Insp. kolen stoker

FILE NOTE

460/90

COAL USE IN THE BRICK INDUSTRY - VISIT TO IBSTOCK BRICK(ALDRIDGE) LTD. AT WALSALL ON 1ST MARCH, '82.

Discussions between

Mr Taylor - General Manager - Ibstock
Mr Aiton - BP Oil
Dr Waterhouse - BP Coal

Main Points of Discussion

1. Ibstock Brick have converted their tunnel kiln, for production of 750,000 bricks/week (3750 tons/wk) from LPG to coal.

2. Ibstock currently buy washed singles coal from the National Coal Board (typical specification requirement in Appendix I). This coal is crushed in an attritor on site to the following size range:

Mesh	%
+7	6.2
+14	18.1
+25	22.0
+52	22.1
+72	7.6
-72	24.0

3. The coal in this mixed size range enables a consistent long flame, from the top to the bottom of kiln, giving uniform heating to each "car-load" of bricks.

4. Ibstock use 100 tons/week of coal and claim that since the switch from LPG to coal their energy costs have been decreased by 50%.

5. Ibstock have had a number of operating problems since converting to coal - all relating to storage and handling of the crushed coal. These are claimed to have been overcome - at the time of the visit the whole system was working satisfactorily.

6. Ibstock claim the ideal ash content of the coal should be less than 5% but believe that <10% would be satisfactory.

7. Most of the ash is deposited as a dust in the piles of bricks on the 'cars' in the kiln. This ash is easily removed in a cleaning compartment where the ash is sucked away to an ash hopper.

cont...../d

8. No gas cleaning equipment is fitted to the tunnel-kiln stack and no particulate emission measurements have been made. The kiln appears to pass the alkali inspectorate requirements - purely on visual emissions.

9. Relatively high ash fusion temperatures are required preferably around 1400°C but certainly the deformation temperature must be >1150°C. Total moisture is preferably <6% but certainly must not be >11%.

10. The kiln was built in 1969 for firing by gas oil but was later converted to LPG. It has facilities for firing heavy fuel oil grades if necessary. The whole coal plant is manufactured in the UK under license from H. Lingl Anlagenbau and Verfahrenstecknik GmbH of Germany.

Comment

The use of crushed coal with a low ash specification appears very acceptable for firing of bricks in tunnel kilns. It is the writers opinion that the grade of fuel does not necessarily have to be a "singles" grade. This is a convenient handling grade for which there is little or no premium in the U.K. over smalls. It is felt that provided the quality specification is met, the size of the delivered coal need not necessarily be important.

G W Waterhouse

DR. G. W. WATERHOUSE
7946

6th May, 1982

c.t. Mr J H Sheffner
Mr D S Smith
Mr D C Murphy
Mr D F Hunt
Mrs G Nott
Mr D L Jones/Mr J Scherrenberg
Mr J J Pearson
Mr I Aiton/BP Oil
Mr M W Drew/BP Oil

APPENDIX I

IBSTOCK BRICK(ALDRIDGE) LTD. - DESIRED COAL SPECIFICATION

Calorific Value	Btu/lb	12,500 - 13,000
Ash	%	<5
Ash Fusion Temperature	°C	circ 1400
(Ash Deformation Temp.	°C	>1150)
Volatile Matter	%	35
Sulphur	%	< 1.7
Total Moisture	%	< 6
Inherent Moisture	%	< 3

Energy Conservation Demonstration Projects Scheme

For further information contact:
The Project Officer: Dr K Fletcher
Energy Technology Support Unit (ETSU)
Building 156, AERE, Harwell, Didcot, Oxon OX11 0RA
Tel No: 0235 834621 Telex No: 83135

Conversion of a Tunnel Kiln to Coal Firing and the Development of an Ash Removal System for the Fired Bricks

Host company
Ibstock Brick (Aldridge) Limited
Aldridge, Walsall, West Midlands WS9 8TB

Company activities
Brick makers

Equipment manufacturer/installation contractor
Hans Lingl (UK) Limited
Radnor Park Industrial Estate, Congleton, Cheshire.
Tel No: (02602) 77711
Telex No: 668700
Mr W Reutter

ALAN

Project summary
In addition to the substantial savings in fuel costs achieved by converting to coal firing, energy savings are also claimed because of improved heat transfer with pulverised fuel combustion.
The tunnel kiln conversion uses an Attritor coal mill with the coal distribution and firing system supplied by Hans Lingl. It is expected that energy savings of 15% will be achieved and the monitoring programme will seek to confirm the savings and identify reasons.
An ash removal system is required to maintain an acceptable environment within the plant and to allow unimpeded use of automatic handling and packing equipment. The system is designed to remove 80% of the residual coal ash from the bricks and consists of a single chamber which totally encloses the loaded kiln car. Ash is removed by 'blasting' with high pressure air through reciprocating jets and during the initial part of the cycle ash is entrained in the air stream to loosen more stubborn deposits. The dust-laden air is extracted through a bag filter with the ultimate intention of adding the extract to the brick clay.

Target energy savings by replication
92,000 tce/a

Investment cost
Coal-firing conversion—£346,000
Ash removal—£118,500

Government contribution
£30,000

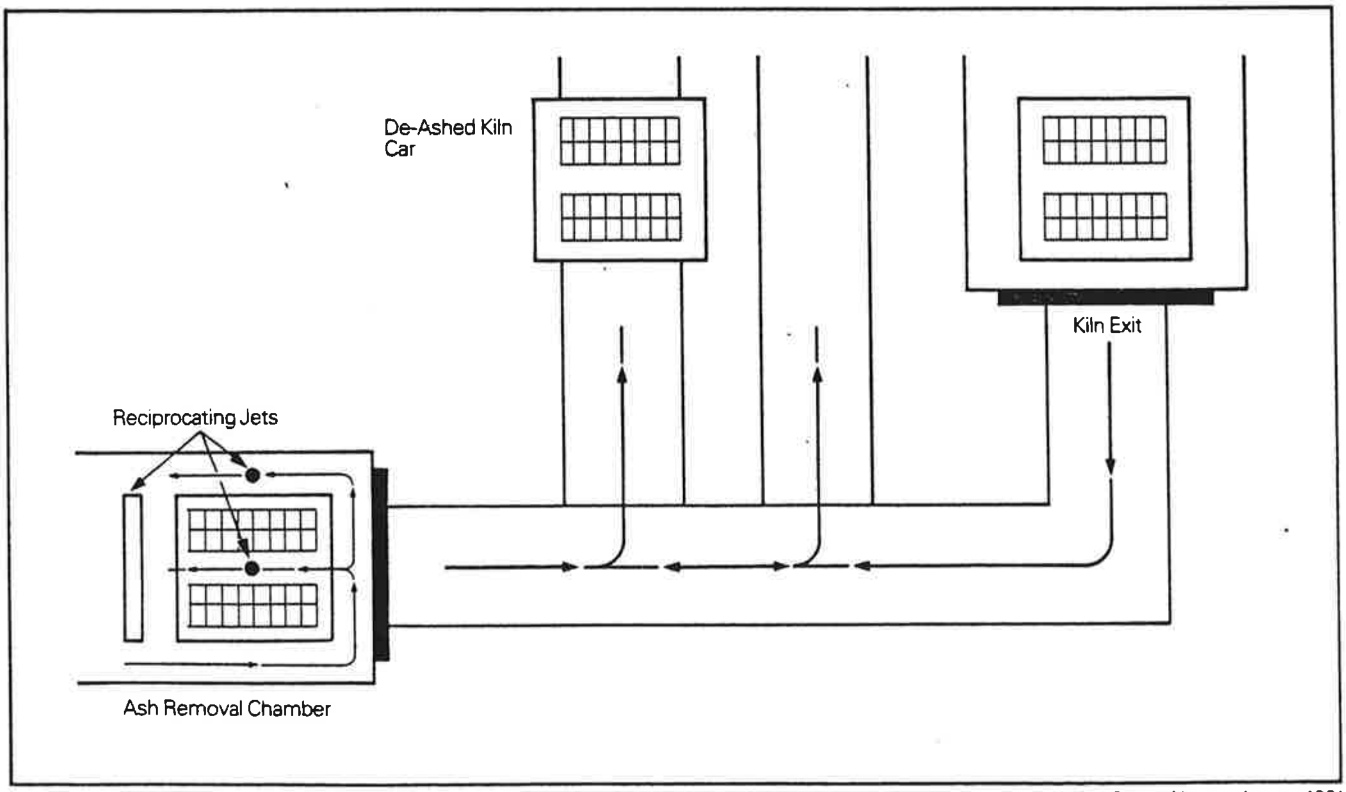
Target savings
1,100 tce/a

Expected payback period
2.5 years

Expected completion date
September 1981

Potential users
Metallurgical industry and heavy clay industry

7



Date of Issue: August 1981

Ibstock Aldridge save energy firing on coal

Having been coal users in the past many brick, pipe and tile manufacturers are naturally a bit wary about encountering it too closely in the future. Even if coal might save cash money—what about those nasty side effects that we have now all thankfully learnt to live without? Many top management people are keen to know the answer. They know that oil, and oil-based fuels like LPG, are expensive, and gas is increasingly pricey and unreliable. So what can coal offer in the 80s?

High energy costs

The high cost of energy to United Kingdom industry has become the subject of debate so any way of reducing energy costs must be welcome. Doubly so by the brick industry—which according to the Department of Energy could save 45% of its fuel costs—a higher figure than any other industrial sector, except paint finishing (45%), and brewing (80%)!

The first brickworks to have had the benefit of the Department of Energy's attention was Ibstock Brick (Aldridge) Ltd and many people were very keen to see the results. Thus it was possibly the most prestigious body of brick, pipe and tile management to be seen in one place since the last ICT Conference that gathered at the Barons Court Hotel, near Walsall, on 15 October 1981, to learn at first hand how Ibstock had invested £464 500 to bring a saving of £150 000 a year.

The day was made possible chiefly by courtsey of Ibstock Building Products Ltd, which has been involved in the coal firing conversion at Aldridge since 1979. The Aldridge project was not officially fully operational, but such was the pressure of interest that the company let competitors, and other friends, in to see for themselves.

The official hosts at the Barons Court gathering were the Department of Energy. The Government is now keen to get industry into coal usage; and the National Coal Board is full of a new spirit of commercial co-operation. The Department of Energy, through its Harwell-based Energy Technology Support Unit, is spending quite a bit of taxpayers' money on advertising and glossy publicity (*but not in this journal*).

This effort is being expended to convince industry to spend less on fuel in the long run by spending some moderate capital now. The Government-backed fuel technology brains are on hand to advise you—and if you have a genuinely new problem you can probably get a grant from the Department of Energy towards solving it, provided that, like Ibstock, you are willing to share information with others.

Demonstration project

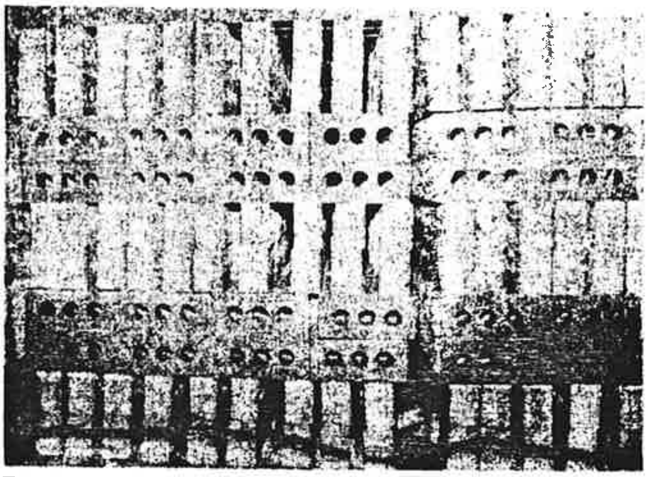
The Energy Conservation Demonstration Projects Scheme, to give it its full ponderous title, will help you to set up a demonstration project on your plant. This will use any novel or traditional equipment, with old or new fuels, or combinations of these to give you the best practicable cost savings on your plant. If the scheme involves coal—as most of them do—you will be shown ways of keeping the pollution monster at bay. The demonstration scheme is competitively objective and the people in charge seem to be fully aware of the special requirements of industry—namely making a profit, while keeping the customers, the unions, and the neighbours, not to mention head office, happy and contented.

At Aldridge the scheme was to convert a tunnel kiln making facing bricks to coal firing from a LPG/gas system. At the end of the day Ibstock may be saving up to £150 000 a year on the basis of a £464 500 investment which may be written off over 2½ to 3 years. The installation consists of a £346 000 conversion of the kiln firing system to coal, and a £118 500 expenditure on a special ash-removal system. The Government gave £30 000 towards the project. They are paying for all the monitoring by British Ceramic Research Association and gave full technical advice.

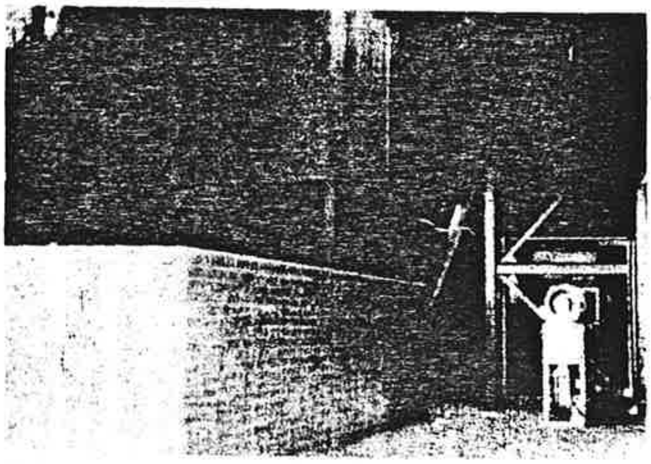
The actual system used at Aldridge is expected to save Ibstock some 1100 t of coal equivalent per year, and the Department of Energy says this means that if all firms now using LPG and oil firing were to adopt the Aldridge type of coal conversion the saving would amount to 92 000 t of coal equivalent per year.

Gordon Taylor, works manager at Ibstock Aldridge has outlined the basic aspects of the coal conversion (*Euroclay*, 4/1981, p 12, *Conversion of a tunnel kiln to coal firing*), where he describes how he paid visits to General Shale in the USA, to Pullman Swindell in the USA, and to Lingl and Thermo Murg in West Germany. In the event it was the Lingl system which Ibstock adopted.

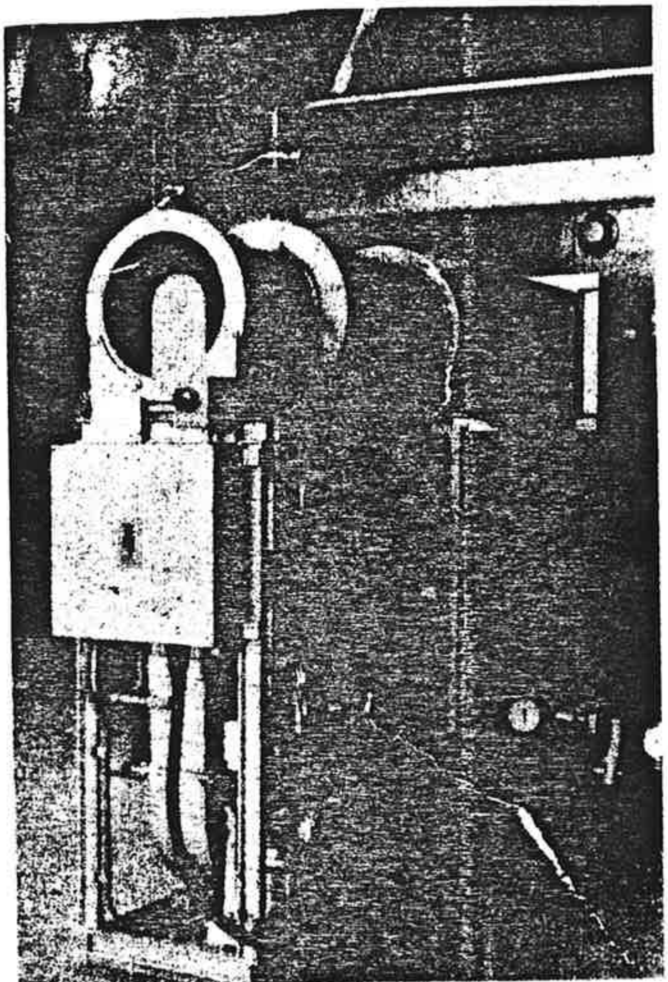
The Lingl system was chosen by Ibstock because it was, in



The high quality of finished product with coal firing at Aldridge can be seen here, only the lowest course in the pack are of second quality. The pack is seen after ash removal.



Coal storage, entry and grinding unit at Aldridge. The absence of dust or dirt is noticeable.



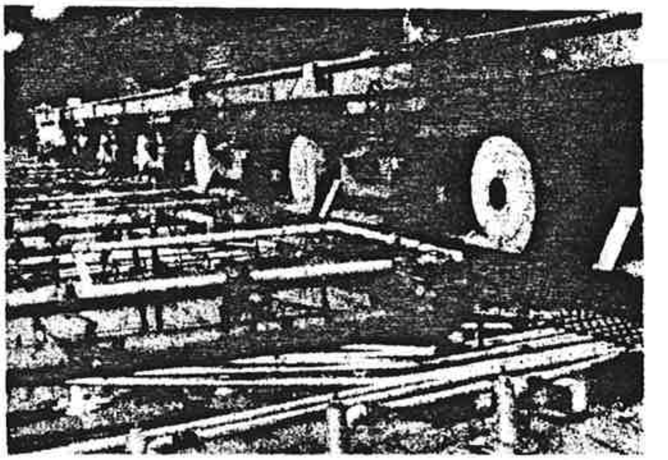
Detail of the lpg (butane) and air entrainment unit on the Aldridge coal grinding unit.

their view, the best for top-fired kilns and fitted the somewhat restricted space available at Aldridge. Furthermore, 90% of the Lingl equipment was made at Congleton, Cheshire, which meant good service and spares availability. Hans Lingl (UK) Ltd, the main contractor, supplied all the equipment, including an Atritor-designed coal preparation unit. The plants visited in the pre-investigation had a 10 to 25% improvement in efficiency. Aldridge was already an efficient tunnel kiln with a high push rate and Ibstock thought it would be asking a great deal to achieve an improvement in thermal efficiency.

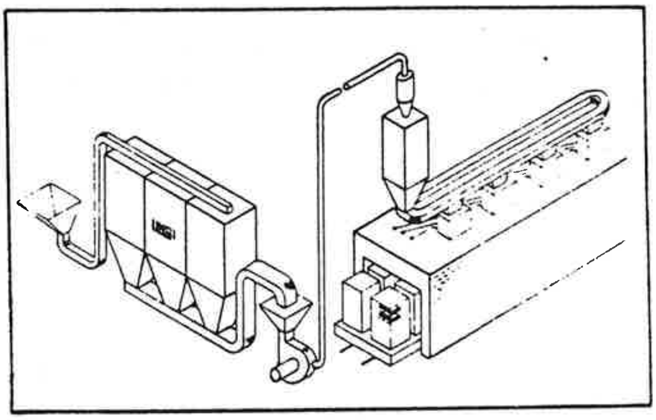
Coal not the main reason for support

In fact the coal conversion, and subsequent fuel cost saving of about 50% (butane average price 36 p per therm; coal price 18.5 p per therm), was not the major reason for the support from the Department of Energy. This was granted because of the *secondary* benefit of actual *energy* savings offering up to 15% of tunnel kiln fuel consumption due to the improved heat transfer during pulverised fuel combustion. The Aldridge scheme is unique (at the moment) in having a specially developed ash removal system — without which the coal firing would be unacceptable. The DoE believe that without a viable ash removal system coal firing would not be commercially acceptable to brickmakers.

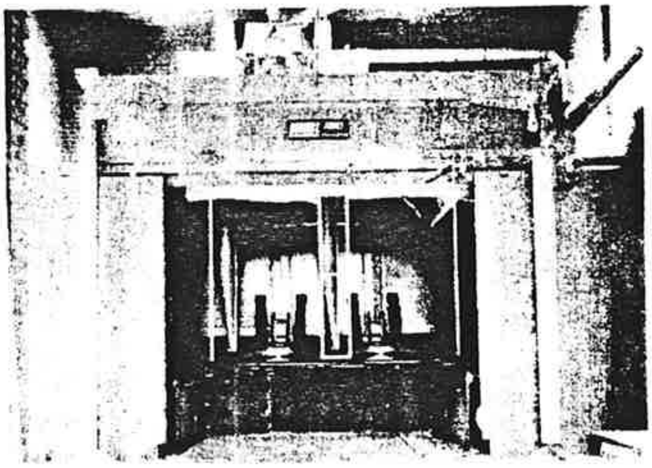
The ash removal system was jointly developed by Ibstock and Hans Lingl (UK) Ltd. It consists of a 'dust plus air blast' unit which removes up to 80% of the ash deposits from the fired brick stacks. The prototype unit at Aldridge has a steel 'cabinet' sited at the end of the exit transfer track. The kiln car, plus transfer car, enters this chamber, which is sealed and a series of high pressure reciprocating air jets which 'blast' the bricks. During the initial part of



Part of the kiln top showing the Lingl coal feed units, during commissioning of the project.



Diagrammatic representation of the Lingl designed coal firing system. Below: the Lingl designed ash removal unit with doors open.



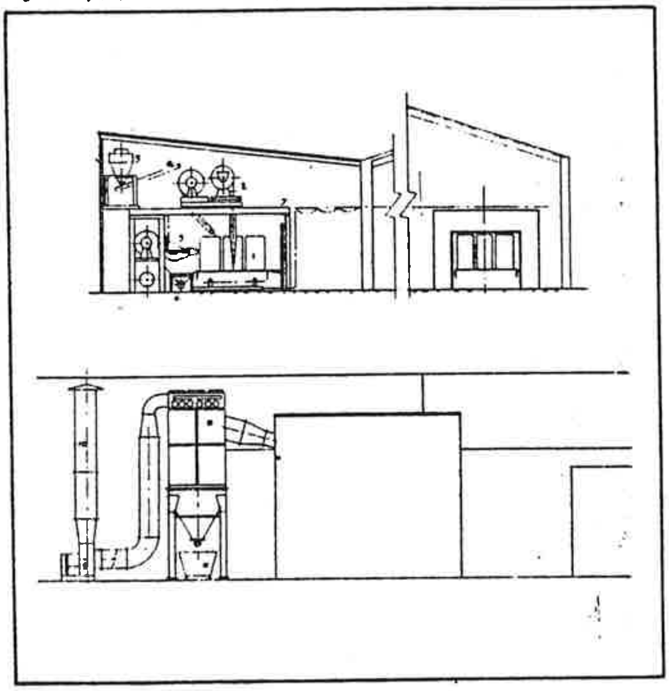
the cycle ash is entrained in the air stream to loosen stubborn deposits. The recycled ash used in this way is retained in a silo. The major part of the dust laden air is extracted by fans through a bag filter system outside the building. The ash is collected and disposed in skips, but in the future it may be transported to the grinding plant and fed into the clay.

The company did not expect to be able to completely clean the bricks but aimed for an acceptable level. The added bonus is the efficiently cleaned kiln car decks.

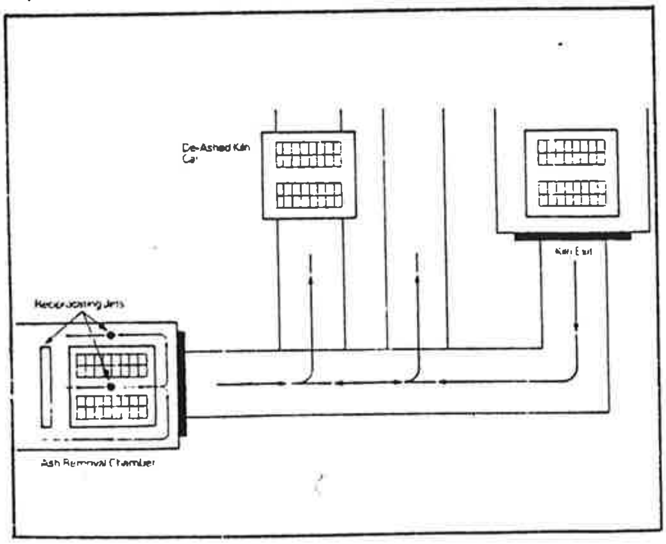
Firing arrangement

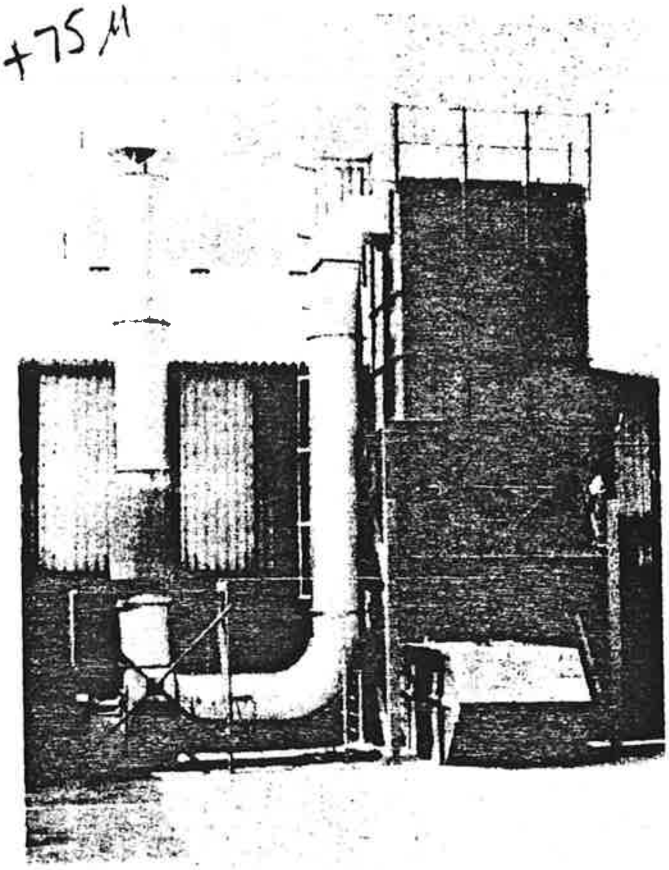
The actual coal preparation and firing system at Aldridge is based on what is known as intermediate storage, ground feed (through the Atritor coal mill). The coal is received via a hopper directly transported by road from the colliery. A Redler conveyer/elevator takes the coal up into three Lingl-designed storage hoppers, thence, on demand to a surge hopper and through the Atritor mill where it is ground to dust-size particles and dried at the same time by a butane-fired burner. The ground product is transported by an air-swept transportation line into a storage hopper located above the kiln via a de-dusting cyclone. From the storage hopper it is passed by a Redler ground coal circuit conveyer to the Lingl coal dosing unit which is the controller of feed to the burners. The burners are stainless steel vertical types, and are arranged to fire in substantially the same way as the LPG ones used before conversion to coal. The firing temperatures have been readjusted to handle the 'lazy' burning character of coal. The temperature between the flame dyke and the brick pack is more even than with Butane because the coal particles burn inside the pack. With Butane the flame dyke heat was higher and so a higher recorded temperature was normally used. Temperatures are not so quickly reached with coal and heat distribution is different.

Diagram of the ash removal system at Aldridge. Kiln exit on the right, (1) brick pack, (2 & 3) blow fans and jets, (4) extraction duct, (5) silo for recycled ash, (6) screw conveyor, (7) cleaning booth, (8) bag filter, (9) extraction fans, (10) exhaust, (11) ash bin.



Layout of the ash removal system at Aldridge.





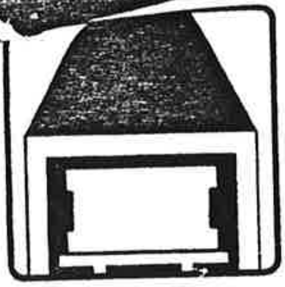
Outside of the Aldridge ash removal plant. (Right): bag filter house with ash bin (skip) underneath, (left): exhaust stack with extraction fans housing at base.

Possible problems

Other special considerations due to coal firing are: the possible deposition and build-up of ash in ductwork and fans—this would mean a periodic cleaning routine; the build up of ash under the kiln cars in the kiln—this means the pit must be cleaned out regularly; the risk of dust pollution from coal handling—but if the plant is correctly designed this should be no problem; fear of exhaust stack pollution—but the Environmental Health Department is reported as being quite happy with the emissions.

Potential savings

The Department of Energy has emphasised five areas which can each bring energy savings to the brick industry: (1) increased brick perforations (up to 25%) (possible saving 20 000 tce/a—tonnes coal equivalent per annum); (2): increased carbonaceous additives (saving 360 000 tce/a)—here there is a need to encourage trials with oxygen injection, reject shales and increased additives; (3): coal firing (possible 90 000 tce/a saving) based on a 15% efficiency improvement in lpg and oil firing only; (4): process control improvements (a possible saving of 100 000 tce/a) here a feasibility study by W.S. Atkins & Partners and BCeramRA to identify possible opportunities is under way; (5): improved drying techniques (possible saving 40 000 tce/a)—based on total replacement of supplementary air heating. The Department estimate that a realistic total saving for the brick industry of 400 000 tce/a might be possible, taking into account the non-additive nature of the individual figures and also the large amount available from carbonaceous additives which is regarded as speculative and long term.

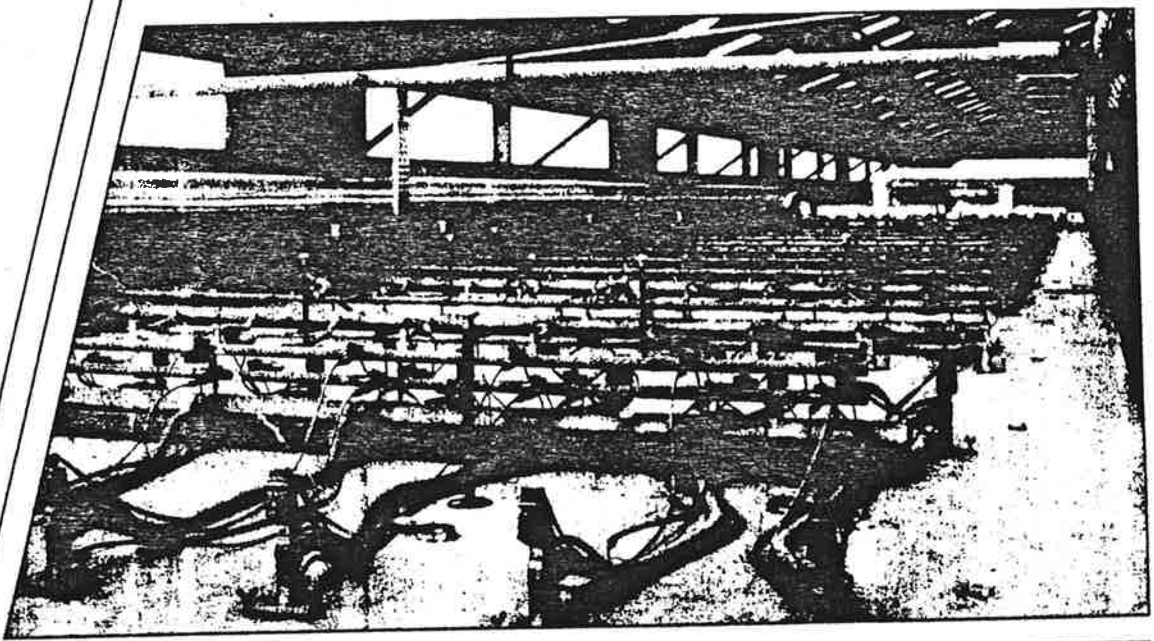


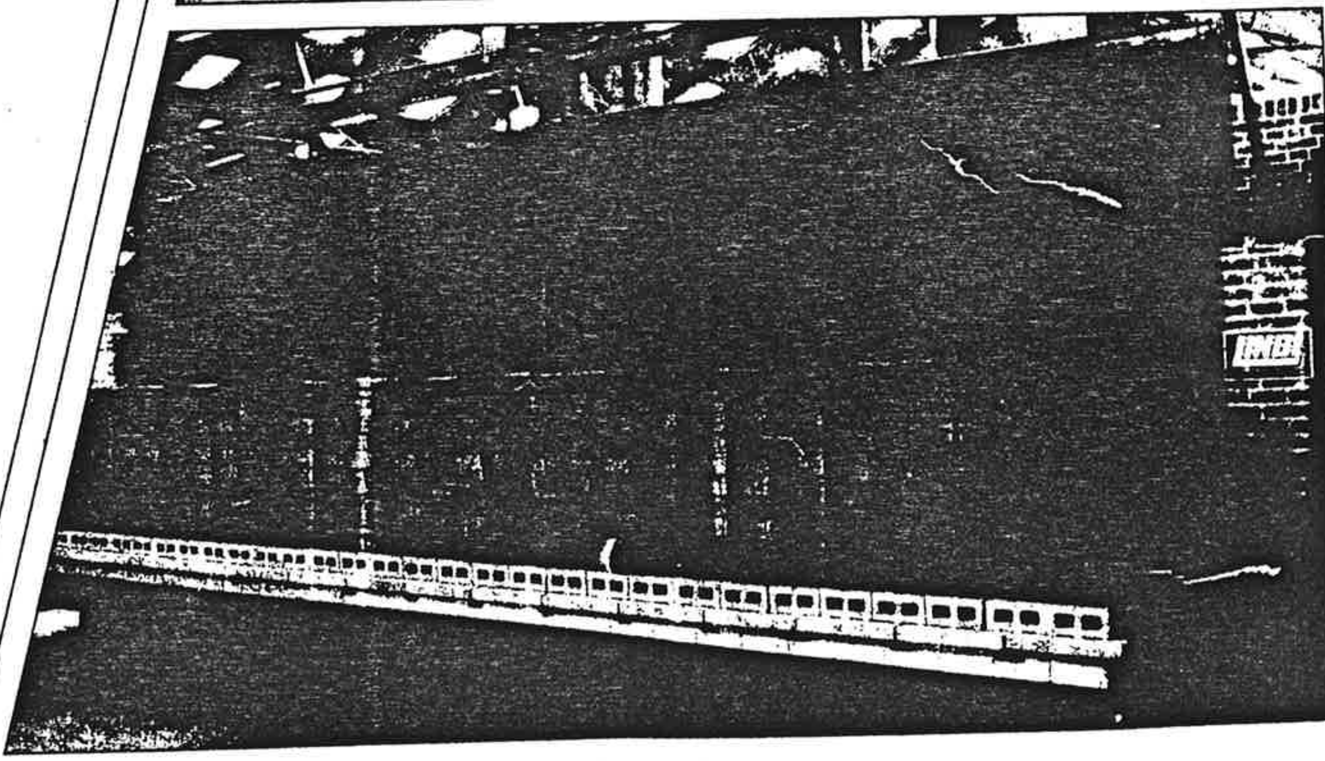
Tunnel kilns for the 80's

Whether 8.60 m wide as shown on this picture or only 1.00 m wide, whether gas, oil or coal fired, LINGL tunnel kilns are most suitably equipped for the 80's in respect of quality and energy consumption. Gas tightness, high insulation quality, short construction period and long life are all equally incorporated into the concept of the kiln structure.

Equally improved firing systems and a new electronic control system increase the economical and reliable operation of the kiln. LINGL kilns are top or side fired depending on the product and operation requirements.

Ask LINGL –
we shall be pleased to advise you.





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By courtesy of Messrs. B. V. Steenfabriek Huissenswaard, Bemmel/NL

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Energy Conservation Demonstration Project

Department of Energy Involvement at Ibstock Brick Aldridge Limited

Ken Fletcher
ETSU
HARWELL

Energy Conservation Demonstration Project

Department of Energy Involvement at Ibstock Brick Aldridge Limited

Introduction

We have heard previously about the National Coal Board's view of the future for coal firing in the heavy clay industry and about coal handling techniques and distribution systems for the firing of kilns. I should like to describe in this paper what the Department of Energy believes to be the first UK example of the conversion of a tunnel kiln from a 'premium fuel' - in this case butane - to a ground coal firing system.

The kiln is at Ibstock Brick Aldridge Limited and Government financial support has been offered to Ibstock under the Energy Conservation Demonstration Projects Scheme (ECDP Scheme) to buy-in for information on both the coal conversion and the new ash removal system developed jointly by the Company and Hans Lingl (UK) Limited.

The single major benefit from a coal conversion in brick making is the fuel costs saving which, when comparing the average UK price of butane at 36p per therm with coal at 18.5p per therm, is about 50%. However, this project is justified for support under the ECDP Scheme because of the secondary benefit of actual energy savings, which offers an estimated potential of up to 15% of the tunnel kiln fuel consumption due to the generally improved heat transfer during pulverized fuel combustion.

The project demonstrates the use of a modern coal handling and distribution system in an already efficient tunnel unit (previous kiln and drier fuel consumption 60-65 therms per thousand compared with the national average for the non-Fletton industry of 85 therms per thousand). In addition, the Company together with Hans Lingl (UK) Limited of Congleton who supplied part of the coal conversion, have developed a unique 'dust plus air blast' ash removal system which appears capable of removing about 80% of the ash deposits from the fired stacks.

This development has been lengthy and time consuming and resulting information is at least is an important to the industry as information about the actual coal conversion - since without acceptable ash removal, a deterioration of working conditions and the reaction of customers, would doubtlessly inhibit future coal conversions. For this reason, it is believed that coal firing and acceptable ash removal cannot be separated commercially and the funding of the Ibstock project under the ECDP Scheme was agreed on the basis of the development work on the ash removal system.

7. ECDP Scheme and Government Involvement at Ibstock

Before discussing the project in more detail I should like to briefly describe the thinking behind the Governments ECDP Scheme which has the purpose of stimulating investment in new ways of using energy more efficiently. It works in two ways. Firstly, companies get grants to mount demonstrations; this accelerates the rate at which novel projects occur. Secondly, information from the demonstration is disseminated to other companies; this stimulates the 'replication' of successful projects, thus accelerating the overall rate of investment.

The types of projects might involve:

- new or improved technologies, including equipment and processes.

- new applications of established energy conservation technologies.

A 'demonstration project' is a full scale trial of a piece of equipment or a process, under normal working conditions with the aim of establishing its technical and economical viability. It is not a laboratory trial, not even a pilot scale production unit - what works in the laboratory or at pilot scale does not always prove satisfactory under full scale working conditions. It is this last hurdle between development and successful commercial operation that the Demonstration Scheme seeks to overcome.

The Scheme came into operation in April 1978 and is sponsored jointly by the Department of Energy and the Department of Industry. It is managed by two teams, one in the Energy Technology Support Unit (ETSU) at AERE, Harwell and the other in the Energy Conservation Unit at the National Engineering Laboratory (NEL) East Kilbride. A third team at the Building Research Establishment (BRE) is just starting work in the Domestic Building's Sector. The original objectives of the scheme are as follows:

a) For each £1 of Government contribution, to achieve annual energy savings of at least £5 from the demonstrations themselves and from similar installations which they stimulate.

   Alternatively:

b) To achieve an overall replication of at least six, ie. that each demonstration should stimulate six or more similar installations.

The original budget allocated to the scheme was £20M over the 4 years 1978/82. Both the budget and the objectives are illustrated schematically in Figure 1.

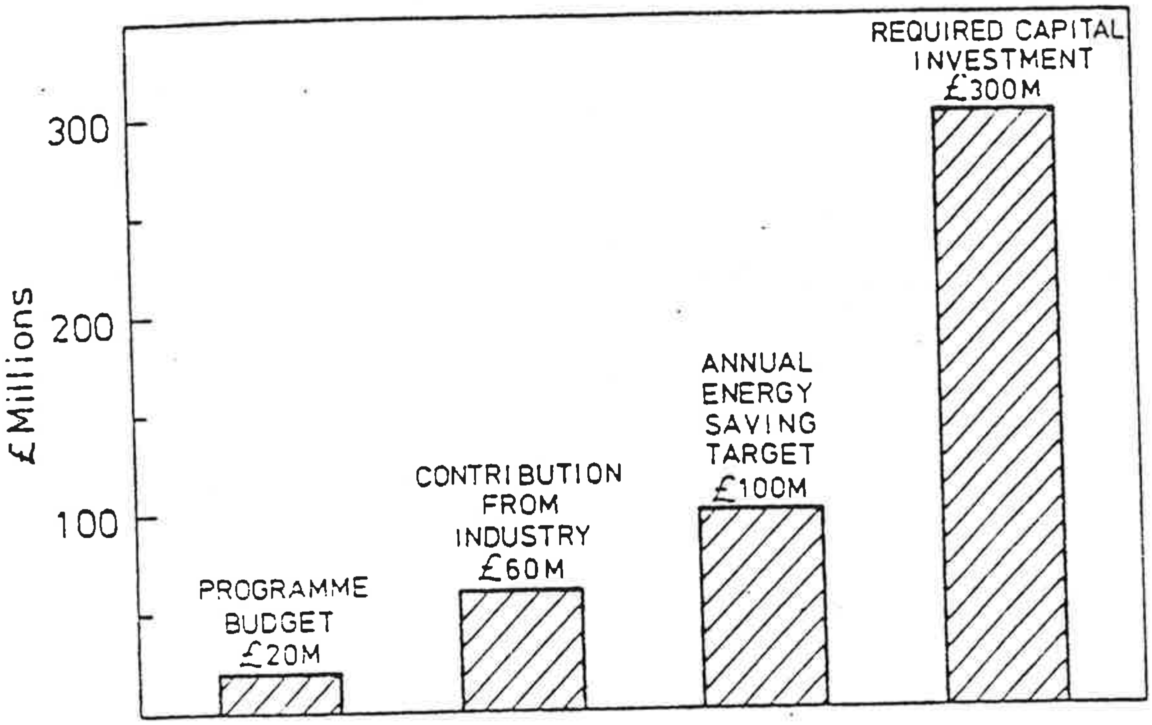

FIGURE 1: Graphical representation of the gearing effect originally sought from the Demonstration Scheme. The target savings/cost ratio is 5/1.

The left hand column shows the £20M which was allocated to the programme. The bulk of this money is used through grants of up to 25%. That means that industry has to find about £60M to invest in the projects - this is shown in the second column. The first hurdle is therefore to persuade companies to go ahead with novel and risky projects on this scale.

The second hurdle is to stimulate additonal investment, the so called 'replication', so that an overall energy saving of £100M per annum is achieved, as represented by the third column of Figure 1. The total investment required to achieve this saving depends on the payback time and this does not always arise from energy savings alone. There may be water savings, material savings, increased throughput, etc, which that the payback with respect to energy alone is shortened. If we assume an average payback time of 3 years, then the capital investment required will be £300M as represented by the fourth column in Figure 1.

Thus, it can now be seen that a very substantial pump priming effect is being sought from the £20M of public expenditure.

It has not proved possible to build up the programme at the planned rate. There was simply not enough proposals satisfying the criteria that the Scheme demands and in consequence not as much as £20M will be committed to projects let alone spent by March 1982. By late June 1981 the Government 'advisory committee' had considered 177 proposals and 104 are expected to proceed. The cost of these projects to Government, including management and promotional costs is £11M and the cost to industry is £20M. The target annual energy saving is 5 million tonnes of coal equivalent per annum valued at £300M and the industrial investment necessary to achieve the replication target is £1200M. The target to cost ratio is currently standing at 27-1 compared with the figure of 5-1 of Figure 1. In order to achieve this level of replication we need to promote strongly successful demonstration projects and this is one of my major reasons for presenting this paper.

The Ibstock project can therefore be seen as only one of over 100 on-going demonstrations but nevertheless with a 10-15% potential energy saving, it is estimated that the demonstration could stimulate national energy savings of 90,000 tonnes of coal equivalent per year within the brick making sector.

It is already apparent that considerable interest in this project is being shown by the rest of the industry and for this reason it was decided to provide access to the plant and its operating data at the earliest possible opportunity. An open day was therefore held on the 15th October 1981 at Aldridge during which a plant visit was arranged and technical reports were given. Results obtained so far by the British Ceramics Research Association who are monitoring the project on behalf of Government, indicate a significant reduction (approximately 10%) in the kiln fuel consumption, but that this is offset by an increase in the fuel used for drying. The overall energy savings so far (2-6%) are less than expected, but savings in fuel costs are substantial and indicate a payback time of 2.5 to 3 years.

The Coal Plant Development

Ibstock decided to seriously consider modern coal firing following visits to the United States and Europe in 1979. The Aldridge plant was chosen for two main reasons – the high cost of LPG and because of the stability of the plant in terms of output and balance of production.

During their visits abroad four main coal firing systems were investigated:

1. General Shale's own system
2. Pullman Swindell
3. Thermo Murg
4. Lingl

It was decided that the Lingl system would be the best suited for the Aldridge plant because in Ibstock's view it was best suited for top fired kilns and the system fitted easily into their somewhat restricted space on top of the kiln. Also, 90% of the equipment would be manufactured in the UK at Congleton, only 50 miles north of Aldridge, which would obviously facilitate a good service and spares availability. Hans Lingl (UK) Limited was chosen as the main contractor and they supplied all the equipment which included an Atritor designed coal preparation plant.

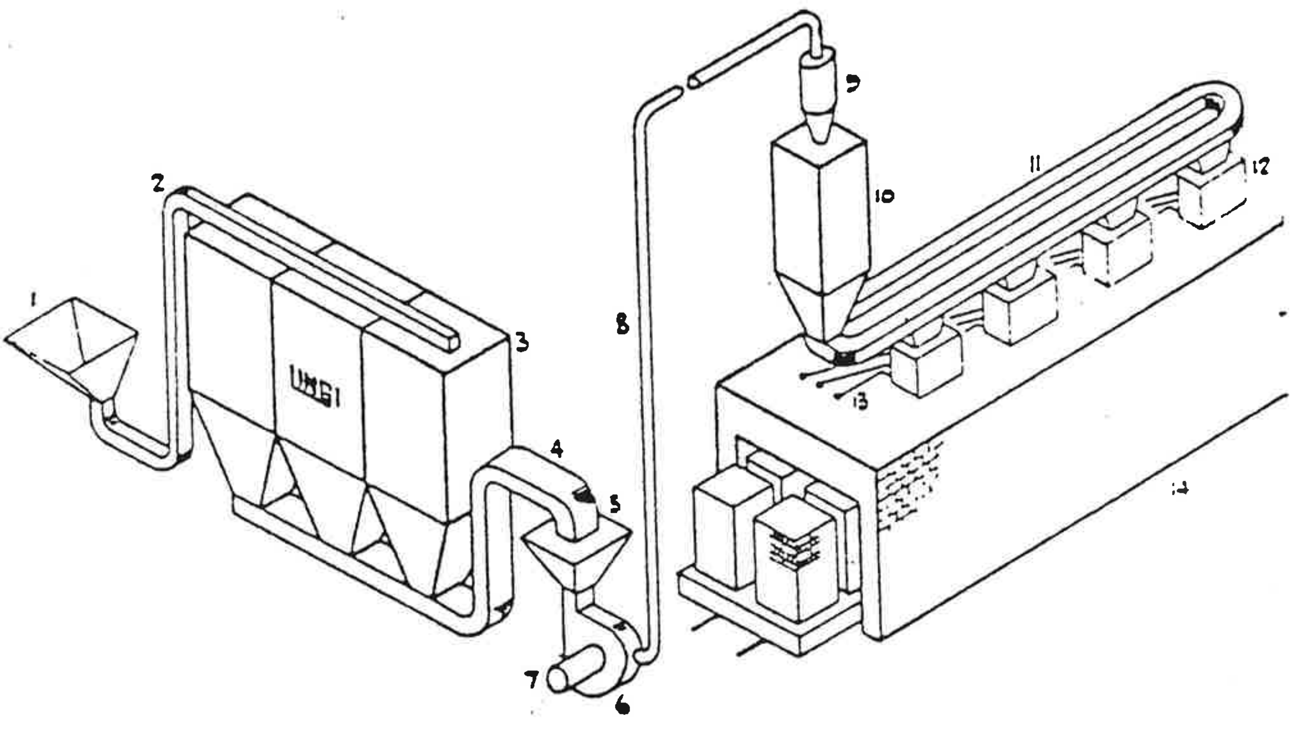

FIGURE 2: Coal Firing Plant

The layout of the plant is shown in Figure 2 and is based on an intermediate storage, ground fuel feed system. Raw coal is received at the reception hopper (1) and is then conveyed via a Redler conveyor and elevator (2) to the raw coal storage hopper (3). The coal is then conveyed and elevated via a second Redler (4) to the Atritor surge hopper (5) and then to the Atritor mill (6). The hot air for the mill is provided by a butane burner (7). Ground coal is transported via an air-swept transportation line (8) to a de-dusting cyclone (9) and then to the ground coal storage hopper (10). The fuel is fed to the kiln burners through a Redler ground coal circuit conveyor (11) feeding the Lingl coal dosing unit (12) each of which feeds 15 coal burner pipes (13).

The commissioning started in September 1980 and the plant required a longer settling in period than anticipated. During the first few months, the normal balancing problems occurred with the firing, which are expected with major changes on a kiln. There were however, also problems with the coupling of the coal preparation plant to the Lingl coal firing system. This was the first plant that Lingl had supplied with its own preparation unit.

The major problem was however, with the storage and coal preparation system and both Ibstock and Lingl had to develop and learn by experience. Consequently, some fundamental errors were made, but gradually these have been rectified through both trial and error and through contact with other industries who have had to cope with similar problems in recent years, i.e. the cement industry. The definition of coal quality has been a major factor and particularly the importance of moisture content both 'free' and 'inherent'.

Ibstock would claim the NCB have also learnt from their experience as to what types of coal are suitable for on site preparation, storage and the firing of bricks and they have also remarked on the consistency of quality being delivered.

Certain on-going modifications to the plant have proved necessary to eliminate problems associated with uncertain design specifications. These have included:

1) Changing the static screen after the cyclone, to a vibrating type.
2) Redesigning and replacing the magnetic separator on the Atritor.
3) Redesigning and altering the outlet of the ground coal storage bin.
4) Modification of the coal dosing units from on/off control to variable speed modulating control.

Changes in Operating Conditions

There are doubtlessly some disadvantages to firing with coal, particularly in an industry which has experienced a number of years in dealing with a very simple and easy fuel. The disadvantages are as follows:

1) Ash deposits left on bricks - this will be dealt with later.
2) The possibility that duct work and fans will need to be cleaned periodically (this has not been experienced yet).
3) There are some ash deposits under the kiln cars and the pit has to be cleaned out periodically.
4) Risk of dust pollution from handling coal - if a plant is designed correctly this will not be a problem.
5) Fear of increased pollution from exhaust stacks - the Environmental Health Department is quite happy and the Ibstock experience confirms results described to them during visits to the United States.

During commissioning various changes in the firing parameters were noted which necessitated changes and re-optimising of firing.

It proved particularly important to establish the correct particle size of coal in order to achieve even top to bottom temperatures. Also the firing temperature had to be adjusted as the heat recorded at the thermo-couple was different in relation to the heat distribution over the whole of the kiln car. On butane firing, the heat in the flame dyke is higher than in the in pack, therefore, there is a tendency to fire at a higher recorded temperature. With coal, the temperature between the flame dyke and the pack is more even because of the coal particles burning within the pack. Also, with coal being a 'lazy' burning fuel, it was found that temperatures were not reached as quickly as with butane, this has meant that in the pre-heat zone butane burning is still required.

Ash Removal Developments

Before converting to coal, it was known that the major problem would be dealing with the ash deposits left on the bricks. Of all the plants previously visited, none had really considered it a problem and therefore, no serious attempt had been made to deal with it. Ibstock knew as responsible employers that they would need to maintain good working conditions and that customer reactions would need to be monitored. It was however, already known that the ash would not be detrimental to the brick after a short period of weathering.

It was therefore clear to Ibstock and Lingl that they needed to go it alone and as there was no previous experience from which to gain they had to start from scratch. Ibstock was faced with the need to continue full output and yet have the time necessary to develop this new system. There were two problems which has to be minimised from the outset:

1) The risk of temporarily creating unpleasant working conditions.

2) The need to allay any customer concern over ash.

Although it took longer than first thought both problems now appear to have been successfully dealt with.

Once the coal firing had reasonably settled in, a trial booth was erected and tests were carried out to establish the airflows and pressures which would be required to dislodge and remove the ash. Because of the layout of the plant at Aldridge, it was necessary that the whole kiln car be cleaned, which presented a more difficult problem. Also because of the relatively fast 'push' of the kiln, the period of time allowed for transferring the kiln car and de-ashing was restricted to 12 minutes.

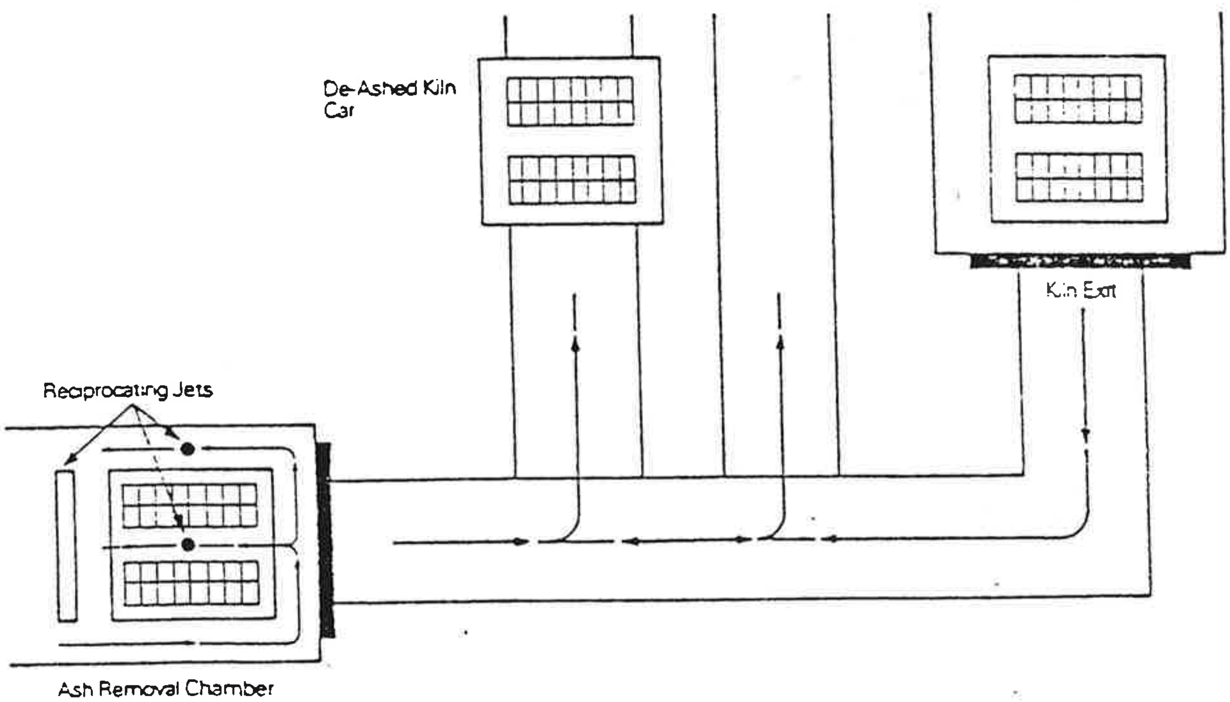

FIGURE 3: Plant Layout

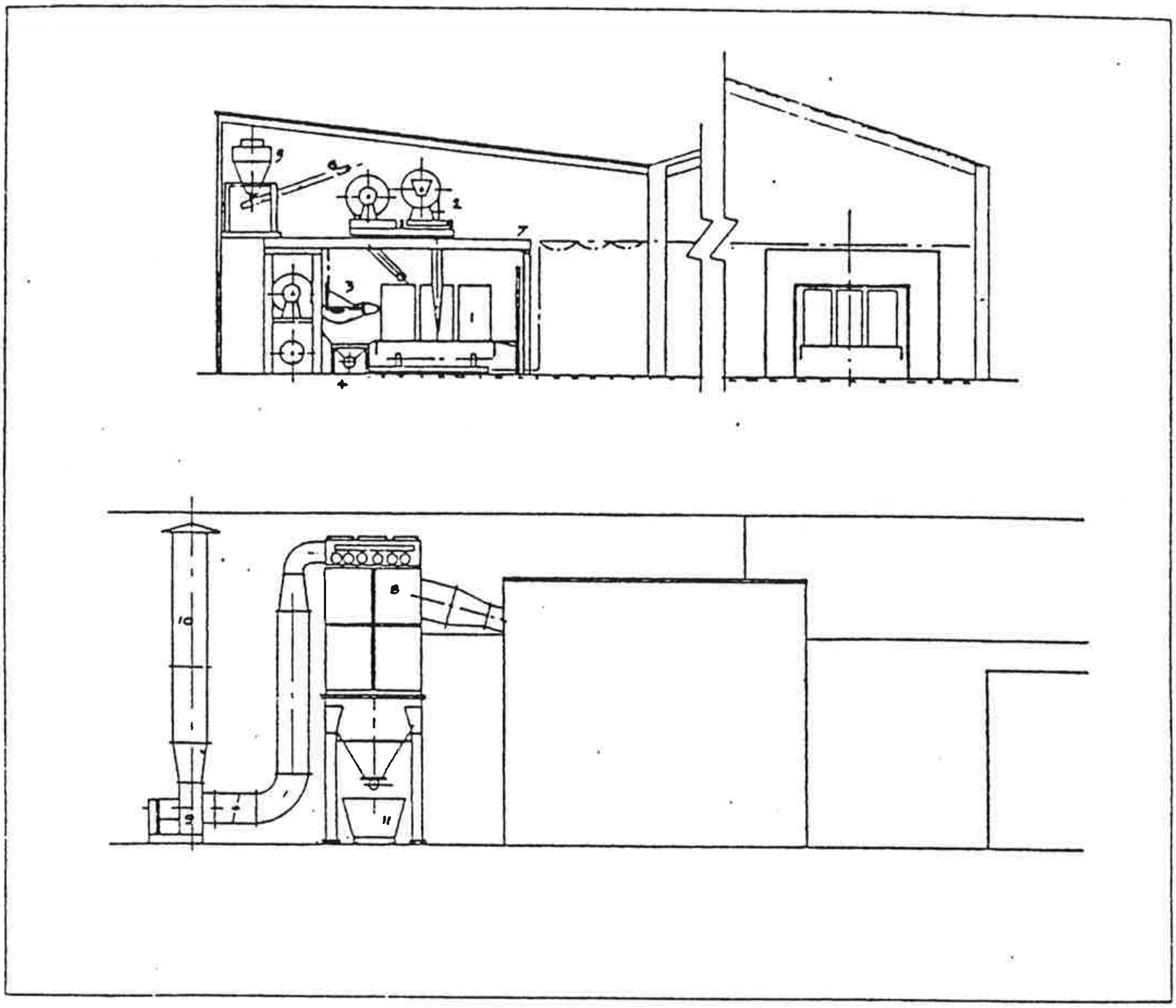

FIGURE 4: Ash Removal System

Key:

1. Brick pack.
2&3 Blow fans and jets.
4. Extraction duct.
5. Silo for recycled ash.
6. Screw conveyor.
7. Cleaning booth.
8. Bag filter.
9. Extraction fans.
10. Exhaust.
11. Bin for ash.

Eventually a satisfactory solution was developed. It consists of a single chamber which totally encloses the loaded kiln car as shown in the plant layout in Figure 3. The kiln car, together with the transfer car, enters the chamber which is then sealed for the ash removal process. This is carried out by blasting with high pressure air through reciprocating jets and during the initial part of the cycle, ash is entrained in the air stream to loosen more stubborn deposits. Extraction fans collect the ash and pass it through a bag-filter. The ash is then collected and disposed of in skips. It is Ibstock's intention for the future, to transport the ash to the grinding plant and feed it into the clay.

A schematic of the ash removal system is given in Figure 4 together with a key indicating the various elements of the plant.

It was never expected to completely clean the bricks, and estimates to date suggest that the units remove about 80% of the residual coal ash and this is now considered an acceptable level. Overall, Ibstock have now satisfied themselves that the fired product quality has changed only marginally and is no more dramatic than the slight change that occurred when the industry changed from fuel oil to gas in the early 70's.

Energy Monitoring Results

It has already been pointed out that the major benefit from this conversion is a reduction in fuel costs although energy savings are expected to occur. The data is still preliminary and an extended monitoring period is still required. Nevertheless, figures to date suggest that during the early part of 1981 a reduction of 9.8% in kiln specific fuel consumption was measured, although this was offset by increases in drier consumption which gave an overall plant energy reduction of 2.7%. During June and July however, a reduction in fuel consumption on the drier has led to a further overall energy saving of 5.7% compared with pre-conversion figures. These figures are shown graphically in Figure 5 and the results are summarised in the table.

MEAN ENERGY CONSUMPTIONS (THERMS/100)

	Kiln	Dryer	Total
Before conversion Weeks 2-35 (1980)	50.8	10.8	61.6
Post conversion Weeks 2-16 (1981)	45.8	14.1	59.9
Weeks 23-29 (1981)	45.5	12.6	58.1

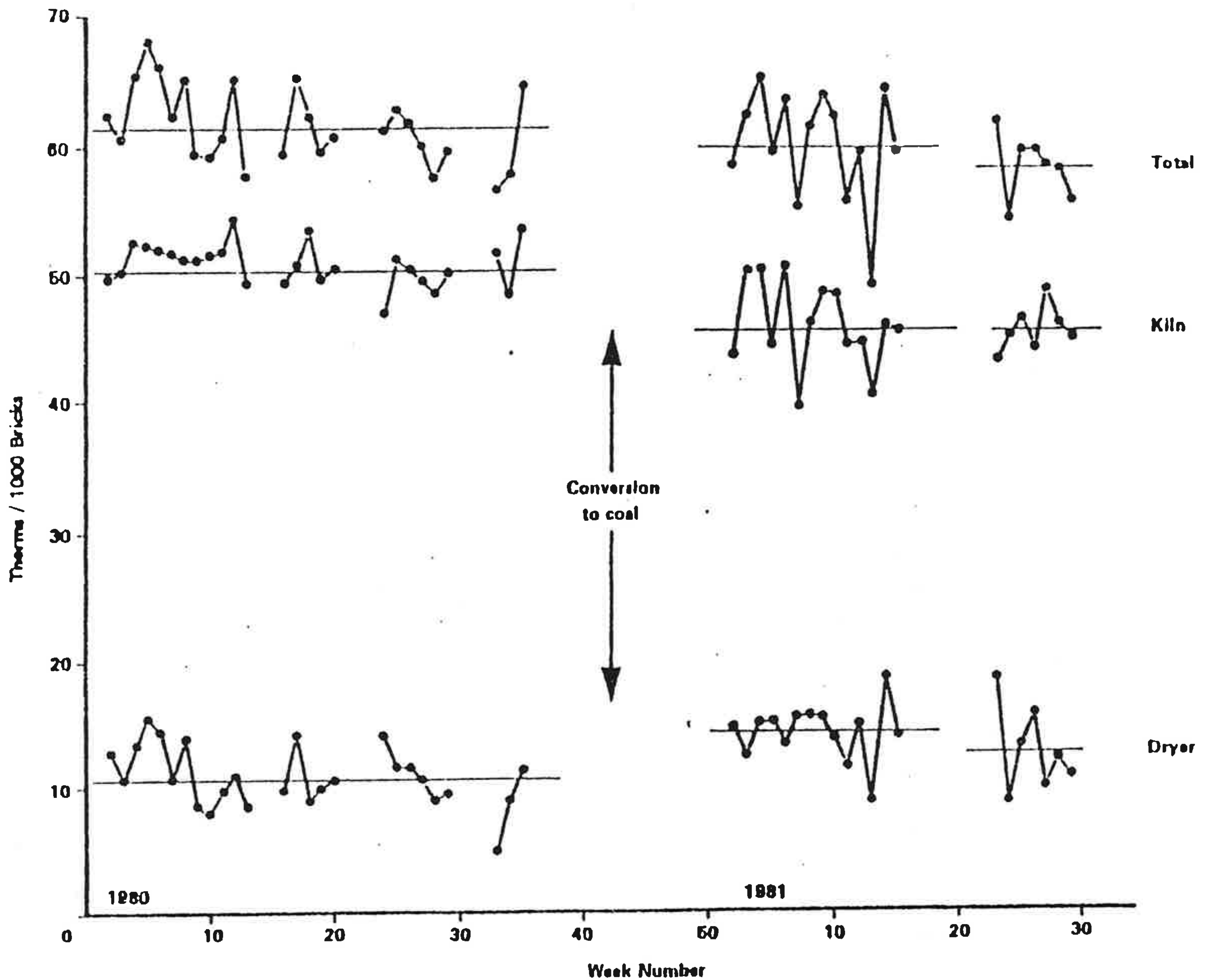

Figure 5: Energy Consumption

Clearly, we require an extended monitoring period to clarify the actual energy savings, but even if energy savings are only marginal, it is nevertheless clear that a major benefit to this industry lies in the fuel cost savings.