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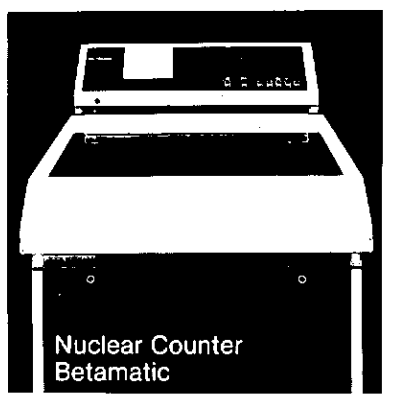

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FEATURES FOR CHEMISTRY IN NZ 1986

Readers and advertisers are advised that the following is our editorial plan for 1986. Relevant editorial contributions are invited and advertisers are encouraged to plan advertising around these features as well as supply product information for editorial inclusion.

APRIL
Haemoglobin; Science funding; UV-VIS Spectroscopy; Safety; plus advance material on careers feature.

JUNE
Devoted to a recruitment issue; extra issue to all final year tertiary students.

This issue will broaden the editorial base to act as a forum for companies to advertise the sort of personnel they wish to attract, both executive, fully qualified scientific staff as well as students.

A water purification feature. It will also include details on the work on ion exchange resins at Massey University which was awarded the Shell Industrial Price in 1984.

AUGUST — The Annual General Meeting issue
NMR (nuclear magnetic resonance), ceramics, a big instrumentation feature, The Annual General Meeting issue — The 1986 NZIC salary survey. A lab equipment and lab furniture survey and articles on corrosion.

DECEMBER
Big 50 year celebration.
Chemistry in N.Z. celebrates its 50th year of publication. This will be a major publishing exercise and suggestions and contributions are invited please.

Write now to:
"The Publisher Chemistry in New Zealand, P.O. Box 9072, Newmarket, Auckland.

OCTOBER
Organic chemistry (reaction studies). Chemicals and safety re: handling, storage and transportation, with special attention to OCCA needs and different container manufacturing methods and materials.

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Front Cover Story

Engelhard Industries — for precious mineral products

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EDITORIAL

ZSM-5 and the Mobil Process for Synthetic Petrol

At the end of this month the synthetic petrol plant at Motunui is due to be officially opened. With that action one might consider that this country has finally arrived on the petrochemicals "scene". The plant is the first in the world to make petrol from natural gas, and is expected to supply a third of the country's needs. It will contain not one, but two, of the largest methanol plants in the world, producing feedstock for the MTG (methanol to gasoline) process. It is expected to save the country over $300 million a year, in 1980 terms, in reduced oil imports.

The key to the process is the Mobil catalyst ZSM-5, one of the family of zeolites.

Zeolites have many and disparate uses. The humble naturally occurring zeolite clinoptilite is used to deodorise hen-houses in Japan; ultra-stable Zeolite-Y, man-made, is used as a cracking catalyst in petroleum refining; and Zeolite-A, synthesised by the kiloton, is used as a water-softener in detergents.

The synthesis of the zeolite ZSM-5 by workers at Mobil, the discovery of its ability to convert alcohols to a mixture of hydrocarbons similar to gasoline, and the decision of the NZ Government to construct the first Synthetic Fuels plant based on this process, have attracted world-wide interest. With the commissioning of the NZ Synfuels plant at Motunui this seems an appropriate time to devote an issue of "Chemistry in New Zealand" to review details of the plant, and also to examine some of the work being carried out in this country on ZSM-5 and the MTG process.

The study of zeolites in New Zealand, and by New Zealanders, has a long history. One of the fathers of zeolite studies is undoubtedly Professor R. M. Barrer, FRS, an expatriate New Zealander who over a 40-year period, mainly at Imperial College, London, has carried out many of the fundamental studies of zeolite synthesis and characterisation; he has also written two authoritative books on the subject. In the 1950's there was considerable interest at the University of Otago in the study of natural zeolites, and this was followed by synthesis and catalysis studies there. This issue of "Chemistry in New Zealand" shows that interest in zeolites is now widespread throughout the country.

Not all work is represented here. Some topics were unfortunately precluded for lack of space, for example:

- the utilisation of specific hydrocarbon products of the MTG process, such as durene,
- nmr, catalytic and deactivation studies, and ZSM-5 acid-site characterisation at Chemistry Division, DSIR.
- work on metal-loaded zeolites and on natural zeolite deposits at the University of Auckland
- and the studies on conventional zeolites at the University of Otago.

History shows us that any new chemical process undergoes a series of improvements as it matures; the Mobil MTG process will be no exception. And there is no doubt that the work being carried out in NZ, and described in part in this issue, will have a role to play in realising these improvements.

In conclusion I should acknowledge the efforts of Dr David Bibby in bringing this issue to fruition. From the original concept, through to presentation of a complete set of edited articles, the credit is all his. Thanks also to New Zealand Synthetic Fuels Corporation Limited, and Mobil Oil New Zealand Limited for the provision of background information and publicity material.

Bruce Graham

Ruakura Reunion

Dear Sir

The Ruakura Research Centre plans to hold a staff reunion on 17-18 May 1986 to mark the closing of the "Homestead".

We are led to believe that the Homestead was built in 1910 for the lodging and indoor instruction of farm students. It has provided accommodation for single staff since the early 1950's and numerous young people have come to Ruakura to gain knowledge in advanced farming and research methods before returning to the industry where they have made valuable contributions. The Homestead has also provided a haven for countless overseas students and travellers who have come to gain knowledge at this world renouned research centre.

Interestingly the reunion will coincide with the centenary of the gazetting of the first piece of Ruakura's land which was set aside by the Government of the day for development as an agricultural college and model farm.

Our biggest problem is contacting those who have left. To this end we would be most grateful if you could find space in your next issue to publish my letter and if possible the enclosed photograph which is instantly recognisable by every Homestead resident. We would like anyone interested in the reunion to send their name and address by return mail to:
Homestead Reunion
Ruakura Research Centre
Private Bag
HAMILTON.

Yours sincerely

Evelyn Uljee
Convenor, Organising Committee

Chromatypography Meeting

Quantitative Chromatography

20-21 May 1986

University of Auckland School of Medicine

A two-day meeting based on oral presentations and a trade display will be held in Auckland during May 20-21, 1986.

The meeting is intended to cover all chromatography and allied techniques. There will be contributions on topics ranging from initial sample handling, correction for extraction losses, data handling requirements and peak identification techniques. The programme will be nominally divided into six sessions with the following themes: Sample handling, data systems, detection/identification techniques, two sessions on applied topics, with examples, trade display.

Registration will be $50 for all participants to cover tea/coffee costs and a meal on the evening of May 20. Special rates will apply to trade participants and speakers giving key lectures. Accommodation will be available in a hall of residence and a motel.

It is expected that there will be some overseas speakers participating in the lecture sessions but further contributions from all chromatographers in New Zealand will be welcome.

It is hoped there will also be presentations of ancillary techniques available to chromatographers for the purpose of confirming peak purity prior to or during the analysis of chromatograms.

If you intend to participate or wish to receive further information later in 1986, please contact Dr D. R. Webster, Dept of Community Health and General Practice, University of Auckland School of Medicine, Private Bag, Auckland.

This meeting is organised by the Chromatography Group of the NZIC.

The Mobil Process

Much of the detail of the Mobil Process has been described previously in articles such as that published in Chemistry in NZ, **45,** 53, (1981). The following material is intended simply as a refresher.

In the Mobil Process used at Motunui, methanol is passed over ZSM-5 to produce petrol. This is only part of the operation however. First the methanol has to be made from natural gas. To do so Maui gas is passed through a steam reforming process, to produce synthesis gas. Using well-known commercial processes, the synthesis gas is then cooled, compressed and passed over a copper zinc catalyst. The carbon monoxide, carbon dioxide, and hydrogen recombine to form crude methanol, with a water-content of 18 to 20 per cent.

The unique Mobil process takes the methanol and reacts it over the ZSM-5 class catalyst, essentially 'wringing the water' from the methanol and recombining the hydrocarbon fragments into molecules identical to LPG and high-octane petrol.

The petrol has an average research octane level of 93.7 and an 83.3 motor octane number without lead. The research octane number is a measure of the performance of the fuel in stop-start driving and the motor octane number indicates high-speed cruising performance.

Taranaki-produced, high-grade petrol will be shipped from New Plymouth to Whangarei and used as blendstock for blending with products from the expanded refinery.

About four million cubic metres of natural gas per day will be converted to 4,400 tonnes per day of methanol. The methanol will be passed over the ZSM-5 catalyst to produce 1,680 tonnes of petrol daily, or 570,000 tonnes per annum. The major difference between 4,400 tonnes of methanol and the 1,680 tonnes of petrol produced daily from it, is water.

Some 235 tonnes of LPG will also be produced daily. This will be recycled in the plant as a fuel gas. For each 100 Btus in the natural gas input, 60 are recovered in methanol production. This uses the standard low-pressure ICI system of methanol synthesis. Its 60% efficiency is widely known and accepted.

From that point, the Mobil process recovers 95% of the hydrocarbons available in the methanol, with 93% in useful energy forms.

Of the 60 Btus present in the methanol, 50 are recovered as petrol and six as LPG.

The layout of the Motunui plant is shown schematically in the attached figure. The key features are as follows:

Natural gas metering station

Incoming gas from the Maui field is measured and monitored for quality. The gas is supplied at the rate of about 155,000 cubic metres per hour (52.5 petajoules per year) at a pressure of about 34 bar gauge.

Natural gas treatment station

The incoming gas is regulated prior to delivery to the two methanol plants. Any liquids are removed.

Steam reformers

The large structures in each methanol plant are the reformer furnace and waste heat recovery systems. The reformer furnaces are about 45 metres high. The gas feedstock passes through a desulphuriser and saturator before entering the reformer furnace for conversion to synthesis gas of hydrogen, carbon monoxide and carbon dioxide. The synthesis gas is then cooled, compressed, reheated and passed through a methanol converter. The product from the converter is condensed as crude methanol (containing about 20 per cent water). Each plant produces 2200 tonnes per day of methanol (water free basis).

Methanol storage tank

This tank has a working capacity of 20,000 cubic metres (about three days production).

MTG conversion reactors

Crude methanol first passes through a vapourisation unit then to the conversion reactors which contain the Mobil ZSM-5 catalyst. Water is "wrung" from the feedstock by the catalyst allowing the hydrocarbons to form.

MTG distillation section

Hydrocarbons from the product separator are treated in this area and split into light and heavy gasoline streams and a high vapour pressure stream. Dissolved gases are removed and used as fuel in the methanol plant reformer furnaces.

Heavy gasoline treatment plant

This plant reduces the concentration of a compound in the gasoline known as durene. This compound solidifies at about 79°C and by a chemical reaction its concentration is reduced to acceptable levels.

Final storage tanks

Each tank contains about 7300 cubic metres of premium quality petrol blendstock. One tank will be blended as the other is transferred by pipeline to bulk storage at the Omata Tank Farm at Port Taranaki prior to shipment to Marsden Point Refinery.

Raw water treatment plant

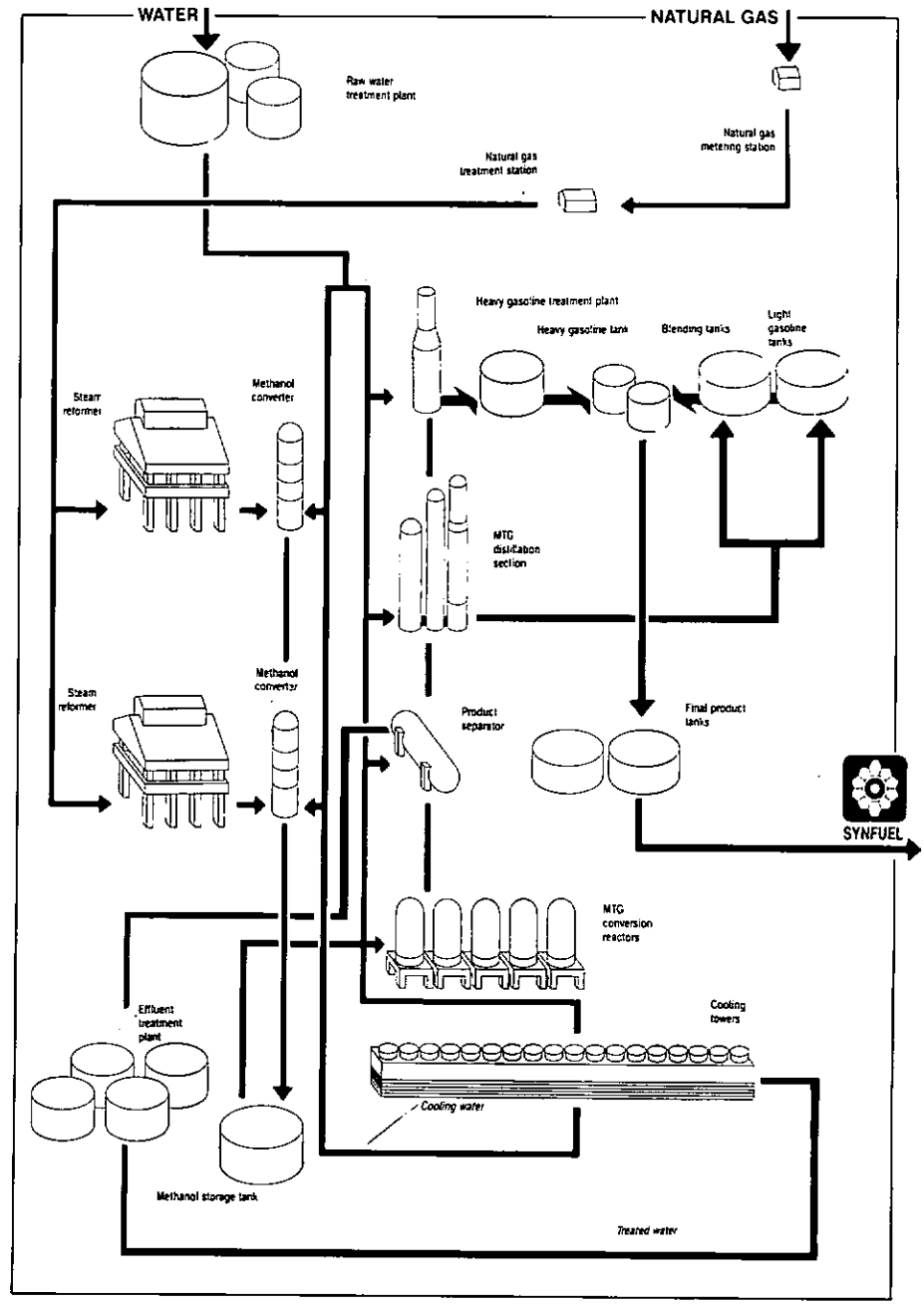
The water from the Waitara River is treated prior to transfer to the cooling water system, firewater, and demineralisers. The demineralised water is used as boiler feed water for steam generation.

Effluent treatment plant

Where all water surplus to the process as well as stormwater is treated. The treated effluent is then fed to the cooling water system.

Cooling towers

This wooden structure, at 12 metres high and 200 metres long is one of the largest wooden structures in New Zealand.



The Mobil Process Cont'd

The Mobil Catalyst

Pure ZSM-5 is a microscopic, powder-like material, so fine it can flow like water. But it is rarely used in that form. More often it is mixed with some additional components, such as alumina, to provide larger particles. In fluid-bed processes the catalyst is still small enough to flow like a liquid. In fixed-bed processes (specified for the Taranaki petrol plant) the ZSM-5 is extruded to produce a form similar to bits of broken spaghetti. In either form, or with either system, however, the material to be reacted still passes into the tiny pores of the zeolite particles. To prepare the catalyst, the raw materials are mixed together in a large reactor where they are crystallised under pressure. After a few days, the waste water is removed and the mixture goes to a rotary vacuum filtration system. The pure ZSM-5, suspended in water, adheres to a drum rotating through the liquid mixture. A burst of air and a scraping bar separate the moist catalyst from the drum, dropping it into a dryer that removes any remnants of water.

After leaving the dryer, the now-fine powder is transported to the mulling operation where a solid binder and water are added to give it strength and substance.

The catalyst continues on to the extrusion machine, where the warm solid is forced through what looks like a pasta machine. At this point, though solid, the catalyst breaks easily into pieces when handled. The extrudates pass through another drying process, getting it just dry enough so it retains its shape under further processing.

Sizing the extrudates comes next, followed by a series of different chemical treatments depending on the end use for that particular batch of catalyst. ZSM-5 destined for use in xylene isomerisation, for instance, is treated differently than ZSM-5 used in distillate dewaxing processes.

After sizing and treatment, the extrudate is poured into drums for final shipping. The finished product is typically cylindrical in shape and approximately ¼-inch long.

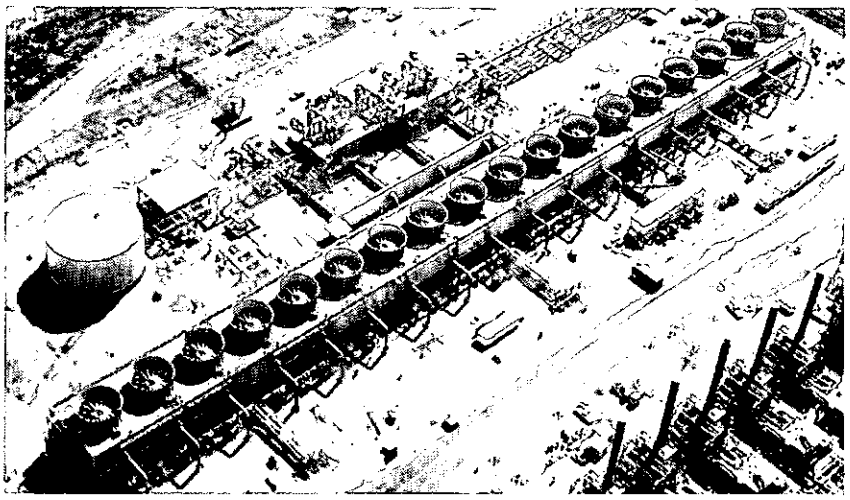
Mobil's worldwide needs of ZSM-5 are currently manufactured at its Beaumont Chemical Specialty Plant in the USA.

The Mobil Company

The opening of the Synfuels plant at Motunui coincides with the 90th year of operation in this country by Mobil Oil New Zealand Limited. The company owns a 25% share in New Zealand Synthetic Fuels Corporation, operators of the plant, and also claims to have 28% of the New Zealand Petroleum Products Market. The company is just one of more than 100 affiliates around the world marketing products under the Mobil/Pegasus logo.

The international Mobil organisation traces its origins back to 1866, to the formation of the Vacuum Oil Company by a carpenter, Mathew Ewing, and a grocer, Hiram Bond Everest. Initially, the aim of these two had been to make kerosene by vacuum distillation of crude oil. Instead they found that the residue remaining after distillation was a better petroleum lubricant than existed at the time, and on this product the company was based. In 1879 the Standard Oil Company (of New York) took a controlling interest in the company — the first of many corporate moves which resulted in the present multi-national organisation.

The Standard Oil origins of the company are still represented today, in the labelling of the Mobil catalyst: ZSM-5 is derived from Z for zeolite, and SM for Socony-Mobil.



ZEOLITES AND THEIR SYNTHESIS

With Particular Reference to ZSM-5

D. M. Bibby, Inorganic Materials Section, Chemistry Division, DSIR, Petone.

"A Zeolite is an aluminosilicate with a framework structure enclosing cavities occupied by large ions and water molecules, both of which have considerable freedom of movement, permitting ion exchange and reversible dehydration."... J. V. Smith.

Zeolites[1] are "tectosilicates" with framework structures, based on infinitely extending three-dimensional networks of SiO_4 and AlO_4 units joined by sharing every corner oxygen atom. These framework structures contain channels and cages of molecular dimensions, giving rise to the sorption and molecular-sieving properties of zeolites. Associated with every AlO_4 tetrahedron there is a unit negative charge which must be balanced by some intercrystalline cation. Because of the open structure of zeolites these charge-compensating cations can be freely interchanged, giving rise to the ion-exchange properties of zeolites. If the cation is a proton then the zeolite can be regarded as a solid acid, and like other acids can mediate in acid-catalysed reactions. The presence of charge centres causes strong intercrystalline electric field gradients so that polar molecules are strongly sorbed into the zeolite structure. Zeolites are therefore good dehydrating agents which can be regenerated by heating to a moderate temperature.

ZSM-5 is the zeolite which is the catalyst in the Mobil Methanol-to-Gasoline (MTG) process[2] being commercialised at Motunui. It exhibits all the characteristic zeolite properties but is unusual for several reasons.

The structure of ZSM-5 contains a large proportion of rings of five SiO_4 units rather than the 4- and 6-membered rings found in virtually all other zeolites. ZSM-5 contains a two-dimensional network of straight and zig-zag intersecting channels (Figure 1) rather than, as commonly occurs in zeolites, a series of cages joined by windows which limit the size of the molecules that can be sorbed. Also the diameter of the channels in ZSM-5, at 6 Å, is intermediate between the commonly occurring "small-pore" zeolites (4.5 Å) and "large-pore" zeolites (7.5 Å). The zeolite ZSM-11 is similar to ZSM-5 but the intersecting channels are straight in both directions, and there are also zeolites intermediate between ZSM-5 and ZSM-11, with layers of the two structures in differing proportions[3].

The Si/Al ratio of ZSM-5 is relatively high, and can vary from ca. 20 to $^{\infty}$. The zero-Al ZSM-5 is by definition no longer a zeolite and has been given its own name "silicalite"[4]. The zero-Al end-member of the ZSM-11 series has also been synthesised[5] and called "silicalite-2".

Because the charge-compensating cations can be interchanged so readily with no effect on the zeolite structure, the zeolite name is often preceded by the particular compensating cation(s) present, and occasionally by their relative proportions, e.g. H-ZSM-5 or 0.4Na 0.6K-ZSM-5.

As the Si/Al ratio is increased the ion exchange capacity and catalytic activity decrease and the zeolite starts to exhibit the hydrophobic properties expected of a pure SiO_2 surface with no "dangling" bonds[4]. As a result silicalites have an interesting potential use: to concentrate organic components from weak aqueous solution[6].

Zeolites need not necessarily contain only Al and Si. It is possible to substitute Ge for Si and Ga for Al in a number of zeolite structures[7] and recently it has been found that aluminium-phosphate analogues of zeolites can be synthesised[8]. On substitution of Si^{4+} for P^{5+} or Co^{2+} for Al^{3+} these aluminium phosphates develop typical zeolite properties[9].

While there are some 40 naturally occurring zeolites, the majority of the 150-to-200 known zeolites have been synthesised in the laboratory. However, the synthesis of zeolites is a complex and, as yet, ill-understood field[7]. The thermodynamic variables are the temperature, pressure and chemical composition of the reactant mixture. But in hydrothermal reactions these variables need not determine the products obtained. Reactant mixtures may be heterogeneous and nucleation appears to be kinetically controlled rather than thermodynamically determined. Nucleation may also be decisively influenced by treatment of reactants prior to crystallisation and by their chemical and physical nature; there is also the influence of mineralisers, templates and various additives. In addition there is the effect of seeding — sometimes deliberate, but frequently accidental and unknown.

The first attempts to synthesise zeolites date back to 1862 with St Claire Deville's reported synthesis of Levynite[1]. However, systematic studies of zeolite synthesis had to wait for the development of the techniques required for zeolite characterisation, primarily X-ray diffraction.

The first industrial research efforts date from about 1948 and were the start of extensive studies of zeolite synthesis[1,7]. During the first 10 years zeolites with low SiO_2/Al_2O_3 ratios 10) were synthesised from reactive aluminosilicate gels in the presence of alkali or alkaline earth metal hydroxides. These gels generally had high pH 13) and were crystallised below 100°C to give zeolites such as zeolite-A, zeolite-X, zeolite-Y, mordenite and many others. This work soon showed the importance of a number of factors:

- reactive starting materials such as freshly co-precipitated gels or amorphous solids;
- a high pH usually introduced in the form of alkali metal hydroxides or other strong bases;
- relatively low synthesis temperatures
- and a high degree of supersaturation of gel components to give the nucleation of a large number of zeolite crystals and rapid growth[7].

In the early 1960's tetramethylammonium (TMA) cations were introduced into zeolite synthesis[1,7]. This altered the gel chemistry and the various reaction processes in such a way that more siliceous versions of known zeolites were produced. It was subsequently found that other tetraalkylammonium (TAA) ions, namely tetraethylammonium (TEA), tetrabutylammonium (TBA) and tetrapropylammonium (TPA) ions, led to the synthesis of new high-silica zeolites which included the ZSM-5[10,11] family and the pure-silica analogues[4,5]. These organic cations are considered to have a substantial structure-directing, or templating, role in zeolite synthesis[7]. Other alkylammonium ions, amines and alcohols have been added to various gels to produce many new zeolites[7]. The organic ions are frequently occluded within the zeolite precursor which forms in the reaction, and are removed by calcination at about 500°C, to give the zeolite.

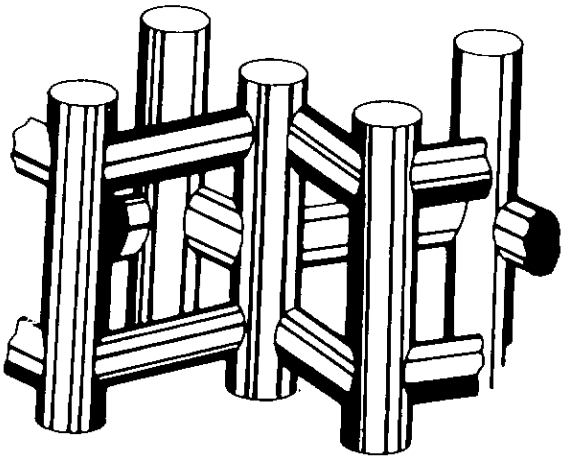


Figure 1: Schematic diagram of the channel structure of ZSM-5.

ZSM-5 can readily be synthesised from a wide range of gel composition containing TEA, TPA, or tetraalkylphosphonium ions, amines, alcohols[12] and even sulphonated detergents[13]. Heavily seeded completely inorganic gels can be used[14] and we have found[15] that the alkali metal hydroxide component of the gel can be replaced by ammonium hydroxide. This has the advantage of producing the useful "acid"-, or protonated-, form H-ZSM-5 directly, without it being necessary to remove any incorporated alkali metal ions by ion-exchange.

In principle amines and alcohols can be used to replace the relatively expensive TAA's. However, we have found that the yield of ZSM-5 from such mixtures is critically dependent on the Al content of the reaction gel (Figure 2). In gels containing n-butylamine with the mole composition;
$SiO.\ xAl_2O_3.\ 0.55Na_2O.\ 0.45nBuNH_2.\ 50H_2O$,
100% yields of ZSM-5 were obtained only when $x \geqslant 0.005$. Similar results were obtained when the n-butylamine was replaced with an equimolar amount of n-propyl alcohol except that the Al content had to be about twice that used in the n-butylamine-containing reactants to obtain the same yield of ZSM-5 (figure 2).

When the yield of ZSM-5 was less than 100% the silica-rich sodium silicates Kenyaite and Magadiite were formed. The presence of aluminium in the gel is probably essential to supply an acid function which will give the protonated amines or alcohols with appropriate structure-directing properties. The differences in ZSM-5 yield using amines or alcohols may be related to the differences in their basicity.

Understanding the mechanism of zeolite synthesis remains a challenge although techniques for the study of gel chemistry, such as laser Raman spectroscopy and Si-29 and Al-27 nmr, may help considerably. However, surprises still occur. For instance, it has always been implicit that water is essential in the synthesis of zeolites, but this may not be the case since we have recently synthesised[17] a high-silica form of the zeolite sodalite using organic solvents in place of water.

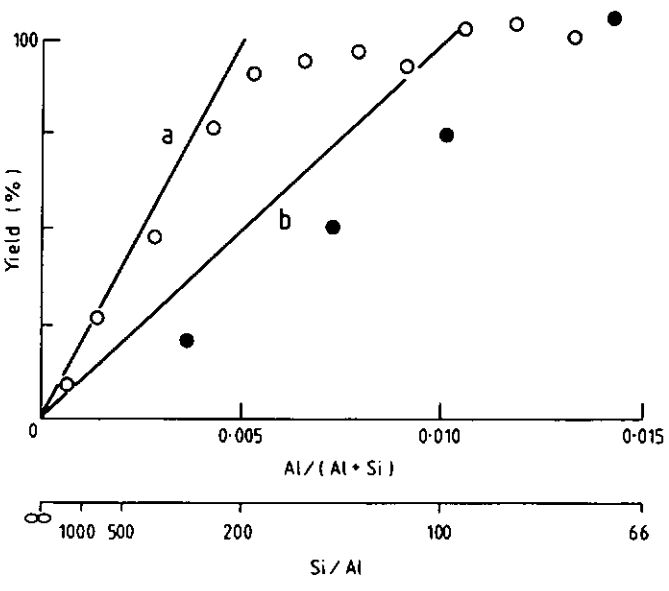


Figure 2: ZSM-5 yield versus Al/(Al+Si) and Si/Al ratios of n-butylamine and n-propyl alcohol-containing reactant gels. Yields from n-butylamine reactants: (0) (average of 4 separate series of experiments). Yields from n-propyl alcohol-containing reactants: (•). The lines show the yield of ZSM-5 which would be obtained if it contained (a) 0.5 and (b) 1.0 aluminium atoms per unit cell.

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Continued on Page 7

Mechanistic Studies in the Methanol to Gasoline Reaction over the "Mobil" Catalyst, ZSM-5

A. L. Odell, Chemistry Department, University of Auckland

With the Motunui plant now on stream it is perhaps time to pause and ask "How much do we really know about the reactions that occur in the channels of the ZSM-5 catalyst in the conversion of methanol to gasoline?"

In 1976 Weisz et al[1] reported the discovery that shape selective catalysts were able to produce hydrocarbons of limited size from small organic molecules. This came at a time when the world was still shocked by the Arab oil embargo of 1973 and set off a stream of development in the technology of synthetic gasoline production. Development was rapid and Motunui came on-stream in October 1985, but understanding of the reactions involved is making much slower progress.

Just how does a zeolite catalyst convert methanol (a one carbon molecule) into more than 150 different compounds with carbon numbers of up to 10 and a few beyond? Of particular interest is the question "How is the first C-C bond formed?" Does this first C-C bond formation pathway remain dominant once the reaction is started or does methanol then add more rapidly to existing skeletons by methylation?

Answers to these questions are now beginning to emerge but the path is thorny, and controversy and uncertainty are rampant. The topic has been reviewed[2] recently by C. D. Chang of Mobil.

When methanol is passed over the 'Mobil' catalyst in its acid form (H-ZSM-5) at about 380°C the first recognisable product is dimethyl ether, followed immediately by a mixture of alkanes, alkenes, methylated aromatics and many cyclic compounds. These reactions are completed in a fraction of a second making kinetic studies difficult. Even the sequence of production of the various products is not very clear.

As a result the literature of this subject contains an unusually high degree of speculation on possible mechanisms for the conversion reactions, and really definitive experiments which help distinguish between rival theories are, for the most part, lacking.

Theories of how the C-C bonds are formed are numerous but may be broadly separated into two groups.

(i) Those that invoke the carbenium ion, CH_3^+, as the active species which lengthens C-C chains by methylation.

(ii) Radical mechanisms in which uncharged free radicals are postulated as intermediates, with special emphasis on the diradical carbene CH_2:

One of the most impressive attempts to distinguish between these two proposed intermediates was made[3] by Chang and Chu of Mobil in 1982. They observed that when methanol was converted over H-ZSM-5 in the presence of the inert gas helium the ratio of abundancies of isobutane to n-butane (usually abbreviated to "i/n ratio") was about 4. When the helium was replaced by propane the i/n ratio fell to about 1.

They argued that propane had been methylated to form the two butanes (though this point has not been proved beyond doubt) and that the origin of the change of i/n ratio lies in the ability of carbene, CH_2:, to react with a paraffin by an "insertion" reaction, inserting itself between a C atom and its bound H atom, thus:

$$-C-H + CH_2: \longrightarrow -C-CH_2H$$

This process is known to occur at primary and secondary carbons with equal efficiencies. Hence n-butane should be favoured over isobutane in the ratio 6:2.

i.e. $H_3CCH_2CH_3 + CH_2:$ → $H_3CCH_2CH_2CH_3$ (6-fold chance)

→ $H_3CCH(CH_3)CH_3$ (2-fold chance)

If the methylating reagent were CH_3^+, they argue, there is known to be a preferrential attack by this reagent on secondary carbon atoms in which the H atom is displaced and the CH_3^+ unit may well enter without loss of any of its 3 hydrogen atoms. (It has been shown[4] by Anderson and Mole in CSIRO Materials Science Laboratories, Melbourne that, at least in methylation of aromatic rings, CD_3 groups remain intact during methylation).

The observation that i/n changes from 4 to 1 on addition of propane to the mix is claimed as proof of methylation by carbene.

In our laboratory at Auckland University we have undertaken a detailed study of the Chang and Chu experiment[3].

It has been known for some time that alkanes above ethane are cracked and converted when passed over H-ZSM-5 at ca. 370°C and we have shown that n-heptane converts to gasoline nearly as well as methanol. Propane shows a lower degree of reactivity but does convert forming, inter alia, isobutane and n-butane with i/n = 0.4, i.e. n-butane is favoured. This immediately suggests an alternative explanation of the Chang and Chu effect, namely that the change of i/n from 4 to 1 on adding propane may simply be due to the diluting of products from methanol conversion with products from propane conversion.

We are currently following up this idea with both tracer methods and quantitative studies to see whether the observed change in i/n may be quantitatively accounted for by this simple model without invoking the methylation of propane.

If a choice can be made between CH_2: and CH_3^+ this might clear the mechanistic air quite a lot.

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ADSORPTION MEASUREMENTS IN ZEOLITE CHARACTERISATION

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The ability of zeolites to act as effective and versatile adsorbents and catalysts is clearly related to the state of the sorbed molecules within the molecular sieve crystal. To understand and use these materials efficiently we need to have as detailed a knowledge as possible of the interactions of the guest molecules with each other and with the crystal framework. Adsorption studies are most revealing in this context and can often complement and extend the information which can be obtained from, for example, infra red and NMR experiments. Furthermore, adsorption measurements are more directly related to the information which is required and are considerably cheaper, even if they are more demanding, to perform satisfactorily.

When a new zeolite is prepared, it has become routine to quickly monitor its probable pore structure by rough adsorption capacity measurements using a set of carefully size graded molecules; and to gauge the strength and number of acid sites present by examining the adsorption of selected bases and polar molecules[1]. This work is often extended by means of catalytic reactor studies, in which the active sites are essentially titrated with strongly adsorbed species which can act as catalyst poisons. These techniques are all very useful but more precise sorption work can often yield a good deal of more detailed information.

The possibilities of this approach were first explored in depth about 30-40 years ago[2]. The initial emphasis was on establishing how much reliable detail about the state of physically adsorbed molecules could be obtained from comparisons between measured thermodynamic properties of adsorption, and properties calculated for a variety of model systems. Much was achieved but the net result was certainly disappointing as it gradually became apparent that a given set of results could often be interpreted in a number of distinctly different ways. For example, it is not normally possible, even in favourable cases, to decide with confidence whether sorbed molecules are localised or mobile.

In retrospect, surprisingly little use was made of the technique of comparing the results obtained with a carefully chosen set of adsorbates interacting with the same adsorbent. A notable exception was the study of Kington and Macleod[3] which demonstrated the importance of the large electrostatic field gradients present in the adsorption space of zeolites, and even allowed an independent estimate of their size.

The work I have been carrying out depends almost entirely on comparisons between measurements with closely related adsorbates on the same zeolite, and with the same adsorbate on closely related molecular sieves. In this latter context, it is a happy chance that the technically important catalyst, ZSM-5, can be compared with its catalytically inactive pure silica analogue, silicalite.

My first example concerns the use of amine adsorption to assess the number and distribution of acid sites in a sample of ZSM-5. The size and shape of the trimethylamine molecule (Figure 1) ensures that when it is within the zeolite it can interact with only one proton. Hence, the amount of strong adsorption, at say 150°C, can give a measure of the number of acid sites. This turns out to be essentially the same as the Al content as measured by chemical analysis, and confirms the expected result that each incorporated Al atom results in one acid site. A series of experiments were then carried out, all at 150°C with diethylamine, di-n-propylamine and di-n-butylamine. The first two showed the same amount of very strong adsorption, which appears to be good evidence that nearly all the acid sites are separated from each other by about at least the length of the dipropylamine molecule, and are thus rather uniformly distributed in the crystal. Surprisingly, the adsorption of di-n-butylamine is a good deal weaker, though again one molecule per Al atom is more strongly bound than the rest. This suggests that this molecule cannot associate itself so effectively with an acid site, presumably for steric reasons. The fact that the total amount of strongly bound material is the same, even for so large a molecule, seems to imply that the zeolitic protons can migrate to the sorbed mole-

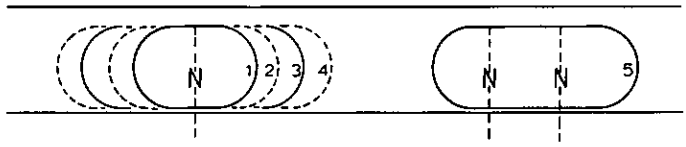
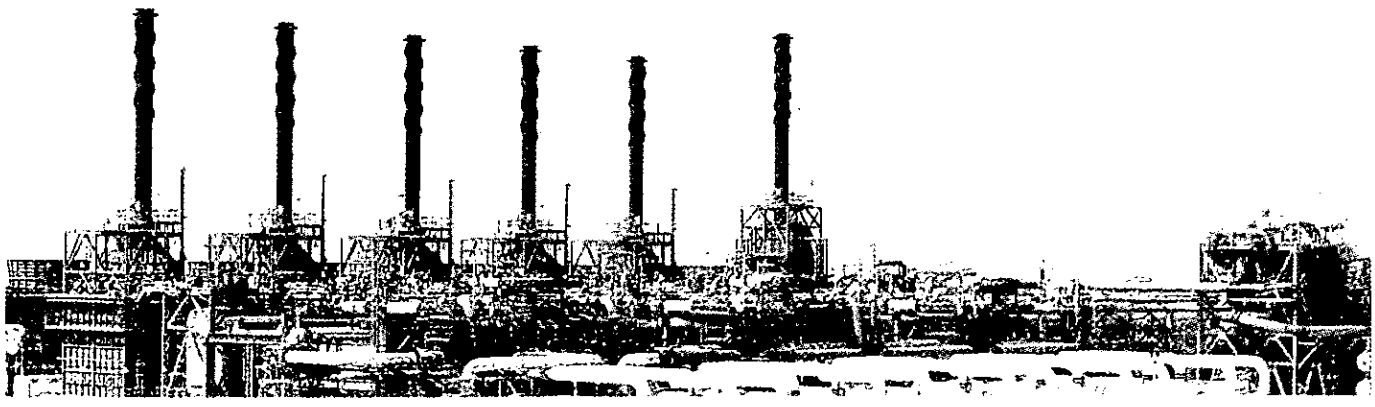


Figure 1. Schematic diagram showing the approximate relative sizes of 1, trimethylamine, 2, di-ethylamine, 3, di-n-propylamine, 4, di-n-butylamine and 5, N N-dimethyl N′-ethylethylene diamine in ZSM-5.



MTG plant

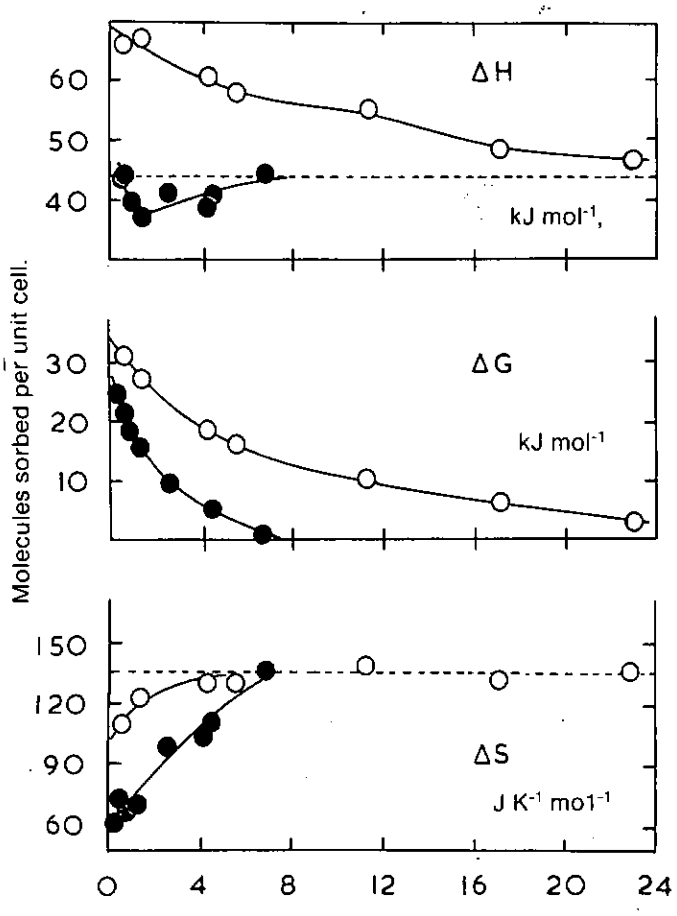


Figure 2. Enthalpy (ΔH), free energy (ΔG) and entropy (ΔS) of water sorption at 323.16 K.

○ ZSM-5

● Silicalite

Dashed lines give values for liquid water.

cules, just as sorbed molecules can migrate to a site. This was confirmed by examining the behaviour of NN-dimethyl N-ethylethylene diamine. Adsorption was extremely strong at 150°C up to a limit of one molecule per two Al atoms. These results show that surface acidity is totally available for interacting with guest species at 150°C, irrespective of steric considerations, though of course the strength of the interaction may be affected by how the species can arrange themselves.

My second example uses the comparison between the adsorption properties of the same sorbate, water, in different porous crystals. It is well known that zeolites are typically strongly hydrophilic, and that the adsorption preference for polar molecules decreases as the Al content goes down. Silicalite, the pure silica analogue of ZSM-5, in fact selectively adsorbs non-polar material from a mixture of polar and non-polar molecules, and so is called a "hydrophobic" adsorbent. The term "hydrophobic" is easily abused, and so it is of interest to find out what it really means in this case. An approach to this, is to compare the change in thermodynamic properties when water is sorbed into each of these solids in turn. The data are shown in Figure 2. Clearly at large water contents, the state of the sorbed water in both silicalite and ZSM-5 is remarkably similar, and similar to the state of liquid water itself. The situation is not much changed at lower loading in silicalite, but in ZSM-5 the Al content clearly leads to stronger adsorption sites for the first few molecules adsorbed, and this produces its hydrophilic character. So, how hydrophobic is the silicalite surface? — about as hydrophobic as liquid water itself!

There are, of course, very many other interesting examples that could be used, particularly when kinetic measurements are also included[4]. All I have tried to do is to show that classical physical chemical measurements can still be very viable.

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SPECTROSCOPIC STUDIES OF THE MTG PROCESS

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The most significant progress that has been made in recent years in converting heterogeneous catalysis from a black art into a science has come through the application of modern spectroscopic techniques to characterise catalysts and to study reactions occurring on catalyst surfaces. In Auckland, we have set up a research programme aimed at unravelling some of the mysteries surrounding the methanol-to-gasoline (MTG) reaction using spectroscopic techniques. This article describes very briefly the techniques employed and some of the results that are now being obtained.

Infrared Spectroscopy

Infrared spectroscopy was one of the first spectroscopic techniques to be used for observing molecules adsorbed on catalyst surfaces. With a conventional wavelength scanning infrared spectrometer this can be a difficult experiment. The concentrations of molecules adsorbed on a typical catalyst surface are extremely low, and their infrared spectra are often obscured by intense absorption bands from the catalyst itself and by scattering of infrared radiation by catalyst particles. The advent of fourier transform infrared (FTIR) spectrometers has however opened up new possibilities in this area. The signal to noise advantage resulting from replacement of a diffraction grating by an interferometer gives orders of magnitude improvement in sensitivity, and the subtraction of sloping baselines due to scattering and absorption bands from the catalyst is routine with the computer that is a necessary part of FTIR instruments.

Our FTIR studies of the interaction of methanol and other molecules with the ZSM-5 catalyst are undertaken with an **in-situ** infrared cell which also functions as a microreactor. A catalyst sample in the form of a thin pressed water is held in the cell at the desired temperature in a stream of nitrogen. Pulses of reactant are injected into the cell, infrared spectra recorded, and desorbed products detected by gas chromatography. In this way spectra are obtained of the catalyst and species adsorbed on the catalyst surface under reaction conditions, and the infrared spectra can be correlated with reaction products. The FTIR instrument can collect an entire spectrum in 1 second, although we usually average together several hundred scans over a 5-10 minute period in order to improve signal to noise ratios.

The **in-situ** infrared technique is illustrated in Figure 1, which shows spectra recorded before and after exposure of a ZSM-5 catalyst to methanol at 150°C. The zeolite shows an intense ν(OH) band at 3609 cm^{-1} due to strongly acidic protons located within the zeolite pores and a weaker band at 3720 cm^{-1} due to hydroxyl groups located on the external surface of zeolite crystallites, both superimposed on a broad band due to hydrogen-bonded hydroxyl groups. Both internal and external hydroxyl groups react with methanol at 150°C to form methoxy groups:

$$Z\text{-}OH + CH_3OH \longrightarrow Z\text{-}OCH_3 + H_2O$$

This can be seen most clearly in the difference spectrum (Figure 1(c)); negative peaks correspond to species removed and positive peaks to species gained. The ν(CH) bands at 2960 cm^{-1} and 2855 cm^{-1} are due to asymmetric and symmetric stretching modes of the methoxy groups. At this temperature, the methoxy groups are quite unreactive, and no hydrocarbon products are detected. Above 200°C however injection of methanol produces a mixture of methoxy groups and a second species containing methyl groups whose identity has not yet been established with certainty. We are currently exploring the possibility that this second species may be the trimethyloxonium cation, which has been postulated as a key intermediate in the formation of the first C-C bonds from methanol:

$$ZOCH_3 + 2CH_3OH \longrightarrow ZO^-(CH_3)_3O^+ + H_2O$$

$$ZO^-(CH_3)_3O^+ \longrightarrow ZO^-CH_3CH_2O\ HCH_3$$

$$ZO^-CH_3CH_2O\ HCH_3 \longrightarrow ZOH + C_2H_4 + CH_3OH$$

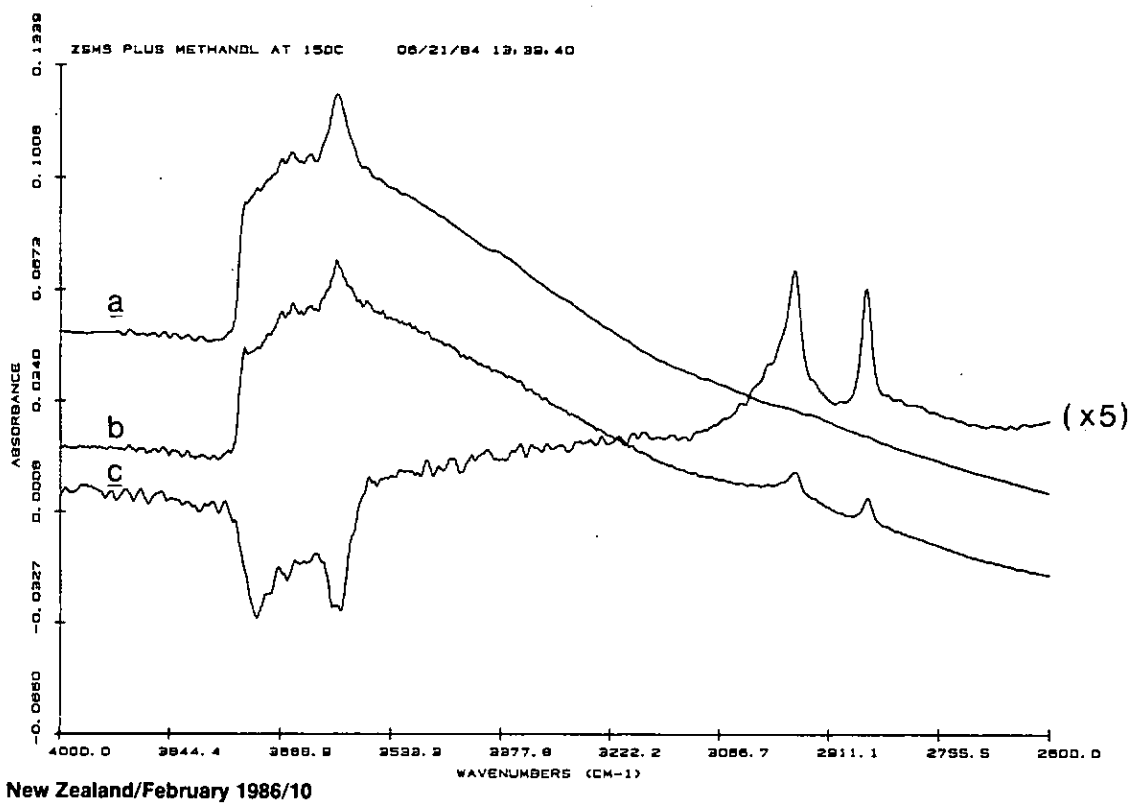

Figure 1. (a) HZSM-5 at 150°C; (b) plus CH_3OH at 150°C; (c) difference spectrum 5X ((b) — (a)).

The appearance of the second species certainly correlates with the first appearance of hydrocarbon products (ethene and propene) and with cleavage of C-H bonds (as shown by exchange between CD_3OH and zeolite OH groups). The second species is furthermore a potent methylating agent; addition of benzene causes its disappearance and the formation of toluene product. Thus the **in-situ** infrared experiment appears to be observing species which are directly implicated in C-C bond formation.

Once ethene and other light alkenes are formed from methanol, a second question to be answered is how these react further to form aromatics. This chemistry within the zeolite can also be studied by **in-situ** FTIR. We find for example that ethene is readily protonated by the internal highly acidic protons to form an alkyl carbenium ion which rapidly oligomerizes

$$ZOH + C_2H_4 \longrightarrow ZO^-C_2H_5^+ \longrightarrow ZO^-C_nH_{2n+1}^+$$

We are currently investigating the conditions under which the initially linear oligomer is converted to branched, cyclic and/or aromatic molecules. This requires correlations of the infrared spectra of species within the zeolite with the product molecules detected downstream from the reactor. The extent to which the alkene to aromatic conversion is influenced by zeolite structure is also studied by performing similar experiments with zeolites of different structure.

An important practical aspect of the MTG process is the deactivation of the catalyst which is anticipated to occur over a 3-4 week period on stream. Although this is readily attributable to coke formation, the detailed chemistry is poorly understood. We have found FTIR to be a useful probe for studying coke formation. Prolonged exposure to methanol produces infrared bands characteristic of methyl substituted polynuclear aromatics within the zeolite. The accompanying loss of acid sites is monitored by adsorbing bases such as ammonia or pyridine. Deactivation occurs in two distinct stages; there is an initial rapid loss of acid sites due to accumulation of methyl substituted polynuclear aromatics within the zeolite pores, followed by a more gradual decline which may be due to external coke deposits blocking access to the pores. We are presently investigating factors influencing the rate and extent of coke formation (e.g. acid site density and distribution) and the chemistry of coke removal (catalyst regeneration), in a joint project with Chemistry Division, DSIR.

Other Spectroscopic Methods

Although FTIR has been our major spectroscopic tool to date, other methods are complementing the infrared technique. For example, Raman spectroscopy, although inherently much less sensitive than infrared, has been used to confirm the formation of methyl aromatics in coked catalysts. Transmission uv-visible spectroscopy is employed to follow the colour changes (white through yellow-brown to grey and black) occurring on exposure of ZSM-5 to methanol at reaction temperatures. These colour changes are due to reactions of alkenes; in particular formation of allyl carbenium ions through proton abstraction by alkyl carbenium ions:

$$RCH_2CH_2^+ + CH_3CH = CH_2 \longrightarrow RCH_2CH_3 + (CH_2CHCH_2)^+$$

The allyl cations subsequently cyclise and form aromatic cations which are responsible for the grey to black colour associated with lightly coked catalysts. We hope to elucidate the detailed chemistry of these steps by comparison of uv-visible and infrared spectra.

EPR measurements of catalyst samples exposed to methanol show no evidence for free radical involvement in the initial stages of the MTG reaction. Weak poorly resolved signals are obtained after prolonged exposure to methanol at high temperatures, and experiments with model compounds suggest that these are due to radical cations of methylsubstituted polynuclear aromatic molecules. The role played by such radical cations in coke formation has yet to be established.

No single spectroscopic method can provide all the answers, and all spectroscopic methods suffer the limitation that they detect usually the most abundant species on the catalyst surface which are not necessarily those important in catalysis. Nevertheless, it is our contention that spectroscopic studies of the type described above, when combined with the results of more traditional catalytic measurements, must lead to an improved understanding of what is going on inside the MTG reactors at Motunui.

Acknowledgements

This work has been undertaken by MSc students T. R. Forester and S. T. Wong, and PhD student G. D. McLellan. Financial support from DSIR and many useful discussions with members of the Inorganic Materials Section of Chemistry Division are gratefully acknowledged.

THERMAL STABILITY OF ZSM-5

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Introduction

The zeolite catalyst ZSM-5 used in the conversion of methanol to gasoline in the Motunui gas-to-gasoline plant has a remarkably high tehermal stability due partly to its high Si/Al ratio and its unique structure. In the industrial process the stability of ZSM-5 is of interest as it undergoes a high temperature reactivation treatment to remove coke, the carbonaceous residue that forms during the methanol conversion. The stability of zeolites is known to be modified by the presence of water vapour and the alkalinity of their environment but little has been reported regarding the thermal stability of ZSM-5. A study of the thermal decomposition of ZSM-5 using FTIR absorption spectrophotometry has been made firstly to determine the stability limits and secondly to elucidate the decomposition mechanism. Stability is investigated as a function of aluminium substitution, sodium exchange and ambient humidity. Two regimes, with activation energies of 4.6 eV and 7.3 eV, are manifested.

Experiment

ZSM-5 samples were synthesised by the Chemistry Division of DSIR. They contained 2.5%, 1.0%, 0.5% aluminium and were named ZSM-5/40, ZSM-5/100, ZSM-5/200 and ZSM-5/$^\infty$ respectively. Aluminium-free ZSM-5 is also known as silicalite. These were supplied in the protonated form while additional ZSM-5/40 was provided with 4% and 100% of its protons exchanged for sodium ions. Batches of samples of about 10 mg were heated in a furnace at fixed temperatures between 750°C and 1200°C, depending on the sample, and then successively withdrawn at appropriate intervals and immediately introduced to a dry box where they were ground with KBr and pressed into discs for infrared analysis. Some samples were also annealed in a high temperature steam environment.

The discs were analysed by infrared absorption on a Nicolet 5DX Fourier transform infrared spectrometer in the Chemistry Department at Auckland University. As illustrated in Figure 1, the absorption spectra of ZSM-5 exhibit five main structural peaks in the mid-frequency infrared region[1]: three associated with the SiO_4 tetrahedra, and two with the characteristic ZSM-5 ring structure. During isothermal anneal there is a progressive collapse of ZSM-5 to an amorphous residue which is characterised by the three SiO_4 tetrahedra absorptions only. The

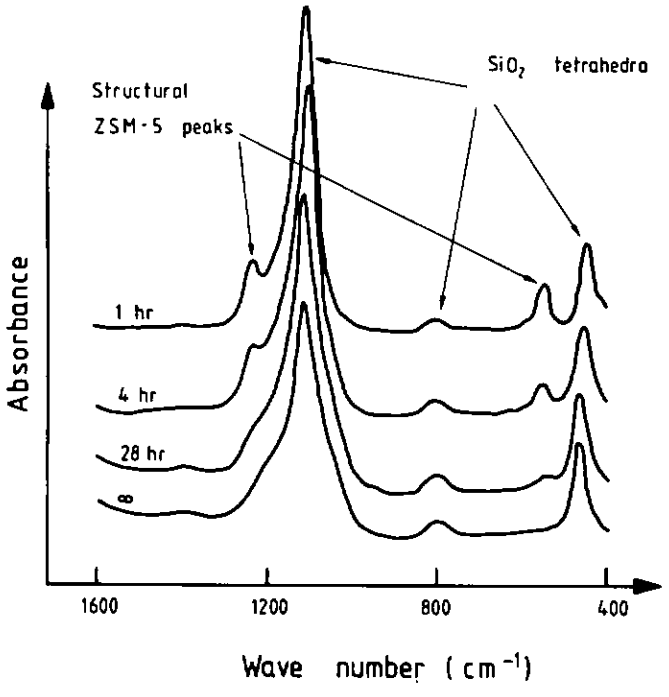

Fig. 1 Infrared absorption spectra after different anneal times showing the progressive loss of ZSM-5 features.

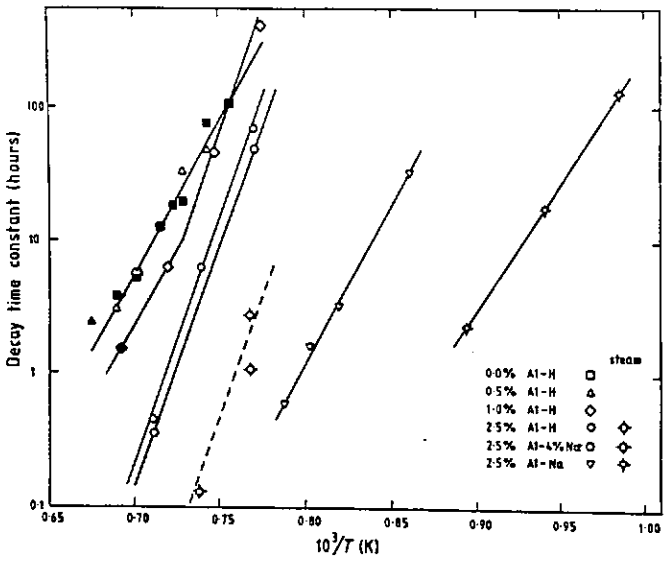

Fig. 2 The Ahrrenius dependence of the decay time constant (τ) for various samples and treatments. Closed symbols are first order, open symbols are second order decay. Samples containing 2.5%, 1%, 0.5% and 0.0% aluminium are named ZSM-5/40, ZSM-5/100, ZSM-5/200 and ZSM-5/$^{\infty}$ respectively in the text.

amount of ZSM-5 remaining at any time during the decomposition is determined by measuring the relative absorptions under the ZSM-5 peaks and the SiO_4 peaks.

Results

The decomposition, i.e. the rate of decrease of ZSM-5, of aluminium-free ZSM-5 was found to be first-order: that is the rate of change of ZSM-5 is proportional to the amount of undecomposed ZSM-5. Samples which contained substituted aluminium displayed second-order kinetics: the rate of change of ZSM-5 is proportional to the square of the amount of undecomposed ZSM-5. This is irrespective of the cation or the presence of water vapour except at the highest temperature (>1170°C) where both the ZSM-5/200 and ZSM-5/100 samples displayed first order kinetics. Generally the decomposition was quite uniform with no evidence for an induction period or of premature decay due to thermal shock.

Fig. 2 presents a summary of the time constants of decay, τ, obtained from the slopes of the decomposition lines. The time constants for ZSM-5/$^{\infty}$ and ZSM-5/200 have the same activation energy of about 4.6 eV. In contrast, ZSM-5/100 has the same activation energy at high temperature but displays the greater activation energy of 7.3 eV at low temperatures. ZSM-5/40 exhibits the greater activation energy of 7.3 eV at all temperatures and it is unaltered by both steaming and 4% sodium-ion exchange, even though they shift the decomposition to lower temperatures. 100% sodium-ion exchange substantially diminishes thermal stability and, significantly, recovers the activation energy of 4.6 eV exhibited by the dilute samples. Finally, steaming of the 100% sodium exchanged ZSM-5 results in a lower activation energy still, 4.1 eV, and further diminishes the thermal stability.

Discussion

The occurrence of second-order kinetics in the decomposition of aluminium-containing ZSM-5 together with first-order kinetics in the aluminium-free ZSM-5 silicalite, strongly suggests that decomposition in the former is nucleated by migration and eventual mutual encounter of pairs of aluminium atoms. This amounts to a thermally activated demonstration of the rule, usually known as the Loewenstein Rule[2], that no two aluminium ions can occupy the centers of tetrahedra linked by one oxygen without rendering the lattice locally unstable.

The nucleation process of crystallite collapse may be seen to proceed in two steps: the diffusion stage and the association stage. The diffusion stage is the time during which individual aluminiums diffuse through the lattice before encountering another aluminium. The association stage is the time during which an aluminium makes one hop into a tetrahedra linked by one oxygen to another tetrahedra occupied by an aluminium. As noted above this results in the mean total time being dominated by the diffusion step with an apparent activation energy of 4.6 eV. For H-ZSM-5/40 a five-fold increase in aluminium concentration results in a 25 fold reduction in the diffusion time so that the total mean decomposition time is now dominated by the association step, and it has an activation energy of 7.3 eV.

Sodium exchange reduces the association time, possibly by virtue of its polarisability as well as by stabilising the local end product, so that the process is again dominated by the diffusion step. It is clear that the diffusion step is also shortened, otherwise, for a given temperature the decomposition period would be just 1/25 that of H-ZSM-5/200.

Finally, steaming is understood to increase the mobility of tetrahedral sites and aluminium in particular, as well as to progressively dealuminise[3] by hydrating the ion. The aluminium changes from tetrahedral to octahedral co-ordination and, as a hydrated ion, can freely diffuse along the channels. The former process ensures that the decomposition is more rapid but remains association dominated. On the other hand, steaming at temperatures below the range of rapid decomposition should produce the opposite effect. Dealumination will of course, produce a sample which at higher temperatures will be diffusion limited.

Conclusion

Time constants for the thermal decomposition of ZSM-5 with varying aluminium concentrations in both the protonated and sodium exchanged forms have been presented. Firstly, it was found that increasing the aluminium content decreases the stability, secondly the sodium exchanged form is less stable, while water vapour reduces the stability of all forms. The observation of second-order kinetics indicates that the decomposition results from the mutual encounter of pairs of aluminium atoms and is dominated by either one or two steps: a diffusion step with an activation energy of 7.3 eV or an association step with an activation energy of 4.6 eV.

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Methanol to Gasoline Catalysis: PROCESS ENGINEERING INVESTIGATIONS

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Process parameters can have significant effects on the performance of the methanol-to-gasoline process, and the work at the Industrial Processing Division of DSIR is aimed at further clarifying these effects. The primary indicators of these changes in performance are the hydrocarbon product composition and the zeolite catalyst performance. Reactor systems, supporting services, and operating experience have been established in order that the effect of varying process conditions on these indicators can be reliably assessed.

Reactor Systems

Three reactor systems have been built to enable a wide range of experimental investigations to be undertaken. All are fixed bed medium pressure systems capable of operating over the full range of conditions relevant for methanol to gasoline catalysis.

Two systems are based on small single pass reactors shown schematically in Figure 1a. Together these systems provide the ability to operate with between 5g and 20g of catalyst powder at pressures up to 5000 kPa and with a range of carrier gases including hydrogen based mixtures.

The third system is a larger bench-scale system with separate dehydration and conversion reactors and light gas recycle, as shown in Figure 1b. Although based on a catalyst charge of only 200g this system can be used to provide pilot-scale data as the ability to recycle light gases gives a realistic model of the production plant.

All systems are fully instrumented to provide detailed information on process conditions and to allow for safe continuous operation. An on-line gas chromatograph provides detailed analysis of the off-gas composition and the liquid phase products are analysed by a capillary gas chromatograph. Sufficient product is produced by the bench-scale unit to allow a range of product quality tests, eg octane numbers, to be undertaken on the complete product or fractions of it.

Process Investigations

A significant factor in fine-tuning of the MTG process will be the ability to adjust the product specification and process yields within the constraints of the existing process equipment. The possibility of diverting the heavy aromatic fractions for use as a chemical feedstock while still maintaining the maximum possible product quality is an example of the type of change that may have to be accomplished.

To this end the investigations using the reactor systems described above have concentrated, and will continue to concentrate, on the variations in product yields and compositions that can be gained by changes in process parameters (eg. flowrates, pressures, etc.) and by manipulation of intermediate stream compositions (eg. recycle gas composition). Process operations that affect the activity of the catalyst are also of importance and so consideration of the effects of varying regeneration conditions, for example, forms part of any investigation.

Consideration of the conditions within the conversion reactor shows that there are five variable process parameters; temperature, total pressure, partial pressure of reac-

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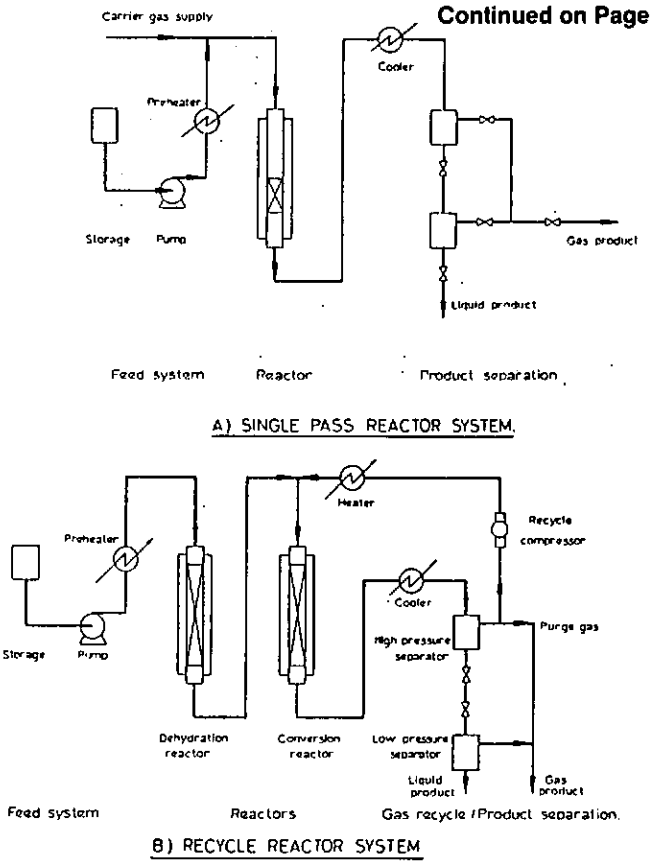


Figure 1. Schematic diagrams of reactor systems.

Table 1: The Effect of Partial and Total Pressure on Aromatic Production

Components	Total Pressure (kPa)		Methanol Partial Pressure (kPa)		95% Confidence Limits For Differences in Means
	1100	2100	410	790	
All Aromatics	25.5	25.4	22.7	28.2	1.2
C7 Aromatics	3.7	3.5	3.1	4.1	0.4
C8 Aromatics	10.4	10.0	9.5	10.9	0.6
C9 Aromatics	7.0	7.1	6.4	8.0	0.4
C10 Aromatics	3.7	3.9	3.2	4.5	0.2
Durene	1.7	1.9	1.5	2.1	0.2

THE USE OF COILCOATED STEEL FOR INSULATION JACKETING AT MOTUNUI

D. F. Christian Technical Manager Coated Products Division New Zealand Steel Limited

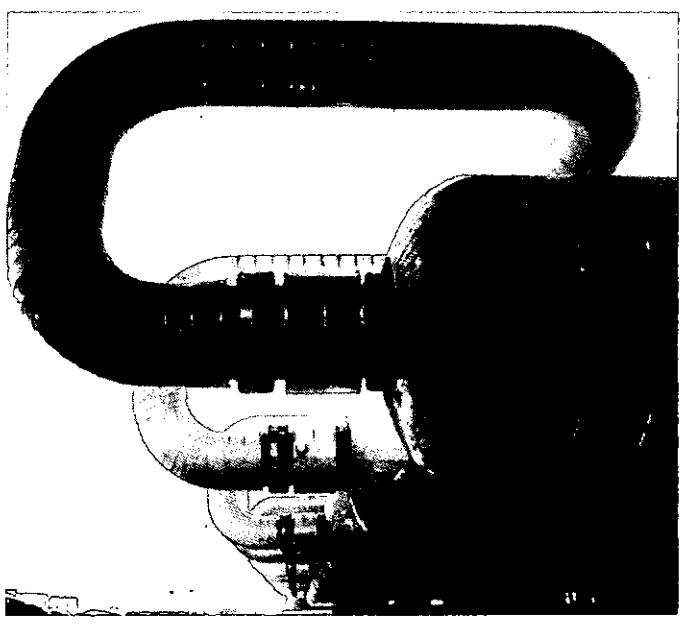
A. Introduction

The continuous coilcoating process, where metal strip is uncoiled, cleaned, pretreated and painted prior to recoiling emerged in the 1950s as a natural progression from other continuous coating processes like hot dip galvanising and electroplating. Initially, aluminium was coilcoated for end uses such as venetian blinds, awnings and ceiling panelling or lacquered prior to can manufacture. These early lines operated at a few metres per minute on light and narrow strip and had one coating station and oven only. This is a far cry from the fast lines of today capable of transporting and coating heavier metals like steel in addition to aluminium in widths as great as 1800mm and speeds over 200m. min^{-1}. These modern lines are generally of the two-coat/two-bake type, paint curing usually being achieved by convection but three-coat/two-bake and three-coat/three-bake lines are also in use. The New Zealand Steel line commissioned in 1982 uses high-velocity convection curing by means of computer-controlled ovens. Its maximum rated speed of 65m. min^{-1} is not high by modern standards but still enables an average house roof to be painted every three minutes or 15 million m^2 of strip to be coated each year.

Roofing and siding and the architectural market in general certainly represents a major customer to the coilcoating industry. Overseas, the automotive and transportation industries are also large consumers and steady growth is being achieved for the appliance, whiteware and canstock markets. Similarly, in the construction of the Motunui Synthetic Gas to Gasoline Plant, cladding formed a major part of the business for the New Zealand coilcoating industry but another significant and interesting application was for insulation jacketing.

B. Possible Materials of Construction

Process vessels and pipework, that are designed to contain or transport hot and cold fluids, require insulation for energy conservation. The sheathing or jacketing maintains the insulation material in contact with the process vessel or pipe and, hopefully, keeps it dry and weatherproof. Properties required of the jacketing material include good exterior durability, resistance to mechanical damage, fire resistivity, low emissivity and ease of installation.



A variety of materials are available for this application including electrogalvanised steel, hot dipped galvanised and aluminised steels, aluminium and stainless steel. The preferred choice is dictated by technical factors such as the corrosivity and fire hazard potential of the application and, of course, cost considerations. The corrosion resistance of the lower cost metal systems can be upgraded further by the application of a paint finish.

One commonly used electrogalvanised steel based jacketing system has a vinyl coilcoating paint system on the exterior surface and a fire resistant polythene/kraft barrier film laminated on the interior surface. Care has been taken to maximise the protection for the steel on the interior surface of the product based on the expectation that corrosion in service is more likely to arise from moist insulation than the exterior environment.

This same system was specified initially for the Synthetic Gas to Gasoline Plant. A contract variation was subsequently agreed upon comprising ten times as much zinc on the steel and five times as much paint on the exterior surface. The more purist amongst us may attribute this to technical reason prevailing based on the severe marine environment. However, it is quite likely that the successful tenderer suggested the alternative because he was more familiar with its use than with its potentially greater durability on the West Coast of New Zealand.

C. Vinyl Plastisol

Although the coated product specified or the coating itself had never been produced in New Zealand, the size of the job, estimated at 40,000m^2, certainly warranted efforts towards local manufacture.

Samples for examination were available both on buildings clad up to 15 years ago with imported material and from material arriving for the project on preinsulated equipment. The coating system was also under study as part of our laboratory outdoor exposure testing programme. The coating, known as (vinyl) plastisol, is composed of polyvinylchloride resin dispersed in plasticiser. Because of its very high volume solids content (85% to 93% v/v) compared to conventional paint systems (35% to 50% v/v), it is possible to achieve much higher paint film builds. The globules of vinyl resin fuse together in the curing process and it is very important to avoid entrapped air which would result in holidays in the coating. This necessitates special equipment both for manufacture and application. As well as being thick, the coating is flexible and robust providing improved resistance to damage during fabrication, transit and installation.

Plastisol coated galvanised steel cladding is widely used overseas for improved durability in aggressive atmospheres. In the United Kingdom, it is the standard architectural finish and is available in a wide range of colours. Unfortunately, dark colours of early formulations imported from the United Kingdom did not fare well in our environment with its higher temperatures, humidities and levels of ultraviolet light. These early failures hindered its wider acceptance in New Zealand. Because plastisol is more susceptible to breakdown under heat and weathering than the traditional decorative coilcoatings used locally, formulation and colour choice are all important. Notwithstanding this feature, it has real value as a heavy duty protective coating.

D. "Colorsteel VP" (see footnote)

Following examination of buildings up to 15 years old clad with imported plastisol coated galvanised steel in light colours

and our own exposure information, we felt confident that the product could offer a satisfactory service life in New Zealand. Since there was no domestic manufacturer of the paint system, an overseas Swedish supplier, which had the major share of the European market, was selected. Paint was imported first by airfreight and subsequently, as market volumes grew, by seafreight. Contrary to our expectations, based on our flotation ovens with their very fast heat transfer capabilities, this thick coating was able to be rollcoated and cured without application problems.

The local company that had won the installation contract for the insulation was Bestobell-Fletcher, a joint venture of Bestobell (NZ) Ltd and Fletcher Mechanical Ltd. They opted for 0.4mm thick steel for extra resistance to damage during installation rather than the standard 0.25mm base metal thickness. This was also to the advantage of our hot dip galvanising process. The colour chosen was an off-white for the exterior of the jacketing which gave us extra confidence as far as weathering resistance. If it was considered that moisture and corrosion might be a problem inside the jacketing in a particular application, the product was ordered with the heavy coating on both surfaces. In the final result, about one-third was ordered double side coated and the remainder with the plastisol on the exterior surface and a standard much thinner backing system on the interior surface. It is pleasing to recount also that the size of the business far exceeded the early projections. It is our understanding, for example, that much of the preinsulated jacketing had to be removed because the pipes required pressure testing.

This product, with the plastisol coating, now forms a standard item in our range and is called Colorsteel VP. It is frequently supplied for cladding in heavy industrial applications. Although our exposure site testing is showing that modern formulations of dark colours perform substantially better than the earlier versions, we have adopted a conservative position and our range of colours is limited to whites and light pastel shades. The Swedish paint manufacturer had previously licensed a local paint company, Healing Industries, for coilcoating technology and this coating will soon be part of their local supply. Bearing in mind their Epiglass paint range, it is, perhaps, a testimonial to their efforts in helping to pioneer the product in New Zealand that our most visible application to date is the new roof on the Bean Rock lighthouse that stands amidst the pleasure craft of the Waitemata Harbour.

Footnote: Colorsteel is a registered brand name of New Zealand Steel Limited. Colorsteel VP is the specific brand name for hot dipped galvanised steel coilcoated with vinyl plastisol.

Continued from Page 13

tants (or recycle ratio), feedrate of reactants (or when expressed in terms of the mass of catalyst, the weight hourly space velocity, WHSV), and the residence time (or again when expressed in terms of the mass of catalyst, the weight time). The simplicity of the single pass reactor systems has allowed experiments to be conducted to investigate the effects of these variables.

For example, Table 1 gives results that show the significance of total pressure and partial pressure of reactants on the yields of aromatic components. The experiments were part of a larger factorial design and the values given are mean yields as a percentage of the total hydrocarbons at each total or partial pressure for a range of conditions at two temperatures, two WHSVs and two partial or total pressures respectively. Also given are the 95 percent significance levels for differences between the means. The results show that total pressure is not a significant factor in determining the aromatic yield. In accordance with data presented by Chang, et al.[1] the reactant partial pressure does have a significant effect. Although these results were obtained using the small single pass reactor system they are relevant to any consideration of the effect of total pressure and recycle ratio on the full scale process.

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BRANCH NEWS

Waikato

Dr **Harvey Indyk,** NZ Cooperative Dairy Company, Waitoa, talked about "The Dairy Industry — Some Challenges to the Analytical Chemist", at the September branch meeting. He described some of the differences between human and dairy milk or substitutes and discussed problems facing chemists when analysing milk and dairy products. In particular, he commented on the impact of HPLC in the dairy industry.

Dr **Ron Locker,** Meat Industry Research Institute of NZ, Hamilton, presented his views on "Surviving the Nuclear Winter — Down Under", following the branch AGM in October. He commented on the likelihood of nuclear war and pointed out that New Zealand has no plans to defend itself against nuclear war. However, the speaker was distinctly optimistic regarding New Zealand's chances of surviving a nuclear war in the northern hemisphere. A lively discussion followed the talk.

Manawatu

The Branch's activities for 1985 concluded with a visit to NZ Pharmaceuticals Ltd at Linton on 18 November. After a conducted tour of the plant, the group viewed a video produced by the Company, describing the principles of biochemical processing and titled "A Quiet Revolution".

In January, NZ Pharmaceuticals Ltd and the Dairy Board announced that they are to set up a joint venture company called AlaPharm Co. to investigate the commercial isolation of lactoferrin and lactoperoxidase from either milk or milk byproducts, eg whey.

Wellington

The December meeting of the Wellington Branch was held at Chemistry Division, DSIR, in Lower Hutt. The meeting was addressed by Dr **Donald Hannah,** Section Leader of the Food Section. Donald outlined the work of the Section, noting the wide range of analytical work undertaken, and showed that the title 'Food Section' was somewhat of a misnomer as industrial, environmental, and forensic investigations are also carried out.

The title of his talk was "Food Chemistry — the Good, the Bad and the Ugly", and the work on nutrient analysis, contaminant analysis, and the identification of adulterants covered these headings. After a slide display of "uglies" in foods and drinks, including photographs of a mouse in a bottle of beer, the brave members adjourned for drinks and supper to conclude the evening.

Otago

On 15th November, Branch members, together with members of the N.Z. Institute of Food Science and Technology, gathered in Dunedin at a function held to honour **Arthur and Pat Wilson** on the occasion of Arthur's retirement from the position of General Manager at the Southland Dairy Co-op Factory in Edendale. Previously with the NZ Lactose Co., Arthur has been prime mover over many years of many of the developments at the Edendale factories, and in addition has contributed enthusiastically to the activities and well-being of both Institutes in the Region. Also much appreciated has been Arthur and Pat's hospitality extended on many occasions to staff and students of Applied Chemistry from Otago University on their annual trips south to visit factories in Southland. Pat has also been a well known art teacher in Southland, and in conjunction with her husband to take care of technical details, is responsible for the elegant art work which now graces the frontage of the Town Hall in Invercargill.

Following the lead from Wellington Branch, a titrating competition was held for 6th and 7th form students of chemistry in the Region. After analysing a solution at school under the guidance of their chemistry teachers, candidates were invited to perform again unaided at the University under the watchful eyes of Drs **D. Lee** and **K. A. Hunter.** The winner of the competition was Miss **Gillian Whyman,** a 7th form student from Columba College, Dunedin.

UNIVERSITY NEWS

Waikato

Dr **Malcolm Carr** and the writing group from Hamilton and Auckland have completed their work on the new 7th Form Chemistry prescription which has now been gazetted, and will be taught for the first time in 1987. Dr Carr and members of the Science Education Research Unit organised three days of seminars in early December which were attended by teachers and educationalists from all over New Zealand, as well as some overseas participants from Australia and the U.K. A major theme was the concept of energy.

Dr **Derek Smith** has been on study leave since July 1985 based at the University Chemical Laboratory, Cambridge, U.K. and is expected to return early in February. During his absence he was appointed Head of the Chemistry Department and will take up this position on 1st April, 1986.

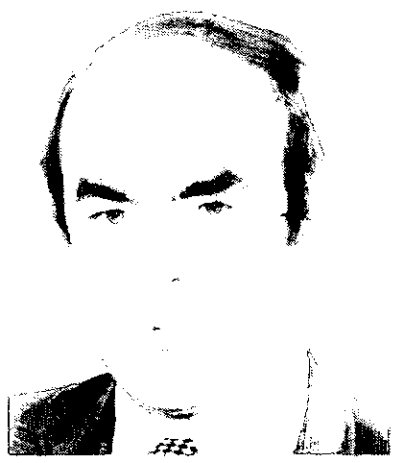
Bruce McCabe has recently completed his D.Phil. thesis and in November satisfied the oral examiners — so congratulations Doctor McCabe. Congratulations also to **Nick Robinson** who has been awarded a U.G.C. scholarship to continue work on his D.Phil. studies.

We are pleased to welcome **Dr Chris Kirk** from the Taranaki Polytechnic who will be with us for a one year Visiting Lectureship.

Professor Mackay and Dr **Brian Nicholson** attended the 1986 Inorganic Chemistry meeting in Melbourne during the last week in January 1986. **Professor J. K. Burdett,** one of the plenary lecturers, was guest speaker at a joint Waikato/Auckland seminar held in Auckland, the week following the conference.

Massey

Professor **Keith Syers** left New Zealand at the end of 1985 to take up an appointment as Head of the Soil Science Department at the University of Newcastle in the United Kingdom. He will be returning to the university where he received his degrees. As the Foundation Professor of Soil Science at Massey University since 1972, Professor Syers has made an outstanding contribution to the teaching and research of soil chemistry, particularly in the area of agricultural phosphates. In recognition of his activities in these areas, he was recently elected Fellow of the N.Z. Institute of Agricultural Science.



Otago

Assoc. Professor **M. Smith** from the Department of Biochemistry has returned full of enthusiasm from study leave at the N.I.H. where he worked on human porvoviruses as gene vectors. He describes working in an Institute with no financial restraints as a "heady" experience, particularly refreshing being the goal of the Institute — rapid progress in research. Dr **Clive Trotman** presented a paper in Antwerp at the 2nd International Symposium on the brine shrimp, Artemia. Co-author of the paper was Dr **Warren Tate.** Described in the paper was the discovery, isolation and structure of a new blue glycoprotein — artemocyanin, which is partly responsible for the colour of adult shrimps. Dr Trotman then went to the John Innes Institute in Norwich where he applied the immunogold technique to localising the site of biosynthesis of the other colourful protein of Artemia, the haemoglotin. Miss **Vicki Sumpter,** the PhD student who won the student paper competition at the Christchurch conference, has now been awarded a D.A.A.D. fellowship to study in Germany for a year as part of her PhD studies. She will be going to the Max Planck Institute for Molecular Genetics.

Dr **D. H. Murray,** Reader in Chemistry from the University of Glasgow, will join the staff of the Chemistry Department in January for about 6 months. His research interests are in organic natural products — coumarin chemistry in particular. Dr **Mervyn Thomas,** Scientific Officer in the Department and President of the Dunedin Astronomical Society, lectured to the Department on a subject with vague chemical connections — Mr Halley's Comet. In 1986, a postgraduate diploma course in Biotechnology is being offered at the University for the first time. It will be a multidisciplinary course, convened by Professor **Margaret Loutit** from the Department of Microbiology, and will have a large biological content. One paper, however, will be concerned with the processes and unit operations of Biochemical Engineering, and will be presented by the Applied Chemistry staff of the Chemistry Department — Dr **D. J. Brasch,** Dr **D. Whyman** and Mr **V. J. Alexander.**

Following the departure of Prof **D. Perrier** from the Department of Pharmacy, Mr **V. H. Thomas** has been appointed Acting Head of the Department until a new appointment can be made. Dr **R. H. McKeown** has left for sabbatical leave at Chelsea College in London. Dr **R. Taylor** from Aberdeen University will stand in for him until May.

From the Nutrition Department, Professor **Marion Robinson** has attended a WHO Expert Committee Meeting in Switzerland to contribute to the revision of a report on health aspects of selenium.

Dr **Peter Barber** from the Textiles Department will attend the 15th Australasian Polymer Symposium in N.S.W. in February. Also, he has

Continued on Page 19

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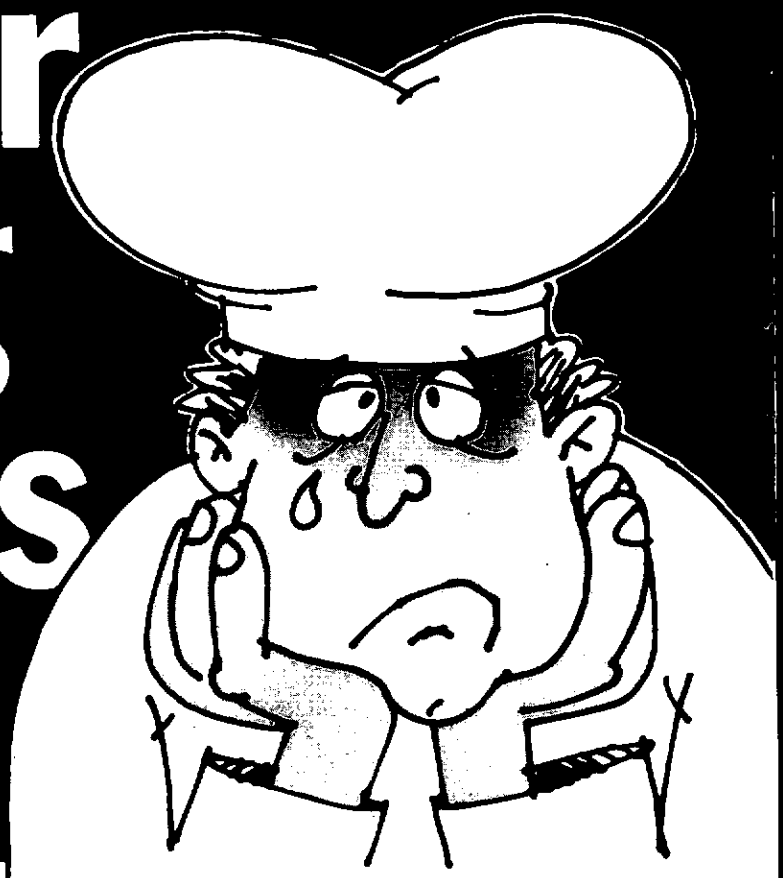

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MAF

Ruakura Soil and Plant Research Station

Dr **Patrick Holland** of the Insect Control and Organic Chemistry Group has taken delivery of a Kratos MS 80 RFA mass spectrometer system. This high resolution instrument combines high sensitivity, high mass range and comprehensive data system facilities. It will be used for a wide range of analyses, including pesticide and hormone residues in meat, dairy and horticultural produce; mycotoxins in pastures and animal feeds; studies on hormonal systems in plants and livestock.

Invermay

Although the financial situation has slowed activities at Government research stations recently, Dr **Kit Turner** is currently working on a new project at the M.A.F.'s Invermay Research Centre. He is now concerned with the problem of yellow-fatted sheep. Some ram lambs exhibit this characteristic which causes their carcases to be downgraded at the freezing works, resulting in considerable financial loss to the farmer. The colour is apparently caused by xanthophylls and other compounds from grass not being metabolised, and so ending up as beta-carotene and other coloured compounds in the fat. It appears that sheep with this problem have a deficiency in their metabolic enzyme systems, which in turn is due to a sex-linked recessive gene. A simple test is required to enable all ram lambs to be screened so that animals with this gene can eventually be eliminated from the flocks.

DSIR

Chemistry Division

The recent Australian Forensic Science Symposium in Melbourne was attended by Dr **P. L. Cropp,** Mr **E. R. Cairns** and Mr **H. M. Stone** from the Gracefield laboratory, Mr **G. A. Brown** from the Christchurch laboratory, and Ms **S. L. Nolan** and Dr **K.A.J. Walsh** from the Auckland laboratory of Chemistry Division. These six scientists delivered five papers to different sessions of the conference, Dr Cropp was also Chairman for one of the plenary sessions at the Conference.

Chemistry Division, Christchurch

Barbara Thompson who had previously worked in the Toxicology Section before going to Canada for overseas work experience, has taken up a six month appointment with the Water Section.

Dave Winter who is completing a PhD under the guidance of Dr **Graham Wright** at the University of Canterbury, has been appointed to a permanent position in the Toxicology Section.

University News Continued From Page 17

been appointed to a 3 year term as representative of the Minister of Science and Technology on the Executive of the Research Institute for Textile Services.

Three people from the Pharmacology Department attended a meeting of the Australasian Society of Clinical and Experimental Pharmacologists in Brisbane. Dr **J. A. Millar** presented a paper entitled, "Economics of treatment of mild hypertension", and Dr **David Clark** presented the results of a recent survey conducted in Dunedin by **Barbara Sinclair,** the paper being entitled, "Understanding and management of asthma". The latter paper was of particular interest because of the high mortality from asthma which occurs in New Zealand.

Applied Biochemistry Division

In mid January Dr **Daryl Rowan** of Applied Biochemistry Division left to work with Professor **Peter Albersheim's** group at the Complex Carbohydrate Research Center in Athens, Georgia, on biologically active oligosaccharides obtained from plant cell walls.

As part of its moves to commercialise products of biological research, the DSIR recently announced the appointment of two commercial managers. **Dave Gaynor** (in Palmerston North) and **Derek Burns** (in Auckland) will form a link between DSIR's Biological Industries Group of divisions and private enterprise industries, to assist in the commercialisation of DSIR technology and to identify problems suitable for the Department's investigation through industry-funded research contracts.

Forest Research Institute

Dr **Terry Lomax** has moved from Peterson Chemicals to the Wood Technology Division of FRI. As a member of the new Product Development Group, he will be looking at wood adhesives and extractives from wood. He will also attend the 15th Australian Polymer Symposium and the RACI Summer School on emulsion polymers and lactices in February.

Dr **Terry Fullerton** has returned from a six-month stint at the Pulp and Paper Research Institute of Canada. He also attended the Institute Symposium on wood and pulping chemistry in Vancouver and visited several pulp mills including the Crown Forests one owned by Fletcher Challenge.

Dr **Bob Allison** has completed a PhD at North Carolina on oxidative pretreatment with hydrogen peroxide prior to alkaline pulping; this technique was shown to accelerate delignification by 50% while maintaining pulp quality.

Wheat Research Institute, DSIR

Dr **Bill Swallow** previously Chemistry Division, Christchurch, has joined the staff as Leader of the Process Group.

The Wheat Research Institute's analytical laboratory was subjected to TELARC assessment during November 1985. A report on the visit has yet to be received.

Wool Research Organisation of New Zealand

Dr **Roy Harwood** from the Scottish Institute of Textiles at Galashiels, gave an interesting lecture on derivative reflectance spectroscopy recently during a week long visit to WRONZ.

Dr **Doug Rankin** will be presenting a short paper entitled "Utilization of NZ Wool Grease" at a one day seminar at Waipuna Travel Lodge, Auckland, 4 March, being organized by the Fats and Oils group of the NZIC.

Building Research Association

Mr **Ron Humphreys** was appointed BRANZ Appraisals Manager in September 1985. Mr Humphreys was previously Contracts Manager at BRANZ.

Helen Brown will be joining the Building Sciences Group in February 1986. Helen is at present completing her Masters degree in chemistry at Canterbury.

Dr **Rob Whitney** and Dr **John Duncan** attended a meeting with representatives of VUW Physics and Chemistry Departments (Dr **Robin Speedy**), DSIR Chemistry Division (Dr **Dave Bibby**) INS and PEL, and Ministry of Works and Development. The objective of the meeting was to consider ways in which there could be a greater exchange of ideas between Materials scientists and technologists in the Wellington region. The meeting was called as a follow up to Dr **Gordon Dunlop's** report for NRAC "Materials Science and Technology in New Zealand an Assessment".

Pulp and Paper Research Organisation

The Pulp and Paper Research Organisation of New Zealand (PAPRO) was constituted recently to service the common research and development needs of the pulp and paper industry in New Zealand.

The formation of PAPRO was in recognition of the need for a substantially increased research effort to support the future development of the pulp and paper industry in New Zealand. During the next two decades there will be a large increase in the output of New Zealand's forests. There is a clear challenge to the pulp and paper industry to expand in parallel with the forest estate and a corresponding need for carefully focussed research and development so that the right processing decisions are made and the best use made of the raw material.

PAPRO has been formed as a jointly funded venture between Government and the pulp and paper industry. It will be located on the Forest Research Institute's campus at Rotorua and will be grown from the small nucleus of pulp and paper scientists already working within F.R.I. The formation of PAPRO and the injection of private sector money means that the funding for pulp and paper research in New Zealand has been trebled, to $1.6 million per annum.

Initially, much of this increased funding is being committed to a new $2.5 million refiner pulping pilot plant. A smaller, but still significant proportion, is providing facilities for related research on paper structure and printing. This equipment for mechanical and high yield pulping and paper product development will complement the excellent equipment resource already available for chemical pulping and microscopic analysis.

The Director of PAPRO is to be Professor **Geoffrey Duffy,** of the Department of Chemical and Material Engineering at the University of Auckland. Professor Duffy has been on the staff at Auckland since 1969. During this period he has gained an international reputation in papermaking fibre research and in 1982 was awarded the L. R. Benjamin Medal, the highest honour bestowed by the Technical Association of the Pulp and Paper Industry of Australia and New Zealand.

Professor Duffy will retain his links with the University of Auckland and will be seconded to PAPRO New Zealand to take up the Director's position in January 1986.

CONSULTANTS

W. Grayson & Associates Ltd have opened an Invercargill Branch of their laboratory to service their interests in the South Island. The manager of this new facility is Mr **Geoff Miles.**

Mr **Les Boulton** recently attended the 25th Annual Conference of the Australasian Corrosion Assn in Newcastle, NSW, Australia; where he presented a paper entitled "Corrosion Performance of Aluminium Alloy Survey Pegs in New Zealand Soils".

COUNCIL NEWS

Queen's Honours. Council on behalf of the members of the Institute offers congratulations to **Dr G. W. Butler,** QSO, **Mr I.R.C. McDonald** and **Mr J.A.D. Nash,** OBE, on the honours conferred on them at the New Year. Mr Nash served as General Secretary of the Institute 1941-44.

President. The Executive Secretary of the Royal Australian Chemical Institute has advised **Professor George B. Petersen** of his election to Honorary Fellowship of the RACI during his term of office as President.

Prizes. Entries for the Easterfield, ICI, Shell Industrial Chemistry and Student Essay Prizes close with the Administrative Secretary on 30th April.

The rules for these prizes are set out on page 35 of the 1985 Yearbook. The Student Essay Prize and AAVA Chemistry V Prizes are now of $100. This is also the value of the Student Paper Prize awarded at Conference.

Members working in industry or in laboratories for research in applied chemistry are asked to consider submitting their work for the Shell Prize. Applications are confidential. Enquiries and suggestions about ways in which this prize may attract more entries are welcomed.

Nominations for the NZIC-RACI Visiting Speaker Award to an RACI member to visit New Zealand in 1987 are required from Branches by 30th June 1986 for submission to the RACI Council following Council's meeting in August.

Similarly nominations for the ACA-NZIC A. C. Kennett Memorial Prize are required before 31st July by the New Zealand Branch, Australasian Corrosion Association, PO Box 5961, Wellesley Street, Auckland.

IUPAC Recommendations. Comments are invited on synopses of IUPAC recommendations on Terminology for Polymerizations involving Chiral Monomers or resulting in optically active polymers before 31.7.86, on Terminology relating to Crystalline Polymers Synopsis before 30.9.86 and Prenol Nomenclature and Nomenclature of Glycoproteins, Glycopeptides and Peptidoglycons before 31.10.86. Copies of these recommendations and the address to which comments should be sent are available from the General Secretary.

Pimentel Report. "Opportunities in Chemistry" is the title of a 352 page report published by the National Academy of Sciences, USA, last year. A summary published in the October 14, 1985 issue of Chemical and Engineering News has been received from the ACS.

The product of a three year study organised under the chairmanship of Professor George C. Pimentel, University of California, Berkeley, who is President of ACS in 1986, it defines as priorities:

1. Understanding Chemical Reactivity.
2. Chemical Catalysis.
3. Chemistry of Life Processes.
4. Chemistry Around Us.
5. Chemical Behaviour under Extreme Conditions.

Ten recommendations are made about exploiting these priorities.

Recruitment. The latest Annual Report shows that the number of student members in our six Branches totals 34 and ranges from one to eleven. For members who have earned an NZCS and so qualified for the unhappily named grade of Technician the range is from zero to ten and the total eighteen. The range for Graduate members is five to twenty-four, with a total of one hundred and twenty.

Council is concerned to improve recruiting of chemists qualified to join the Institute. It will be discussing action planned by Branches at its February meeting.

Council Meetings. On 11/12 February Council meets in Wellington at the Royal Society of New Zealand's headquarters. On 24th August it will meet in Dunedin prior to the Annual Conference.

Telephone meetings of the Standing Committee will be held in May and November.

J. Rogers
Honorary General Secretary.
February, 1986.

1986 BRANCH CHAIRS

OTAGO — I.L. WEATHERALL

Ian Weatherall is an Otago graduate who obtained an MSc (1961) with first class honours in organic chemistry under Professor Ted Corbett. A research fellowship with the CSIRO Division of Protein Chemistry during 1962 was followed by Doctorate studies in Cambridge on nucleic acid chemistry with Professor Lord Todd and Dr Mike Blackburn. Two years as a research fellow in medicine at Harvard University involved studies on t-RNA with Professor Paul Zamecnik.

From 1967-76 he was with the Wool Research Organisation of New Zealand where he contributed to several research programmes on the biochemistry and chemistry of wool. During this period he lectured in organic chemistry at Lincoln College. In 1977 he took up a Senior Lectureship in Textile Chemistry at the University of Otago. Current research interests reflect the interdisciplinary nature of modern textile science and include the structural mechanics of fibre assemblies, diffusion and transfer phenomena, the biomechanics of fibrous proteins and their photochemistry.

He became an Associate of the NZIC in 1967 and has served as committee member and branch editor for both the Canterbury and Otago branches. He is a Licenciate of the Textile Institute, convenor of the NZ Section education committee and serves on the NZ Textile Industries Training Board. Other interests include Lions International and the Dunedin Philatelic Society.

CANTERBURY — M.H.G. MUNRO

Murray Munro is a graduate of the University of Otago where he completed a BSc (hons) in 1962 and a PhD in 1965. After two years postdoctoral experience at the University of Liverpool he took up a lectureship in the Chemistry Department at the University of Canterbury where he is currently a Reader.

His research interests have always tended towards the biological side of chemistry and he has worked in many of the areas of natural products chemistry. Currently his research is concentrated on the screening and isolation of compounds with antiviral and antitumour properties from New Zealand marine organisms. This is being carried out in association with a multidisciplinary research team at the University of Canterbury.

WELLINGTON — P. L. CROPP

Dr Peter Cropp of Chemistry Division, DSIR is the Wellington Branch Chairman for 1986.

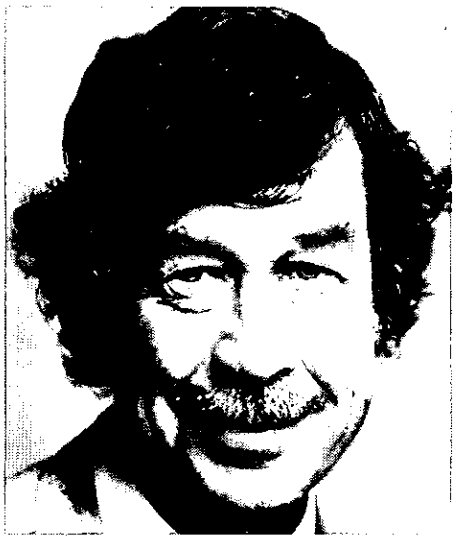
Peter was born in Lower Hutt, but received most of his education in Masterton. He then studied at Victoria University of Wellington, graduating MSc in Chemistry and PhD in Biochemistry.

In 1972 Peter joined the Forensic Section at Chemistry Division where he is involved in the identification and grouping of dried biological fluids. His main research interests are the development of improved methods for the collection and preservation of bloodstains, and determining the factors which promote the deterioration of biological materials.

Peter is married with two children, Patricia aged eight and Malcolm aged six. Catering for the children's interests, and membership of the Kelburn School Committee accounts for some of Peter's spare time. He enjoys gardening, and has a small glass house with many varieties of cactus and succulent plants raised from seed.

Continued on Page 21

PEOPLE



GENZL Announces New Scientific Director

One of New Zealand's leading geothermal scientists, **Dr Tony Mahon,** has been appointed scientific director of the Auckland geothermal consulting firm, Geothermal Energy New Zealand Limited (GENZL).

Dr Mahon, a geochemist, with more than 28 years' experience in the geothermal industry, was previously geothermal co-ordinator for the Department of Scientific and Industrial Research. In his new position he will take responsibility for GENZL's scientific consulting activities and business development. He has already been closely involved with GENZL's projects in Ethiopia, Indonesia, Greece and Japan, where he has taken part in the chemical evaluation of geothermal resources and resource modelling.

Dr Mahon began his career in 1956 when he joined the Chemistry Division of the DSIR. While there he took charge of the scientific side of geothermal matters at the Wairakei, Broadlands and Ngawha geothermal fields. In 1982 he became the geothermal co-ordinator for New Zealand with responsibility for scientific investigations into the country's geothermal resources and co-ordination of the New Zealand geothermal programme.

He has worked in almost all of the world's major geothermal areas and as a member of several United Nations teams has contributed to the development of geothermal fields in Chile, El Salvador, Panama, Mexico, Nicaragua and Kenya. He has published more than 120 papers on geochemistry and geothermal resources and is a co-author of the text book, 'Chemistry and Geothermal Systems'. Dr Mahon is a member of the NZIC and a past president of the New Zealand Geochemical Group.

Branch Chairs Cont'd From Page 20

His other interests include reading, following the stock market, and fishing when the weather is suitable.

The New Zealand Forensic Science Society was established during 1984 and Peter became the first secretary, a position he has retained to this year. He has promoted joint meetings of the Wellington Branch of the NZIC and the NZ Forensic Science Society. It is intended that the 1986 Wellington Branch programme will include a number of joint meetings between the NZIC and other professional societies.

Look out for the three other Branches in April.

Paul Hartman

Many of the older members of the NZIC will remember Dr **L. (Paul) Hartman** who was on the staff of the Fats Research Laboratory in Wellington for 30 years. He was born in Poland, where he graduated in chemical engineering, before joining Unilever in Germany to work on fatty acids. He came to New Zealand in 1939 to work in the same field, but soon after joined the Fats Research Laboratory, under the direction of Dr Brian Shorland, where his special interest was the chemistry of partial glycerides. In 1968 he went to Sri Lanka on a United Nations project; he returned briefly to Wellington in 1969 to formally retire from the DSIR before taking up a post at the University of Campinas, Brazil. While at FRL Dr Hartman studied at the University under the late Prof. P. W. Robertson, finishing with DSc in chemistry.

At Campinas he became Professor of Food Chemistry, and a few years ago went to Montevideo to deliver the inaugural address at the opening of the faculty of Food Technology in the University of Uruguay, adding Spanish to his formidable list of linguistic abilities. Two years ago he retired from Campinas and joined the Brazilian Government Institute for Research in Agriculture and Food (EMBRAPA) as a consultant.

Paul has recently written to our two-timing predecessor, Stan Brooker, to say that he has recently been awarded the University's highest distinction, the title of Livre Docente. His many friends here will be sorry to learn that, while he is still in reasonable health, he does not feel that he can undertake the long trip back to New Zealand. His address is:- Professor L. Hartman, Rua Honorio de Barrio L.G. — APTO 301, FLAMENGO — Rio de Janiero R3 22250, Brazil.

New CIT Principal

Mr **Don Griffin** a Fellow of the Institute of Chemistry has recently been appointed to the position of Principal of the Central Institute of Technology. He succeeds Mr J. A. Bateman who will retire at the end of this year.

Mr Griffin is a graduate of Victoria University where he completed a Masters degree in chemistry in 1956. He joined CIT in 1960 in the School of Pharmacy, of which he was Head from 1971 to 1975. In 1976 he was appointed to Deputy Principal. For two years, 1982-83, Mr Griffin was seconded, at the request of the Minister of Education, to chair on a full-time basis the national examining authorities: the NZ Trades Certification Board and the Authority for Advanced Vocational Awards. He continues as a member of the Authority and the Vocational Training Council.

In 1977 Mr Griffin was elected as an Honorary Member of the Pharmaceutical Society of NZ.

In the Wellington region Mr Griffin has had a long experience in the administration of sport, particularly rugby. For the past four years he has been selector and coach for the WRFU Representative Colts side.

ICI NZ Science Fair

Interfacing a computer with a chemical instrument was the aim of Riccarton High School students Shaun Clarke (left), John Stephens and Andrew Easton (right) in their project which won first prize in the ICI NZ Science Fair in Auckland last year.

A grant of $600 from the NZIC will assist them with fares to participate in the San Diego Science Fair in April.

In designing their computer controlled titration, they aimed to show how a computer could be used to control and display the progress of a titration as well as to provide an instructional program for a student using the equipment. After assisting the student to set up the apparatus, the computer controls the flow of titrant by an air bleed and measures its volume by optically counting drops as it is delivered from the burette. A pH meter detects the end point.

OBITUARY

Obituary — A. G. Freeman, MSc, PhD, FNZIC, ARIC 1935-1985

Dr Alan George Freeman, Senior Lecturer in Chemistry, Victoria University of Wellington, died in Hospital on October 24th, after a short illness, aged 50.

Alan was born in Birmingham and undertook his undergraduate training at the Birmingham College of Advanced Technology (now Aston University). He moved to Aberdeen for postgraduate study, working with Dr H. F. Taylor, on the chemistry and crystallography of amphiboles (a group of minerals which includes asbestos). He was awarded MSc in 1960 and PhD in 1962 from the University of Aberdeen. Alan then spent a period as Postdoctoral Fellow at Birbeck College, of the University of London, continuing his studies of the X-ray crystallography of minerals, and lecturing in the Chemistry Department of Borough Polytechnic.

In 1964 Alan was appointed Lecturer in Chemistry at the Victoria University of Wellington, and in 1969 was promoted to Senior Lecturer. He was a competent teacher and well-liked by students; he was never too busy to help a student with a problem. Alan continued his research interests in various aspects of solid state chemistry, particularly of the intercalation properties of compounds with layered structures, such as graphite and clay minerals, in which 'guest' molecules are introduced between the layers to produce 'sandwich-like' structures. Latterly he had been working on possible uses of this phenomenon to produce catalysts for reactions of organic molecules.

Alan became a member of the New Zealand Institute of Chemistry in 1965, and was elected to the Fellowship in 1977. He was a member of the Wellington Branch Committee at the time of his death.

Alan was fond of the outdoor life, and thoroughly enjoyed a season in the Antarctic with the V.U.W. expedition of 1964.

Alan was a popular member of the department, always cheerful and co-operative, and always carrying his share of any work which needed doing. He will be sadly missed. Alan is survived by his wife and three children.

BOOK REVIEWS

A Time To Remember: The Autobiography Of A Chemist

A. Todd, Cambridge University Press, 1983 Pp 257

£(U.K.) 15.00 ISBN 0-521-25593-7

As the dust jacket proclaims, this autobiography of Alexander Todd (Lord Todd of Trumpington) is a general account of his life until 1980 with emphasis on the events that shaped his career as a distinguished scientist. According to the preface its writing was motivated by the paucity of information available to the author when he was preparing biographical memoirs of a number of eminent Fellows of the Royal Society. Be that as it may, Todd has produced a very readable account, liberally spiced with anecdotes, of his progress from Holmlea Public School in Glasgow to President of the Royal Society. Along the way he catalogues a truly impressive list of honours that he has been awarded ranging from the 1957 Nobel Prize for chemistry and a life peerage to a Doctorate of Science from the (non-existent) University of Wau.

Although the book deals with his chemical achievements emphasis is placed on his interest in the interaction between science and government. His membership from 1947 and subsequent chairmanship of the Advisory Council on Scientific Policy until its abolition in 1964 are detailed, as is his interest in international chemical affairs. His views on scientific policy are given in six appendices which cover his Presidential address to the British Association for the Advancement of Science (1970) and his five anniversary addresses given to the Royal Society as its President (1976-1980). In them Todd extols the benefits that science can bring and the need to keep it free from political influence.

Much of the man's nature is revealed from his anecotes. Todd emerges as a man sure of himself who was not afraid to push for the top. He has an incisive mind, a remarkable ability to assess other peoples capabilities, and the ability of a canny Scotsman to say he thought of it first, for like most great achievers, Todd does not hide his light under a bushel. However, his authority and imposing bearing are tempered by charm and friendliness. The reviewer well remembers the singular honour accorded to him when Todd was invited to act as external examiner for his D. Phil. The Oxford examiner was more apprehensive before the viva than the reviewer, but after a few preliminary questions to ascertain that the applicant understood his work, Todd proceeded to put us both at ease by launching in to a lengthy discourse on the merits of pyrophosphate as a leaving group in biosynthesis.

Todd's charm is exemplified by the names of his many friends which sprinkle the book. Some New Zealanders receive mention, e.g. "Bob" Briggs, and his former students R. E. Corbett and C. H. Hassall, but while Todd enjoyed the "great natural beauty of New Zealand", its cities and inhabitants are written off as being very provincial in their outlook.

The book will appeal mainly to organic chemists, especially those who know or have met Todd. It will also appeal to those who have a fascination with the lives of great men of science.

R. C. Cambie
Professor of Organic Chemistry
University of Auckland

Chemical Research Faculties: an International Directory, 1984

This directory was published in 1984 by the American Chemical Society and is available at a charge of US$156.00. It aims to give information about Departments of Chemistry, Chemical Engineering, Biochemistry, and Pharmaceutical or Medicinal Chemistry in the world, excluding the United States and Canada. The latter were covered by the *ASC Directory of Graduate Research 1983.*

The core of the information is a listing of the academic staff in the Departments with brief curricula vitae and the titles of the two most recent publications. This information is up to 1982. A statistical summary covers staff, postdoctorate, and graduate numbers together with the numbers of masters and doctoral level degrees granted for the years 1980/81 and 1981/82. Information is also provided about the national chemical societies. Indexes of faculty, institutions, and research subjects are included. While the first two are complete, the index of research subjects, while extensive, does depend on the definitions provided by the faculty.

In conception, this publication is extremely valuable and in execution it appears to be well done and reasonably error free (although Otago will be surprised to learn that they apparently do not offer Doctoral level degrees!). The main draw-back of the publication is its lack of completeness. If one looks for information about the Universities hosting the two current Organometallic Chemistry Conferences, Vienna and Padova, one finds that there is no entry. Looking for information about the plenary speakers who are coming to the Melbourne Conference on Inorganic Chemistry, one finds that of the nine speakers, three are omitted because they come from the U.S.A. and there is no entry for two others. In one case, because there is no entry for that University, and in the case of Professor Shaw of the University of Leeds, one finds that although the University is in the Index, the entry is from the Department of Organic Chemistry only. In the preface, it is noted that while 1150 Departments were invited to participate, only 727 replied. The completeness of the coverage is unpredictable. Thus all New Zealand Institutions replied, whereas it would appear that only half of those from Italy responded. One finds the Technical University of Vienna but not the University.

However, once the basic draw-backs are accepted, the publication is extremely useful and fully deserves a place in all chemistry libraries. It would be expected that the North American Directory would also be held. One would also hope that the ACS will continue to support the publication and will aim to produce new editions (preferably one integrated publication) at regular intervals. We must also hope that the value of the publication will be recognised by those departments who have not contributed this time.

The printing, though small for the bulk of each entry, is clear and the general level of production is excellent.

K. M. Mackay
Professor of Chemistry
University of Waikato

Cover Story:

ENGLEHARD INDUSTRIES

For Precious Metals & Performance Mineral Products

Gasoline and satellite communications systems.

Pharmaceuticals and catalytic converters.

Gold-trimmed tableware and colourful catalogues. Fertilizers and exercise outfits.

Englehard helps make all of these products and many more that are an integral part of our daily life.

Through technology.

In fact, the Company's history can be told by its technological developments over the last century. With roots planted deep in the foundation of science, Engelhard has grown into a world leader by applying technology to the needs of the marketplace.

From two key raw materials — precious metals and performance minerals — Engelhard has invented or developed processing systems and intermediate materials essential in the production of literally thousands of products.

Engelhard's origins can be traced to three companies utilising these materials in their products: liquid gold solutions for decorating, ceramics and glassware, brought from Europe by Charles Engelhard in the 1890's; platinum in jewellery and dental products from the Baker Company before the turn of the century; and applications of kaolin as a performance mineral in paper production from the Edgar Brothers Company, dating to the early 1900's.

In the 1920's, Engelhard began to work with precious metals, inventing ways to speed the reaction in the catalytic process. This opened the door to wide-scale application and, since that time, the Company has pioneered one development after another, reaching across the basic processing industries.

It helped create catalysts for making pharmaceuticals during the 1940's. With Sinclair Oil Co., it developed a new platinum catalyst, to increase the efficiency of gasoline production. It began making catalysts for the giant chemical/petrochemical industry, simplifying the production of hydrogen peroxide, nitric acid, aromatics, ammonia, vinyl acetate, olefins and other materials indispensable to the manufacture of many products.

Using the performance mineral kaolin, the Company learned how to impart brightness, whiteness, opacity and other important characteristics to papers, enabling printers to achieve high quality results in working with assorted paper stocks.

Then, in the 1960's, Engelhard took the performance mineral to the petroleum industry, perfecting the zeolitic fluid cracking catalyst which has revolutionised methods for making gasoline and distillate. Several major developments have followed, including the *ULTRASIV®* fluid cracking catalyst line early this decade, and now the *DYNAMICS* family, offering seven separate products.

Meanwhile, the Company has advanced its technology in precious metals and is helping to produce complex components for the demanding microelectronics industry.

All through the years, the Company's increasing knowledge of the diverse properties of precious metals as electrical conductors, heat reflectors, corrosion resistors and temperature sensors has been put to use in the creation of more than 10,000 products that go into manufacturing everything from glass and steel to cars and dental fillings.

Further details of Engelhard's activities, and some of its products of particular interest are detailed below.

Noble Metal Catalysts

Engelhard Industries is one of the world's leading fabricators and refiners of products containing precious metals. These metals are platinum, palladium, rhodium, osmium, iridium, ruthenium, gold and silver. Among the most important products are Engelhard Noble Metal Catalysts and Noble Metal Compounds. Our catalysts are extraordinarily active and can be tailored to fit many needs. They catalyse a variety of reactions, including hydrogenation, dehydrogenation, isomerisation, oxidation, carbonylation, hydroformylation, oligiomerisation, telomerisation, and silylation.

Engelhard Noble Metal Catalysts are used throughout the world by chemical and petroleum industries in the manufacture of such bulk chemicals as ammonia, hydrogen, cyanide, nitric acid, formaldehyde, acetaldehyde, butyraldehyde, acetic acid, phenol, adiponitrile, caprolactam, propylene oxide, cyclohexanone, vinyl acetate, sorbitol, aniline, diaminotoluene and gasoline, as well as in the synthesis of many fine chemicals and drugs. In addition, Engelhard Catalysts are used in purification of chemical process gas effluent streams.

Engelhard Noble Metal Catalysts take many forms. They may be particulate or monolithic, supported or unsupported, pellets, spheres or extrudates, granules or fine powders, needles or gauzes. The type of catalyst needed depends on its use. Finely divided powders are used in batch reactors. Pellets, spheres, extrudates or granules are used in fixed-bed reactors. Metal loading may vary widely. In general, fixed-bed catalysts contain about one-tenth the metal (0.1% to 2.0%) of powdered catalysts (1% to 10%). Some catalysts fall beyond these extremes, from 0.01% to 100% metal (metal blacks). Homogeneous catalysts, metal complexes dissolved in solution, have found increasing use in recent years.

For economic reasons a catalyst should be reused as many times as possible, with or without intervening on-site regenerations. But eventually every catalyst deactivates to a point where continued use is no longer warranted. The spent catalyst can then be returned to the Engelhard Industries Refinery Department for metal recovery.

Catalyst Evaluation Kits

To assist customers in the selection of a suitable catalyst, Engelhard offers a number of kits containing laboratory scale quantities of their most popular products. Kits are available covering platinum metal catalysts on powder supports for liquid phase reactions, pelletted or granular supports for fixed-bed studies, and a recently released selection of the range of homogeneous catalysts now available. As this is seen as an important customer service, the kits are available at a nominal cost.

Pollution Control

Engelhard catalysts have applications in pollution control. Catalytic after-burning of plant emissions containing organic vapours and carbon monoxide can be achieved with the TORVEX® Catalytic Reactors. The use of a catalytic system over conventional incineration has considerable advantages, including operation at lower temperatures, high efficiencies, and heat recovery options to reduce overall processing costs.

Also of particular interest is the PTX® range of exhaust gas purifiers for use on diesel, petrol, LPG, and CNG-fuelled engines. While there are no statutory requirements for exhaust emissions control in this country, these units are finding particular application with vehicles such as fork hoists which are often used indoors and in enclosed spaces. The catalysts can reduce carbon monoxide emissions by more than 90%, as well as removing most hydrocarbons and other sources of odour.

Gas Purification

The Engelhard Deoxo gas purifiers are available for the removal of oxygen and hydrogen from a wide variety of industrial gases. Designed for laboratory use, the purifiers use a catalyst to combine oxygen with hydrogen, and are claimed to give removal to less than 1 vpm from hydrogen containing up to 1% of oxygen. They may also be used with other gases such as nitrogen and helium, provided there is sufficient hydrogen available for reaction with the oxygen.

Chlorination Systems

Historically water chlorination has been achieved using chlorine gas or hypochlorite salts (HTH etc) both with their accompanying hazards. Engelhard's Chloropac system now offers a safer alternative — electrolytic generation of hypochlorite is an insitu process. Chloropac is a modular system with capacities as required for any application, high efficiencies, and moderate costs.

The system has also been incorporated into the ODOXO® odour control system for use in chemical plants, sewage pumping stations, and a wide variety of other applications. Here the Chloropac generator is used to produce hypochlorite for use in a conventional gas scrubber-proven technology for odour control applications.

Metal Finishing

The Engelhard Chemical and Electrochemical Division manufactures a range of products for the chemical, metal finishing and allied industries. These products — chemical compounds, anodes, and electroplating solutions — are made principally from the precious metals: gold, silver, and the platinum group. The Division also markets specialist electroplating plant and control equipment. This total involvement with the metal finishing trade extends from the refining of the original ingots to the recovery and reprocessing of customers' spent solutions and other residues, i.e. the complete cycle.

The above is just a small selection from the wide range of products and services available from Engelhard Industries in New Zealand. For further information contact the company at either their Auckland (74-76 Upper Queen St, ph 732-949), or Christchurch (244 Oxford Tce, ph 63-240) offices, or circle 12 on the reader reply card.

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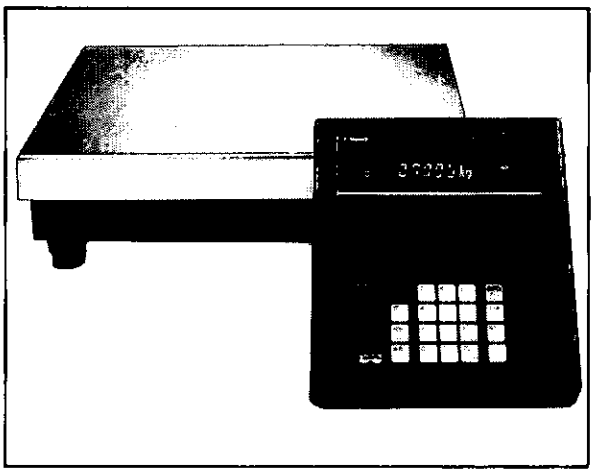

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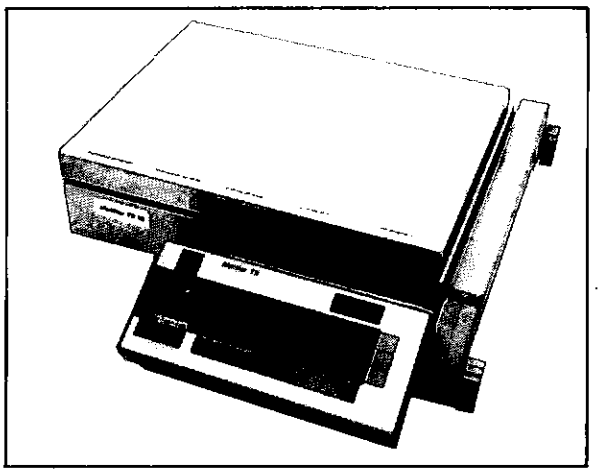

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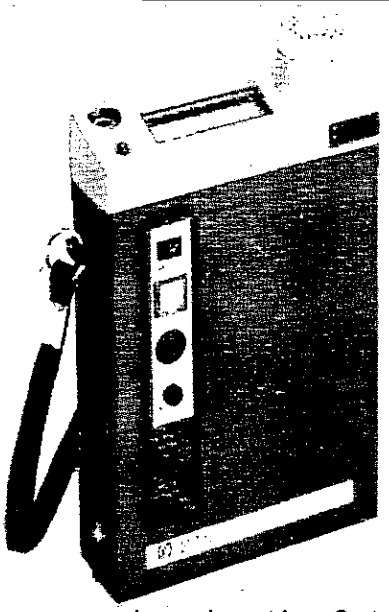
PRODUCT NEWS



Oxygen measuring equipment from Gastec

The Oxytec Oxygen Minimonitor Model GOA-2H is a pocket size, plastic housing, dry cell battery powered, direct reading digital read-out instrument designed to measure oxygen concentration in air and to provide an alarm when oxygen concentration decreases to the preset warning level by means of an alarm buzzer and flickering red L.E.D.

The Oxytec Oxygen Minimonitor Model GOA-2H is most suitable for detecting oxygen deficiency hazards in confined, inaccessible areas such as manholes, tunnels, tanks, chemical vessels, cargo hatches, granaries, warehouses or other underground work environments.

The Oxytec Oxygen Minimonitor Model GOA-2H uses a self-generating electrolytic cell (Oxygen Galvanic Cell) containing a silver, and a lead electrode in a basic electrolyte and a semi-permeable membrane.

Oxygen diffusing through the fluorocarbon membrane of the cell face initiates redox reactions which generate current proportional to the oxygen concentration (the oxygen partial pressure). The generated signal is converted to a proportional voltage, which is displayed on the indicating meter as a direct oxygen concentration. The converted proportional voltage activates a pre-set alarm circuit when the oxygen content is below the pre-set level triggering an alarm buzzer, and flashing L.E.D.

The Oxytec Oxygen Minimonitor Model GOA-2H is also designed to operate safely in hazardous area as an intrinsically safe instrument.

Two other units are in the Gastec Minimonitor series for the measurement of Carbon Monoxide and Hydrogen Sulphide.

Full details are available from New Zealand's Gastec distributors, Kempthorne Medical Supplies Ltd, P.O. Box 1234, Auckland, or circle 14 on the reader reply card.

Watson Victor Appointed Gallenkamp Agents

As from 1 February, 1986, Watson Victor Limited have been appointed to represent the Gallenkamp Company in New Zealand.

Watson Victor will be pleased to handle your inquiries for any Gallenkamp equipment listed in their catalogue, other than where a sole New Zealand agency exists.

According to Watson Victor spokesman, Mr F. W. Wharton, the move was a logical step as both Watson Victor and Gallenkamp are members of the Fisons Group.

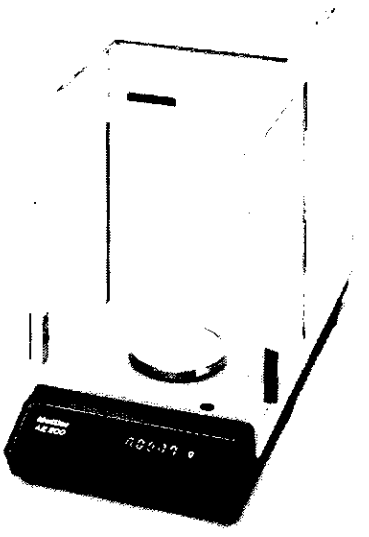
Mettler extends analytical balance range

The highly successful Mettler AE series of electronic analytical balances is being expanded. The newest member of the family, the AE200, has a 0...205g weighing range and a readability of 0.1 mg.

With this increased weighing range, the AE200 is perfectly suited to determine the density of spray cans and other containers, for working with heavy mortars, and for the determination of liquids and solids according to the immersion principle.

This latest top loading analytical balance has all the same features and advantages as the other Mettler AE models. Various options make it possible to transfer data via the popular RS232C, CL and IEEE488 data interfaces. The balance is operated with a single control bar and the weighing chamber is freely accessible from three sides. An adjustable stability detector and a selectable integration time extension make it possible to adapt the balance to specific operating conditions. Accurate weighing is guaranteed by the convenient autocalibration mode, which features a built-in weight for operator convenience.

The Mettler analytical range comprises the following models:-



AE200 205g/0.1mg
AE163 162/0.1mg and 31g/0.01mg
AE160 162g/0.1mg
AE100 109g/0.1mg
AE50 55g/0.1 mg
and with exclusive Mettler DeltaRange,
AE166 162g/1.0mg and 60g/0.1mg

For further details contact Watson Victor, or circle 21 on the reader reply card.

PRODUCT NEWS

Sci-Med Re-opens its Palmerston North Branch

Late last year Mr Robert Saunders was appointed to the Palmerston North branch of Sci-Med, further emphasising the company's commitment to this important and expanding centre of research and education and industry. This now also places Taranaki and Hawkes Bay customers within easy reach and should result in further improved service of these regions.

The Palmerston North phone number is (063) 78-959, and postal address remains Box 6004. The company may also be contacted by telex in Palmerston North now at NZ 3835, attention Sci-Med.

Versatile Research Grade FT-IR

Sci-Med announces the availability of the Bruker model IFS-88 Fourier transform IR spectrometer for demanding applications in the analytical and research laboratory.

The spectrometer combines a modular table top optical system with a sophisticated computer, data storage and data output station. In its standard configuration, it is a high performance single beam instrument operating in the mid IR range. Therefore the IFS-88 can handle many problems which arise in the modern analytical laboratory. However the flexible optical design allows easy extension to the visible, near and far infra-red ranges. The IFS-88 in such an extended configuration can also be of great value in the demanding research environment.

Optics: The optics housing consists of three separate, purgeable modules for the interferometer, sample, and detection units. This modularity allows quick adaption of the spectrometer configuration to various experimental techniques. Up to three measurement beams can be built-in and selected using computer controlled switching mirrors. Two beams have a focus at the normal sampling position whereas a third beam enters the sample compartment as a parallel ray. This latter beam can aid the user in optically adapting special sampling accessories to the spectrometer.

Two sources and up to six detectors can be permanently mounted and selected under control, thus facilitating easy change of spectral range. A choice of two parallel exit beams is available for coupling to external accessories, eg. GC-IR, microscope etc. Studies of remote sources in emission is carried out with a choice of two entrance ports.

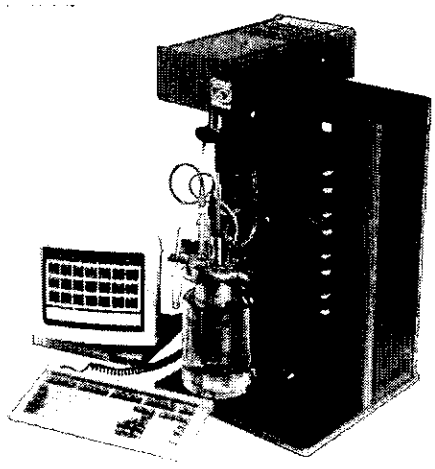
Applications: The IFS-88 features high sensitivity and accuracy. A specially designed Michelson interferometer with fast scanning capability is used for time resolved measurements like in-situ spectro-chemistry, catalytic surface reactions, or on-line coupling techniques with liquid or gas chromatographs.

The easy adaption of cooled detectors further enhances sensitivity and is recommended for low energy throughput sampling accessories like attenuated total reflectance (ATR) accessories for surface and water solution measurements, diffuse reflectance units and for emission work at ambient temperatures.

A special slow scanning mode of the moving interferometer mirror optimises the coupling of slower photoacoustic detectors.

The adaption of the BRUKER infrared microscope is possible by using one of the two infrared signal exit ports or one of the standard sample channels. With this microscope easy and efficient infrared measurements of spot sizes down to the diffaction limit of 10 micrometer diameter can be carried out.

For further details contact your nearest Sci-Med office, or circle 2 on the reader reply card.



Queue Mouse

The line up of innovative products for today's tissue culture laboratory from Queue Systems includes the Mouse, a bioreactor system that is microprocessor based for controlled, scientific fermentation and cell culture.

The deceptively simple, logical design is based on a benchtop computer, video screen and keyboard, which accept and implement all commands and conditions for bioreaction; allow constant, at-a-glance monitoring, and store recorded data for further processing, storage or printout.

The range of interchangeable bioreactor vessels includes conventional designs for fungal and bacterial applications. For eukaryotic cell culture, choose from a round bottomed stirred vessel; an airlift reactor or a hollow fibre bioreactor.

As well as standard built-in monitoring and control of temperature, agitation and airflow, parameter monitor/control options that can be selected to suit particular applications include pH, redox potential, dissolved oxygen, foam control, and multiple gases (including NH_3, CO_2, O_2, CH_4, etc.). Up to four peristaltic pumps can be controlled for addition or removal of liquids.

No computer expertise is required. Software is available for monitoring and control of any parameter that can be electronically measured. The software is preprogrammed, easy to use, and flexible. Built-in screen formats are used to make setpoints, high and low limits, alarm points, and parameter or system shutdowns. There is a sophisticated choice of algorithms for parameter control (based on proportional, integral or derivative) as well as ON/OFF control, or combinations.

Additionally, parameters can be set to react on a cause and effect basis, allowing interactive control over the entire reaction system.

Finally, the Mouse is open-ended, and can be readily expanded to incorporate future developments in sensors and other technology.

For further details please contact your nearest Sci-Med branch, or circle 3 on the reader reply card.

Queue Freezers

The Queue Systems range of ultra-low temperature freezers covers chest and upright models, from -75°C to the -135°C cryogenic preservation chamber — the modern answer to liquid nitrogen dewars, for indefinite viability extension of valuable biological materials.

Whatever cryogenic temperature you work at, you need the assurance of a powerful refrigeration system, with reserve capacity to recover rapidly, and to create a uniform top-to-bottom temperature throughout the unit.

This assurance is provided by the patented Cryostar refrigeration design, the heart of all the Queue freezers. This design is based on a single 1.5 HP compressor, and combines heat exchange physics and refrigerant chemistry to outperform cascade freezers, in a system that requires minimal maintenance and carries a two year factory warranty.

Of course, the Cryostar system has assistance — in the form of a five-inch layer of high-density urethane insulation, inside a rugged, industrial strength cabinet, with counterbalanced lid, and security locks. Controls are centrally mounted and locked, and include a battery operated safety alarm system and power fail warning. Optional are a temperature recorder, a standardised inventory system, and a liquid N_2 or CO_2 back up system for all models, except in the case of the -135°C unit, where a liquid N_2 back up system is supplied as standard.

For further details please contact your nearest Sci-Med branch, or circle 4 on the reader reply card.

Degussa Consolidates Agencies Under Chemiplas

Degussa AG. of Germany announces that from 1st January 1986 **Chemiplas Agencies Ltd** will consolidate all Degussa Divisions within its New Zealand Agency responsibilities:

- ★ Precious Metals: Gold Silver, Platinum
- ★ Dental Products: Alloys, Sundries, Instruments
- ★ Technical Metal Products: **Electroplating Thermocouples** — Electrical contacts **Special Metals** — Platinum & Catalysts
- ★ Durferrit Process: Carburising, Annealing, Temperising, Nitriding Salts
- ★ Industrial & Fine Chemicals: **Active Oxygen Compounds** — Carbonates, Peroxides Borates, Acetates **Amino Acids** — Methionine, Nicotinamide **Commodity Chemicals** — Cyanides, Biocynates, Acrylates, Methacrylates, Formates
- ★ Ceramic Colours: Precious Metal Preparations, Decorating Glass & Ceramic Colours, Glazes, Glaze Frits & Stains, Screen Printing Oils

Degussa are manufacturers of the following range of catalysts:

1. **Precious Metal Catalysts**
   DEGUSSA supplies a wide range of precious metal catalysts for the chemical, pharmaceutical and petrochemical industries.
2. **Custom Catalysts**
   DEGUSSA will customise or toll manufacture catalysts to your specifications . . . in strictest confidence.
3. **Activated Nickel Catalysts**
   DEGUSSA activated nickel catalysts are highly effective in hydrogenation and dehydrogenation reactions.
4. **Automotive Exhaust Catalysts**
   DEGUSSA supplies both particulate and monolithic catalysts for automotive exhaust emission control.
5. **Recovery of Precious Metals**
   DEGUSSA offers recovery of precious metals from spent catalysts.

For further information contact Chemiplas, or circle 5 on the reader reply card.

PRODUCT NEWS

New Products From Alltech

A new brochure on the SAVANT range of Concentrator/Evaporators, Refrigerated Traps, etc is available from ALLTECH NEW ZEALAND, who handle the full SAVANT range on an exclusive basis in this country. New products available from SAVANT include a Robotic Controlled SPEED VAC® Concentrator and High Speed Centrifuge, compatible with most robotic systems offered by robotic manufacturers and system assemblers. Opening and closing covers, start and stop, test tube indexing and other typical functions are readily co-ordinated.

Circle 6 on the reader reply card.

★ ★ ★

RHEODYNE announce that many of their high pressure valves are now available in large-bore versions. Designated with an 'L' suffix, these models have 0.040" (1mm) diameter flow passages. The flow impedence through the valves is lower, so they are more suitable for viscous fluids and prep-scale LC flow rates above 100mL/minute. Circle 7 on the reader reply card.

★ ★ ★

The VALCO 140B Electron Capture Detector is now available with a maximum operating temperature increased to 400°C. This proven system extends the linear dynamic range to five or six decades of sample concentration. Used with a suitable GC column, the VALCO ECD permits quantitative analysis from picograms to micrograms, with no need for expensive reruns or critical sample sizing.

The VALCO 140B is a stand-alone detector, complete with power supply and precision detector temperature control. Circle 8 on the reader reply card.

★ ★ ★

A full range of quartz and glass spectrophotometer cells, manufactured by GASUKURO KOGYO, of Tokyo, is available from ALLTECH NEW ZEALAND. A fully illustrated brochure is available on request.

Also available from GASUKURO is their Model HG-225 Hydrogen Generator, featuring simplified maintenance, and safety in continuous hydrogen supply with limited mains electricity running cost, using only purified water. A brochure is available from ALLTECH NEW ZEALAND. Circle 9 on the reader reply card.

★ ★ ★

ALLTECH NEW ZEALAND announce that they have been appointed sole New Zealand distributors for the PHILIPS range of pH and conductivity meters and cells. Circle 10 on the reader reply card.

New management training programme for technical and scientific personnel

New Zealand produces many excellent scientists, engineers and technologists. Graduates from our universities and from our technical institutes can hold their own anywhere in the world.

Many scientists and engineers, because they are good at their jobs, are eventually promoted to administrative, supervisory or managerial roles. It is at this point in their careers, however, that good scientists can become mediocre managers as they may move into administrative positions without adequate preparation and training. A few will succeed because of their inherent managerial skills but most struggle to achieve their full potential in the absence of proper training.

The Testing Laboratory Registration Council (TELARC), which already operates a national accreditation agency for testing laboratories in New Zealand, is attempting to fill this gap in our technical education resources by launching a management training service specifically directed at technical and scientific personnel. The new service will offer a series of modular training courses on various aspects of technical management aimed at all levels of staff.

TELARC's Deputy Director, Malcolm Bell, who will manage the new service, notes that many people do not realise the breadth of skills required by a testing laboratory manager.

"They must be technically competent in their fields of technology and be able to foresee, recognise and cope with any technical problems that may arise. They must also maintain their technical expertise by keeping abreast of developments in their fields as techniques learned 20 years ago may be irrelevant today.

They must be quality assurance specialists able to develop and implement quality management systems in their laboratories and they must understand and be able to use the new information processing and communication technologies now available.

Above all else though, they must be able to lead, motivate, and support their staff and provide an environment in which technical specialists can provide competent reliable work."

TELARC undertakes about 250 assessments of testing laboratories each year. These range from sophisticated hospital pathology laboratories using the very latest automated equipment to laboratories that test the sloppiness of wet concrete.

"After 12 years of operations we have seen just about everything that can go wrong," says Malcolm Bell. "Our new training programme will draw extensively on these experiences."

TELARC's courses are modular in concept so that companies can integrate them into their existing training programmes. Most courses will be presented in the main centres but they will also be taken to smaller provincial centres if there is sufficient demand. Courses can be presented in-house for larger organisations.

A prospectus is available from TELARC fully describing the new training service. (P.O. Box 37-042, Auckland, phone (09) 778-621/2.

SelectiSpher-10™ HPLAC Columns

Pierce Chemical Company introduces new High Performance Liquid Affinity Chromatography (HPLAC) columns.

SelectiSpher-10™ HPLAC columns combine the selectivity of conventional affinity chromatography with the high resolution, speed of analysis and sensitive detection of HPLC.

The following columns are now available from Pierce:

SelectiSpher-10 Boronate for the separation of nucleosides, nucleotides, glycoproteins, catecholamines, carbohydrates and transfer RNA.

SelectiSpher-10 Concanavalin A (Con A) for the separation of closely related carbohydrates and glycoproteins.

SelectiSpher-10 Activated Tresyl for the immobilisation of primary amine and thiol containing ligands to affect various specificities.

All SelectiSpher-10 HPLAC columns are available in 5, 10, and 25 cm lengths with 5 mm internal diameters. For additional information contact LabSupply Pierce, or circle 11 on the reader reply card.

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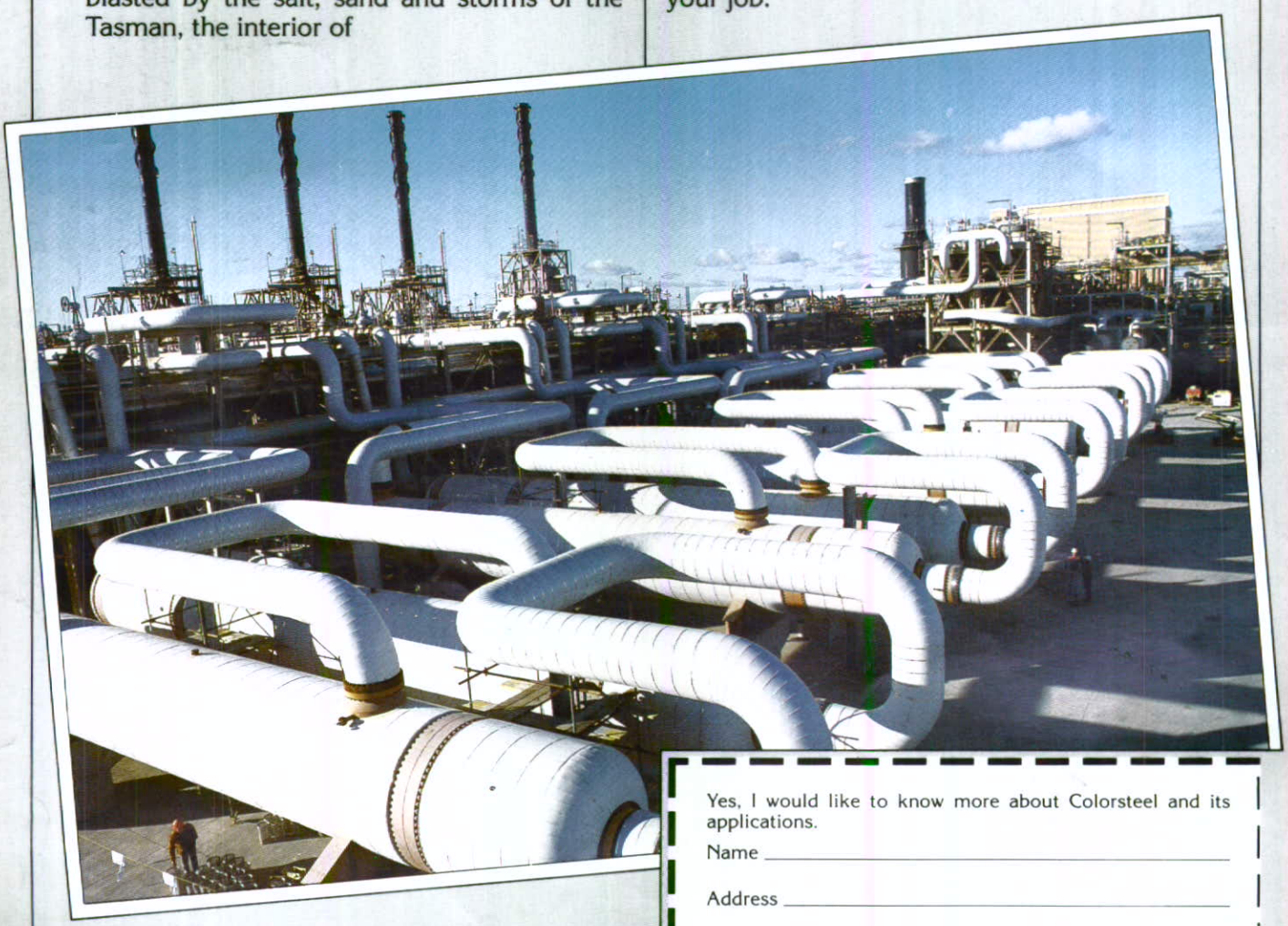

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