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RATIONAL USE OF ENERGY IN THE CEMENT INDUSTRY

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SUMMARY

1. The Australian Cement Industry is described in broad outline including:
   1.1 Its present role and future prospects.
   1.2 The size of the industry.
   1.3 Plants, types of plant, and their geographical location.
   1.4 Fuels and their changing pattern over the last 30 years;
   Coal with wet process plants.
   Oil fuel and modern dry process plants.
   Gas, and its price escalation.
   The oil price crisis and the reversion to coal.

2. The trend to energy efficient operations (both fuel efficiency and electrical efficiency).

3. A case study is presented of one cement plant which changed over from small wet process oil burning kilns, to a 4 stage oil burning preheater kiln, and then to coal burning. With the addition of a second preheater and precalcinating system it now achieves much greater output and operational efficiency. The conversion to coal and the installation is describing in detail, and the benefits achieved at each stage of the three stage upgrading are discussed. Although such benefits might not apply to all plants, they include on this plant greater quarry efficiency, increased raw material mill output, greater kiln output, less kiln off-line time, fewer rings and preheater accretions, improved brick life, the ability to use cheaper fuels, and the assurance of being able to use indigenous fuels rather than imported ones. Comparative fuel costs are mentioned, and the range of possible alternative fuels discussed.

4. The importance of using poorer grades of fuel in the cement industry is mentioned stressing the peculiar advantage that cement kilns (and especially some types of modern precalcining kilns) have in being able effectively to use low grade fuels or fuels of high ash content which are unsuitable for many other purposes. It is stressed that high grade fuels should be reserved for other purposes where possib

5. Some ideas on policies of fuel conversion are explored. The special case of developing countries is considered, and possible initiatives for both industry and Governments are discussed.

6. Conversion from oil or gas to coal burning does not present any major problems if a competently designed plant is installed.

RATIONAL USE OF ENERGY IN THE CEMENT INDUSTRY

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SECTION 1 - THE AUSTRALIAN CEMENT SCENE

1. Australia may seem a remote part of the world to most of the delegates at this conference, and it may come as a surprise to learn something of its size. If a map of Europe were superimposed on the map of Australia it would be found that from east to west, the map of Australia would encompass the distance from Ankara in Turkey to Lisbon in Portugal, and from north to south, it would reach further than from Oslo to Athens! And yet within that vast continent dwell only about 14 000 000 people - both Shanghai and Tokyo/Yokohama have nearly that population in a city!

The reason for this small population is found in the character of the continent. In the centre are vast areas of hot and almost uninhabited desert, and the main population is located round the fertile edge of the continent, over half of it being concentrated in about six major cities.

Consequent on this, the sixteen cement making plants are also largely located round the edge of the continent and as close to the major cities as the availability of raw materials will allow. The major centres of population are 800 km or more apart, and so the supply of cement in each area is largely restricted to the local factories, with the notable exception of my own Company which operates its own specialised bulk cement ship and transports cement into its own two terminals located in the cities of Melbourne and Sydney from its plant on the southern island of Tasmania.

Due to this need to supply a number of discrete and localised markets, the development of the cement industry has been patchy. In some areas, notably Western Australia, the industry boomed a few years ago with a mining boom, and now that this has slowed down, Western Australia has excess cement capacity.

The present economic climate in Australia is, like most of the world, very depressed, and consequently the Australian cement industry with a capacity of about 8 000 000 tonnes per year has about 30% of idle capacity at present.

In a well developed country the cement consumption can be expected to be about 350 to 450 kg per person per year, and so the industry is reasonably well equipped to meet the demand when the recession ends, although some of the plant is old and of the wet process type which is expensive to operate, and some of the plant capacity may be in the wrong geographic location to supply a rising market.

Australian is a country rich in mineral resources - iron ore, bauxite, coal, copper, zinc, gold, silver, lead, uranium, tungsten and many others, and rich in primary industries - cattle, sheep, wheat, etc. I can feel confident that in the coming revival of the world economy our country has a very bright future, and with the growth of commercial activity the cement industry will certainly grow, and grow economically because of our large reserves of indigenous fuel.

Our plant commissioned major extensions two years ago, and a new plant opened in Queensland last year. My Company has further expansion plans drawn up, and we will proceed with these when the economic climate improves.

2. In Australia cement is made from a great variety of materials, ranging from coral and calcareous sands dredged from the sea, hard limestones that must be drilled and blasted, through to limestones soft enough to break out with rippers and scrapers.

Raw materials are quarried on the plant site in several cases, but in others they are transported to the plants by ship, aerial ropeway, road, rail, overland belt, and even in one plant by wet raw milling at the quarry site and transporting the slurry over 15 km through a pipeline, to be filtered and fed to a suspension preheater.

There is even more diversity in plant types, ranging from the old type of wet process, semi-wet, (Lepol type), dry (suspension preheater type), vertical kiln, and precalcining suspension preheater. Fuels used are mainly natural gas and coal.

3. Let me now address myself to the changing pattern of fuel use in the cement industry in Australia. When I first entered the industry 30 years ago the norm was a wet process kiln or kilns, fired with coal. The only exception to this was one small dry process simple kiln which used waste heat for power generation and one small vertical kiln operation. Coal was the universal fuel, and about one third of the plants owned and operated small coal mines near to their cement making sites.

In the early 1960's Australia was importing increasing quantities of Middle East crude oil and refining it, and there was an embarrassing glut of heavy residual oil. Consequently the oil companies made very attractive offers to industries which could use such fuel, and many of the cement companies including my own, changed from coal to heavy oil fuel. The exceptions, as you might expect, were those who owned and operated their own coal mines. In fact, these plants have continued to use coal and are still doing so.

In the middle of 1960's the modern fuel efficient kilns began to appear in Australia. First a small suspension preheater, then a Lepol grate kiln, then two plants built larger suspension preheater kilns (ours in 1966), and progressively over the intervening years kilns of this type have been installed, until now nearly half the productive capacity in Australia is of the dry process type.

The next stage of the fuel story occurred progressively in the later 1960's and early 1970's when large fields of natural gas were found in Australia. Unfortunately, being a large country, the gas fields were all in remote areas, involving long pipelines to get the gas to the cities, and so certain industries, including some cement plants, were offered very attractive gas prices to provide a basic market to make costly pipe lines viable. Several cement plants accepted gas as their fuel and are still using it. My Company was not able to get gas supplies in our area, and our fuel remained oil. Then in about 1973-74 the escalation of oil prices began, and we made the decision to go back to coal fuel. We built a coal plant in 1975 and commissioned it in 1976 in time to avoid most of the impact of oil price escalation.

Subsequently we have converted the plant into a precalcining plant with the addition of a second preheater and in 1979 we purchased a coal mine to assure our fuel supplies.

4. The trend to energy efficiency in the cement industry is now world wide. The industry consumes large quantities of energy both as primary fuel and as electrical energy. Energy efficiency was being considered by the more progressive companies in the 1950's and 1960's when many new installations of the energy effic ient preheater kilns were being made, but installations of wet process kilns (using 1.5 to 2 times as much fuel per tonne of product) were still being commissioned. The energy crisis of the middle 1970's changed the situation dramatically and the installation of wet process kilns practically ceased, and gave way to various types of fuel efficient dry process plants.

Other areas of energy saving have been pursued with less spectacular but useful results, such as more efficient electric motors, and improved electrostatic precipitators, which also save energy by reclaiming partly processed materials whic would have been lost as dust. Larger kilns have been built as these are more effic ient both in minimising radiation losses and incidentally in saving manpower, and most recently precalcining kilns have been introduced which contribute to efficienc in various ways, which I will discuss later in this paper. Perhaps the least succe ful area in energy efficiency is in milling of raw materials and finished cement. Certainly the vertical roller mill uses less energy than a ball mill but tends to have a high maintenance cost, and is unsuitable for some abrasive raw materials. Tandem mills which consist of a hammer mill in series with a ball mill have distinc energy advantages, which will also be mentioned later in this paper.

SECTION 2 - A CASE STUDY IN FUEL CONVERSION AND UPGRADING OF A CEMENT PLANT

I would now like to enter into a case study of the progressive upgrading of my Company's plant which has, I think, been an excellent example of progressive plant development in both energy and efficiency.

As I mentioned earlier, we originally had two small wet process kilns fired with coal, and subsequently with oil. These were phased out over 10 years ago, and eventually dismantled.

I will discuss the upgrading of our plant in three stages, describing each stage of upgrading and its consequences separately to show how they affected our plant at that time.

Some advantages which appeared at the coal conversion, for example, are less important now after two subsequent upgradings.

Part 1: Conversion from Oil to Coal Firing

I will describe our coal installation in some detail. Australia has vast deposits of coal of varying grades, ranging from excellent black coals of very low ash content, to poorer grades of 25-30% ash, and also very large deposits of brown coal (lignite). Our small island of Tasmania has considerable coal deposits of a medium grade (20 to 25% ash).

Tasmanian coal is a black coal which occurs in fairly shallow seams making working something of a problem. It is a non caking humic coal with about 23 to 24% volatiles and 45 to 55% fixed carbon and about 20 to 25% ash. It contains about ½% of sulphur and has nett calorific value of about 24 000 joules/gram (or 5 700 calories/gram).

The main problem from a technical point of view in conversion to coal burning was that the Humboldt kiln with the Claudius Peters batch homogenising system is not amenable to changes in coal quality, because there is quite a large amount (usually 1 to 1½ days supply) of kiln feed material prepared and stored in silos in such a way that its analysis cannot be adjusted. This is unlike our old wet process, where we could change the material fed into the kiln fairly readily.

This means that the first essential of a suitable supply of fuel is consistency.

As we had bought coal many years ago from a number of companies, and suffered with considerable variations in quality, mainly due to extraneous matter appearing in the coal, we approached the one remaining coal company in Tasmania, with a proposition that we would be potential customers for sizable quantities of coal (something like 50 to 60 thousand tonnes a year initially and possibly more at a later date) if they could guarantee us a supply consistent in ash content. This they were able to do, since they have a coal washery on their lease and they have access to several different mines. By blending coal from different mines with washed coal they undertook to give us an ash content of 23% $\pm$ 1% controlling their quality with a small laboratory at the washery.

The coal is shipped 150 km from the mine once a day, five days a week, in aluminium wagons designed by the local railways department which are very efficient coal carrying wagons, with an excellent pay load to tare ratio, being 50 tonne capacity wagons with only about a 13 tonne tare. These arrive at our Works in the evening, where they bottom dump into a pit. A vibrator feeds the coal on to a belt, over a weigher, and through an automatic sampler which is controlled by the weigher, so without any manpower of ours, the coal is unloaded and stockpiled in a double stockpile around two steel rill towers which gives us the capacity to store a large amount of coal. About 5 000 tonnes is our normal live storage, which is two to three weeks supply, but we can easily store up to 14 000 tonnes. Even more can be stored by bulldozing out and reclaiming later.

The coal plant that we chose for preparing the coal is a Fuller plant based on a Loesche vertical roller mill (LM 14) using hot air from the Claudius Peters cooler for drying. The coal is stockpiled in the open because it has the characteristic of not absorbing excessive moisture. At about 12 to 13% moisture it is saturated, and the amount of waste heat we have available to us will easily cope with this quantity of water in the coal.

The coal is extracted from the stockpile via an underground reclaim belt with a number of points of entry which is linked automatically to a one hundred and fifty tonne raw coal storage bin. This bin has a nuclear level device in it, and when the level gets down to a set point, the reclaim belt is actuated and the bin is automatically filled to a preset level. Coal is extracted from this bin with a vibrator, on to a belt weigher which is controllable by the kiln operator, and passes through a triple gate feeder into the hot air swept Loesche mill, which is capable of grinding coal up to approximately 14 tonnes an hour of wet coal.

The coal mill is swept by a hot air supply which comes from a triple air device connected to the grate cooler. Most of the drying air comes from the stack of the grate cooler which normally runs at about 220 to 230°C and provides sufficient hot air to do most of the drying, but to supplement this we have introduced a duct into the side of the cooler over the second chamber from which we can take air at around about 500°C through a de-dusting cyclone and use this to increase the temperature of drying air if needed. At the same time, there is a third air inlet which supplies cold ambient air to reduce the temperature of the air sweep. The blending of these three supplies of air is entirely automatic and is governed by the exit tempeature of the Loesche mill. A controller is set to keep this temperature at 80°C and it does this as the coal quantity and moisture content varies, by varying the ratio of the three sources of air. The inlet temperature of the mill must not exceed 400°C.

The coal having been ground, dried and swept out of the Loesche mill, passes up to a cyclone which drops it into a small pulverised fuel bin of about 15 tonnes capacity which is mounted on load cells. The air then sweeps on out of the de-dusting cyclone still carrying a small amount of very fine coal, and passes to a junction point where the primary air for firing the kiln is extracted from this warm air supply (approximately 70°C) and the excess air passes out through a five chamber bag filter system which shakes in rotation and a mechanism transports the collected coal back into the fine coal bin by induced suction.

The coal stored in the fine coal bin is at about 12% residue on 4900 mesh DIN, (or 170 mesh ASTM) and contains about 1% moisture. It is extracted through a rotary valve on to a weigher feeder on which the required amount of coal can be set, and fed automatically. Of course there is a small addition of coal carried through with the primary air and allowance must be made for this, but it is a very consistent amount to be added on to the amount put in by the coal feeder.

The coal passes off the weigher, through another rotary valve, and into the primary air stream. The primary air is about 10% of the total air used for combustion.

We looked at various methods of control of the coal milling system and contemplated a fairly sophisticated sort of an automatic control, but we have found in actual fact that is is extremely simple to control. The kiln runs very steadily. The amount of coal required is consistent and the whole system is operated by the kiln operator. He simply watches the level of pulverised fuel in his bin, keeps it a little over half full, and adjusts the feed to the Loesche mill within certain limits to either slowly raise or slowly lower the level of coal in the pulverised fuel bin. He would probably only have to vary the raw coal feed once or twice a shift.

There are a number of advantages of burning coal in our plant most of which we anticipated, but some proved to be more advantageous than we expected. (I stress that I am describing the situation when we converted to coal - the further alterations to the plant are mentioned later in this paper.)

The first and most obvious one is that it is a local product and is not subject to the vagaries of international supply. We have it available right within our State. It serves to increase employment in our State, gives employment to our railways department, it gives us a much more assured supply of fuel, and we are able to store very much more than we could oil fuel.

In our process, ever since it was installed, the raw mill had been a bottleneck. Our kiln was installed as a guaranteed 900 tonne a day kiln, and the raw mill was quite capable of supplying the amount of meal needed for this. However we very quickly found that the kiln was capable of producing more than its guarantee, and a great deal of work went into improving the capacity of the raw mill. However, we also increased the capacity of the kiln by making certain alterations to it, and over the years the limiting factor of our production had been the amount that we could force through the raw mill.

Fuelling the kiln with coal of 23% ash produced a number of advantages in our process. Starting from the quarry, we need less siliceous material. Our raw materials are hard blue limestone and a fairly wet clay which can be up to 30% moisture in winter. Since we are adding siliceous material to our mix by virtue of coal ash, we need to handle very much less clay through our quarry processing system, which is a double rotor hammer mill. Getting the clay material through this unit mixed with limestone had always been a problem and caused blockages and a great deal of wear and maintenance because of the abrasive nature of its siliceous material. Hence there is a distinct advantage in quarrying and crushing.

In raw milling we had always had a problem in the winter with reduced production due to the very wet, sticky nature of the clay material that we fed as part of our raw material. Milling for coal burning uses less clay as a raw material because of the siliceous ash addition in the kiln. Thus we found a very great advantage in that our raw mill ran with much less clay, and looking back at our production records for various years, I would estimate that over a full year, through milling less clay, we probably gained about 3 tonnes an hour of output from the mill because of its much better operation. With the mill bottleneck, this is equivalent to being able to make 2 tonnes an hour of extra clinker.

As well as this, we were burning sufficient coal to add 2 tonnes an hour of siliceous coal ash into the kiln, which of course, does not have to be raw milled at all. Consequently another 2 tonnes an hour of extra production came from the kiln, remembering again that the raw mill was the bottleneck. So altogether we can say that by burning coal our particular plant produced about 4 tonnes an hour of extra clinker. This equals about 32 000 tonnes of extra clinker per year, which, at that time, represented a 10% increase in production.

Thus we received value for our investment twice over - once through burning a cheaper fuel and once through effectively increasing the output of the plant by about 10%.

As a side benefit, we were putting considerably less sulphur into the kiln than we were when we burnt fuel oil and we found that the tendency for accretions to build up in the bottom of our preheater system was greatly reduced. They were not eliminated, but were greatly reduced compared to the quantities that we had on oil burning. So much so in fact, that we were able to operate the preheater with one man on day shift engaged in cleaning activities and he was not fully committed to the preheater and could do other things. However, with oil burning, for many years we had run with a preheater attendant on shift work. In other words, we were employing four preheater attendants to cover the four shifts. So we had quite a distinct saving here and this also has the effect of increasing the kiln capacity, because the limitation usually is on the amount of gas that you can pull through the system and the accretions in the preheater inhibit the gas flow.

Another benefit which became evident was a significant improvement in brick life. We think doubling of brick life was likely, but later improvements were made and we could never be sure which improvement was responsible. There is not doubt, however, that brick life with coal as a fuel was significantly improved in our plant.

We anticipated that in burning a lower sulphur fuel we would need to use more gypsum in our cement, and in costing for the conversion we allowed for an increase in gypsum, but we were pleasantly surprised to find that the SO_3 of our clinker was much the same as it was when burning oil. Obviously the extra sulphur from our fuel oil that was going into the system was being lost, and after conversio we would appear to be trapping virtually all of our sulphur, giving us a clinker with much the same SO_3 as we had before. We had anticipated a sizable increase in gypsum usage at a considerable cost, but we have found that this is not so, and that our gypsum usage was much the same as before, so this is another benefit above our expectations.

The conversion of our Humboldt plant to coal was a very satisfactory exercise both technically, because we were able to keep exactly the same standards of quality control that we had always insisted on, due to the good performance of our coal supplier in giving us a consistent fuel, and financially in that we enjoyed a cheaper fuel price than we would have had if we had continued burning oil and at the same time were able to produce more clinker with the same plant.

The coal installation is a very neat and simple arrangement. The milling and burning system was engineered by Fuller, and it is operated without any expenditure of man power. There is certainly a little more maintenance on it than there was on the oil preparation plant, (possibly one extra man, including cleaning) but from the point of view of operating man power the number of men we have on shift is reduced.

Part 2: Raw Material Mill Upgrading

In 1977, following the conversion to coal, our plant was running nearly to capacity, and the bottleneck in the system was the raw material ball mill, especially in the winter months, when a very wet and cohesive clay must be handled. Consequently it was decided to upgrade the raw milling section by adding a Humboldt hammer mill in series with the ball mill to make a "tandem mill". The normal Humbo tandem mill integrates the hammer mill with the discharge end of the ball mill, and utilizes a single classifier and pair of cyclone separators. Owing to limitations of space, and to our inability to have an extended plant stop, we had to install the hammer mill as a separate unit, with its own classifier and cyclone separator. The raw feed enters the hammer mill and is swept out to the classifier. About 25% is fine enough to us used as finished raw meal, and the other 75%, which is of an even size and quite dry, having been rejected by the classifier, passes over a weigher and feeds the ball mill, which runs very steadily on such an ideal feed. Hence the whole milling plant was upgraded by about 30%, but the increase in consumed horsepower was only about 20%.

Part 3: Kiln Upgrading

Now the kiln was a bottleneck, so in 1979, in close consultation with Klockner Humboldt Deutz of Cologne, West Germany, the third upgrading was commenced A decision was taken to instal a second preheater, and a Humboldt Pyroclon precalcining system, to be wholly operated on coal fuel. At this time, we believe, no precalcining plant in the world was using coal as its total fuel.

In a period of 12 months a second preheater was built over the end of the operating kiln, together with a new electrostatic precipitator and associated equipment, two conditioning towers and a tertiary air duct. The twin preheaters have a common Pyroclon duct that rises up to the level of the No. 2 cyclones and curves back down to separate into two ducts serving the two preheaters. With a stop of about 6 weeks the final connections were made to the existing plant, and the cooler was modified from a 3 to a 4 chamber unit with the addition of an extra cooling fan.

The whole of this new installation was commissioned in August 1980.

The original preheater supplies all the hot gas for raw milling, and the gas from the new preheater is not used at present. However, the next planned stage of the plant development will see another raw mill in the new preheater gas stream, and auxiliary cooler, and a further upgrading of output. The current output of the kiln is 2250 tonnes per day, and with the proposed extra milling capacity it is expected to achieve 3000 tonnes per day.

Apart from the greatly increased output, major benefits are extreme smoothness of operation and a complete absence of rings building up in the kiln, which were previously a continual problem.

Hence, over the years the plant has been upgraded by 250%, and the eventual output is expected to be 330% of its original guaranteed capacity.

The upgrading has been achieved at a very modest cost, and when the final stage is completed the extra capacity will have been achieved at less than half the cost per annual tonne of an equivalent new plant. This precalcining plant is the only one of its type in Australia.

SECTION 3 - SOME POINTS IN THE CONVERSION TO COAL FUEL

I would like to comment on the actual conversion of a plant from oil to coal. Many cement plant operators may be concerned about problems they see in handling coal, but I would say that with a well designed and engineered plant, installed by people experienced in the technology, the problems are minimal. It is essential that gas flows and the coal to air ratios in the system be correctly designed, because at certain ratios coal and air can form an explosive mixture. The plant must have suitable explosion vents and fire protection.

Two basic types of plant are available, those in which coal is milled and fired directly into the kiln, and those in which coal is milled to a powder, stored, and then fired to the kiln. Both have advantages, but with the modern high efficiency kiln, the latter is the usual type.

SECTION 4: DISCUSSION OF RATIONAL FUEL USAGE IN THE CEMENT INDUSTRY

I have described these successive upgradings to lead up to a discussion of the way I see that the cement industry should move worldwide to maximise the rational use of energy.

Some plants in the world are still using oil, and some are using gas, but the price of oil and the rising price of gas is gradually making these fuels less attractive.

Conversion from one fuel to another is normally forced on an industry by economics. We converted originally from coal to oil because heavy black oil was very cheap, and we converted back to coal 10 years later because heavy oil was becoming so expensive. If we were still burning oil at the present price, our fuel cost would be at least 3 times as great as now.

But there are other good reasons for burning coal in a cement kiln. Oil and gas, despite shortages and gluts, are much scarcer resources in the world than coal. It is essential that these fuels be conserved for mobile equipment and for the petro-chemical industry and other areas where coal is not a substitute. Furthermore, high grade coals should not be used in a cement kiln if possible, as they are much more useful for power stations, etc. in that there is relatively little coal ash for disposal.

The great virtue of a cement kiln is that it can consume high ash coals with no ash disposal problems which are often an embarrassment in other applications since all the ash is blended with the appropriately proportioned raw materials, sintered in the kiln, and becomes that very useful material, Portland cement.

Therefore it would seem to me that it is most advantageous for both the cement industry and the government of any country to use indigenous fuel of types that are not suitable for most other purposes when they are available, (and such fuels are widely spread throughout the world). Local employment is stimulated, and money is kept in the country and not spent on unnecessary fuel imports. This may be done by decree, by artificially elevating the price of high grade fuels, or, more acceptably, by government assistance to open up marginal mines and to subsidise transport to stimulate the country's economy.

The question of the problems of developing countries merits special attention. In developing a fuel efficient cement industry, attention must be given to the problems of providing employment, of avoiding the outflow of money by importing fuel, and of not introducing too complex a technology too quickly. Most of my paper has concentrated on efficiency in fuel and manpower, but in a developing country I would see the ideal cement plant as one that is modern in its design and concept but simple to operate; one not locked into high technology where the infrastructure for highly specialised maintenance is not accessible; one that is able to use indigenous but lower grade fuels; one that is somewhat labour intensive, but lends itself to the elimination of some labour cost areas as the economy of the country develops. Coal mining, loading, and unloading, and bulk cement handling are all carried on in our organisation in a highly mechanised manner. I would see that a developing country should have coal mining done with much hand labour, and coal loaded and unloaded by manual methods also. The kiln would be a simple four stage preheater kiln as ours was originally, but designed to burn low grade local coal. Cement would be shipped mainly in bags.

However, the whole system would be planned so that mining, loading and unloading could be mechanised when needed. The kiln would be designed for upgrading, automation and possibly computer control when the economy and development of the country justified it.

I understand that some countries have already actively discouraged the use of gas in the cement industry by price increases or decree. This may not be a popular move with the gas users, but for the ultimate fuel resources of the world it seems to me to be a necessary approach, although I would personally prefer to see encouragement and help to use other fuels as a much better philosophy than coercion.

SECTION 5 - SUGGESTED INDUSTRY AND GOVERNMENT ACTIONS

What key actions should governments and the cement industry take to achieve the rational use of energy?

Industry must acquaint government with its unique ability to use local lower grade fuel, and ask the government through its mining development authority to identify and assess fuel resources.

Industry must be prepared to install the appropriate equipment and to adopt its processes to them, and to retrain its staff and employees.

A factual cost benefit study must be prepared.

Governments must react to industry's initiatives, and be prepared to encourage the use of local resources. Industry's cost benefit study must be supplemented by a government study of the benefits accruing to the country by the stimulation of employment and the saving of foreign exchange.

It may well be that, as a result of these investigations, even if the industry's study shows the conversion not to be cost effective, it could pay the government to help the industry to convert to local coal by subsidy, or the payment of a bonus on each tonne of cement made with local fuel, or by some form of tax relief, to the overall benefit of the country.

SECTION 6 - CONCLUSION

Financially the conversion to coal can be a rewarding exercise, and if approached with expert advice, should present no serious problem to any cement plant operator. The cement industry is in a unique position to contribute to the rational use of the world's energy resources through its ability efficiently to use poor grade fuels which are not suitable for most other industries, and, taking the long term view of the world's resources, cement manufacturers should be encouraged by their governments to convert their operations to such fuels wherever possible, and to conserve the higher grade fuels for use in industries where lower grade fuels cannot be used.