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ENGLISH

POLLUTION CONTROL IN THE BRICK AND TILE INDUSTRY

SI/IRQ/85/801

IRAQ

Terminal report

Prepared for the Government of the Republic of Iraq
by the United Nations Industrial Development Organization
acting as executing agency for the United Nations Development Programme

Based on the work of W. Buchanan,
brickmaking consultant

United Nations Industrial Development Organization
Vienna

V.86-56531
3053T

Explanatory notes

The monetary unit in Iraq is the dinar (ID). References to dollars ($) are to United States dollars.

Besides the common abbreviations, symbols and terms, the following have been used in this report:

DGCIE	Directorate General for Co-operatives and Industrial Estates
DGPMEHS	Directorate General for Preventative Medicine and Environmental Health Services
NIE	Naharawan Industrial Estate

ABSTRACT

The purpose of the consultant's mission under the project "Pollution control in the brick and tile industry" (SI/IRQ/85/801) for which the United Nations Industrial Development Organization (UNIDO) is acting as the executing agency for the United Nations Development Programme (UNDP), was to improve the performance of the brick and tile industry in respect of pollution control. The consultant was attached to the Federation of Iraqi Chambers of Commerce and Industry and through the Federation to the Baghdad Chamber of Commerce and Industry. The duration of his mission was two months, from 26 January to 27 March 1986.

At the beginning of the mission it became clear that long-term plans for reducing the effects of industrial air pollution caused by antiquated private-sector brick factories within the Baghdad city boundaries were underway. Essentially this would be achieved by a mandatory closure of these factories, of which there were said to be about 90, and encouraging relocation of brickmaking facilities at a new industrial estate located at Naharawan, some 50 km outside of Baghdad.

The existing private-sector brick factories within Baghdad were examined, a large government-owned factory within Baghdad was also visited and discussions were held with the Directorate General for Co-operatives and Industrial Estates which is responsible for the development of the Naharawan Industrial Estate. The consultant gave a lecture to various government personnel at the Baghdad Chamber of Commerce and Industry, where the subject of brickmaking and air pollution was looked at from the point of view of understanding the industry itself.

Discussions were held with environmental health authorities, public-sector brickmaking industry officials and others who had an interest in pollution control and in the brickmaking industry. The effect of the proposed relocation of the industry at Naharawan was considered both from the points of view of pollution and of the effect which the changeover might have on the brickmaking industry.

The consultant recommends a gradual relocation programme and points out the technology and manpower requirements of the Naharawan project which are estimated to cost $US 150 million. To address the needs for technology transfer and training of that project, the consultant proposes a two-phase technical assistance programme for which he has elaborated a draft project document.

CONTENTS

INTRODUCTION

The purpose of the consultant's mission under the project "Pollution control in the brick and tile industry (SI/IRQ/85/801) for which the United Nations Industrial Development Organization (UNIDO) is acting as the executing agency on behalf of the United Nations Development Programme (UNDP), was to improve the performance of the brick and tile industry in respect of pollution control. The consultant was attached to the Federation of Iraqi Chambers of Commerce and Industry and through the Federation to the Baghdad Chamber of Commerce and Industry. The duration of his mission was two months, from 26 January to 27 March 1986.

The problem of industrial air pollution from old brick factories within the city of Baghdad has long since been recognized as a serious health hazard.

The Government has already taken steps to close down the private-sector factories within Baghdad, giving the owners the opportunity to relocate in a modern industrial estate developed mainly for that purpose.

The consultant examined existing private-sector brick factories within Baghdad, and visited a large government-owned factory. Discussions were held with the Directorate General for Co-operatives and Industrial Estates (DGCIE) which is responsible for development of the Naharawan Industrial Estate. Discussions were also held with environmental health authorities, public-sector brickmaking industry officials and others who had an interest in pollution control and in the brickmaking industry. A list of the persons met during the mission is contained in annex I.

The principal considerations are that the new factories will have to use modern technology as opposed to the antiquated methods they were previously employing. The producers inside Baghdad are the major suppliers to the building industry and care will have to be taken to avoid disruption of that industry through shortages of bricks. The pattern of brick types and prices may change with the establishment of the new brick factories, but apparently higher prices may be offset by higher quality, better delivery systems and effectively lower costs "in-the-wall". A more diverse product range and modern marketing methods will be necessary, but this is supported by the fact that bricks have been made in Iraq for thousands of years and are used to some extent in most buildings. Even so, the technical, marketing and economic information to justify and even quantify the type of investments in brickmaking, have to be updated and completed. Following this, there will be an urgent need for high-quality specialist advice in the fields of general management, clay technology and brickplant maintenance. This is better appreciated in the light of the magnitude of the future brick factories which may eventually have an aggregate output of 1,000 million bricks per year. two-phase project has been detailed to overcome these problems (annex II).

There are still opportunities to encourage brickmakers within the city of Baghdad and within the wider area of the Governorate of Baghdad to minimize pollution, initially by improvements of operating practice. There is also the opportunity for pollution to be monitored at the new industrial estate at Naharawan and to maintain a green belt around the industrial area within the estate.

The consultant also gave a lecture to various government personnel at the Baghdad Chamber of Commerce and Industry, where the subject of brickmaking and air pollution was looked at from the point of view of understanding the industry itself. The text of the lecture is reproduced in annex III.

A draft final report was prepared and left with UNDP and the Baghdad Chamber of Commerce and Industry, but this has been subsequently amended following further information which became available in Vienna, after the consultant's mission to Iraq.

RECOMMENDATIONS

1. The Federation of Iraqi Chambers of Commerce and Industry should implement those recommendations which fall within its sphere of activities and should liaise with those other government departments as necessary to achieve implementation of the other recommendations.

2. The private-sector investors and the responsible government authorities who are to develop brickmaking and related activities at the Naharawan Industrial Estate should seek essential technical assistance. A proposed project for such assistance is detailed in annex II to this report and should be seen against the background of a potential gross investment at Naharawan in excess of $US 150 million; the radical changes in technology involved from current to proposed future production methods; the potential disruption of the building industry; related employment and social factors; and the need to diversify production and prove the quality of raw materials up to production level.

3. In order to minimize disruption of supplies to the building industry, the closure of the private-sector brick factories within Baghdad should be phased over a period of time taking into account the following suggestions:

(a) Advice on improvement of operating techniques should continue to be given through the Baghdad Chamber of Commerce and Industry with a view to reducing smoke emissions. However, apart from maintaining chimneys in good condition, it is not recommended that any major capital costs be incurred by the factories since they will soon be closed down;

(b) Those brickmakers who have made a definite commitment to invest in brickmaking at Naharawan should be permitted to continue production at their present factories in Baghdad until their new factory at Naharawan has started production;

(c) Those brickmakers who succeed in reducing smoke emissions should be permitted to continue production until, say, the end of 1988 instead of the currently scheduled closure time of 1987;

(d) When closure of brick factories is actually being implemented, those closest to the road or to denser populated areas should be closed first;

(e) The existing Hoffmann type kilns at the brick factories which are closed should be dismantled (e.g. by the owners) as a source of bricks to alleviate any shortage of supply whilst the factories at Naharawan are being established.

4. If it is seen that the establishment of brickmaking at Naharawan by the private sector is going to be insufficient to provide for the needs of the construction industry, and other public- and private-sector factories cannot make up the deficiency, the Government should consider establishing one or more factories at Naharawan with the objective of ultimately selling them to the private sector.

5. The current plans to have a three kilometre non-industrial area between the residential and industrial sites at Naharawan should be extended to a three kilometre green belt around the industrial areas of Naharawan. Such a green belt might be developed, e.g. jointly with the Ministry of Agriculture, into a productive forestry.

6. The Directorate General for Preventative Medicine and Environmental Health Services should commence a programme of monitoring pollution and related effects at Nahrawan, since this area may become a major industrial growth centre.

7. The Baghdad Chamber of Commerce and Industry should investigate the reasons as to why previous attempts at encouraging pollution control were unsuccessful, and implement measures to reduce pollution from those private-sector brick factories outside of the city limits but within the Governorate of Baghdad. Such reductions of pollution might be achieved by implementing better operating techniques, but the obligatory installation of better burner systems may have to be considered too.

8. There is an urgent need to examine the traditional potteries at Kerbala with a view to assisting them to modernize production in an economic way with an efficient production process. This is particularly urgent as the potteries have already started to relocate outside of the main centre of Kerbala. It is essential that the traditional skills are not lost during any process of modernization. UNIDO should, through formal channels, maintain contact with the Federation of Iraqi Chambers of Commerce and Industry, to evaluate the need or form of this assistance, e.g. through a Special-Industrial Services project, such as is proposed in annex IV to this report.

I. BACKGROUND

In recent years the Government of Iraq has been placing increasing importance on the private-sector industries which complement the public-sector industrial units. The former functions not only as feeder units to the latter, but responds to the domestic demand for various products. In this connection the Federation of Iraqi Chambers of Commerce and Industry plays a pivotal role. Similarly with the development of provision of industrial estates where such development rests with the Ministry of Light Industry's State Organization for Industrial Development through the Directorate General for Cooperatives and Industrial Estates.

For some years there has been a serious health problem caused by air pollution from a large number of brickmaking factories located in two zones within the city limits of Baghdad. The problem has been worsening as the city expands towards the brickmaking areas. The number of factories involved is reported to be about 90 inside the city limits, but there is also a substantial number, perhaps a further 40 or 50, outside of the city limits but still within the Governorate of Baghdad. Furthermore, there exist a number of public-sector brick factories, employing modern technology, which were not included in the consultant's terms of reference and are therefore not covered by this report.

The purpose of the project was to improve the performance of the brick and tile industry in respect of pollution control by:

(a) Visiting representative manufacturing units of the brick and tile industry in the Baghdad area with a view to analysing their pollution problems and offering recommendations for their solution;

(b) Elaborating a set of recommendations for how the Federation can contribute towards reducing pollution in the brick industry.

The consultant was attached to the Industrial Development and Studies Section of the Baghdad Chamber of Commerce and Industry. 1/

The consultant was advised that the Government had already taken steps to solve the air pollution problem caused by the private sector brickmakers by:

(a) Deciding to enforce closure of all such private sector producers by 1987;

(b) Establishing a new industrial estate at Naharawan, some 50 km from the centre of Baghdad. The area of the estate is 100 km^2 and it is subdivided into sites of various sizes, most of which are set aside for factories for bricks or heavy-clay products. Provision has been made for other industries and for a residential area which has now been planned as being 3 km from the industrial area. Services are supplied to the sites, e.g. roads, water and power;

(c) Making provisions to encourage the establishment of factories by providing loans at low interest rates. In the case of residential sites, the land will be supplied at nominal cost (freehold) and there will be no interest

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1/ In 1985 the Federation of Industry and Chambers of Commerce were amalgamated into a single body - the Federation of Iraqi Chambers of Commerce and Industry. The Baghdad Chamber has responsibility for the Governorate of Baghdad.

on the loans required for house building. With respect to clay quarries, there will be no royalties charged for quarrying the clays.

The principal requirement for investors in the heavy-clay factories is that modern technology must be used.

The above developments changed the work plan of the consultant, but not the overall purpose of the project.

II. FINDINGS

The primary problem of air pollution from private-sector brickmakers within the city of Baghdad is to be solved by mandatory closure of such factories. The closures are planned to be complete by 1987. Opportunities are being made available for private-sector producers to establish production facilities on the new industrial estate at Naharawan, some 50 km from the centre of Baghdad.

The Naharawan Industrial Estate (NIE) is being developed by the Directorate General for Co-operatives and Industrial Estates (DGCIE) and it is well underway to completion. A dual carriageway has been established from the main Baghdad road to the estate boundary, a domestic water treatment plant is almost complete, process water will soon be available to the first brickmaking sites as will in-site roads. The necessary geological work has been completed to prove the quantities of clay, and the preliminary testing work has been completed. However, the clays are very high in calcium carbonate (said to be 30 to 35 per cent) and final testing to prove the quality for producing a wide range of heavy-clay products appears to be lacking up to final pre-production level.

Consultations were held at NIE with representatives of DGCIE, the Directorate General for Preventative Medicine and Environmental Health Services (DGPMEHS), the Baghdad Chamber of Commerce and Industry and the consultant. One of the main concerns was that the residential area might fall within an area of serious pollution. Representatives of DGCIE pointed out that it was now decided that the residential area would be a minimum of 3 km away from the nearest point of the industrial area, and that the prevailing wind direction is usually north-west, i.e. from the residential area towards the industrial area. The other main wind direction, of lower intensity, was said to be from the south and, again, this would not carry pollution from the industrial area towards the residential area. A member of the DGPMEHS team said chat 5 km should be the minimum distance between the industrial and residential areas and the consultant's opinion was asked on this point. It was reiterated that the consultant's initial queries regarding wind directions were to establish the possibility of pollution being carried into the residential area. Given that there was a good wind régime in the directions indicated, the distance of 3 km seemed reasonable. There was always a balance to be maintained in these cases to get a safe distance for habitation whilst permitting the workforce to live reasonably close to their work, with health being a primary consideration. Although arbitrary distances could be set, the real factors were site-specific and should be taken account of.

A mandatory green zone was suggested as being essential between the industrial and residential areas at Naharawan. It was generally accepted that this was desirable but the development of such a zone would be expensive. The consultant suggested that consideration should be given to making a green zone of a productive nature. For example, a forestry zone would be in keeping with national policy of developing forests, would act as a barrier against particulate air pollution, might be a source of timber to the industrial estate and could also be a recreational area. The question of soil suitability and related factors would have to be investigated.

A prerequisite for the establishment of brick factories at Naharawan is that they use modern production techniques which might include a measure of automation, artificial dryers, tunnel kilns etc. It is desirable that a range of products is made, i.e. not only standard bricks, and that the quality is of an acceptably high standard. It is recognized that this will involve major changes from previous investment and operating procedures as practiced by the

private sector in Baghdad. It is also recognized that, because of this, the investors will require specialized assistance at various operational levels during the initial years. In fact, the success or otherwise of the first investors may well determine the success or otherwise of the industrial estate in the longer term. It is noteworthy that the aggregate planned output of the brick factories at NIE is two to three times higher than that from any single factory in the world. The investment needed to replace the existing factories in Baghdad with modern factories is in excess of $US 100 million. Such investment will take place over a period of years and it has been suggested that the initial investors may have to use foreign labour for some of the skilled positions.

The Commerce and Industry Bulletin of December 1985 gives the following selling prices for bricks:

	Unit	ID
Private sector		
Ex-plant, loose	1,000	20
Broken bricks	m^3	7.5
Public sector		
Ex-plant, loose	1,000	26
Ex-plant, strapped	1,000	28
Delivery by truck, loose	1,000	28
Delivery by truck, strapped	1,000	30
Broken bricks	m^3	7.5

The future private-sector brickmakers at NIE will be allowed to sell their bricks at the public-sector prices to compensate for their higher investment and production costs and the higher quality product. However, since they will be using artificial drying instead of natural drying, their fuel costs will be substantially higher. Because Naharawan is located further away from most parts of Baghdad than are the existing brick factories, delivery costs will also be higher, hence the cost to the building industry will be higher due to a price increase of about 30 per cent and the higher delivery costs. Equally important in terms of the potential for successful investments is the fact that there appears to be no up-to-date market survey showing how a new range of products will be accepted or even if the current public-sector prices are profitable. From a technology point of view it seems that it has yet to be established that the raw materials at NIE are suitable for a range of high-quality products.

Private-sector producers in Baghdad make a simple non de-aired extruded brick, which is air-dried and fired in a simple Hoffmann-type kiln. Summer production has to be sufficient to maintain firing during the winter wet season when extrusion and air-drying has to stop. There are said to be some 90 producers in two areas of Baghdad, with kilns that produce 30,000 to 35,000 bricks per day. Assuming a six-day working week, an average kiln output of 32,500 bricks per day, a further thirty non-productive days per year and 90 producers, the total output would be 825 million bricks per year. Such a high overall production must obviously have a major effect on the building industry in Baghdad. If not already done, it is important that the Government ascertains the actual annual output from these factories.

The quality of bricks from private producers is said to be low. They are often delivered loose in trucks and tipped off at the building site with resultant high percentage of breakages. Broken bricks, ostensibly cheaper than whole bricks, are in fact about the same price when the bulk density is

taken into account. There is a need to examine the whole question of prices and values with a view to seeing how, for example, the price ex-factory can remain at an economic level whilst maintaining the price "in-the-wall" as low as possible. Further upgrading of the quality and diversification of products may be ways of justifying acceptable commercially viable prices.

At the request of the Baghdad Chamber of Commerce and Industry, the consultant gave a lecture on brickmaking and air pollution to various engineers and other professionals. The notes used for the lecture and some following questions and answers are reproduced in annex III to this report. It will be seen that the main areas where brickmakers can reduce air pollution are:

(a) Efficient and appropriate operating procedures;

(b) Better selection of pollutant-free raw materials;

(c) Purification or upgrading of raw materials and water by physical, chemical or other means;

(d) Reducing fuel consumption;

(e) Treatment of flue gases after combustion;

(f) Increasing chimney height to achieve better dispersal of pollutants, reducing the effects to the population, plants and animals;

(g) Better maintenance, escpecially of flues and chimneys.

Referring to NIE, it could take some 18 months between placing an order for a factory and getting initial production. Thus if all the private-sector brick factories within Baghdad were to be closed with effect from 1987, there is little time left to evaluate what treatment might be developed for the clays at Naharawan to beneficiate them with the objective of reducing pollution caused by the soluble salts which they are said to contain.

Given the unique position which Iraq has in the world in terms of its long history of brickmaking and use of bricks, there are opportunities to capitalize on the existing skills in this area. In looking at the obvious skills which designers and artisans have exhibited here over the years and taking into account the limited brick types available in Baghdad (i.e. in terms of colours, shapes, texture and quality) there may be much more which can be done to establish a broader and more secure market for the private sector.

As already indicated, a most important aspect in the development of the heavy-clay industry at NIE is the rapid and successful development of the first few factories. It has been said that these factories might have to employ expatriate labour at professional and operator levels, at least initially. The cost of the professional labour will not be low, if the calibre is high, and equally important is the related experience in the successful development of the heavy-clay industry which such professionals and artisans must possess. It is possible to get low-cost professional staff, but the ability and experience of such staff is sometimes less than adequate. In the early years of production when cash flow is least but perhaps most needed, the highest quality professional assistance is essential. This can be achieved by a jointly funded project for technical assistance which would assist the initial brick factories and seek to establish the best range of products which should be made to suit market demands. Details of such a project are given in annex II to this report.

On the last day of the mission, the consultant was taken to the ancient city of Kerbala where two ceramic tile factories and a brick factory were seen. The brick factory was outside of the town and reasonably far away from residential areas, but seemed no different from those in Baghdad. The two tile factories made tiles and similar ceramic wares for use in mosques and for general sale. There was evidence of a high degree of skill in all the work seen, but it was stated that there was a need to modernize production methods whilst still retaining the old craft skills. One of the tile factories was in the process of transferring production to a site outside of Kerbala and the other factory was scheduled to move in the future, although the management said that it would be preferable to improve firing techniques and stay in their present location inside the town. According to what was seen and the discussions held, it was clear that assistance was required in designing a more efficient process system with improved technology, but still retaining areas where traditional skills are maintained.

III. CONCLUSIONS

The establishment of a brickmaking and heavy-clay products industry at Naharawan will be a major undertaking due to the size of the industry to be established and the changes from what is, effectively, 19th century technology and procedures into what will be late 20th century technology and procedures. The related potential effects on the building industry cannot be ignored. It is of special importance that the raw materials at Naharawan be of proven quality to suit a range of heavy clay products and that consideration is given to the potential for some beneficiation of these materials with a view to reducing pollution and possibly improving the quality of the materials.

Various means can be used to reduce or eliminate the potential disrupting effects to the building industry of closing the brick factories within Baghdad. Some of these are mentioned in the chapter "Recommendations". There is an opportunity for the Baghdad Chamber of Commerce and Industry to continue to assist the brickmakers to reduce pollution by showing them how to lessen at least smoke emissions.

Where every assistance is given to brickmakers to enable them to reduce pollution, i.e. by way of advice from the Chamber of Commerce and Industry, and the brickmakers make no effort to improve the situation, it may be necessary to implement some form of sanction through the Chamber or DGPMEHS.

The most important consideration in terms of promoting brick production at Naharawan is to get investors who will at an early stage invest in the size and type of factories which are required. This presupposes that there are detailed cost-benefit analyses supported by technical data and market information which have been objectively compiled and which can convince the investors that their investment will, in fact, be secure. The provision of technical assistance as part of any package to convince the potential investors to come to Naharawan may not simply be an inducement but an absolute necessity.

It is unavoidable that there will be pollution from the factories at NIE. It will be a reality that profitable operations will create a better atmosphere for investing in pollution control measures whilst good operating procedures will also be essential to maintaining low pollution levels. There is the opportunity for DGPMEHS to be involved in monitoring and assisting with pollution control throughout the development of the estate.

It would be tragic if the lessons of Baghdad were ignored and the residential area of NIE or even of a future Baghdad became affected by pollution from the industrial area. Thus there is now the opportunity to create a three kilometre green belt around the industrial areas of NIE. There is the possibility of developing such a green belt into a multi-purpose area e.g. by incorporating the area into an existing programme of tree planting.

The potteries of Kerbala are being relocated as part of a scheme to move such industries out of the centre of towns. This will no doubt contribute to reduced pollution in the towns. The other aspects of such relocation should be looked into urgently in more detail since it involves modernization of the potteries. Whilst the owners and operators obviously understand their present technology, it does not follow that they will understand new technologies.

Annex I

PERSONS MET DURING THE MISSION

Federation of Iraqi Chambers of Commerce and Industry

Technical Studies Sector

Director of Section	- Yusuf Hassan Mahdi, expert engineer
Deputy Director	- Nazar Abdul Majeed
	- Zaid A. H. Bilal*

*Mr. Bilal acted as general liaison officer.

Baghdad Chamber of Commerce and Industry

Director General - Falih Ali Al Salih

Industrial Development and Studies Section

Director of Section - Kamal Tawfiq Tahir,* chief engineer, and various engineers and support staff in the Section.

*Mr. Kamal was chosen as a counterpart because of his background and specialized knowledge of the brick industry and gave every assistance to the consultant.

Studies and Statistical Section

Director of Section - Abdul Hussein Mohamed

This section made the arrangements for the lecture on brickmaking and pollution.

Directorate General for Co-operatives and Industrial Estates

Director General	- Shukri Al Hadithi
Technical Manager	- Ghanem E. Gasgous

Directorate General for Preventative Medicine and Environmental Health Services

Director General - Dr. Felix J. Jurgi, and various professional staff

General Establishment for Brick Industries

Assistant Manager (Technical) - Fikrat Hekmat Mohamed and related staff

National Centre for Occupational Health and Safety

Director General	- Dr. J. Al Adzan
Deputy Director General	- Dr. Zahawi

United Nations Development Programme

Senior Programme Assistant	-	Feriyal Ramli
Senior Administrative Assistant	-	Marharet Randquist
Senior Administrative Assistant	-	Mohamed El-Eid
Senior Finance Assistant	-	Miranda Dahan

Annex II

DRAFT PROJECT DOCUMENT

Title: Assistance to the brickmaking industry

Number: Duration:

Primary function:

Sector: (Govt. class.) _____ (UNDP class. and code) _____

Sub-sector: (Govt. class.) _____ (UNDP class. and code) _____

Government implementing agency: Federation of Iraqi Chambers of Commerce and Industry

Executing agency: United Nations Industrial Development Organization

Estimated starting date: November 1986

Government inputs: _____ (Iraqi dinars) UNDP inputs: _____ (US dollars)

Government cost sharing: _____

Signed: _____ Date _____
on behalf of the Government

_____ Date _____
on behalf of the United Nations
Industrial Development Organization

_____ Date _____
on behalf of the United Nations
Development Programme

PART I: LEGAL CONTEXT

This project document shall be the instrument referred to as such in article I, paragraph 1, of the Assistance Agreement between the Government of the Republic of Iraq and the United Nations Development Programme, signed by the parties on (date).

The government implementing agency shall, for the purposes of the Standard Basic Agreement, refer to the government co-operating agency described in that Agreement.

PART II: OBJECTIVES

A. Development objective

The project supports the ongoing development effort by the Government aiming at a decentralization and modernization of private industry and improved health conditions.

B. Immediate objective

The immediate objective of the project is the development of a modern, private-sector heavy-clay industry at the Naharawan Industrial Estate. The project will be implemented in two phases with this document providing the essential data to promote the first phase and indicating the tentative requirements for the second phase.

The logic of the first phase is that the nature of the market for heavy-clay products indicates the range and volumes of products required whilst the raw materials are limiting factors on what is actually feasible to produce. The private-sector investors will decide to what degree, if any, they wish to invest in production facilities at Naharawan. By updating and broadening the scope of market analyses; by carrying out production-orientated tests and possibly development work on the raw materials, in order to better understand the potential of the raw materials and the necessary technical processes required to achieve a product range; by providing a wider insight into industrial estate operations, as such, and into the manufacture and use of a range of heavy-clay building products; both government personnel and private investors will be in a better position to make decisions regarding technology, industrial estates operation, and product diversification and use. The involvement of a qualified government officer in all aspects of the raw materials evaluations will strengthen the ability of the Government to continue such work in the future, such continuation being essential by virtue of the extremely large production and investments envisaged. In a seminar the results of the market survey related to the raw material capabilities and taking into account financial and investment possibilities should be presented. Without a clear indication as to potentials for profitability and the methodology required to achieve such profitability, it is possible that the necessary investments may not be forthcoming, or, if made, they may not mature, to the detriment of those investors as well as future potential investments. This could have disastrous effects on the brickmaking and building industries as well as on the employment opportunities which should derive from healthy investment.

The second phase of the project will be designed to meet the needs of new investors in a modern sector of the brickmaking and heavy-clay industry where general management, marketing, product development and diversification, and brickworks maintenance will be crucially important to healthy development of

the investments. The second phase will not preclude the individual investors from engaging affordable expatriate personnel, but will ensure that there is the necessary top level advice and assistance available to give objective support to both the investors and the government personnel involved in developing the heavy-clay industry.

It is important that the overall objective of the project is understood in terms of the requirement of technical assistance, and it will then be appreciated that the sub-objectives stated below contribute to the overall objective through this first phase. These sub-objectives are:

(a) Proving of raw material quality to investment/production level and determination of optimum technology;

(b) Provision of an updated market analysis indicating in quantifiable terms the ranges and types of products required;

(c) Established investment information for the public and private sectors which will enable investment decisions to be made with confidence, to be presented in a seminar to be held in Baghdad;

(d) A better understanding of: operation and development of industrial estates; the production and use of heavy-clay building materials; technical evaluation of heavy-clay raw materials. To be achieved through study tours, a fellowship, and counterpart operations with the various consultants;

(e) To develop and prepare a project document, acceptable to the Government and UNDP/UNIDO, for the second phase of the project.

C. Special considerations

The development of the Naharawan Industrial Estate came about as a direct result of government efforts to reduce air pollution within the city of Baghdad, from the decision to relocate the brickmaking area from within Baghdad to the Industrial Estate at Naharawan. The large private sector of the brickmaking industry which produces inside Baghdad city limits will be encouraged to modernize and establish new facilities at the Estate. Closure of the old factories will commence in 1987.

A modernization of the brickmaking process does not in itself eliminate air pollution. Good operating practices will have to ensure that air pollution is minimized with optimum economic benefits. Such practices will be part of the planned outputs of the second phase of the project.

D. Background and justification

Iraq is characterized by, amongst other things, a heritage which includes brick buildings and structures going back thousands of years into history. In these modern times this total familiarity with the manufacture and use of bricks can be seen from the large numbers of bricks produced (estimated at over one billion bricks per year for Baghdad alone) and the wide range of modern houses, flats, commercial and other buildings.

Many of the relatively small brick factories which make bricks for use within the Baghdad area are located within the city boundary. As with most modern cities, urban expansion in Baghdad has been rapid and the effects of the smoke from the brick factories has become an increasing health hazard. The Government made efforts in the past to reduce this pollution by assisting

the private-sector brickmakers to install better burner systems. These systems were allowed to fall into disrepair and then disuse with the result that of the about 90 factories involved with an annual output said to be of the order of magnitude of 800 million bricks per year, only a very few still use the burner systems. It was then decided that the real solution lay in relocating the factories, modernizing the production facilities in keeping with the policy of modernizing the private sector, and achieving decentralization by establishing an industrial estate outside of Baghdad, yet close enough that the estate would still serve the Baghdad market.

The Naharawan Industrial Estate, developed primarily to permit relocation of the Baghdad brickmaking facilities, is located some 50 km outside of Baghdad and covers an area of some 100 km^2. Areas within the estate have been set aside for the location of brick factories, clay quarries, other factories and for residential development. Financial incentives will take the form of credit at low interest for capital investment, low site rentals, services supplied to the sites (treated domestic water, process water, power and roads), and for interest-free loans for housing with purely nominal values set for land purchase. The main consideration with respect to the brick factories is that the technology used must be modern, precluding the transfer of equipment from the existing facilities.

With the closing down of the private-sector brick factories within Baghdad there are a number of important considerations which must be allowed for:

(a) The existing producers supply the bulk of the bricks for the building industry in and around Baghdad. Any disruption to this supply could have serious effects on the building industry;

(b) Relocation of production facilities to a single site on one side of the city distorts the supply situation since the existing brickmakers are divided between two sides of the city. The cost of bricks will rise substantially because of extra transport costs but also because of the need to pay back the high investment costs and higher fuel costs involved in modern production (previous drying was by atmospheric methods);

(c) It has been assumed that there will be substantial product diversification at the new site. For example, hollow blocks and other clay products may be made as well as standard bricks. However, it is clear that the final clay tests have not been carried out to prove the industrial potential of the material, taking into account the exceptionally high calcium carbonate content (said to be up to 35 per cent) and the problems experienced with similar clays in modern government factories;

(d) Investment in brickmaking factories at Naharawan will depend upon the perceived benefits to be gained from such investment. If such investment is not forthcoming at appropriate times, the programme of closing the brick factories in Baghdad may have to be postponed, or, there may be problems in the building industry due to a shortage of bricks;

(e) A marketing strategy must be developed at an early stage of the investment process and this will be strongly related to an analysis of the market at present. The reasoning behind the strategy needs to be made clear to the investors who will ultimately have the responsibility for implementation;

(f) In spite of the fact that Iraq in general and Baghdad in particular consume large quantities of bricks, there appears to be little by way of modern industrialized building methods, such as transport, delivery or

handling systems, using hollow-clay blocks instead of bricks where appropriate. There is also little product diversification, e.g. a range of facing bricks where a variety of colours and textures could be used to enhance the multi-formity of buildings. These considerations will be essential to the ability of the brick factories to produce a range of clay products which may justify the higher prices, taking into account the fact that it is the price "in-the-wall" which is important;

(g) By virtue of the size of the industrial estate at Naharawan and the planned (eventual) production of more than one billion bricks per year, clay test and development work will be justified for many years in the future. This requires the services of experienced personnel and training for such personnel;

(h) The estate at Naharawan has already had the equivalent of some $US 40 million invested in development of infrastructure and it should be developed to the point of being available to investors in 1986-1987. The management of such a large estate is by no means a simple task and, apart from being the biggest such estate in the country, Naharawan is the fore-runner of other such estates. The responsible government personnel who will manage the estate and deal with the private-sector investors would therefore need appropriate training. Such training could be effectively complemented by suitable study tours of selected industrial estates.

The existing private-sector investors whose factories are to be closed, use a technology which is essentially of the late 19th century, and the new factories at Naharawan must use modern up-to-date technology. Since the investment potential at Naharawan is very large, the investors will be under considerable pressure from sales representatives to install the system they offer. It is essential that the investors and supporting government officials have the opportunity to examine the investment potential in some detail, e.g. via a seminar.

E. Outputs

A report on the results of detailed production-orientated testing of the raw materials from (or available to) Naharawan, supported by physical samples, as indicated below:

(a) A list of products which can be produced, realistically, from the clays at (or available to) the brick factories which may be established at the Naharawan Industrial Estate;

(b) Details of the proposed technology, with reasonable alternatives, which would be recommended for the production of the various products to be determined under (a) above, assuming production levels of 15 million, 25 million and 60 million brick equivalents per year. For the purposes of the various production levels, it would be assumed that production would be on a two-shift basis (three shifts for drying and firing) with 3 840 production hours per year. It would also be assumed that eventual production efficiency would average 80 per cent;

(c) Details of beneficiation processes which might reasonably be used to reduce the effects of harmful impurities in the clays, or to upgrade the production potential of the clays;

(d) Samples of the end products which can be produced from the raw materials.

A report based upon a detailed market study related to the use and future potential of clay building materials as used in sub-soil constructions, walls, roofs, ceilings or other constructions. The study shall take into account the current and future production and supply situation brought about by the development of the Naharawan Industrial Estate. Further details on the areas which the study should cover are given in appendix 1.

A report giving investment information to be presented through the medium of a seminar as below:

(a) A report based upon previous tests and evaluation work and updated market analyses, taking into account all fixed and variable costs related to brick-factory projects for Naharawan and presenting these in the form of economic and investment analyses which can be understood by the participants of the seminar. For details see appendix 2;

(b) A seminar at which the results of the various reports are presented and discussed in relation to their investment potential

Two study tours and a fellowship as detailed below:

(a) A study tour for three persons to selected large industrial estates (e.g. in India, Ireland, Turkey) with observations and discussions on factors related to the success of the estates visited;

(b) A study tour for six persons to two areas where (i) a wide variety of bricks are produced and used and consumption of bricks on a per capita basis is similar to the Baghdad area (e.g. Western Australia) and (ii) a wide variety of burnt-clay blocks is produced and used in walls, floors etc. (e.g. Austria, the southern part of the Federal Republic of Germany or Switzerland);

(c) A fellowship for one person for 5 1/2 months in the laboratory where the clays will be tested and evaluated, as indicated in the first output above.

A project document for the second phase of the project. The document shall be prepared after an assessment of all stages of phase I, to take into account the wishes of the Government and the needs of the developers and investors at the Naharawan Industrial Estate. (A preliminary budget is proposed in appendix 3 to this project document since, in view of the importance of phase II of the project it will be necessary to make early budgetary arrangements for planning purposes.)

F. Activities

The activities are listed below in the order corresponding to the outputs, with indications as to planned starting and completion times. It will be appreciated that the sequence of activities should be maintained since some are relying on the results of the previous ones to be effective.

No.	Activity	Start	End
1.1	Selection of consultants	Sept. 1986	Dec. 1986
1.2	Sampling by Government (clays)	Nov. 1986	Dec. 1986
1.3	Shipping samples	Jan. 1987	Feb./March 1987
1.4	Testing samples	Feb./March 1987	June/July 1987
1.5	Reporting	July/Aug. 1987	
1.6	Fellowship (5 1/2 months)	Feb. 1987	July/Aug. 1987

continued

No.	Activity	Start	End
2.	Market study		
2.1	Selection of consultants	March 1987	July 1987
2.2	In-country study	July 1987	Sept./Oct. 1987
2.3	Report	Oct./Nov. 1987	
3.	Investment study		
3.1	Selection of consultants	March 1987	July 1987
3.2	Studies by consultants	Sept./Oct. 1987	Nov./Dec. 1987
3.3	Report (to Government/UNDP)	Dec. 1987/Jan. 1988	
3.4	Seminar	Jan. 1988	
4.	Study tours		
4.1	Preparatory work and arrangements for study tours	Oct. 1986	Apr. 1987
4.2	Study tour - industrial estates	Feb. 1987	March 1987
4.3	Study tour - brick and block production, construction, design centres etc.	May 1987	June/July 1987
5.	Phase II of project		
5.1	Project document prepared	Jan./Feb. 1988	March 1987
5.2	Project document signed	Apr. 1988	
5.3	Start of phase II	May 1988	

Allowance has been made in the project budget for two man-months of consultancy services under budget line 11-01. This consultancy will be used to maintain a dynamic implementation of the activities of phase I and for the preparation of the project document for phase II.

The above activities are shown in a bar chart on the following page. However, individual consultants will be expected to supply more detailed information on their work schedules.

G. Inputs

Government inputs

The principal government inputs shall be in the form of support to the expert and consultancy personnel attached to the project, e.g. transport and living costs. The details of such support shall be worked out between Government and the United Nations Development Programme prior to the signature by UNDP of the project document for phase I, and shall be attached as an annex to the project document.

The Government shall arrange for qualified staff to take the necessary clay samples (1,000 kg for each raw material type, e.g. plastic clay, less plastic clay and sand or sandy clays) and for the packing and shipping of the samples to the laboratory which will be engaged to carry out the test and development work on the clays. The cost of such sampling and shipping shall be included as part of government's counterpart contribution to the project.

The necessary counterpart staff shall be made available to consultants attached to the project, and the necessary arrangements made to permit national personnel to participate in the study tours and fellowship training.

Preliminary work plan

No.	Activity	1986				1987												1988				
		September	October	November	December	January	February	March	April	May	June	July	August	September	October	November	December	January	February	March	April	May
	Project document for phase I signed			x																		
1.	Clay testing																					
1.1	Selection of consultants	x	---	---	x																	
1.2	Sampling of clays			x	--	x																
1.3	Shipping clay samples					x	---	x														
1.4	Testing/development							x	---	---	---	---	---	x								
1.5	Report submitted												x									
1.6	Fellowship						x	---	---	---	---	---	---	---	---	---	x					
2.	Market study																					
2.1	Selection of consultants							x	---	---	---	---	---	x								
2.2	In-country study											x	---	---	---	x						
2.3	Report submitted														x							
3.	Investment study																					
3.1	Selection of consultants							x	---	---	---	---	---	x								
3.2	Studies by consultants													x	---	---	x					
3.3	Report to Government/UNDP																x					
3.4	Seminar																	x				
4.	Study tours																					
4.1	Preparatory work		x	---	---	---	---	---	---	---	---	x										
4.2	Industrial estates							x	--	x												
4.3	Brick/block production/use/design									x	---	x										
5.	Phase II of project																					
5.1	Project document prepared																	x	---	x		
5.2	Project document signed																				x	
5.3	Start of project																					x

Note: UNIDO evaluation missions and consultancy/expert services to be scheduled after activity 1.5 has been completed.

UNDP inputs

UNDP shall arrange for early consultations with the Government to finalize the details of the cost sharing, such that the project can proceed within its proposed time scale as indicated under "Activities". The proposed breakdown of costs is on a 50/50 basis for the first phase of the project.

UNIDO shall make early arrangement to contact consulting companies, including those proposed by the Government, to prepare a shortlist of companies for submission to the Government. All personnel who are expected to visit Iraq shall submit a detailed CV to UNIDO for clearance by the Government.

UNIDO shall make all necessary recruitment steps in good time to recruit and have cleared any UNIDO consultants or experts. Staff members for missions related to the project shall be available as required. The responsible substantive section shall maintain an effective liaison, through UNDP, with the Government, to ensure that project activities take place in a progressive manner.

H. Work plan

The project activities in detail are reliant on each related foregoing activity. Thus the subsequent activities may have to be modified in detail, according to the results of foregoing activities. UNIDO shall maintain a monitoring role in adjusting or modifying activities according to available information on the progress. The preliminary work plan has been indicated in the form of a bar chart following the section on "Activities".

A detailed work plan for the implementation of phase I of the project shall be prepared by UNIDO in consultation with the Government. This will be done at the start of the project and, as indicated in the paragraph above, it will be periodically updated. The agreed-upon work plan will be attached to the project document as annex I and will be considered as part of that document.

I. Development support communication

Within the country, the private-sector brickmakers should be kept informed by the Federation of Iraqi Chambers of Commerce and Industry, as to the project, its purpose and the potential for their questions on investment at Naharawan to be answered through the planned seminar. At the same time, one representative of the potential investors should be selected for inclusion in the study tour to brickmaking and blockmaking factories.

An architect should be selected by the Government for inclusion in the study tour to the brick- and blockmaking areas. Selection of the architect should be on the basis of his or her professional distinction in Iraq.

The Federation of Iraqi Chambers of Commerce and Industry, through its headquarters and at Chamber level, should liaise with the Directorate General for Industrial Estates to maintain an efficient development of private sector activities at the Naharawan Industrial Estate.

Country: Iraq
Project No.: DP/IRQ/86/
Title: Assistance to the brickmaking industry, phase I

		Total		1986		1987		1988	
		mm	$	mm	$	mm	$	mm	$
11-01	Consultants, short-term	2	20 000	0.5	5 000	1	10 000	0.5	5 000
11-99	Subtotal	2	20 000		5 000		10 000		5 000
16-00	Other personnel costs		12 000		6 000				6 000
19-99	Total personnel costs		32 000		11 000		10 000		11 000
21-00	Subcontracts		180 000				160 000		20 000
	Training								
31-00	Individual fellowships		12 500				12 500		
32-00	Study tours		66 000				66 000		
39-99	Total training component		78 500				78 500		
59-99	Total - miscellaneous		1 000		250		500		250
99-99	Project total		291 500		11 250		249 000		31 250

Appendix 1

MARKET STUDY - CLAY-BASED BUILDING MATERIALS

The study shall cover the area which is to be served by the brick factories proposed for the Naharawan Industrial Estate (NIE).

The consultants shall investigate the potential for clay-based building materials from NIE but shall also examine:

(a) The current situation of supply;

(b) How the transition from existing brick factories to the NIE will affect the investors (current) and the construction industry;

(c) What effects there would be from a phased closing down of the existing brick factories, assuming such closures would take place over 2, 5, or 10 years from 1987 on.

In considering the market for clay-based building materials there should be clear distinctions between the market as it exists for bricks and the market which can be developed for products which could be produced by existing factories (i.e. those which are not affected by the proposed closure) and those factories which might be established at NIE.

The study should indicate, for all products which are to be considered for production at NIE, requirements of quality, such as conformity to size and shape, strength, durability, efflorescence and other properties considered relevant by the consultants.

The study shall include trends in market prices, volumes, and, if possible, local manufacturing costs.

The endusers shall be studied and the areas of consumption shall be defined as far as is possible, with trends being indicated. Estimates shall be made of population and per capita income growth, and this shall be taken into account in estimating consumption trends.

The market share of clay bricks and other proposed products shall be indicated. It should be determined which part of the market any proposed product will serve and which part cannot or should not be served, indicating the reasoning behind the determinations.

Estimations shall be made of the costs "in-the-wall" for proposed products versus existing products. ("Proposed products" are those which are proposed for production at NIE, whilst existing products are those currently produced by factories in the private and public sectors.) The calculations shall take into account the location of NIE versus other principal suppliers or supplying areas and the main consumption centres.

The benefits to the consumers of using proposed products from NIE should, as far as possible, be quantified. It should be estimated or indicated if and how such benefits will be appreciated by the consumers.

The main purchasing groups shall be indicated and also how the proposed products can best be marketed.

Existing products shall be examined and it shall be indicated if and how such products can be improved, e.g. through quality, product range, efficiency of production etc.

With respect to using proposed products, the needs for upgrading of skills or training shall be indicated, e.g. in the building industry.

Existing brick-delivery systems shall be evaluated and improved systems considered from the point of view of reducing delivery costs or reducing the cost of the products "in-the-wall".

Based upon the above and other considerations shown to be relevant, the consultants shall evaluate the alternatives for private-sector investors at NIE, taking into account raw materials, technology, skills and government objectives.

The final report should be presented within four weeks of the in-country investigations being completed, and should show the detailed reasoning and calculations behind each conclusion.

Appendix 2

INVESTMENT STUDY AND SEMINAR

Capacities

The consultants shall take into account the results of the raw materials and market studies. Factory capacities shall be discussed based upon clear indications as to:

(a) Present optimistic and pessimistic demand estimates;

(b) Realistic estimates of actual outputs as a percentage of the designed capacity. This should be taken into account in any cost-benefit analyses;

(c) Future increases in demand and options for expanding output;

(d) Possibilities for future diversification of production and steps which might be taken in the factory design stages to minimize costs of diversification in the future.

Technology

Alternative technologies should be discussed and recommendations made regarding the choice of technology. The criteria for selection should be given and these shall include consideration of the following:

(a) Investment costs;

(b) Operating costs;

(c) Suitability for local conditions;

(d) Durability and reliability;

(e) Ability of the building industry (or consumers) to use the products.

Raw material additives to be imported for any of the proposed technologies or products shall be discussed, giving details of the proposed suppliers or sources of supply, prices and any present or future possibility of providing or making them within the country.

Location of sites

The site locations are to some extent already determined within the Naharawan Industrial Estate (NIE). However, the benefits of one site over another should be discussed in terms of requirements and advantages.

It should be noted that the total area set aside for various brick factories is about 3.5 km^2, although only a part of this will be opened up for roads and services in the first phase of operations.

Engineering

The consultants shall include in the report a general plan of the sites, buildings and facilities for each brick factory proposal or alternative. Types of buildings to satisfy special requirements, such as technical,

safety etc., should be clearly described. Variants of buildings and building materials e.g. concrete, brick, prefabricated steel structures etc., shall be compared and the most suitable recommended.

Services within the factory for provision of process requirements such as compressed air, vacuum, treated water, electric power, storage and handling of fuel etc., should be discussed in sufficient detail to satisfy the purposes of the study and also for negotiating and contracting for the supply and delivery of constituents. Alternatives should be compared and the best recommended.

Various technologies should be reviewed, giving detailed descriptions for each type of technology with flow diagrams and material balances. The alternatives of using whole packages or parts should be analysed and compared, giving the optimal set-ups consistent with local conditions, minimized investment and operating costs, good products quality and the durability of the plant. For the production equipment the main units should be described in detail. Special technical know-how and similar issues should be discussed. The opportunities for in-plant and inter-plant standardization on equipment or other items should be discussed in detail.

Company and factory organization shall be discussed in detail and organization charts provided in the study. The manpower requirements shall be stated by categories and section-wise. Training and expertise requirements shall be indicated generally, but in detail for key positions.

Financial and economic evaluation

The consultants shall prepare the following and include detailed justifications:

(a) Capital cost estimates for each project. The estimates shall be broken down into production units and major components. Allowances for price and physical contingencies shall be calculated as well as interest on investment during construction and other pre-operational expenses. Costs of investment in local and foreign currency are to be shown separately;

(b) Working capital to be calculated for each project;

(c) Financial feasibility, including:

(i) Financial plan and disbursement schedule;

(ii) Production costs by categories to be tabulated as a whole, showing fixed and variable costs;

(iii) Financial performance under projected financial conditions, showing projected financial statements (income statements, cash flows and balance sheets) for the life of the projects. The financial analyses should include:

- Rates of return (simple and internal, both economic and financial);
- Payback period;
- Debit service coverage ratio;
- Changes in working capital;

(iv) Sensitivity analyses, including:

- Effect of production levels;
- Effect of sales prices;
- Effect of operating expenses;
- Effect of capital cost over-runs;

(v) Risk analyses: identification of the risks and suggestion of remedial measures;

(vi) Competitive analyses: comparison of capital and major production costs with major competitive (producer) sources.

General

Sources of information shall be indicated and major assumptions avoided unless absolutely essential and justified. Possible difficulties in implementation, management and operation of the project shall be identified and recommendations made for plans to overcome them.

The consultants shall prepare and submit their reports in English with a summary in Arabic.

Based on the report, a seminar shall be held at Baghdad, convened and arranged by the Baghdad Chamber of Commerce and Industry. The consultants shall be prepared to discuss their report at the seminar, showing how their conclusions have been reached and explaining any points as requested by the participants. The seminar shall take place over two working days, the first day being allotted to a presentation of the report and the second day to answer arising questions. The working language of the seminar may be English or Arabic, provided that an official translation service from one to the other language will be available.

Appendix 3

PRELIMINARY BUDGET, PHASE II

Country: Iraq
Project No.:
Title: Assistance to the brickmaking industry, phase II

		Total		1988		1989		1990		1991		1992	
		mm	$	mm	$	mm	$	mm	$	mm	$	mm	$
	International experts												
11-01	General management	48	440 000	7	60 000	12	105 000	12	110 000	12	115 000	5	50 000
11-02	Heavy-clay production	48	440 000	7	60 000	12	105 000	12	110 000	12	115 000	5	50 000
11-03	Brick factory maintenance	48	400 000	7	60 000	12	105 000	12	110 000	12	115 000	5	50 000
11-50	Consultants	3	32 500	1	10 000	1	10 500					1	12 000
11-99	Subtotal	147	1 352 500	22	190 000	37	325 500	36	330 000	36	345 000	16	162 000
13	Admin. support personnel		75 750		8 750		15 000		16 500		17 000		18 500
16	Other personnel costs		8 000						4 000				4 000
19-99	Total personnel component		1 436 250		198 750		340 500		350 500		362 000		184 500
39-99	Total-training component		30 000						10 000		10 000		10 000
49-99	Total-equipment		10 000		1 000		2 500		2 500		2 500		1 500
59-99	Total - miscellaneous		22 500		5 000		5 500		5 000		5 000		2 500
99-99	PROJECT TOTAL		1 498 750		204 750		348 500		367 500		379 500		198 500

Annex III

BRICKMAKING AND POLLUTION a/

CONTENTS

SUMMARY AND CONCLUSIONS

The subject has been viewed from the point of view of the industry with the clear understanding that all air pollution is potentially harmful and that it must be contained within acceptable levels. "Acceptable" has been defined as what is acceptable to the Government after having taken into account the facts as presented by the various relevant parties involved, and the wellbeing of the people.

The brickmaking process is briefly detailed and the potential sources of pollutants are indicated. With specific reference to pollutants in the fuel such as sulphur-based pollutants, it is held that the oil industry or refiners can possibly supply a refined pollution-free fuel, but that this is outside the scope of the brickmakers. On the other hand, it is technically possible for brickmakers to purify their raw materials by washing out soluble salts.

Good operating practice can minimize and sometimes eliminate (e.g. smoke) pollution. The private-sector brickmakers at Baghdad have not taken advantage of improved technology, nor is their operating practice such that pollution is minimized. The result is that they will be relocated off their present sites and out of the Baghdad area. This gives the related opportunity to take all precautions in the new area (Naharawan) to ensure that pollution control is introduced at the planning stage and that the brickmakers understand and can profitably utilize their new technology.

The costs of introducing pollution control methods may be borne by the brickmakers but the benefits will be felt by the community at large.

NOTES BASED ON THE LECTURE "BRICKMAKING AND POLLUTION"

A. Any air pollution is potentially harmful

The detailed study of air pollution is relatively new. As is usual in such cases, we have learnt that we do not know as much as we thought we did

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a/ Lecture given by the consultant on 24 February 1986 at the Baghdad Chamber of Commerce.

and much more information is needed on specific and multiple pollutants before we can say with certainty that this condition (of pollution) or that one causes this or that effect. It may be argued that this is to some extent academic. We can see smoke, smell and taste other pollutants, observe increases in respiratory diseases - even deaths - during extreme pollution occurrences.

In London, in 1952, a severe smog was blamed for 4,000 additional deaths in the city, mainly old people and young children. Air pollution has been blamed for annual maintenance costs running into many millions of pounds Sterling in Great Britain. In the Los Angeles Basin it has been said that air pollution has effectively destroyed the fruit growing industry, and cost the United States some billions of dollars.

It is now apparent that what were previously thought to be harmless concentrations of pollutants may indeed have long-term harmful effects. We can never be complacent about pollution and think, for example, that if we get rid of smoke we have solved the problem. Or, if we reduce higher levels to lower levels (of pollution) we can sit back and relax. In Great Britain there are records indicating that in areas with higher levels of air pollution, a history of chest illnesses was more common in children living in those areas than for children living in less polluted areas (see appendix I). Particulant pollutants or combinations of pollutants may have localized effects according to meteorological conditions. As can be seen in Europe, airborne pollution can have effects far away from the source and severe effects have been attributed to sources from other countries. Thus air pollution is an international as well as a national problem. One example in Iraq is that of dust pollution from natural sources which are believed to be in desert areas to the south and west of the country.

It is essential that records are made and kept of pollution levels using methods which are internationally comparable. Such records might go hand in hand with records of observations on people (health), plants, trees and animals.

Attached to these notes are some appendices with information from an Industrial Air Pollution Handbook which was compiled by over 20 specialists, and from the 51st Conference of the (British) Society for Clean Air. These books are being left as a small gift to the Baghdad Chamber of Commerce and Industry for the benefit of anyone who wishes to study the subject further and as an initial source of some reading material.

B. Pollution as related to brickmaking should be looked at from the wider background of the industry but with the firm objectives of eliminating those pollutants which can be eliminated and containing within acceptable levels those which cannot be eliminated

It could be a matter of semantics - what do we mean by "acceptable" levels? Acceptable to whom? In the personal opinion of the writer, what is "acceptable" is what is deemed to be acceptable by the Government after having considered the facts as presented to it by the various interested parties and after having taken into account the wellbeing of its people. "Acceptable" may change according to policy changes or in the light of substantially new information.

Having recently gone to visit a brick factory in Baghdad with an engineer having his first visit to such a factory, it occurred to the writer that it

may be of benefit in this lecture to discuss some of the wider aspects of brickmaking. These are related to pollution in many ways, and influence whether and how the brickmaker can effectively reduce pollution.

Air pollution is an undesirable by-product of the brickmaking process. To reduce such pollution may simply require a change in operating procedures, but more often requires additional capital and operating expense. In some cases, to suggest a change in operating procedure is seen as a direct criticism of management.

Some years ago a number of the private-sector producers at Baghdad were obliged to install more modern burner systems on their kilns with the object of eliminating smoke emissions. These systems involved an additional capital input to the business, additional operating costs for electric power and maintenance, and a higher level of operator skill. The benefits would have been a substantial reduction in air pollution - a community benefit - and possibly reduced fuel costs through more efficient combustion. An additional benefit to the brickmakers may have been the right to continue production for a longer time since the present situation is that they will be moved to an alternate location outside of Baghdad. It is important to investigate and determine exactly why these brickmakers could not or would not use the new burner systems since the same problems may arise at the new industrial estate. It is also important to recognize that smoke elimination is only part of the problem being solved - there are many other pollutants which are not so visible as smoke.

Additional costs are resisted by any industry and more so by the private sector for whom profit is essential to survival and who see such additional costs as being a direct attack on their profits, their markets and their survival. The exception is where additional costs can be shown to have some return by being an investment from which there will be a future profit. There are several possibilities:

(a) Increased operating costs = less profit;

(b) Increased operating costs = more efficient operation;

(c) Increased capital costs = less profit;

(d) Increased capital costs = increased production/quality/sales and increased profit;

(e) Without additional ing (procedural changes, increased operating and/or capital costs) permission to continue operations will be withdrawn = no profit, or, fines may be imposed = less profit.

In most cases considerable discussion and explanation will be essential and in many cases substantial assistance may be required by the brickmakers.

Sulphur in fuel is a major source of pollution and increased operating costs may simply take the form of using a fuel with a lower sulphur content. There may be no savings in operating efficiency from using such fuels but there could well be savings through reduced corrosion. There will be benefits at community level. With respect to clays, it would be possible to reduce the contents of sulphur and soluble salts by washing the clays - this implies both capital and operating expense. The benefits would be through a higher quality product free from soluble salts, possibly lowered corrosion and related problems in the firing/flue systems and possibly a (washed) raw material which is easier to process. In the case of a higher-quality product the brickmaker could be justified in asking for a higher price to offset the higher costs.

The question of higher prices, for whatever reason, is one which should be looked at in more detail. Prices affect markets, either directly by reducing the number of customers who can afford the higher prices, by making alternate goods more cost competitive etc. If higher prices are limited to only a part of an industry there is always the possibility of the part with the lower prices increasing production at the expense of the others. Without in any way reducing the objectives of eliminating/reducing the problems of air pollution, it will be seen that the related factors of production and viability should be taken into account.

Where brickmakers are operating in a manner which is satisfactory to them and they are making an acceptable profit margin, it would usually be difficult to get a voluntary change except one which offered a higher profit or one which was obviously essential for their continued operation. This is the situation which has arisen in Baghdad where extensive visible (smoke) air pollution by the private sector brickmakers and a refusal or inability to adopt practices which would at least have eliminated smoke emission, has led to the situation where their factories will be closed down and they will be obliged to move to a new industrial estate whilst at the same time updating their production methods. That this will substantially reduce pollution in Baghdad is without question, just as it is equally certain that it will introduce air pollution to Naharawan. The move of these private-sector brickmakers is a major undertaking by any standards. It is quite possible that their aggregate output is greater than that from any single factory anywhere in the world.

Brickmaking

It is perhaps relevant at this point to say something about brickmaking as a whole. Iraq would likely qualify as the birthplace of brickmaking and most Iraqis have seen ample evidence of the durability of bricks and the pleasant aesthetic qualities which even simple brick structures may have. Both ancient and modern brick structures in Iraq testify to a high level of architectural and engineering skills. It is a fact that where bricks are and have been available for a long time, professionals in the construction industry develop an unusual expertise in working with bricks as a construction medium. Equally as important as the professionals are the artisans and others who have the skills necessary to translate designs into reality. Anything which affects brickmaking affects all of these people too.

Most people "know" that bricks are made from clay, and think little more of it. In fact there may be less than 50 per cent clay in bricks and the raw materials that do go to make bricks are amongst the most variable that can be found under this one name of "clay". From the available materials, no matter how good or bad they may be, the brickmaker uses a combination of skill and technology to make a product which must be consistently acceptable in size, shape, strength etc., in numbers which run to hundreds of millions per year. The more modern, high-speed and automated the process, the more homogeneous on a consistent basis must be the raw material feed to the production machine, which in this case is an extruder. If brickmaking at Naharawan reached a level of 500 million bricks annually, this would imply a consumption of some two million tonnes of clay per year, involving the quarrying and processing of some 1.3 million cubic metres of material plus unwanted overburden and transporting by road some 1.5 million tonnes of product.

The remarkable quality of clay is that it exhibits plasticity when mixed with water. Although there are forming processes which use very little water, the process of wet extrusion, as seen in Iraq, uses a wet mixture with,

probably, a moisture content (dry basis) in excess of 20 per cent. Thus it may be seen that 1,000 bricks weighing 4 tonnes would comprise 3.33 tonnes of dry material and 670 kg of water. This water has been partly contained in the raw material as it was found in the ground, but mainly added later as part of the production process. Since the object of the water is to make the material plastic, as soon as it has been formed into a brick shape and size, the water must be removed. Such removal or drying, is accompanied by a substantial shrinkage which varies according to the different nature of different materials and the amount of water present.

Drying of bricks is the first stage in the process where a major amount of fuel is used and in some cases more fuel is used for drying than for firing the bricks. If we return to the case just mentioned of 1,000 bricks containing 670 kg of water to be removed, it can be seen that a brick factory producing 150 million bricks per year would, in this case, have to dry off 100,500 tonnes of water per year or more than 275 tonnes per day. Most of the required heat is supplied from a separate heat source (other than the kiln), some may be supplied as waste heat from the kiln, and some of the final drying will likely take place in the kiln itself. In the older system of brickmaking atmospheric drying was used. This saved a substantial amount of fuel but necessitated more handling of the bricks with associated higher labour requirements and damage to the bricks. In addition, a larger number of bricks were kept in stock over the longer drying period. Even where well-trained labour or automatic handling systems reduce damage, the ultimate economics of the system will be related to fuel costs and stock tied up in the dryer. Even so, the economics should be considered in some cases, since:

(a) There is a substantial reduction in fuel consumption;

(b) There is a subsequent reduction in pollution and the sometimes costly methods which may have to be taken to control pollution;

(c) Reduced fuel consumption will have benefits by conserving national resources.

Following the drying stage the bricks are fired to develop the durable qualities which are expected of burnt clay bricks. The traditional European school of brickmakers looks for a high degree of ceramic bonding and high strength, normally associated with the ability of bricks to withstand severe weather (e.g. wet and freezing) and perhaps loadbearing situations. In Iraq, the two principal uses of bricks appear to be where they are used as facings and may or may not be loadbearing, and where they are used in non-loadbearing situations such as in filling in between reinforced concrete work, internal walls etc. In the latter cases (non-loadbearing), if the bricks are strong enough to withstand the handling and transporting from the brickworks, they are likely to be adequately strong and the main requirements would be good shape, regular size and low soluble-salts content. Such bricks need not be so well fired, but only need to be adequately fired to develop the necessary qualities to an adequate degree. Thus firing temperature and hence fuel consumption might be reduced. In fact it would appear that for other technical reasons (high calcium-carbonate content) some bricks in Iraq are deliberately being fired at very low temperatures and giving a satisfactory product.

There are various types of kilns which can be divided into intermittent or continuous types and the continuous types can be further divided into moving fire (annular), or moving ware types. Most modern kilns are of the continuous type with a notable exception being the shuttle kiln which is an

intermittent type tunnel kiln. There is a tendency in modern factories to use tunnel kilns, i.e. moving ware types where the bricks are set on kiln cars and move through the various stages - final drying, preheating, final firing and soaking, cooling - before passing out of the kiln for sorting, packing and dispatch.

Modern kilns are relatively easy to operate, given that there is a good understanding of how they work. With particular reference to tunnel kilns, it is essential that skilled maintenance services are available for the mechanical, electrical and instrument components. Tunnel kilns can be operated by a single person per shift who checks the various operations, loads and unloads kiln cars into and out of the kiln. Such an operator must be capable of recognizing when faults or problems are appearing which require assistance. In other words, modern kilns, whilst capable of minimizing pollution if properly operated, require a higher investment in equipment and personnel than did the older, simpler kilns.

The Hoffmann-type kiln was first used some 130 years ago and the design has changed through the years to make the operation more efficient, reduce labour requirements, improve the quality of the burnt bricks and to reduce fuel consumption. Modern kilns can be loaded and unloaded using forklift trucks and with modern burning systems they are as pollution-free as tunnel kilns - which may not mean too much if the fuel and the raw materials are sources of, for example, sulphur- or fluorine-based pollutants. The Hoffmann kiln would likely be cheaper and easier to operate than a tunnel kiln, and there is much to recommend it for these reasons unless a tunnel kiln is essential for some special purpose such as maintaining a very accurate control over firing schedules.

Particularly in recent years, due to higher oil prices, there has been much development in the fuel efficiency of kilns and this has, by virtue of lower fuel consumption, led to lower levels of fuel-based pollution. On the other hand, increased industrialization has led to higher fuel consumption.

Pollution

Pollution, as we are dealing with it here, is the introduction of unnatural material from brick manufacture into the environment. Other industries also pollute the environment, as does nature herself, e.g. from forest fires, volcanoes, decaying vegetation etc.

All brick factories pollute the air (assuming that the product is burnt clay bricks) and those which produce smoke are more obvious than those which do not. The sources of air pollution from such factories are:

(a) Material treatment processes;

(b) Combustion processes;

(c) Fuel;

(d) Clays and other raw materials;

(e) Water.

The above can be divided into the actual materials which contain pollutants, e.g. clay, fuel, water etc., and the systems by which pollutants are produced or released, such as crushing, grinding, screening, burning etc.

Material treatment and transportation processes are sources of pollution in the form of dust which is usually of sufficiently large particle size that it settles out fairly close to the source. Even so, such dust must be contained and if necessary filtered out of the atmosphere. Continued exposure can cause serious illness in some cases, e.g. silicosis. Using fan-induced draft and bag filters is usually an adequate system of collection. Proper design of conveying systems and hoppers can prevent the spread of dust and reduce the need for dust collection systems.

Air pollution from brickworks' chimneys or flues is mainly a product of the combustion process but may also contain harmful pollutants from the raw materials used in the process of brickmaking. The pollutants may be gaseous, vapours, fumes, dust or grit. With respect to solid matter, fume can be taken to be solid matter if the particle size is less than 1 μm(1), dust as solid matter if the particle size is +1 to 100 μm, and grit is taken as solid matter if the particle size is +100 to 1,000 μm. The principal pollutants from brickmaking would be carbon dioxide, carbon monoxide, water vapour, sulphur dioxide, sulphur trioxide, hydrogen fluoride and soot - the composition of which might vary. Methods of reducing this pollution are those which eliminate the pollutant at the source - purification of raw materials and fuels, those which eliminate or reduce the production of pollutants - more efficient burning processes and reduction of fuel consumption, and those which seek to eliminate or reduce the harmful pollutants in the flue gases, e.g. neutralizing hydrogen fluoride with lime in the stack or flue. When other methods are not successful or perhaps cannot be implemented for economic or technical reasons, tall chimneys are used as a means of dispersing pollutants such that (hopefully) natural elimination processes will deal with them or the concentration will be too low to be of significance.

The "solution"

It would be nice to say that there is an easy solution to the problems of pollution - there is not! As has already been indicated, there are some steps which can be taken and there are targets to be aimed for to eliminate, reduce or contain the pollutants within acceptable levels.

Since oil is the principal fuel used in Iraq, it is not proposed to deal with solid fuels such as coal and coke. With respect to oil, refining is a major process in its own right, and no brickworks has the ability to afford a refining plant to remove pollutants such as sulphur and fluorine. If lower-sulphur oils were available, probably from a refinery as opposed to natural sources in Iraq, they would cost more than the present fuel oils but would substantially contribute to the elimination of at least a part, possibly a major part, of sulphur-based pollution. Sulphur-free oil coupled with washed clays could virtually eliminate pollution through sulphur in flue gases. This might be expensive, and at least in terms of fuel purification could hardly be justified on the basis of the consumption of the brickmaking industry alone.

A second important pollutant found in fuels and in clays is that of fluorine, probably present as a fluoride. This is easier to neutralize in the flue gases, although any clay washing process would also have the potential to remove soluble fluorides as well as soluble sulphates and other soluble salts. Fine lime powder blown into the flue gases e.g. in the stack, will react with the hydrogen fluoride to form the relatively harmless calcium fluoride.

It may be recalled that the wet bricks contain a substantial amount of water, e.g. typically 670 mls per brick, certainly sufficient to contain large amounts of soluble salts in solution. Where such soluble salts exist in the clays, the water being removed from the wet bricks travels via the pores in the brick to the surface where it evaporates. Salt formation (precipitation) takes place on the bricks surfaces, typically this may be concentrated in order of magnitude at the corners, arrises and plain surfaces. These salts may be volatolized in the burner flames or simply carried off in the gas flue, in either case to contribute to the potential for air pollution. Otherwise they may remain on or under the surface of the bricks to cause other problems later. There are several methods of removing or reducing the potential for pollution from soluble salts:

(a) Washing the clay, removing the soluble salts from concentrates of wash water;

(b) Adding chemicals to the clay which would convert the soluble salts into insoluble salts, one example being the addition of barium chloride to react with calcium sulphate to form the insoluble barium sulphate;

(c) Adding some soluble material to the clay which will inhibit the solution of soluble salts or interfere with transportation of such salts to the surface of the bricks. The material added should not in itself be a pollutant or harmful to the bricks, e.g. some soluble hydrocarbon;

(d) Spraying the surface of the bricks with, e.g. tar, to inhibit or prevent precipitation of soluble salts at the surface.

The various methods must be considered in terms of their suitability under prevailing conditions and a short development programme might indicate the best course of action to be taken. With respect to Naharawan, it is highly desirable to know at the planning stage which steps can be taken to minimize pollution since this may influence the efficiency of initial investments.

As with the actual clay raw material, all other materials used in the brickmaking process should be analysed to determine if they contain pollutants and to determine how such pollutants can be removed. Water is an obvious source of pollutants (dissolved salts etc.) and one which may lend itself to chemical treatment.

If one looks at the old brickmaking areas of Baghdad where many Hoffmann-type kilns are pouring smoke and other pollution into the air there are some immediate remarks which can be made:

(a) Some kilns smoke more than others implying that the "smokeless" kilns are being operated better or that they are simply not being fed with fuel at the time. (Some kilns are not being operated at all - the fires being out - and these are excluded from these observations.) The implications are that (i) all kilns could be operated better to reduce smoking, or (ii) more regular fuel feeding rather than heavy intermittent feeding would also reduce smoking;

(b) Many of the chimneys are badly cracked. This means that cold air is drawn into the flue system, reducing the temperature of the flue gases, possibly causing acid precipitation, certainly overloading the flues and also reducing the effective height of the chimney to cause higher concentrations of pollution at lower levels;

(c) Where paper seals are not properly made inside the kiln, cold air is drawn into the flue system, with similar types of effect as just mentioned for cracked chimneys;

(d) Burner systems which would have permitted much better combustion have largely been scrapped and are no longer in use;

(e) Where the next chamber is being taken on fire, the temperature in the chamber was too low to encourage efficient combustion - this could not be said of all kilns, since not all were examined. In this type of Hoffmann kiln it is not unusual to take on the fires in a "V" formation to allow for the fact that the centre of the kiln is hotter before the sides, due to the pattern of gas flow. This may be better understood from the following figure.

Representation of fireholes on Hoffman kiln

	1	2	3	4	5	6	7	8
a	*	*	*	*	*	*	*	*
b	*	*	*	*	*	*	*	*
c	*	*	*	*	*	*	*	*
d	*	*	*	*	*	*	*	*
e	*	*	*	*	*	*	*	*

In the figure the asterisks represent the fireholes, and we can assume that the row 1, 2, 3 and 4 are in the next chamber ready to be taken on fire. In the kiln, hot air is moving from the right where the chambers are currently under fire, towards the left where it heats up the colder bricks and eventually passes out of the kiln through the flues and chimney. Maximum airflow rate will be at the centre of the kiln, i.e. line "c". Since better combustion takes place with higher temperature, it is logical to take the new fires on in the order 4c; 4b, c, d and 3; 4a, b, c, d, e, 3b, c, d and 2; 4a, b, c, d, e, 3a, b, c, d, e, 2b, c, d and 1; etc. until all the feedholes are being used. It may be obvious that the detailed row by row example given here need not be adhered to religiously, it is the condition of the kiln temperature pattern which indicates how the fires should be taken on. At the same time, if the kiln is pressurized due to excessive ingress of cold air (past the paper seals and through cracked chimney) such that there is insufficient combustion air being drawn into the firing zone and the products of combustion are not escaping fast enough, there will be bad combustion with the resultant smoke and high carbon monoxide emissions.

It is not certain as to why the private-sector brickmakers effectively discarded the new burner systems which were introduced at considerable cost. It may have been that they simply did not understand the operation and maintenance of these new systems, that the older systems were easier and less expensive to operate, or for some other reasons. The fact appears to be that the problem of air pollution will be solved by compulsory removal of these brickmakers from the sites within Baghdad. This brings about the potential of other problems related to air pollution elsewhere and to the need for the brickmakers to modernize their production if they are to re-establish themselves at Naharawan.

When all possible steps have been taken to minimize or eliminate air pollution and the emissions are still unacceptable, the final solution is to raise the height of the chimneys. In the United Kingdom of Great Britain and Northern Ireland, this has in some case resulted in chimney heights of 80 metres. However, with the establishment of new brick factories there is much that can be done to eliminate air pollution or at least to see that the effects are minimized. The locations of domestic dwellings should take into account the location of industrial facilities, both present and making allowance for future planning. Topographical and meteorological factors should be taken into account (if the relevant information is available) to ensure that effluent from chimneys will actually be assisted by weather and other local factors, in being dispersed or directed away from habitation and people or other areas where there may be damage.

Appendix 1

EXTRACTS FROM INDUSTRIAL AIR POLLUTION HANDBOOK a/

Pages 21-22

"Clifton et al. used the daily totals of bronchitis certificates from the working population in Sheffield as an index of incapacity with which to attempt correlation with changes in measured concentrations of smoke and sulphur dioxide. They found that relatively small increases in pollution during brief smog episodes were accompanied or followed by a doubling of numbers of certificates of bronchitis for a day or so."

"Lawther et al. concluded that the minimum daily concentration leading to a change in health was 500 $\mu g\ m^{-3}$ of sulphur dioxide accompanied by 250 $\mu g\ m^{-3}$ of smoke. Lawther also thought that during such 24-hour averages of pollution, relatively brief periods of much higher concentrations are probably responsible for the clinical effects, but of this there is no proof."

"A study made in 1966 by Colley and Reid again showed that children born in different parts of Britain still exhibit differences in the number of attacks of acute respiratory illnesses. In this study there were clinical examinations and a survey of symptoms in 10,000 children living in contrasting areas of England and Wales. A history of past chest illness was commoner in children living in areas with high levels of air pollution than in those in less polluted districts ... pollution by smoke and sulphur dioxide was worse in those areas where the children's lungs performed least well."

Pages 32 ... 41

"Air pollution from man's industrial and domestic activities has long been known to have significant and occasionally devastating effects on plants, under both cultivated and natural conditions, and on animals."

"The principal air pollutants responsible for damage to plants are sulphur dioxide, fluorides, smoke, soot, dusts and the components of photochemical smog; most harm to farm animals results from fluorides and metallic dusts. General, plants are more susceptible to damage by gaseous pollutants, whereas animals seem to be more susceptible to damage either directly or indirectly by particulate pollutants."

"2.2.2.2. Fluorides
"Damage to plants and animals by fluorides in usually localized in areas affected by emissions of fluoride-containing compounds, principally from brick, ceramic and other industries which use fluoride-containing clays or which, as in the case of aluminium production, employ cryolite as a flux in their processes."

Pages 12-13

"Cost of damage by air pollution
"In November 1972 the Programme and Analyses unit of the British Department of Trade and Industry and UK Atomic Energy Authority working in cooperation

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a/ A. Parker, ed., McGraw-Hill.

issued a report on 'An Economic and Technical Appraisal of Air Pollution in the United Kingdom'. That report gave the direct annual cost of the damage due to air pollution at about £410 million per annum, including £5 million for window cleaning, £42 million for corrosion and protection of metals, £33 million for damage to textiles, paper etc., £195 million for damage to agricultural produce and £130 million for damage to health. In addition the report estimated a total of about £780 million per year for social or disamenity cost, including £510 million for health and £100 million for amenity, so that the overall total of these estimates was in the region of £1,190 million a year, which is equivalent to about £21 per capita."

"Whilst there is often a real cost involved in reducing or eliminating pollution, it will be apparent from the above figures that there are savings to be made too. The savings are not always directly or easily seen by the industrialists who have to control pollution since such savings may be realized on a community basis or even accrue to other sectors of industry."

Appendix 2

EXTRACT FROM TRENDS IN ACIDIFICATION OF PRECIPITATION IN THE UK AND WESTERN EUROPE a/

Page 7

"Table 1
Examples of Annual European SO_2 Emissions (as Sulphur, millions of tonnes)

	1950	1972	1980
Czechoslovakia	0.50	1.43	1.55
France	0.86	1.50	1.60
German Democratic Republic	1.56	2.74	2.00
German Federal Republic	1.36	2.10	1.79
Norway	0.02	0.09	0.07
Sweden	0.09	0.46	0.22
United Kingdom	2.60	3.26	2.34
Europe (excluding Soviet Union)	9.99	18.35	19.98

Cox, R. A., Ozone Formation and National Trends (page 1)."

"The presence of ozone in the air at ground level was recognized quite soon after the discovery of ozone in the middle of the last century. It was detected by its strong oxydising effect and became associated with clean 'healthy' air, particularly at the seaside. Towards the end of the nineteenth century spectroscopic observations in the atmosphere revealed that ozone is present at about 25 km altitude in much higher abundance than near the earth's surface. ... Thus ozone is a natural component of clean air, the amount depending on location, season, and other meteorological factors. The fact that ozone concentrations could become high in polluted air was first discovered in Southern California during studies of air pollution in the Los Angeles area in the late 1940s ... Subsequently, research by Haagen-Smit and co-workers in the 1950s shows that ozone formations occurs by photochemical reactions in the atmosphere involving nitrogen oxides and unburnt hydrocarbons, originating from motor vehicle emissions and other combustion and industrial sources. Since ozone is formed from reactions of primary pollutants in the atmosphere it is termed a secondary pollutant."

"The most economically important effects of photochemical ozone are on agricultural crops and other vegetation. The smogs of Southern California eliminated citrus fruit growing in the Los Angeles basin, and damage to numerous tree species and a variety of crops are well documented. The loss of crop value due to damage by elevated ozone in the United States has been assessed at three billion dollars. Recently it has been suggested that ozone damage may be an important factor in forest dieback in the Federal Republic of Germany, which is at the centre of current debate regarding acid deposition."

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a/ By C. F. Barrett.

Appendix 3

SOME QUESTIONS AND ANSWERS FOLLOWING THE LECTURE

Q.1: In using a gas analyser it was found that there was an excess of carbon monoxide in the flue gasses. What is the cause of this?

A.1: Assuming that the kiln had an adequate combustion system it is probable that large excesses of carbon monoxide are caused by poor process control or, as a result of poor maintenance.

An example was where a kiln operator noted that the kiln temperature was too low and he increased the gas flow to the relevant burners. The kiln temperature continued to drop and the operator further increased the gas flow - again, the temperature continued to drop.

In fact, the initial temperature drop had been caused by a lack of air (i.e. an excess of gas) and not by a lack of fuel. Therefore, in increasing the gas flow, the operator was making the problem worse and, apart from the excessively low kiln temperature, the poor combustion in this case would have given rise to excessive carbon monoxide emission.

Where poor process control is suspected, it is necessary to examine the process to discover where the necessary adjustments are needed. This presupposes a knowledge of the process.

With respect to maintenance, the process relies upon the efficient operation of plant and equipment such that it can operate properly. This includes such things as repairing cracks in gas flues and chimneys, keeping fans (and their blades) in good condition, maintaining good seals on kiln cars etc.

Q.2: Where should residential areas be sited in Naharawan with respect to industrial sites? Were specific minimum distances set in other countries between industrial and residential areas?

A.2: The location of residential areas relative to industrial areas might vary according to the nature of local meteorological and topographical features.

A simple example is that where there is a single predominant wind direction, due notice is taken of this in the relative positioning of industrial and domestic areas. At the same time, it is necessary to take account of the workers' preferences to be located reasonably close to their workplace but with the over-riding factor being that of health.

It is not known if specific mandatory minimum distances are set by some countries, because the factors which might influence the effectiveness will vary from place to place. However, it is normal that industrial sites and domestic sites are kept strictly apart in many countries and the construction of homes within, or domestic use of, industrial sites is totally forbidden. Similarly where there are different areas set aside for different industries and commercial enterprises.

With respect to Naharawan a growth centre was being created which might eventually grow into a town. There is the opportunity to ensure that all possible measures are taken now with respect to air pollution and environmental matters.

Q.3: Did Mr. Buchanan advocate atmospheric drying or artificial drying?

A.3: Both atmospheric drying and artificial drying should be considered to determine which was most economic. In particular, modern handling techniques and atmospheric drying may have some application. However, fuel prices would be an important determining factor with respect to the economics of the systems, as would the large number of bricks tied up in stock with atmospheric drying.

In referring specifically to Naharawan, where aggregate production might reach 500 million bricks per year, artificial drying would be advocated.

It was pointed out that in view of the large amounts of water to be dried off, e.g. some 667 kg of water per 1,000 bricks, the drying process can consume as much fuel as the firing process and can, therefore, contribute just as much to air pollution from that combustion.

Q.4: Which type of kiln would be advocated, the "cut-end" Hoffmann or a tunnel kiln?

A.4: If properly operated, the tunnel kiln is better for high-output regular production and gives better control over the firing process. It does, however, represent a higher capital cost, is of more advanced technology, and requires a higher level of maintenance staff than does the Hoffmann-type kiln. The Hoffmann-type kiln is perfectly adequate for many applications and both systems should be evaluated on their merits at the time of analyses for each individual factory.

Q.5: With respect to Naharawan, are there any suggestions with respect to the (clay) quarry?

A.5: It has already been suggested by others that a common quarry could be a viable proposition. This view was agreed with in that it permitted reduced material costs through economies of scale in terms of equipment. Allowance would have to be made at the quarry, or at the sites of the individual brick factories, for storage of clay materials during wet weather.

Q.6: Is it possible to reduce the amount of water used in the brickmaking process?

A.6: The extrusion process used in the Baghdad area was the so-called soft extrusion process. The "stiff" extrusion process uses substantially less water but much higher power consumption to produce a dryer, stiffer product. From what little has been seen of Baghdad clays, they are fine grained and it is not certain if they can be adapted to the stiff extrusion process. Stiff extrusion sometimes creates difficulties with drying where the permeability of the clay body is reduced.

Subsequent to the lecture a second possibility was mentioned, i.e. that of examining the possibility of using electrolytes to alter the rheological properties of the clays.

Annex IV

JOB DESCRIPTION

Post title:	Consultant in Traditional Ceramic Industry
Duration:	1 month
Duty station:	Kerbala
Purpose of project:	To provide advice on how the traditional potteries of Kerbala can upgrade their production efficiency and techniques while retaining traditional skills for which they are famous.
Duties:	The consultant will be attached to the Kerbala Chamber of Commerce and Industry through the Federation of Iraqi Chambers of Commerce and Industry and will work in close co-operation with the Chamber and the management of the potteries to carry out the following duties: (a) Analyse the problems of the two main potteries at Kerbala with a view to assisting them in the development of a more efficient process-flow system in their new locations; (b) Advise in detail how the potteries might upgrade their technology, increase output and reduce operating costs; (c) Advise in detail how the existing traditional skills in design and other aspects of ceramic technology can be retained within the arrangement of a modernized industrial/craft pottery; The consultant will be expected to prepare a final report setting out the findings of the mission and the recommendations to the Government on action which might be taken.
Qualifications:	Extensive practical experience in both industrialized and craft pottery manufacture. Experience in carrying out economic evaluations of ceramic factories and preparation of cost-benefit analyses.
Language:	English, knowledge of Arabic useful.
Background information:	The Government of Iraq is encouraging private industry to modernize production methods, sometimes this being tied with the needs for the factory to move out of town or residential areas into industrial areas supplied by the Government. The potteries at Kerbala are world-famous for the ceramic wares they produce for mosques as well as for private use. The potteries are being

relocated and will at the same time introduce more modern production methods. There is an urgent need to develop such modernization within an overall plan for creating an efficient process-flow in the factories.

The traditional crafts in the potteries are based upon generations of inherited experience and it is considered essential that any modernization should be such that the potteries will still retain the ability to employ and utilize the traditional craft persons.

There is the potential for a substantial export market for the products of a more industrialized pottery industry and this should be examined and considered as a possible justification for increasing the production.