Environment has established new directions for harmonised approaches between the agencies responsible for guidelines development and their subsequent implementation through regulation.

The close linkage between health and the environment has recently been recognised by the conclusion of a Memorandum of Understanding between the NHMRC and the Standing Committee of the Australian and New Zealand Environment and Conservation Council which is intended to expedite the development of uniform health and environmental guidelines and standards.

DOSE RESPONSE RELATIONSHIP

The current state of scientific knowledge in the field of human exposure-response relationships limit the development of air quality guidelines to 'best guess' approach. Consequently, standards are usually decided on the basis of what has been termed 'questionable physiological, biochemical and pathological' evidence (Kagawa 1984). There is an obvious requirement for further research on the health effects of all air pollutants, paying particular attention to uniform physical and biological response methodologies and study design. This is essential to provide a comprehensive database for criteria development and the ongoing review of established guidelines in an attempt to reduce the uncertainties that currently exist.

There is an increasing concern relating to potentially carcinogenic pollutants. To date this class of pollutants has not been reviewed in Australia. Dose response research to an experimental zero effect threshold is not feasible requiring that risk evaluation be more closely integrated into the guideline development process. For example, the USEPA has developed procedures to address the problems of criteria development for potentially carcinogenic air pollutants. These developments include detailed methodologies and guidelines for exposure assessment, carcinogenic risk assessment, mutagenicity risk assessment, health risk assessment for chemical mixtures and health assessment of suspect developmental toxicants.

The inadequacy of a threshold concept for potential carcinogenicity limits the scientific methodologies appropriate for research and changes some procedures that may be used for criteria development.

FACTORS WHICH GO INTO SETTING GUIDELINES

There is no co-ordinated Governmental initiative in Australia either for assigning priorities for health oriented pollutant studies, including control and mitigation or for channelling resources towards a national indoor air research and development program. Such health research as is undertaken has arisen either in response to specifically identified concerns for particular parameters such as asthma initiation from sulphur dioxide exposure or the effects of nitrogen dioxide on school children.

There is a need for Australian based health effects research to assist in development of national criteria. The criteria developed for specific Australian environments will therefore require research to be conducted to account for Australian conditions. With the exception of exposures in target populations, eg the Port Pirie lead study, sulphur dioxide in Kalgoorlie and exposures of Sydney school children to tetraethyl lead from motor vehicle emissions, few epidemiological studies have been undertaken. To obtain the best value the research effort must not duplicate or extend overseas work but must be directed towards those factors which are uniquely Australian. The research into the effects of air pollutants should concentrate on Australian targets, conditions of exposure, concentration, duration, pattern and climate.

In the area of mitigation and control research into measurement methodologies and abatement measures for indoor air pollution is lacking; methods for assessing the potential for contamination arising from new building construction needs to be undertaken and fundamental examination of design measures to avoid indoor air pollution whether from public or occupational sources required examination. Finally, techniques needs to be evaluated and mechanisms established for information dissemination to effected population groups. This should be undertaken in regard to air pollution sources and concentration high risk building types, potential health and environment effects and to provide recommended approaches for prevention and abatement of indoor air pollution.

In the absence of a more comprehensive national commitment towards investigation of health and environmental effects of known pollutants development of guidelines and standards will remain a largely ad hoc process.

Perhaps the area of 'ambient' measurements most readily undertaken are from point source discharges. Like the occupational situation, the materials of concern and approximate concentrations are generally known. Using stack dimension calculations, flow rates and dispersion modelling the potential 'at ground' concentration and location can be fairly readily established. Translation of this point source data into area ambient concentrations may be difficult particularly if a multiplicity of sources are present. These may involve similar or quite different pollutants which may chemically interact resulting in new materials of concern.

Study of the non-occupational environment both ambient and indoors is fraught with difficulties. In general, efforts to determine the time and severity of adverse effects for health associated with community exposure to contaminants have shown relatively weak correlations compared with those found in the occupational environment. Measurement of non-occupational concentrations, not infrequently in the ppb range require great care for sampling, analysis and

interpretation. Instrumentation is often required to operate to sensitivities near the limit of manufacturers specifications with particular attention required to calibration and standard reference 'spikes'. Difficulties may arise in data interpretation with null values requiring a number of assumptions.

The formulations of mandatory standards, codes of practice and other regulatory instruments employ US guidelines as their basis but they must also take into consideration **realities** including both direct and indirect cost/benefit considerations, social and intended long term policy and implementation strategies.

The development of harmonised health and environmental guidelines has been attempted by the USEPA, whose biomedical division is the largest unit - 10,20 sites.

AIR QUALITY CRITERIA GUIDELINES AND STANDARDS

Health criteria must focus on those sections of the population at greatest risk bearing in mind that not all sensitive individuals can always receive total protection. In recent times an increasing number of complaints are being received of hypersensitivities perceived as resulting from volatile biologically active contaminants. While little quantitative data is available it appears that the incidence of immune reactivity resulting from exposures is increasing.

Not unlike the situation in the USA where the guidelines development procedure of the US Environmental Protect Agency have mushroomed from a six step process in the early Seventies to 32 stages in 1988, Australia's relatively simple five step procedure of 1981 has now increased first to 11 steps (1989) and now some 16. These steps involve commissioned research, toxicological data assessment and scientific consensus, through to canvassing of State and Territory health and environmental regulatory agencies and an extensive public consultation process. As might be anticipated, the review period for revision of a guideline has increased accordingly.

Social, political, economic and cultural factors are to be considered. While these factors do not influence interpretations of the scientific database, they are necessary if guidelines and standards of broad societal acceptability are to be developed. Differing international weightings on these factors requires that Australia undertake its own independent reviews and in some cases develop a national research database unique to our local situation. Health criteria in regard to air pollutants must focus on those sections of the population at greatest risk bearing in mind that not all sensitive individuals can always receive total protection. For indoor air where exposures may be prolonged, particularly sensitive groups identified include young children, pregnant women and the elderly many of whom may spend as much as ninety percent of their lives indoors.

Pulmonary health detriments arising from single pollutant gases are relatively well understood, albeit that most studies by necessity have shortcomings when the data is extrapolated into real indoor circumstances. Where a large number of exposure materials are acting in combination, additionally or synergistically to produce effects, we still have relatively little firm data on which to make health judgements.

There are groups who would argue against the setting of public health goals to the lowest common denominator, but prudent public health policy aims to protect the majority of the population including susceptible groups.

SIGNIFICANCE OF INTERNATIONAL LEVELS

To account for uncertainties associated with the health data and exposure estimation, and missing information on multiple exposures, some organisations (eg. CEC, World Health Organization) adopt safety factors. This has the effect of lowering the acceptable concentration for a given pollutant. Generally, no such factors are applied to the Australian Guidelines values as safety factors are considered arbitrary. As is reflected by the NHMRC guideline value for sulphur dioxide identified sensitive groups (eg. asthmatics, children, the elderly and the sick) may not receive comprehensive protection following adoption into legislation of the guidelines. Clinical studies do not normally include the most sensitive components of the population and consequently judgements of potential health impairment in this group is at best unsatisfactory.

The future looks promising in regard to our understanding of air pollutants, large amount of research including the United Nations Environment Programme (UNEP) Human Exposure Assessment Location (HEAL) project is generating the kind of data needed to assess total human exposure to pollutants from air/food/water. The database on health effects of air pollutants is increasing but there are shortcomings from most studies that by necessity look at each contaminant in isolation, which is far removed from the real situation that exists indoors in which large numbers of individual materials are acting in combination to produce effects on the human organism.

Internationally generic health guidelines both for methodologies, practices, industry and enterprise specific to specific toxicant species abound. Neither health nor environmental standards have received international acceptance with a single Decision of the OECD (dioxins post Seveso). There is a trend within the EEC towards international standards and codes of practice for pollutants, including atmospheric compounds, but this remains to be implemented.

The development of harmonised health and environmental guidelines has been attempted by the USEPA, whose Biomedical Division, Office of Toxic Substance Control, is the largest unit with some 650 staff.

FUTURE DIRECTIONS IN GUIDELINES DEVELOPMENT

Specific areas that have been identified for future Australian research are directed towards adaptive response to repeated exposure and interaction amongst pollutants. Research priorities include;

- the identification of susceptible groups within the wider Australian population for all indoor pollutants;
- studies to account for other factors such as smoking, climate, nutritional and immunological condition;
- synergistic effects for pollutant mixtures; and
- chronic pulmonary and respiratory diseases in connection with nitrogen dioxide.

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Acceptability of New Chemicals to Replace CFCs

S. RAJ and F. KERNEBONE

INTRODUCTION

In the worldwide movement to protect the stratospheric ozone layer chlorofluorocarbons (CFCs) are being rapidly phased out and replaced in many applications by new chemicals, the hydrochlorofluorocarbons (HCFCs) and hydrofluorocarbons(HFCs). These chemicals are being chosen not only for their low or zero ozone depleting potential (ODP) but also for their compatibility with existing equipment and technology which makes a rapid substitution for CFCs technically possible.

The candidate chemicals for replacement of CFCs have been subjected to rigorous scientific study. The results to date have shown that not only do HCFCs and HFCs provide significant improvements in terms of ozone depletion potential (ODP), but generally they also have lower global warming potential (GWP) compared to the CFCs, mainly because the estimated atmospheric lifetime (EAL) of these hydrogen- containing fluorocarbons is an order of magnitude lower than that for CFCs (UNEP, 1991). However the low ODP of HCFCs are still unacceptable in the long term and they are to be phased out by the year 2030.

Other factors being studied to determine the acceptability of the alternatives include indirect environmental effects, occupational safety and public health, as well as technical suitabilities such as energy efficiency (important for global warming as well as economy), heat transfer properties, and compatibility with lubricants and materials of construction (AFEAS 1991).

This paper describes the steps being taken to assess the health and environmental effects of the alternatives to CFCs and provides a summary of the results of the tests conducted to date. It is based on technical information provided by the United Nations Environment Program (UNEP), United States Environmental Protection Agency (US EPA) and other international organisations specifically set up to study the candidate CFC alternatives (UNEP 1991, AFEAS 1991, PAFT 1991, USEPA 1993).

SCIENTIFIC TESTING OF THE CFC ALTERNATIVES

Protection of the ozone layer requires urgent action. To make the alternative chemicals available in the minimum period with minimum expense and competition for limited testing facilities, those companies intending to enter the HCFC/HFC markets pooled their resources to set up the Alternative Fluorocarbon Environmental Acceptability Study (AFEAS) and the Program for Alternative Fluorocarbon Toxicity Testing (PAFT) (AFEAS 1991, PAFT 1991). These organisations are involved in the long term testing of the most promising alternatives for CFCs. The aims of the organisations are to carry out in-depth research on the potential effects of CFC alternatives on the environment and on human health, and to facilitate prompt dissemination of scientific information to research organisations, government policy makers, relevant industries and the public.

The AFEAS program focuses on evaluating the effects of the proposed CFC alternatives on stratospheric ozone, global warming, mechanisms of product degradation and the potential environmental effects of the degradation products in air, water and soil (AFEAS 1991). The results of the AFEAS studies are summarised in Table 1.

The PAFT program, which was launched in 1987, focuses on worker safety, risk assessment and consumer protection issues. The main area of its work has been the toxicity testing of the alternate chemicals (PAFT 1991, Harris 1993). The program evaluates and integrates all available toxicological information and then carries out acute, sub-chronic and chronic toxicity studies, together with carcinogenicity and genotoxicity studies for each of the potential alternatives. The studies addressing the toxicology of HFC-134a and HCFC-123 have been completed, and some of the results are contained in Table 2. The following chemicals are still being tested: HCFC-141b, HCFC-124, HFC- 125, HCFC-225ca, HCFC-225cb and HFC-32. Further tests will be organised when other potentially viable alternatives are identified.

In addition to the above studies, the United States Environmental Protection Agency (US EPA) is also assessing the available alternatives and plans to restrict the use of substitutes for ozone depleting chemicals where it has identified other alternatives that reduce the overall risks to human health and the environment (Harris 1993, Smithart 1991). The assessment is carried out under the Significant New Alternatives Policy (SNAP) program.

RESULTS OF THE TESTING PROGRAMS

The reports of the various tests carried out so far under the AFEAS, PAFT and SNAP programs show that, in general, HCFCs and HFCs satisfy the various criteria for acceptability with respect to the environment and health and are therefore acceptable alternatives for many CFC applications. Tables 1 and 2 present summaries of the properties of the promising CFC substitutes. They are presented relative to CFC-11 (UNEP 1991, Smithart 1991, Rusch and Finnegan 1992).

The AFEAS program evaluated the ODP, GWP and EAL of the potential alternatives (Table 1). Whilst the HCFCs and HFCs retain many of the desirable properties of the CFCs, the presence of hydrogen in the molecule results in their being broken down to a much greater extent by chemical reactions in the lower atmosphere. Because of their shorter lifetimes in the

Table 1. Properties of CFC Alternatives

CHEMICAL (bp °C)	FORMULA $CC1_3F$	ODP 1.0	GWP 1.0	EAL 55
HCFC-22 (-40.8)	$CHC1F_2$	0.055	0.39	16
HCFC-123 (27.8)	$CHC1_2CF_3$	0.02	0.02	2
HCFC-124 (-12.1)	$CHC1FCF_3$	0.022	0.11	7
HCFC-141b (32.0)	CH_2CC1_2F	0.11	0.14	11
HCFC-142b (-9.3)	CH_3CC1F_2	0.065	0.44	22
HCFC-225ca (51.1)	$CHC1_2CF_2CF_3$	0.025	0.04	3
HCFC-225cb (65.1)	$CHC1FCF_2CC1F_2$	0.033	0.15	8
HFC-32 (-51.8)	CH_2F_2	0	0.13	7
HFC-125 (-48.6)	CHF_2CF_3	0	0.86	40
HFC-134a (-26.1)	CH_2FCF_3	0	0.29	16
HFC-152a (-24.2)	CH_3CHF_2	0	0.04	2
HFC-23 (-82.1)	CHF_3	0	7.9	310

NOTES:
1. Ozone Depletion Potential (ODP) and Global Warming Potential (GWP) are defined relative to CFC-11 on amass basis.
2 CFC-11, HCFC-22, HCFC-142b, HFC-23 and HFC-152a are pre-existing, commercially available chemicals that are not part of the present PAFT studies.

Table 2. Long-Term Toxicology Testing of CFC Alternatives
Sub-Chronic (90 Day) and Chronic (2 Year) Tests

CHEMICAL	SUB-CHRONIC MAXIMUM	SUB-CHRONIC LOEL	SUB-CHRONIC NOEL	CHRONIC MAXIMUM	CHRONIC LOEL	CHRONIC NOEL	RECOMMENDED OEL
CFC11	10 000	N/A	10 000	5 000	N/A	5 000	1 000
CFC12	10 000	N/A	10 000	5 000	N/A	5 000	1 000
HFC134a	50 000	N/A	50 000	50 000	50 000	10 000	1 000
HCFC123	5 000	300	< 300	5 000	300	< 300	10*
HCFC141b	20 000	20 000	8 000	20 000	5 000	1 500	500
HCFC124	50 000	50 000	15 000	50 000	In Progress		1 000
HFC125	50 000	In Progress		Not Currently Planned			1 000
HFC32	50 000	In Progress		Not Currently Planned			1 000
Ammonia	Low OEL determined by high acute toxicity, no long-term test data.						25
Propane	Low acute toxicity, no long-term test data found, assumed OK.						None Set
Isobutane	Low acute toxicity, no long-term test data found, assumed OK.						None Set
Cyclopentane	No toxicology data found, assumed OK.						600

NOTES: All doses expressed in parts per million (ppm)
Maximum = Maximum Dose used in Test
LOEL = Lowest Observed Effect Level
NOEL = No Observed Effect Level
OEL = Occupational Exposure Level (time-weighted average, 8 hrs/day, 5 days/wk). An OEL is recommended by industry pending a determination by a recognised body, e.g. ACGIH.
N/A = Not Available

Source: Harris, 1993.
* Du Pont recommend 30 ppm.

atmosphere, ozone depletion and global warming concerns are significantly reduced. An exception is HFC-23 which has been used for many years. It has a very long EAL and consequently a very high GWP.

The studies conducted under the AFEAS program have identified the breakdown products of the alternate fluorocarbons. These include inorganic compounds such as carbon oxides, hydrogen halides, carbonyl halides and organic compounds such as trifluoroacetyl (TFA) halides. The studies found that the secompounds are removed from the atmosphere by various processes including dissolution in cloud water and the ocean surface within months.

The PAFT studies found that in some cases the HCFCs/HFCs are even less toxic than the CFCs that they replace (Table 2) (UNEP 1991, AFEAS 1991, PAFT 1991). For example, the full results of the PAFT studies have confirmed the intrinsically low toxicity of HFC-134a and have assured the manufacturers and users that it is a safe alternative for CFC-12 in air conditioning and refrigeration applications.

HCFC-123, which is the only non-CFC alternative low-pressure refrigerant presently available, was found to produce benign tumours in rats exposed to very high concentrations in air over two years (Smithart 1991). Paradoxically, both the incidence of tumours and survival increased with the concentration of HCFC-123. As a precaution the chemical manufacturers in 1991 recommended a conservatively low occupational exposure level (OEL) of 10 ppm (Smithart 1992). Du Pont later revised their OEL for HCFC-123 to 30 ppm (GCCR1993). In practice, actual concentrations in plant rooms have been measured at well under 1 ppm (Smithart 1992). In most respects HCFC-123 is quite benign compared to many industrial chemicals already in widespread use such as trichloroethylene.

HCFC-123 is being used to replace CFC-11 in chillers used for large building air conditioning by retrofitting existing equipment or in new equipment using similar technology which is cost effective for its application. Over sixty machines in Australia have either been installed with HCFC-123 or have been retrofitted with it.

No recommendations on occupational exposure limits have so far been made by recognised authorities like the American Conference of Governmental Industrial Hygienists (ACGIH) or included in the Australian Worksafe Exposure Standards and no Government standards have been set. However, in Australia, the Association of Fluorocarbon Consumers and Manufacturers (AFCAM), which is the peak industry body dealing with the phase out of ozone depleting substances in Australia, has requested Worksafe to carry out an assessment on HCFC-123 to determine the conditions under which the chemical can be used industrially in Australia. This assessment is in progress. The US EPA has already investigated HCFC-123 under its SNAP program and proposes to approve its use not only in refrigeration but also in foam blowing and portable fire extinguishers (USEPA 1993).

A high toxicity rating does not mean that a chemical cannot be used safely, but rather that stringent precautions are required to limit exposure of workers and consumers. Ammonia, for instance, is a commonly used non-fluorocarbon refrigerant which is both toxic and flammable although it has little environmental impact.

Some preliminary results are available on the other chemicals being tested. The initial tests on HCFC-124 indicate that it is of relatively low toxicity, but the final results will not be available until 1995. The toxicity program on HCFC-141b is nearing completion and it has been found to have low toxicity. HFC-125 appears to be of very low toxicity and the tests will be completed by the end of 1993. Two isomers, HCFC-225ca and HCFC-225cb, which would be produced and used as a mixture, are being tested separately and they both appear to have low toxicity. The tests will be completed by 1995. Testing of HFC-32 has just begun but it is also expected to have a low toxicity.

The SNAP program concluded that HCFC-141b, HCFC-123, HCFC- 225ca/cb and perfluorocarbons are unacceptable substitutes for use as solvents in cleaning applications because more environmentally acceptable substitutes were generally available (USEPA 1993). As a result of this finding, the US EPA plans to restrict the use of these substitutes. However companies may still be granted a critical use exemption if they can demonstrate that no other substitutes exist that meets performance or technical criteria. All other solvent substitutes were found to be acceptable, including aqueous/semi-aqueous cleaners, other chlorinated solvents, no-clean technologies, and organic solvents such as ketones, esters and ethers.

Most of US EPA's decisions to restrict substitutes are based on concerns about the potential for further ozone depletion, principally from expanded use of long-lived HCFCs such as HCFC-141b [4](USEPA 1993). However, perfluorocarbons will only be allowed in restricted applications because of their long life and global warming potential.

In November 1992, the Montreal Protocol was amended to include HCFCs as controlled substances. The Parties to the Protocol made a decision to limit the uses of HCFCs to applications where there were no appropriate substitutes because of the significant although low ODP of HCFCs.

Apart from the issues discussed above, alternatives are also tested for flammability, boiling point, heat capacity, thermal conductivity, energy efficiency, solvency, compatibility with materials of construction and other technical properties (UNEP 1991, AFEAS 1991, PAFT 1991, USEPA 1993).

CONCLUSIONS

The candidate CFC alternatives under study were chosen because of their zero or very low ozone depletion potential. Their globai warming potential is also much lower than the CFCs. However none of the fluorocarbon alternatives closely match all the desirable properties of the CFCs they are intended to replace, and each alternative has trade-offs in energy efficiency, flammability and in one case (HCFC-123) toxicology. The trade-offs can be minimised by conservation techniques (i.e. recovery, recycle and leak prevention), limiting the use of higher ODP and higher GWP alternatives to only where technically necessary, by limiting occupational exposures, and by using in accordance with the manufacturer's recommendations.

ACKNOWLEDGMENTS

The authors thank the Environment Protection Authority

New South Wales (EPA NSW) for. permission to publish this paper.

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HAZARDOUS WASTE MANAGEMENT IN ALBERTA: CANADA'S SUCCESS STORY

K.J. SIMPSON* and V. BULLOUGH*

•ALBERTA SPECIAL WASTE MANAGEMENT CORPORATION,
*ALBERTA SPECIAL WASTE TREATMENT CENTRE

ABSTRACT

The establishment of a comprehensive special waste management system, including a state-of-the-art treatment facility, in the province of Alberta is a unique success story given the prevalence of the "Not In My Backyard" syndrome. This article describes the facility, its design, components and monitoring program, but more importantly outlines the process of public participation that made it possible. The technology of waste treatment is well-established. What is not as commonly available is the cooperation of the public working towards comprehensive hazardous waste management solutions.

INTRODUCTION

The province of Alberta, Canada, has a significant and geographically dispersed industrial sector. Industries such as petrochemical plants, refineries, gas processing plants and other manufacturing sectors contribute to an estimated 100,000 tonnes of hazardous waste produced annually in the province.

In the late 1970's, before such major environmental crises as Love Canal, Three Mile Island, or Valdez, hazardous waste became a focus of public interest in Alberta. The government established a Hazardous Waste Management Committee and instructed the Environment Council of Alberta to conduct province-wide public hearings on the issue.

The result of this process was to strongly urge the government of Alberta to establish and develop a comprehensive waste management program and to proceed at the earliest possible date.

It did. In 1984 the Special Waste Management Corporation (ASWMC) was established, and in September of 1987 the Alberta Special Waste Treatment Centre was opened. Located near Swan Hills, 250 kilometers northwest of Edmonton, it is North America's first fully integrated hazardous waste treatment and disposal facility and the hub of a comprehensive provincial system for the collection, transfer and transportation of hazardous wastes.

SITING PROCESS

The success of this exercise resulted from the Alberta government's commitment to public participation. Throughout the search for a solution, no preconceived facility location was determined by the government and no locality was considered without public invitation.

Following the recommendations of the Hazardous Waste Management Committee, the process designed for facility site selection involved assessing all areas of the province and eliminating those which did not fit criteria appropriate for the development of a hazardous waste handling facility. Data derived from government and research agencies was compiled in such a way as to present a total picture of environmental suitability for industrial development.

Following this constraint mapping exercise, all data were returned to participating municipal councils. Public input was invited and the community was encouraged to recommend free to choose constraint-free lands for further consideration. Those areas chosen were then assessed in more detail.

Within two years of program initiation, five candidate sites were undergoing detailed hydrogeological assessment. All sites proved to be environmentally suitable.

PUBLIC INVOLVEMENT

With an issue as unfamiliar as hazardous waste management, the public needed considerable information and time to fully understand the issues. The public needed to identify with the problem before ever considering any responsibility in developing a solution. The key was to spark an interest or awareness of the issues of hazardous waste management. Then opportunity was provided to access and assess background information on the reasons for the facility siting program, the proposed approach, development plans and potential impacts (both positive and negative). This brought the public to a point where it was not only able to, but prepared to make some well educated decisions.

It was this involvement of citizens throughout the process and the consideration of both the scientific and sociological aspects of the project that prevented the NIMBY syndrome (Not In My Backyard) from taking hold.

ONGOING PUBLIC LIAISON

Building on the basic premise that public involvement and support was key to successfully siting the facility, the ASWMC was committed to maintaining citizen involvement. During the year following site selection, from discussions with residents and elected officials of Swan Hills the concept of a citizen's advisory committee was developed. This committee would ensure that the townspeople would remain aware of

and involved with decisions regarding the facility's operating practices by providing them with a means for ongoing communication.

FACILITY

The $50M (CDN) facility is jointly owned by private industry and the Alberta Special Waste Management Corporation. The facility is designed to accept and treat all hazardous wastes generated within the province which require off-site management. It was designed to treat approximately 17,500 tonnes annually through incineration, physical/chemical treatment methods and stabilization. The solid residues, which are rendered non-hazardous, are disposed of on-site in a secure landfill and wastewaters are treated and disposed of down an injection well. The facility is fed from large industry directly and from small industry and households through the collection and transfer components of the system.

TECHNICAL ASPECTS

Design basis

The Treatment Centre has been designed to process and treat virtually any special waste, excluding radioactive wastes and explosives, and to dispose of all treated residuals on site.

In general, organic wastes such as oils, solvents and PCBs are treated by high temperature incineration. Inorganic wastes such as acids, alkalis, and heavy metal bearing liquids or sludges are treated by physical chemical methods such as neutralization, oxidation/ reduction, precipitation and filtration.

Fixation and stabilization processes are applied to residues from other waste treatment processes and wastes which are not suitable for organic or inorganic treatment. The stabilized solids are ultimately disposed of in the secure, double lined landfill. Aqueous residues from the treatment processes, as well as truck wash water and surface run-off, are deepwell injected (approx. 2000 m below the surface) after being proven compatible with the deepwell formation.

In order to determine the appropriate size of the Treatment Centre, an inventory of wastes was compiled for Alberta in 1980, which suggested that approximately 100,000 tonnes of special wastes were generated annually. This figure could not be used directly as the design basis for the Treatment Centre, since experience gained elsewhere has shown that the volume of waste that is actually received by such a plant may be as little as 20% of the total generated. This is due to such alternative management options as recycling, reuse, on site treatment and waste exchange.

In other words, industry looks to reducing the amount of wastes they generate, or for which off-site treatment and disposal is required. The need for a conservative approach towards Facility design was, therefore, paramount and in the case of Alberta, 17,500 tonnes per annum was used as the design base -12,500 tonnes of organic wastes, 2,500 tonnes of inorganic wastes and 2,500 tonnes of other wastes.

A more recent study, performed in 1989 to evaluate the need for a major plant expansion, has shown that 40,000 tonnes of special waste now require disposal each year in Alberta.

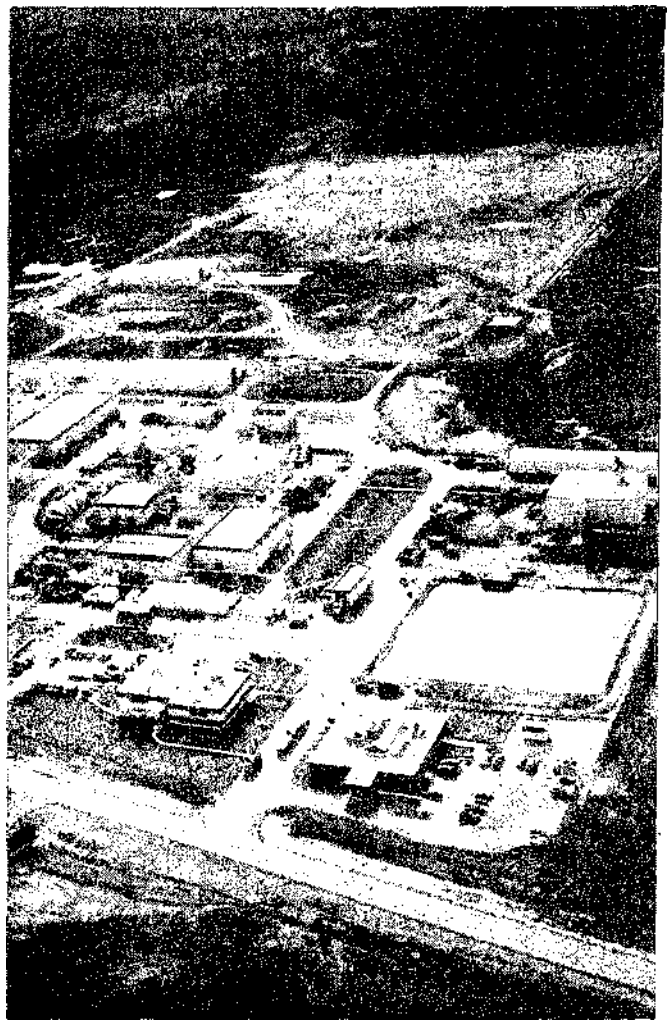

FIGURE 1. Alberta's Waste Treatment Facility.

Plant Layout

As is evident from Figure 1, the Treatment Centre comprises both non-process (infrastructure) and process (waste treatment) components. The former group includes:

- reception area, including gate/guard house, truck scales;
- laboratory and administration building, including analytical laboratory, data processing, offices etc.;
- operations and maintenance building, housing personnel change rooms, visitors centre/lecture room, lunchroom and a comprehensive electrical and mechanical maintenance complex;
- storm water retention ponds - all raw water run-off is collected from the entire 24 acre fenced process area for potential deepwell injection;
- water supply, collection and treatment system, storage reservoir and sewage treatment plant;
- truck wash facilities.

The components specifically involved with the movement, the treatment or the disposal of the waste materials, in one manner or another are:

- waste collection and transportation
- waste storage and drum processing area
- incinerators

- physical/chemical treatment plant
- stabilization plant
- secure landfills
- injection deepwell

Each of these process components is discussed in more detail.

SYSTEM COMPONENTS

Reception

The waste reception area of the Special Waste Treatment Centre is equipped for waste sampling, drum processing, chemical storage and waste mixing. Thus, it provides the final element in the interface between the Treatment Centre and the waste generator.

Waste Storage Area

At the Treatment Centre, the specially designed transportation containers are used as interim storage of wastes prior to either blending or treatment. In addition, there are two coid storage buildings and one heated storage building (for water contaminated wastes or those which cannot be allowed to freeze) presently in use. The total storage at the Treatment Centre can accommodate up to 3200 tonnes of commercial and plant generated waste for a feed stock capacity of approximately 100 operating days.

Laboratory

The laboratory is subdivided into four distinct sections: sample receiving/fingerprinting lab, wet chemistry lab, organic lab, and inorganic lab.

The sample receiving/fingerprinting lab performs 10 different analytical tests to quickly verify the information provided by the generator on the waste profile sheet. Some typical measurements include: verifying the presence of phenols, heavy metals, chlorine and cyanide; measuring flashpoint and pH; and determining viscosity.

This lab also checks the compatibility of new and old waste by analyzing the liquid waste stored in the facility's storage tanks before new liquid waste is added.

Once a waste has been verified it then goes to one or more of the other labs for advanced analysis for development of treatment protocols. Quality control of processes is also a responsibility of the laboratory.

Incinerators

in order to destroy organic material, incinerators have been installed which are capable of treating liquids, sludges and solids. Two rocking kiln incinerator and a rotary kiln incinerator are operational and a new, larger rotary kiln is planned to be added. Both types of incinerators have similar operating characteristics and are capable of meeting the environmental emission criteria. The rocking kiln, by design, has a wider range of operating conditions and is thus suitable for treating unique waste streams. The rotary kilns are most suited for high volume solids processing.

The centre has two rocking kiln incinerators with a nominal capacity of 8 to 10,000 tonnes/year. The rocking kiln is a steel cylindrical drum, lined with refractory brick, that rotates on its longitudinal axis. The rocking motion produces a mixing action to promote incineration of the waste matter at the bottom of the kiln, thus ensuring rapid and complete combustion.

The operating temperature of the rocking kiln is typically 800°C to 1300°C. In the stationary secondary combustion chamber, temperatures are somewhat higher in order to ensure adequate destruction and removal efficiency of the principal organic hazardous constituents in the flue gas.

The gas purification train is a wet based system designed to handle the effluent from either or both rocking kilns simultaneously. Its basic function is to scrub HCI, SO_2 and particulate matter from the flue gas stream. After passing through the gas purification train, the final treated gases are discharged to the atmosphere through a 762 mm diameter by 20.1 m high stack. The exit temperature of this gas is approximately 43°C. Gas is continuously monitored to ensure acceptable performance.

The rotary kiin incinerator was designed to provide additional solids incineration capacity. The design capacity was approximately 8,000 tonnes per year and throughput on the order of 1.5 tonnes per hour of PCB contaminated soil is regularly achieved. The kiln has also been used to destroy paint sludges and gas plant filters. For this unit the waste material is fed into an inclined rotating kiln which also operates at temperatures between 600°C and 1200°C. The solid material progressively travels down the length of the kiln over a period of 30 to 60 minutes after which it is discharged into a slag removal unit. The rotational velocity and angle of tilt can be altered to obtain the required residence time.

The gases from the rotating kiln pass into a secondary combustion chamber in which the incineration process is completed at elevated temperatures (greater than 1200°C) in an excess oxygen atmosphere. The resulting flue gas is treated in a purification train which scrubs the acid gases, such as HCl and $SO_{2)}$ and particulate matter from the gas stream. These purified gases are subsequently discharged to the atmosphere via a flue gas stack which is continuously monitored and regularly tested to ensure acceptable performance of the unit.

A special transformer decontamination unit has been added to the rotary incinerator system. The purpose of the transformer furnace is to decontaminate Askarel and PCB contaminated transformers in preparation for either disposal or metal recovery.

The transformer to be "roasted" is placed within an inner retort and heated to approximately 800x C to drive off the PCB contamination. The gases are passed to the secondary combustion chamber of the rotary incinerator where they are destroyed at 1200°C.

Physical/Chemical Treatment Plant

The physical/chemical plant, is designed to treat 2,500 tonnes/year of inorganic waste, the plant is capable of processing a wide range of substances varying from waste acids to heavy metal solutions and cyanides in varying strengths and mixtures and can receive these substances in the form of liquids, sludges or solids.

Available treatments include neutralization, precipitation and oxidation/reduction. The resulting sludges and precipitates are dewatered using a pressure filter. The filter cake is further processed at the stabilization plant for subsequent landfill disposal and the water is

pumped to the pH adjustment tanks prior to injection into the deepwell.

Stabilization Plant

The stabilization process is provided for the treatment of residues and effluents from other waste processes and for the treatment of wastes not suitable for either incineration or inorganic treatment. Stabilization comprises solidification and/or fixation. Fixation is a process whereby chemically reactive compounds, such as cement, are mixed with the water and other components in sludges and other aqueous wastes, to form more stable solids such as concrete. This both immobilizes and, in some cases, chemically changes the waste to render it non-toxic and non-leachable.

Secure Landfill

The landfill area is comprised of a series of trenches or cells designed to supplement the existing natural containment afforded by the extremely impervious clay at the site.

Engineered measures, such as the installation of a 2 mm (80 mil) high density polyethylene liner with an associated network of leachate collection systems, are further aided by a policy of ensuring only dry, stable materials are placed in the cells.

The leachate collection system is checked weekiy. Since very little liquid is disposed of in the secure landfill and any active cell is completely covered by a temporary building there is only a small amount of leachate generated. No untreated waste is disposed of in the landfills.

Injection Deepwell

In Alberta's oil and petrochemical industries, deepwell injection of aqueous based wastes is a technique widely used. These liquid wastes are injected into suitable geological formations where they are isolated from any aquifer or potable water. This method has been used in Alberta for disposing of drilling fluids and saline wastes from oil exploration and production wells. This procedure is also used by industry, where the hydrogeology is appropriate, to dispose of aqueous, usually saline, process wastes.

At the Special Waste Treatment Centre, this method of disposal is not used for the disposal of any untreated special or hazardous wastes. It is used for processed waste water, site run-off water, and wash water from the truck decontamination system.

Scope of Wastes Treated

The treatment centre provides various treatment options and technologies employed for the disposal of an incredibly wide array of hazardous wastes available in the province of Alberta. The wastes that are dealt with routinely can be broken into six primary categories.

- The first are:
  solvents used for cleaning such as acetone, benzene, carbon tetrachloride, ethanol, isopropenol, kerosene, methyl chloride, toulene, trichloroethyiene, Varsol and white spirits.
- The second are:
  the acids—and—alkalies used in rust removal, acid batteries, chemical manufacturing, lab experiments, printing and come in the form of ammonium hydroxide, hydrochloric, nitric, sulphuric and phosphoric acids, potassium hydroxide and sodium hydroxide.
- The third are:
  reactive—wastes generated by chemical and metal manufacturers, such as hypochlorites, organic peroxides, sodium perchlorate, potassium sulphiteand sodium sulphite.
- The fourth category is:
  ignitable—wastes and are common items such as paint wastes, paint and varnish removers, paint brush cleaners, epoxy resins and adhesives.
- The fifth group is:
  heavy—metals found in paints, chemical manufacturing labs, metal manufacturing and processing such as coating, engraving, heat treating and electroplating.
- The last category is generally the most highly publicized waste stream which includes:
  those materials contaminated with PCBs or varieties of PCB contaminated soil, phenolic compounds, dioxins, and furans.

Monitoring Programs

The basic principles of the environmental monitoring program are that it should be an added indicator of the safety and operating practices at the plant and provide early warning should there be unexpected emissions from the plant.

Based on the above principles, a three tier monitoring program has been established as follows:

- Worker Health Surveillance and industrial Hygiene Monitoring;
- Plant Boundary Air Quality Monitoring and;
- Plant Vicinity Biological Monitoring.

The Environmental Monitoring Program began in 1985, a year after the siting of the facility was finalized. The incinerator operation commenced in the fall of 1987, thereby allowing a two year baseline condition monitoring program. Data collected during the operational phase are compared to baseline conditions to identify trends.

The health surveillance program is comprised of two phases. A pre-employment medical examination establishes the workers' health status as a baseline. Periodic examinations, complete with a biological monitoring program, track any changes that might occur.

The air monitoring program at the plant boundary measures concentrations of specific airborne chemicals which might be leaving the Facility. Meterological conditions are also recorded in order to establish dispersion patterns.

The purpose of the off-site biological monitoring program is to measure the effects, if any, the treatment centre might have on the ecosytem. Annual assessments are made of the quality of ground water, surface water, stream sediments, fish, wildlife, soil and vegetation.

Ownership and Infrastructure

The Alberta Special Waste Management System, intended to provide the highest attainable level of

environmental protection at a competitive cost to the industry in Alberta, has proven to be a highly successful experiment in public and private sector co-operation. This success has been due in great measure to several unique features which distinguish this venture from other, similar projects concerned with special and hazardous waste treatment and disposal.

The Alberta Government, through its agency, the Alberta Special Waste Management Corporation, which is specifically charged with a mandate to facilitate establishment of a special waste management program, has assumed a 40% ownership position in the facility by forming a Joint Venture with Chem-Security (Alberta) Ltd.'s parent company, BOVAR. The latter company has the remaining 60% majority interest in the Venture.

This distribution in ownership reflects the Government's recognition of the operating efficiency which is characteristic of the private sector but still provides the government with sufficient control to ensure accessibility of the system to the user at rates which are competitive with other jurisdictions.

Throughout the design process, the Treatment entre was viewed as an integrated system rather than a collection of independent, unrelated, albeit efficient, processes. Thus, each essential operation was thoroughly analyzed, interactions were clearly defined and innovative, proven technologies were carefully evaluated for each aspect of the treatment process. This approach permitted the incorporation of compatible, complementary unit operations into a comprehensive, flexible and easily expanded facility.

The Treatment Centre bears no similarity whatever to the traditional "solid waste dump". On the contrary, the various unit operations reflect the latest in technological advancement and, except for the nature of the feed stock, the unit processes resemble those of contemporary, attractive and environmentally conscientious chemical and petrochemical plants. The Centre is, in every respect, an asset and source of pride to the host community.

Highest priority in the design construction and operation of the Treatment Centre has been assigned to safety and the protection of the environment. Every reasonable precaution has been taken to ensure that neither system failure nor operator error will constitute a hazard to the health of the community or impairment of the surrounding environment. To this end, the designs of essential elements incorporate generous safety factors, critical control systems are interlocked and protected with several levels of redundancy and the site design is based on a concept of total and guaranteed confinement of all entering special wastes and the destruction products of these wastes.

CONCLUSION

The most complex of the problems associated with the establishment of a special waste treatment facility are not, generally, of an engineering or technological nature, rather, they relate to public perception and acceptance. Alberta's unique approach was based on a cautious, step by step procedure, which emphasized community involvement throughout the entire selection process, resulting in the first voluntary acceptance of a special waste treatment facility by any community in North America. Continued liaison with the community has resulted in a supportive yet watchful population who are host to the world's most advanced hazardous waste treatment facility.

The Alberta experience has shown that public acceptance of environmental protection facilities is not only possible, but can be achieved with a high degree of enthusiasm. Transference of this positive phenomenon is certainly possible to other jurisdictions which are attempting to site similar facilities.

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and know-how on environmental problems are available, makes this location for a workshop particularly suitable for the final synthesis.

A scientific synthesis on mercury contamination from gold panning, dam constructions and irrigation as well as mercury cycling and behavior in tropical areas will be published as an output of the project. However, the planned coordination of the work with the WHO projects can be expected to open the possibility of overviews of human health aspects in the same volume.

Prof. Claes Ramel, The Wallenberg Laboratory
University of Stockholm, Sweden.

(This article originally appeared in SCOPE Newsletter No. 43 and is reproduced with permission.)

BOOK REVIEWS AND BOOKS

Air Monitoring Instrumentation, A Manual for **Emergency, Investigatory, and Remedial Responders, Carol J. Maslansky, Steven P. Maslansky, Van Nostrand Reinhold, New York, ISBN 0-442-00973-9, 1993, 304pp, Distributed by Thomas Nelson Australia. $AUS 116.95.**

This soft covered manual provides a useful starting point for those having to detect and quantify the hazards associated with airborne gases and vapours, ionizing radiation and other specialist applications including evaluating oxygen sufficiency and combustible atmospheres. It is based on personal field experience with a wide range of instruments and hence adopts a refreshing practical approach, which will be especially appreciated by those with limited experience in the measurement of atmospheric contaminants.

The eleven clearly defined chapters deal with specific applications for monitoring instruments and the different types of detector systems. These include detector tubes and dosimeters, combustible gas indicators, oxygen deficiency and toxic gas combination meters, photoionization detectors, flame ionization detectors, multi-specific gas detectors and radiation detectors. Topics include theory of operation, use, what the readings actually mean, calibration, trouble shooting and most importantly the limitations and precautions associated with each instrument type. This text can be used either as a reference source or as a self paced training manual. Each chapter begins with learning objectives and concludes with a comprehensive set of review questions and problem sets. Numerous references are given in each chapter if a more detailed treatment of the subject matter is required.

The text is complimented with informative tables, diagrams and photographs characterizing instrument design and performance. Examples of printouts and chromatograms provide a quick and easy means of assessing the differences in performance of columns and detectors for the separation and identification of compounds. Unfortunately the page layout is poor resulting in much wasted space which contributes to the overall size of the manual.

The appendices do little to compliment the main text or to enhance the overall level of information contained in the manual. Their purpose is unclearfor while they provide abbreviated procedures and instructions for a limited number of instruments they are not sufficiently comprehensive to use without reference to the manufacture's information. The treatment given in the appendices to detector tubes is mystifying as they include only two detector tube systems and a limited number of tube types. If this manual is to be used to assist in the selection of instruments the reader would be better served if it included the same level of information for all instruments and instrument types.

As expected many of the references are specific to the US with regulations, standards and performance specifications out of USEPA, OSHA and NIOSH often cited. Whilst still useful some caution is required when interpreting this information. For example UL of FM certification for a battery powered instrument's intrinsic safety does not mean it satisfies requirements for certification in Australia.

A problem that any book of this type suffers is that with the rapid advancements being made in electronics and detector systems the technical information in them rapidly becomes outdated. However there is sufficient general information on subjects such as hazard identification, properties of hazardous materials and principles of detection to make it a worthwhile addition to one's technical library.

Doug Rhodes
Shell Co. of Australia

"Guide to Environmental Legislation in Australia and New Zealand"

ANZECC Report No. 28

The Australian New Zealand Environment and Conservation Council (ANZECC) has produced this publication as a guide to the current environment protection and related legislation of the Commonwealth, State, Territory and New Zealand Governments. The Guide is the successor to Australian Environment Council Report No. 18 (Second Edition) of 1988.

Copies may be obtained from the ANZECC Secretariat, GPO Box 787, Canberra, ACT, 2601; Fas (06) 274 1858. The cost is $40 per copy. Orders can be placed by either faxing a purchase order to the Secretariat and an invoice will be issued or by enclosing a cheque with the order form below. Cheques or money orders should be made payable to the CPM, DEST ANZECC Trust Fund.

Twenty-Fifth Mid-Atlantic Industrial Waste Conference
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Session topics from the conference held July 7-9, 1993 at the University of Maryland include: Solidification; Incineration and Air Quality; Soil Treatment; Chemical Treatment; Biological Treatment/Bioremediation; Legal Issues; Remediation/Site Investigation; Waste Minimization; and Composting/Sludge Treatment.

These proceedings are a major source of new information for environmental regulators, engineers, and researchers; plant managers; and waste management personnel.

Hazardous and Industrial Wastes. Proceedings from the 25th Mid-Atlantic Industrial Waste Conference, July 7-9, 1993, University of Maryland. Editor: Allen P. Davis. ISBN: 1-56676-067-4, 610 pages, 6 x 9, softcover, $85.,00.

Available from Technomic Publishing Company, Inc., 851 New Holland Avenue, Box 3535, Lancaster, PA 17604, U.S.A. Telephone: 717-291 -5609, Fax: 717-295-4538. A detailed brochure describing this book is available from the publisher upon request.

Valuable New Environmental Resources from the Air & Waste Management Association.

New RCRA Regulations for Industrial Boilers, Furnaces and Incinerators
1992, 232 pages. $40 for Association members, $60 for others.
Order code SP-80.

This proceedings from an Air & Waste Management Association specialty conference covers evaluations of various impacts of the new RCRA regulations, problems and experiences in achieving compliance, issues related to hydrocarbon emissions, behavior of heavy metals, recent technical and regulatory experiences with incinerators, and emission measurement techniques and experiences.

The User and Fabric Filtration Equipment VI
1993, 312 pages. $55 for Association members, $85 for others.
Order code SP-84.

This proceedings from the sixth in a series of conferences provides information on new fabric developments, high temper-

ature filtration, incineration, and metals and cement applications. Monitoring test results and industry experience are also detailed.

Continuous Emission Monitoring
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1993. 458 pages. $45 for Association members, $70 for others.
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Continuous emission monitoring systems are in place in a variety of industries. But what are, or will be, the best systems for continuous emission monitoring in the 1990s? The papers in this book describe the technology that answers that question. Topics discussed include: the new Acid Rain Program Part 75 CEM requirements and the challenges of meeting them; measurement of VOCs; new and alternative technologies; and data acquisition systems.

Waste Combustion in Boilers and Industrial Furnaces
1993. 314 pages. $45 for Association members, $70 for others.
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The papers in this proceedings examine the latest experience with application of RCRA regulations on boilers, industrial furnaces and incinerators. With particular emphasis on the boiler and industrial furnace (BIF) regulations, the papers air overviews of various impacts of these new regulations as well as a variety of technical reports dealing with novel compliance and testing approaches.

Southern California Air Quality Study Data Analysis
1993. 356 pages. $50 for Association members, $75 for others.
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Papers are presented in seven categories: descriptive overview; emission inventory development and evaluation; aerosol characterization and receptor modeling; the Los Angeles Aerosol Characterization and Source Apportionment Study; aerosol modeling and visibility; meteorology and transport; and photochemical modeling.

Emission Inventory Issues
1993.. 714 pages. $50 for Association members, $75 for others.
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Emission inventories provide the basis for control strategies for attaining the National Ambient Air Quality Standards for ozone. The Clean Air Act calls for base year inventories for 1990 and periodic emission inventories every three years.

Standards, Certification and Training of Environmental
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1993. 132 pages. $35 for Association members, $55 for others.
Order code VIP-28.

Proceedings includes presentations and discussion of emerging standards and certification programs related to environmental assessments and audits. Both national and international standards development activities are discussed.

Field Screening Methods for Hazardous Wastes and Toxic Chemicals.
1993. 1342 pages in two volumes. $80 for Association members, $120 for others.
Order code VIP-33.

The role of and need for field screening methods for the identification and quantification of contaminants in environmental media are growing rapidly. Field screening methods that generate real-time information on the nature and extent of contamination improve the cost-effectiveness of remediation.

This proceedings of an international symposium cosponsored by the EPA Environmental Monitoring Systems Lab and the Air & Waste Management Association presents papers on the state-of-the-art science and technology of field screening.

Municipal Waste Combustion
1993. 1108 pages. $75 for Association members, $115 for others.
Order code VIP-32.

The proceedings from a specialty conference that focused on the assessment and development of pollution control measures for MWC facilities, and on the role of MWC facilities in overall strategies for MSW management. The papers address the planning, design, construction, operation, maintenance, regulation and development of MWC facilities.

The Role of Meteorology in Managing the Environment in the 90s
1993. 454 pages. $50 for Association members, $75 for others.
Order code VIP-29.
The papers in this proceedings address new technical developments and applications in the field of air pollution meteorology. Topics include: model development; modeling applications; fluid modeling; deposition; regional and global pollution; measurements and field studies; and physical meteorology.

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   Air & Waste Management Association
   One Gateway Center, 3rd Floor
   Pittsburgh, PA 15222

   Credit card orders may be faxed to (412) 232-3450.

Shipping Charge Chart

$0	United States
$5	Canada
$10	Mexico and Central America
$15	Europe, South America, Middle East
$20	Asia, Africa and Australia

Name

Company

Address

City

State/Prov.

Country Postal Code

Phone Fax

☐ *Yes -- Member # if known* ☐☐☐☐☐☐

☐ *No -- Please send me membership information.*

Method of payment

☐ Check -- Payable to A&WMA

☐ MasterCard

☐ VISA

Credit Card #

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Exp. Date ☐☐☐☐

Name as it appears on card

Signature

All prices are given in U.S. dollars.
Please allow 7 work days for normal processing of your order.

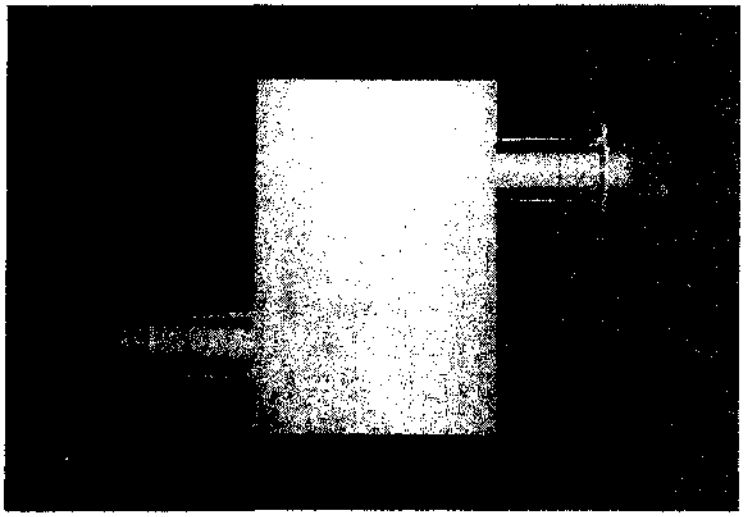
Title	Order Code	Quantity	Price	Total

Thermo Environmental Instruments Inc.

STACK AND AMBIENT MONITORING INSTRUMENTS FROM THE WORLDS LEADING SUPPLIER OF INSTRUMENTS AND SYSTEMS.

NEW!

MODEL 220
ULTRASONIC STACK GAS FLOW METER



KEY FEATURES

- Analog Output
- Digital Output
- Multiple Alarms
- Automatic Test Function
- 90° Mounting
- Mass Rate Output (Optional)
- Purge Air Heaters (Optional)
- Blower Plenum Temperature Sensor
- Flue Gas Temperature Calculation
- Teflon Coated Transducers
- Surge Protected Circuitry
- Diagnostic Internal Reference (Patented)
- Configurable via Customer Personal Computer

Thermo Instruments Australia Pty. Ltd.

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