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JORDAN

Technical report: Ceramics*

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

Based on the work of P.J. Batchelor

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INTRODUCTION

This mission has been carried out at the request of the Ministry of Industry.

Broad conclusions were drawn from information obtained during a previous mission to Jordan (October - November 1989), when it was established that

- (a) Raw materials required for the manufacture of ceramics are available in Jordan.
- (b) Jordanians adapt well to working within the industry at the shop floor level, and because the industry is labour intensive significant employment can be created.
- (c) Because the clay based industries are new to Jordan there is a severe shortage of technical knowhow.
- (d) The market for ceramic products in Jordan is small but the potential to export is considerable.
- (e) Fuel and other energy costs in Jordan compare favorably with those in countries which have established ceramic industries.

After considering the above it was felt that a more detailed review of the prospects of establishing clay based industries in Jordan should be undertaken. This work was carried out during March and April 1990, and a brief report now follows.

THE CLAY BASED INDUSTRIES

The term "ceramics" is very often misunderstood. Many people associate it with the manufacture of dinnerware (cups and saucers) only. Others think of it as referring to artistic ware only.

In the U.S.A. the term also embraces the glass and silica industries, and in other parts of the world ceramics only applies to the hobby potter.

To avoid any confusion we will refer to the "clay based industries". This embraces any industry which uses clay as the main

constituent material.

The most important products falling into this category are.
Heavy clay products - usually made from red burning clays.

- Building bricks and pipes
- Refractory bricks and slabs
- Sewer pipes
- Roof tiles

White ware products - made from white burning clays.

- Sanitary ware
- Wall tiles
- Dinnerware
- Electrical insulators
- Technical ceramics

Artware - which can be made from either red or white clay or a combination of both.

- Vases, ashtrays etc
- Lamps
- Figurines

MATERIALS USED

There are many variations of body recipes (raw material mixers) used.

The difference from one mix to another is usually in the proportions of each constituent used.

Heavy clay products can be manufactured from raw clays which need little processing. However white ware bodies are more complex and the materials must undergo extensive processing if consistent good quality products are to be made.

Raw materials required for the production of whiteware fall into three categories.

Body materials

- Clays
- Feldspar
- Silica
- Granite (as feldspar substitute)

Glaze materials

Frit (as prepared silica)

Colouring oxides

China clay

Decorating materials

Oxides

Prepared colours for screen printing etc.

Most of the above are found in Jordan in the natural state but to bring these materials to an acceptable quality they need to be beneficiated (processed).

The equipment required for beneficiation is relatively simple and inexpensive.

however the expertise required is complex and is not available in Jordan.

Of the materials used clays form the largest bulk in a ceramic body.

so far acceptable quality clays (after beneficiation). have been found in the following areas. (See map appendix A).

MAHIS - 20 km North West of Amman

AL MUDAWWARA - In the South close to the Saudi border

AZRAQ

Of these, the deposits at Al Mudawwara seem to be the most promising.

A visit was made to this area, and the deposits were examined. A small representative sample was taken for analysis. The clay is of sedimentary origin and is found in large hills.

Although some 15 km from the main road it is easy to extract and appears to be of consistent quality.

A chemical analysis of the material revealed the following composition. (by percentage)

SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	TiO ₂	CaO	MgO	K ₂ O	Na ₂ O ₃	L.O.I
50.85	29.86	2.46	2.80	0.56	0.69	2.50	2.36	7.38

This compares well with the average ultimate analysis of clay compiled from Ries which is as follows

SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	CaO	MgO	K ₂ O	TiO ₂	L.O.I.
57.84	28.66	0.91	0.18	0.32	0.80	0.00	10.37

(L.O.I - Loss on Ignition).

Physical tests were also carried out on this material. (Details are given in appendix B).

To illustrate the commercial potential of this material - Jordan Mining Company sells local clay to the ceramic industry for 6 J.D. per tonne.

Processed Jordanian materials is unavailable, and the ceramic companies purchase imported clays which cost 120 - 125 JD per tonne. At the very most it would cost 10 JD per tonne to process Jordanian clays to an acceptable quality standard.

CURRENT PRODUCTION IN JORDAN

There is one large company with 4 separate but interdependant production units.

1. Sanitary ware plant
2. Artware plant (Joint venture with China)
3. Twice fired tile plant
4. Very modern once fired tile plant.

This company has been in existence for many years and enjoys a good reputation in both the local and export markets.

Another company due to commence production in April 1990 has been established to manufacture wall and floor tiles, mainly for export.

Considerable capital investment has resulted in the establishment of this very modern and complex production facility.

There are two substantial factories set up to manufacture heavy clay products.

One (not operating during the consultants visit), manufactures building bricks and hollow blocks. The kilns are not of modern design and the equipment is in need of re-furbishment. It would

be difficult to justify any capital investment at this plant or indeed to find any justification for continuing the operation.

The other plant is modern and very well constructed. It was built some eight years ago to manufacture ceramic sewer pipes. There is no market for this product in Jordan, (all pipes now being of plastic or concrete).

The company has tried to diversify into other products such as building blocks and roof tiles, but have not been successful, as a result the plant is working at less than 10% capacity.

In addition to the plants described above, there are many small studios workshops making traditional handicrafts and household dishes.

REVIEW OF TECHNICAL INFORMATION

Using the library at the Ministry of Industry as a base. A review of all technical information apertaining to Jordanian ceramic raw materials was carried out.

This exercise revealed some^{surr}prising information.

For instance over the last 25 years, there have been seventeen technical reports written about Jordanian clays.

Generallly they contain much detail about the geology and chemistry of clays, and most contain a chemical analysis of the materials under study.

The conclusions drawn are similar in that they suggest that Jordanian materials are not as suitable as imported materials for the manufacture of ceramics.

however in each case a comparison was drawn between the chemical composition of the Jordanian material unprocessed and the imported materials which have been carefully processed.

In fact many of the Jordanian materials when processed compare favourably with imports.

After carefully reviewing all of the work previously carried out

the following conclusions are drawn.

- (a) Many studies have been completed on Jordanian clays, but because of lack of experience, misleading conclusions were drawn.
- (b) There is enough technical information in the reports to allow a detailed evaluation of Jordan materials to be made without the necessity to conduct further studies.
- (c) It would be preferable to adopt a practical approach to the development of the industry. The objective would be to look at the Jordanian materials and determine what products could be manufactured from them and how the physical and chemical properties could be changed to advantage.

DEVELOPING THE INDUSTRY

Again following the practical approach it is logical to assume that a ceramic product manufacturing industry cannot be developed unless the manufacturers have access to good quality prepared materials. However, the present Jordanian market for materials does not justify the expense of a refinery. On the other hand the export potential cannot be realized until Jordan is in a position to offer refined materials.

A further handicap is the fact that Jordan does not have the technical and marketing skills to develop the concept of beneficiating raw materials for export.

PROPOSED JOINT-VENTURE - ESMALGLASS/JORDAN MINING COMPANY

The Jordan mining company has a license to mine most of the materials required for the manufacture of ceramics.

Discussions with Mr Yousef Al-Nimri confirmed that the company would like to become involved in offering processed raw materials. Visits to N.R.A. and Jordan Phosphate company pilot plant facility confirmed the consultants opinion that, although Jordan has the

manpower and resources to carry out technical evaluation of materials it does not have the people with the knowhow or marketing experience to develop a commercial operation.

An idea was discussed with Mr Nimri to form a joint venture with a well know European processor of ceramic raw materials. The consultant made several enquiries which resulted in an interest from ESMALGLASS a major supplier of prepared materials in Europe, based in Spain. Mr Parry together with the ESMALGLASS consultant on clays visited Jordan to discuss the possibility of a Joint Venture and a copy of the notes relating to these discussions are enclosed (Appendix C).

briefly the visit concluded with an agreement that Jordan mining company and Esmalglass would persue the possibilities of forming a joint venture.

The proposed enterprise would have the following objectives:

- (a) To process local clays feldspars and silica for use in the Jordanian ceramic industry.
- (b) To promote these materials for export.
- (c) To set up a plant to manufacture frits and glazes for use in the local industry and for export.
- (d) To develop other services required in the ceramic and related industries.

THE ARTWARE INDUSTRY

As part of the evaluation of Jordanian clays the deposit at MAHIS was studied.

The clay lies in lenses in an area about 20 km from Amman.

because of the structure of the deposit very limited supplies of good quality clay exist (MAHIS 1). However there is an abundance of material which has a high iron content (MAHIS 2 and MAHIS 3). This material is not suitable for the manufacturing of white ware, but because of its physical properties (good placticity and nigh green strength), it is ideal for the manufacture of artware.

The techniques required to use this material are not in common use, however there is a material of similar properties used very successfully in Canada.

Blue Mountain Pottery in Ontario (the largest pottery in Canada) has many years experience in manufacturing artware from this material.

Contact was made with Blue Mountain who have expressed an interest in providing technical knowhow and training inputs to a Jordanian company set up to manufacture similar products.

Two Jordanian businessmen have expressed interest in developing a factory to produce artware under license to Blue Mountain. Several discussions have taken place at the Canadian Embassy.

Mr William Pourd (First Sec. Commercial and Consul) has been very helpful, and as a result of his co-operation the Jordanian promoters will shortly visit Blue Mountain Pottery in Canada for discussions (See separate note Appendix D).

TABLEWARE - Tableware is not currently manufactured in Jordan. The Jordanian refined materials will be suitable for the manufacture of semi vitreous earthenware (the most common product found in Europe).

The manufacture of tableware is a complex operation, it is very much a fashion oriented industry. Any Jordanian intending to invest in a manufacturing facility would be advised to seek co-operation from an established manufacturer.

Heavy Clay Industries - Construction methods in Jordan rely heavily upon the use of concrete and stone and there is therefore very little use made of bricks or hollow clay blocks. However several neighbouring states use hollow blocks and the export potential for these should be investigated.

Clay roof tiles are becoming more popular in Jordan. Freight costs make this an expensive commodity to import.

There is therefore scope to manufacture good quality roof tiles for local use and for export.

TILES AND SANITARYWARE - The two established plants have adequate capacity to satisfy the local market and current export potential.

both rely heavily upon export markets-especially Iraq.

It is important to note however that the ceramic industry in these countries is growing. (Iraq is currently building four plants). This will make it increasingly difficult to secure orders for finished products, but the prospects for exporting Jordanian processed materials will improve.

OTHER PRODUCTS

There are many other products suitable for manufacture in Jordan these include

- Electrical insulators (low tension)
- Filters
- Refractories
- Drilling muds

CONCLUSIONS

Very early in the mission it was established that a viable industry could be developed in the clay based industries.

There are few industries with an export potential which can be established using Jordanian materials.

It was felt that further academic exercises were not needed.

Positive steps towards establishing commercial enterprises was the primary aim.

We have proved that it is possible to attract foreign interest in helping develop this industry, and, that in a relatively short time encouraging progress can be made.

A start has been made but there is still much to do.

It will be important for all parties, The Ministry of Industry, U.N.D.P., local investors and foreign partners, to maintain the momentum started.

We must remind ourselves that success can only be claimed when an industry is created using Jordanian materials and skills.

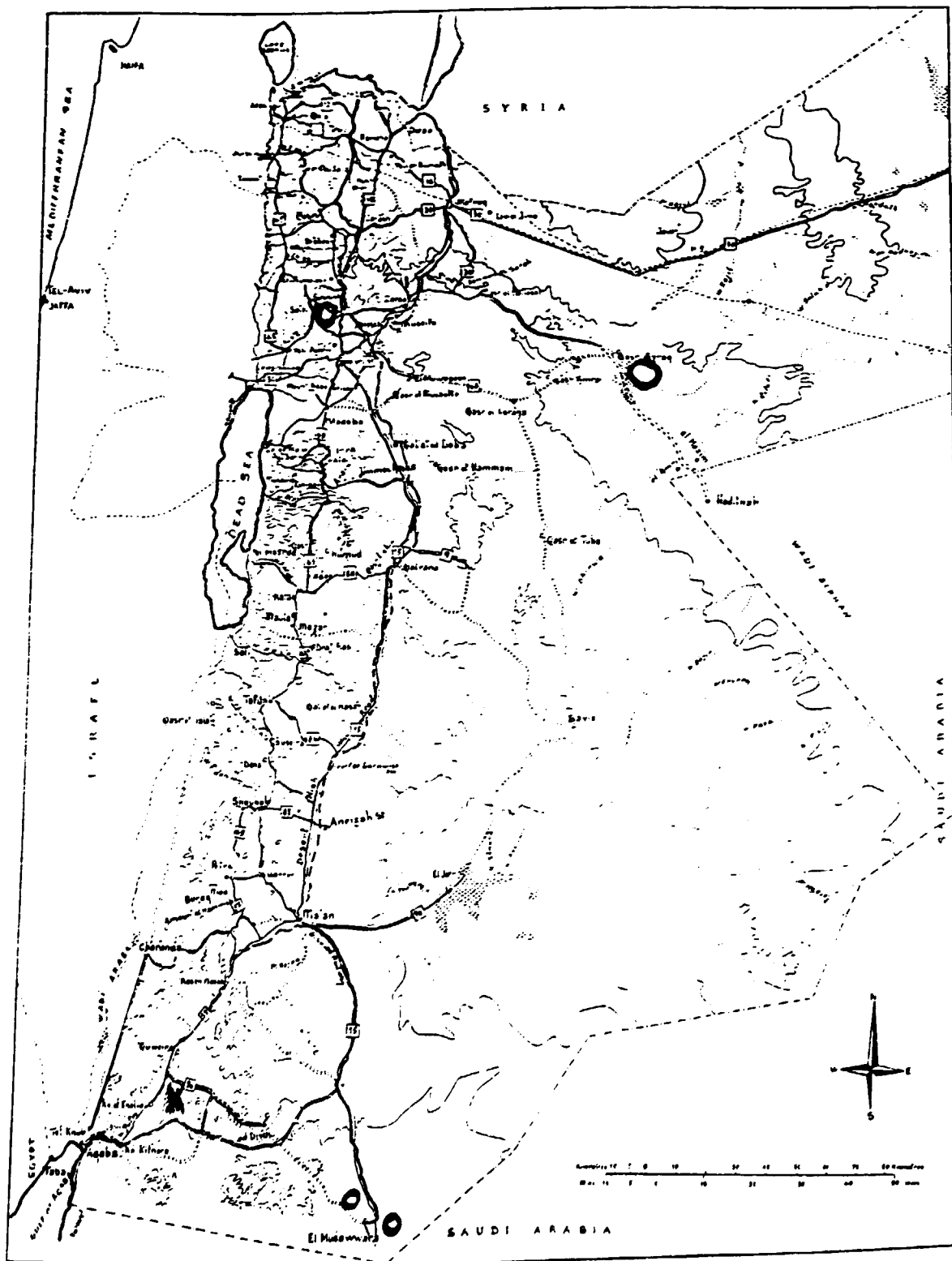
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- APPENDIX C. COPY OF NOTES OF DISCUSSIONS HELD BETWEEN
ESMALGLASS AND JORDAN MINING COMPANY.
- APPENDIX D. COPY OF NOTES ON POSSIBLE INVOLVEMENT OF
BLUE MOUNTAIN POTTERY CANADA

APPENDIX A

0 CLAY DEPOSITS

X FELDSPAR DEPOSITS



APPENDIX B

Physical test carried out on small sample of clay from Mudawwara deposit.

Residue on 0.4 mm mesh 14.56 %

Residue on 0.25 mm mesh 2.54 %

Shrinkage :

Sample not sieved. Slopped up, dried down to $\pm 6\%$ mc

Then pressed in lab press. Not magnet fired on Glost tile

kiln : (two identical samples)

Sample A	Shrinkage	2.3 %
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	L.O.I	10.46 %
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Sample B	Shrinkage	1.75 %
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	L.O.I	10.56 %
--	-------	---------

Fired on S/ware kiln (two samples)

Sample A	Shrinkage	10.6 %
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	L.O.I	10.9 %
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Sample B	Shrinkage	9.9 %
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	L.O.I	12.93 %
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NOTES REFERENCE POSSIBLE COOPERATION BETWEEN
JORDAN MINING CO. AND ESMALGLASS

Circulation

- Mr. Yousif Al-Nimri (JMC)
- Mr. Gwyn T. Parry (Esmalglass)
- Mr. Peter Batchelor (UNDP)
- Mr. Usama Mufti (UNDP)
- Dr. Bani Hani (Ministry of Industry)

Further to our discussions in the offices of JMC, I detail below some notes which I hope may give a "Minute" of our meeting.

The purpose of the writers visit to Jordan was to discuss the involvement of Esmalglass International in a joint venture, in some form or other, aimed at the expansion/creation of a Jordanian based ceramic industry in cooperation with the Jordan Mining Co.

We know little of the commercial history of the Middle East. but believe it has been an area of "cross roads"- an area which has provided an arena for business. commerce and trading.

The Lebanon was, for many years the most important centre.

We can see in Jordan -in its style, political stability and geographical position- a potential to develop a major commercial centre.

The inputs of Esmalglass in such a venture would be to supply specialized raw materials, and most importantly technical and marketing advice, support, training etc.

The writer wishes to express, at this stage, his thanks for the support and interest taken by the UNDP and particularly Mr. Peter Batchelor, Ceramics Expert, and Mr. Usama Mufti, Project Coordinator.

The following may be helpful as first thoughts of and opinions by G.T. Parry, and serve as points for future discussion.

On several occasions we have been told that Jordan does not have an abundance of resources.

In fact it does- it has the most important resource- its people.

The writer is impressed with the people, and their courtesy. The attitude has been friendly and helpful, indicating, pride and confidence.

The people met were willing and intelligent.

The most important resource within the Esmalgiass operation is the human one. Any venture here requires an input from the right calibre of people.

Regarding resources, Jordan does possess basic minerals which given the right technology in processing can be used to advantage in the clay based industries. These materials will be important as a substitute for imports and as a potential Jordanian export.

Current ceramic production in Jordan may not justify the construction of a facility to manufacture and process raw materials. However, the ceramic manufacturing industries cannot develop without the benefit of good technical know-how and access to locally produced materials.

Furthermore, for the reasons outlined above, Jordan must consider its neighbours an extension of its market- a vast area from Turkey in the North, Iraq to the East, the Gulf to the South, and Egypt to the West.

The proposal therefore, offered at our recent meeting, was that from a ceramic point of view Jordan should aim to become a cross roads, not only for finished ceramic products, but for processed technical products, raw materials, and on to equipment and other ancilliary products and services.

To develop this concept it will be necessary to have a sound business plan consistent with operating in an unsophisticated business atmosphere. The writer has seen, far too often, complicated and highly technically orientated plant installed in areas where it is neither justified or practical.

Our approach must be a practical one which will embrace good technology, extensive training and sound but simple industrial processes.

There are many ceramic plants within the market area using imported raw materials to varying degrees. JMC has identified manufacturers within the area, but much more work remains to be done to evaluate the potential for Jordanian exports.

For instance, we must have an intimate knowledge of the production processes employed in each plant and the raw materials used.

From a non-technical point of view a study of the construction development plans of each country will help to establish future demands for clay based ceramic materials, giving us an idea of future demand for these raw materials.

The study must be comprehensive and should embrace visits to as many potential customers as possible.

We emphasize that a comprehensive marketing study will be crucial to preparing a detailed business plan.

Recommendations

- 1- that we approach each step as quickly as possible, but with the most careful planning. In taking the project step by step we can review our attitudes towards it, and save time.
- 2- A steering committee to be formed as soon as possible, chaired by Mr. Nimri, Mr. Batchelor and Mr. Parry serving, and at the suggestion of Mr. Nimri, a representative from the Government.

The brief for the committee would be to force the thought and planning of the project at the fastest possible pace. To consider, advise and recommend as information was received. and to disseminate the information to other interested parties.

The first priority of the committee will be to authorize, with the assistance of Mr. Batchelor, a detailed market study of the area outlined above. Which will be crucial in preparing budgets and cash flow studies to assist and support Mr. Bachelor in the next phase of development.

- 3- Esmalglass has now completed the exploratory mission to Jordan. An invitation for Jordan Mining Co. to send representatives to the Esmalglass Plant in Spain is warmly extended.

Conclusion

The Jordan Mining Co. is interested in pursuing the project further and providing local inputs.

Esmalglass wishes to be involved in the project by providing technical and marketing advice.

There is a market for raw materials in the Ceramic Industry within the region, and this should be enough for the parties to have the resolve to pursue the project further.

PROPOSAL TO ESTABLISH A SMALL PLANT TO MANUFACTURE CERAMIC ITEMS FROM RED CLAY.

Range to be manufactured

Figurines - animals, fish etc.
Vases - small medium and large vases in a variety of shapes.
Lamp bases- fitted with lamp shades and electrical fittings.
Oven ware - casserole dishes and other cooking pcts.
Coffee mugs.

The concept There are many companies around the world manufacturing ceramic artware from white burning clays, but there are few manufacturers who have successfully developed the technology to make a high quality product from red burning clays.

In Jordan there is an abundance of plastic red burning clays suitable for the manufacture of fine ceramics.

A company in Canada Blue Mountain Pottery, (the largest pottery manufacturer in Canada), have over the last 25 years developed sound technology to manufacture artware from materials similar to those found in Jordan.

It is proposed to bring together the Canadian experience and technical know-how, with a group of Jordanian private sector businessmen, to investigate the possibility of setting up a Blue Mountain type operation in Jordan.

The Market : The market for the range of products proposed is almost entirely satisfied by imports. There is a strong demand for a locally made product in Jordan, and good export potential for the Gulf and other Arab states.

Blue Mountain have developed unique glaze finished, which need exposure to the Jordanian market before an investment decision is made.

Outline of the Manufacturing Unit

Initially a plant would be established to employ 25 persons. A building of approx 400 sqm. would be required. A good water supply, drainage, and 3 phase electricity must be provided.

Imported equipment

- Mixers
- Screens
- Kilns (with furniture)
- Press
- Extruder

Estimated cost \$ 200,000 US

All the above could be supplied from Canada

Local equipment to be fabricated

- Casting benches	
- Slip lines	
- Glazing tanks	
- Work stations	
- Kiln foundations	
Estimated cost	\$ 220,000 US

Materials for the manufacture of glazes would initially be imported from Canada.

Consumables to be imported from Canada.

- Glaze	\$ 20,000 US
- Moulds	\$ 15,000 US
- Chemicals	\$ 4,000 US
- Misc	\$ 6,000 US
TOTAL	\$ 45,000 US

Technical Know-how fees and training fees for first year \$ 30,000 US

Estimated cost of establishing the plant excluding:

- (a) Working capital
- (b) Building cost \$ 495,000 US say \$ 500,00 US

Annual Anticipated Revenue

Sales

A factory employing 25 people in Canada would reach a production of 500 pieces per day at an average selling price of 5.00 US i.e. \$ 75,000 US per month.

Let us assume that in Jordan we achieve 50% of the Canadian production and 50% of the revenue per piece.

Jordanian products would therefore generate \$ 18,750 US per month or \$ 225,000 US per annum.

Anticipated Costs

Costs are estimated as follows:-

- Raw materials local	\$ 10,000 US
- Imported	\$ 10,000 US
- Wages/Salaries	\$ 60,000 US
- Utilities	\$ 12,000 US
- Selling and misc.	\$ 18,000 US
- Depreciation	\$ 10,000 US
- Interest on capital employed	\$ 50,000 US
	\$ 170,000 US

PROCEDURE

It must first be established that the Jordanian party and Blue Mountain can develop a working relationship.

To do this it is recommended that two representatives visit the Blue Mountain factory in Collingwood Ontario.

The visit should be for 10 days duration.

At this time the Jordanians will have access to all of Blue Mountain records, and free access to the factory so that they may assess the possibility of working with Blue Mountain in Jordan.

Also during this visit, the general parameters of a working relationship between the parties will be discussed and agreed.

Following the visit it will be necessary to test fully the potential market for Blue Mountain pottery in Jordan and neighbouring countries.

It is suggested that a full container of Blue Mountain Pottery be sent from Canada to Jordan.

This merchandise to be offered in the market at a price equivalent to the estimated ex factory price from the proposed Jordanian factory.

Dependant upon the outcome of the visit to Canada and the acceptance of the Canadian product in the market. A decision will be made to proceed with a detailed plan for investment.

CERAMIC PROJECT

It is proposed to form a small limited liability company to manufacture and market a range of ceramic products under a technical knowhow arrangement with Blue Mountain Pottery of collingwood Ontario Canada. Mr. Robert Blair the President of Blue Mountain has indicated an interest in persuing the possibility of co-operating in offering technical knowhow and design assistance on a commercial basis.

Two Jordanians with wide business experience have decided to investigate the feasibility of implementing this project.

The Partners have limited capital to invest but they do have land upon which they are prepared to construct premises for the project. This asset can then be used as colateral to support the necessary borrowing.

The experience of the partners is summarised as follows:

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Marka

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JOR/87/009
Industrial Advisory Services And Training
Interim Report on Mission to Jordan

Prepared by Peter Batchellor - Ceramic Consultant

Assistance to Jordan Ceramic Industries

Progress on revising and updating production methods is proceeding slowly.

The programme had lost momentum since the last mission. This was not due to a lack of enthusiasm but a shortage of engineers who are constantly employed in dealing with plant break downs and maintenance.

An engineer has now been assigned to work on a fulltime basis with the programme and good progress should be made by the end of the mission.

Jordan Ceramic industries will require further intermittent advice and assistance over the next 2-3 years if the goals are to be realised.

Ceramic Raw Materials- It has been established that Jordan has the potential to develop a viable ceramic raw material and supply industry. There is a very good potential to export clays and feldspars to neighbouring countries as well as using these materials to develop a manufacturing base in Jordan. There is also a good opportunity to develop clays for use in other industries i.e. fertilizer, paint, paper and rubber industries.

There are many good academics in Jordan operating in the field of clay and mineral exploration. But there is little practical knowledge or experience in processing the materials to commercial advantage.

Between 1960 and 1989 no fewer than 17 studies have been made of Jordanian clay based materials. All of these studies have been financed by external aid.

The conclusions drawn from these are similar, and the methodology used is almost identical.

In general the studies cover the geological aspects well and they all give a similar and accurate chemical analysis of the material.

Generally the conclusions drawn are that the clays are not as suitable for use in the ceramic industry as imported materials.

However, all of the comparisons are made between the local clay unprocessed and the imported materials which have been extensively refined and processed.

The industry in Jordan does not need further external help in scientific evaluation of materials it does need practical help in turning the potential into a commercial opportunity.

To this end I have been in contact with a major supplier of Ceramic Raw Materials in Europe.

This company is interested in cooperating with the Jordan Mining Company in establishing a ceramic mineral refining plant. The principals of the European company will be in Amman in the next two weeks and I will assist both parties in evaluating the prospects. In the mean-time I am continuing to visit the various clay deposits with a view of evaluating the practicalities of exploiting these.

The programme is extensive and covers many areas, Mining, processing, distribution, marketing, financing, and technical. Because of this progress will be slow, but 30 years after the first technical report we are at least getting started.

For this project to be successful continued practical and commercial inputs will be required.

Manufacturing

With the exception of Jordan Ceramic Industries and a new wall tile plant under construction there is very little production of white ceramic ware.

Ceramic expertise in Jordan is limited and any engineers with experienced work for the companies mentioned above. It is therefore very difficult for Jordanians wishing to enter the industry to know where to start. Undoubtedly there is a market for a variety of ceramic products within Jordan and other Arab countries.

I am endeavouring to encourage the private sector to become involved in starting ceramic enterprises and several local organizations have been very supportive. The Ministry of Industry in particular have been extremely encouraging in their response to the possible development of a ceramic industry based upon indigenous raw materials.

A local group of business people have expressed interest in starting a small plant to manufacture artware and tableware. Through the Canadian Embassy, who may assist with financing the project, I have been in touch with a Canadian manufacturer. I telephoned the president of the company, and as a result of this I am preparing a basis for discussion for a joint venture between the Canadian company and the Jordanians.

Queen Alia Jordan Social Welfare Fund- This is a non profitable private sector charity. They have a small pottery. (employing 30 people) they need concentrated help of a technical and production nature over an extended period of at least two months. I do not have the time during this mission to assist on anything but on adhoc basis.

Heavy clay products- There are two plants in Jordan making buidling products out of red clay.

Both plants have a marketing problem. There is no market in Jordan for clay pipes or conventional bricks. Because of this one factory is closed completely and the other only fires the kiln one day per month.

There is a potential to convert at least one of these plants to alternative products and its is hoped that some progress will be made before the end of this mission.

Other uses for Ceramic minerals- If a clay processing plant is to be comercially viable, the whole specturm of uses for these minerals must be exploited. This is time consuming and detailed work, but a start will be made during this mission.

The market- There is a market in Jordan for traditional ceramics, but the future of the industry will depend upon developing specialised products for the region i.e. Refractories and ceramic filters for the many oil refineries in the area.

Conclusion

There is a real oportunity to develop a clay based industry in Jordan.

Private sector investors should be encouraged to participate. Aid should be targeted towards getting people together, trained and started.

Some "seed" money will be required. Good on going, practical and commercial assistance will be required.

Sugested programe for the next two years.

Nov-Dec. 1990 Follow up visit for two months P. J. Batchelor.

Feb-March 1991 Visit by P. J. Batchelor and one other practical potter to assist in getting some projects started - 2 months each. (Total 4 Man months)

Aug-Sept. 1991 Follow up (4 Man Months)

Nov- 1991 P. J. Batchelor one month to review progress.