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CLAY REFREFING AND GLAZED TILES MANUFACTURE ✓

MALTA
(DP/MAT/75/C 2/A/01/80)

Project findings and recommendations

Terminal report prepared for the
Government of Malta

by

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expert of the United Nations Industrial Development Organization
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SUMMARY

The one month exploratory mission in October 1974 recommended a follow-up in the establishment of the ceramic industry in the island. Not having enough background information in this field of activity for a long-term project the Government of Malta submitted to UNIDO another short-term project which has been approved as SIS Project No: SIS/MAT/75/002/A/01/37.

The primary duties of the expert's three month assignment were specified as follows:

- i) make the necessary steps to start with clay samples drilling in the selected area and collect a six tons of representative clay samples which will be subjected to large-scale testing abroad;
- ii) to prepare the programme for the testing of drilled clay samples and recommend the necessary laboratory equipment which will be supplied by UNIDO in a follow-up project and which will enable a satisfactorily testing in chemical as well as in technological way;
- iii) to prepare a complete pre-feasibility study for the industrial plant producing different ceramic items, wall tiles included. The plant should also prepare and dress local clay for craftsmen as a substitution for imported clays from abroad;
- iv) to plan and assist in the preparatory work for the establishment of the laboratory and the Pilot Plant which will be expected to be converted after finishing its basic tests to an ordinary plant producing different ceramic items;
- v) to advise the Government in a follow-up project.

All the duties mentioned above were carried and fulfilled some of them with more or less success. The clay deposit suitable for mining was selected. Also drilling spots were marked by the expert. However, the core drilling itself was not released, because the only one available suitable core drilling machine was booked by the Malta Drydocks which are now being rebuilt to the international standard. Therefore, also the testing programme of the drilled samples was only discussed personally with the Chief of Standard Laboratories.

The necessary laboratory equipment for testing is almost available locally. The list of remaining items which are expected to be supplied by UNIDO in a follow up project has been worked out. The value of this laboratory equipment was estimated to be U.S. \$ 9.750.

A complete pre-feasibility study for a converted ordinary

plant /.....

plant from the Pilot Plant has been worked out. The Pilot Plant is expected to finish its main duties - the large scale trials in different ceramic items - in two years time and should continue in the ordinary production as the separate economic unit. According to the expert's recommendation the converted plant to run on an acceptable economic level should produce except the dressed clay for local craftsmen special types of ceramic wall tiles, wall tiles accessories and decorative ceramic by casting process. Shortly speaking, it should produce items for which is not place in a mass industrial production. The prepared pre-feasibility study shows the profitability of such a converted plant in case if further equipment will be available to complete the existing one.

It has also been started with the establishment of the Pilot Plant. The Government released for it a hut, the size of which is 70 x 12m. The layout has been prepared and building of foundations for the specific machines have already started. Necessary reparations and new paintings of the building have started before the expert left the island.

Three revisions of the Draft Project Document have been prepared by the expert for the follow-up. The third revision, approved by the Ministry of Trade, Industry and Tourism has been submitted to the Office of the Prime Minister for final approval. The Job Description for the follow-up project was also prepared.

According to all the knowledge collected during the mission conclusions and recommendations have been worked out. They are in brief:

- 1) To start as soon as possible with the core drilling in the selected clay deposit.
- 2) To send a 6 tons clay sample abroad in order to make large scale trials.
- 3) To continue with repairing of the Pilot Plant premises and with building of foundations for the machines.
- 4) To submit the follow-up Project Document to UNDP/UNIDO as soon as possible.

INTRODUCTION /.....

INTRODUCTION

The Draft Terminal Report "Vitrified Clay Sewage Pipes and Sandlime Brick Manufacture" (Project No. TS/MAT/74/001/11-01/03) prepared by the same author ends with the Chapter Recommendations which has five points. (Paper UNIDO/ITD.301 dated November 7, 1974).

On the base of these recommendations the Government of Malta asked UNIDO for another 3 months mission (Project No. SIS/MAT/75/002/A/01/37) in order to follow the Recommendations and Conclusions stated in the first Report.

The expert arrived to Vienna for briefing on 25th March and discussed with the UNIDO authorities the Job Description which actually gives some of the tasks which are not possible to be fulfilled during the period of three months only. On the end of the technical briefing it was decided, that the expert will continue in his first mission so, that all his job will lead to the establishment of a ceramic industry in the island.

However, to establish the ceramic industry in any country means to have the following basic knowledge:

- 1) To know the quality of raw-materials and their geological reserves for minimum of 20 years;
- 2) To have the basic semi-large scale equipment for necessary trials;
- 3) To make semi-large scale trials of selected products including their evaluation as far as quality and feasibility are concerned.

Actually these three points are included in those five points mentioned in UNIDO Paper ITD 301 of 7 November 1974 and the expert tried to fill these points as much as possible during his three months mission. The following chapters headed according to the above-mentioned points show the progress up to the 24th June, 1975, it means up to the date when the expert was expected to be debriefed in Vienna.

Chapter No. 1: Raw materials and their geological reserves

From the first Report, dated 7th November, 1974 it is evident, that the geology of Malta is overwhelmingly dominated by sedimentary limestone deposits and the only locally produced building material is limestone blocks, while all other building materials have to be imported.

However, the "Blue Clay Formation" found in the North-western part of Malta and on Gozo Island seems to be a possible basis for an industrial building materials manufacture. The sample laboratory trials which have been done recently indicate that the local dressed clay is suitable for the production of wall tiles and heavy clay building materials.

Because it was decided that the Pilot Plant will be erected at Ta' Qali (see the map of the Island of Malta on the following page) the area for exploratory drillings (marked on the map with an asteric) was selected very close to it. The reasons were as follows:

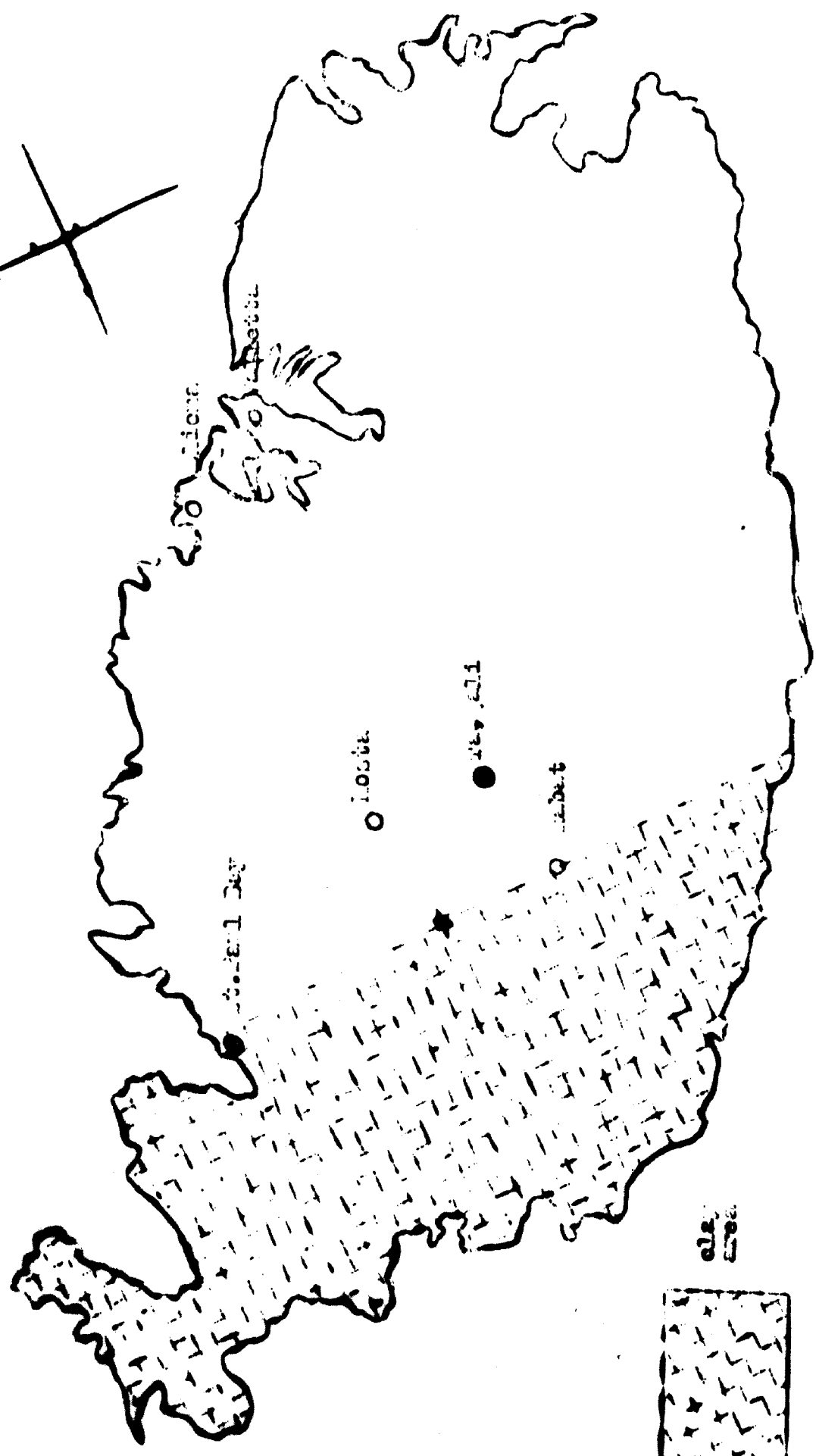
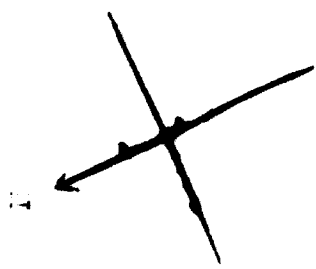
- i) A short distance (about 2 miles by road) between the deposit and the Pilot Plant.
- ii) The blue clay is outcropping there, to the surface and its mining there will not affect the fresh water reserves.
- iii) The clay was previously exploited there for the artisanal pottery and sewage pipes manufacture.
- iv) The area is the Government property.

A more detailed map (see page No. 8) shows the selected area. The expert recommended to test the deposit with six drills of which drills Nos. 2, 3 and 4 are very important for the near future.

The Department of Industry made the necessary steps and negotiations with the Public Works Department - Water Works Section and with the Drydocks to help us with a core drilling machine which is suitable for the clay samples drilling.

However, only one machine which can bring the drilled samples without being destroyed to the surface is available on the island and its working programme is booked for a long time. It is needed urgently at the Dry Docks which is being built in Malta under the Chinese assistance. The Minister of Trade, Industry and Tourism himself arranged the transport of the drilling machine to the clay deposit. The machine was transported to the clay deposit on May 19, 1975 and was to start drilling on May 20. However, in two hours time the machine was recalled back to the Drydocks and therefore, no drilling has started at the clay project. In spite of the fact that the expert tried several times to start with the drilling of the clay, he was not successful and the drilling has not yet been done.

The expert /.....



★ selected area de exit



The expert prepared also the crosssections of the deposit which may be completed after core drilling and testing of the drilled samples.

As far as testing of samples in the Standard Laboratories which depend to the Ministry of Industry is concerned the expert discussed very seriously this matter with the Chief of Laboratories and it had been found that the chemical laboratory is fully equipped to do such tests. ISO Standards for testing of silicoaluminates has also been found in the laboratory. Technological testing may also be done - especially natural humidity, shrinkage after firing to 1000°C, porosity after firing - without any problems.

As it may be seen, everything is ready to start with clay drilling and testing. The situation in this problem before the end of the expert's appointment was as follows: Public Works Department received two more drilling machines from the U.S.A. suitable also for clay drilling. Unfortunately the machines came to the island without the drilling heads which have been ordered recently and are expected to reach the island in 6 to 8 weeks time. Though the situation in drilling capacity will basically approve and one of the useful drilling machines will be released for the ceramic project. It means, that the drilling of clay samples in the selected area may start most probably in the end of July or in August. However, there is plenty of time to finish all the recommended drills before the rainy season comes.

Chapter No. 2 /.....

Chapter No. 3: Pilot plant and semi-large scale equipment

The Pilot Plant was previously the airport area which has been already changed to the industrial area of the island. All the industrial plants such as the weaving factory, cement products factory etc. are expected to be allocated there. There are also allocated other small industrial plants such as Glass, Brick, Battery, Salt, Stone etc. as well as a complex for its Village producing different kinds of handicrafts products for local use as well as souvenirs for tourists. Most of them are allocated in small huts covered with corrugated steel sheets which were previously used during the war for the military purposes.

The Government reserved for the ceramic Pilot Plant a similar hut of a larger size. The size of the hut is 70 x 12m, it means 840m² area. Another hut of the same size is expected to be released in future as the store for raw materials, store for spare parts and maintenance shop. However, one hut is enough to cover all the locally available machines and equipment as well as machines which will be supplied in future through the UNIDO financial help.

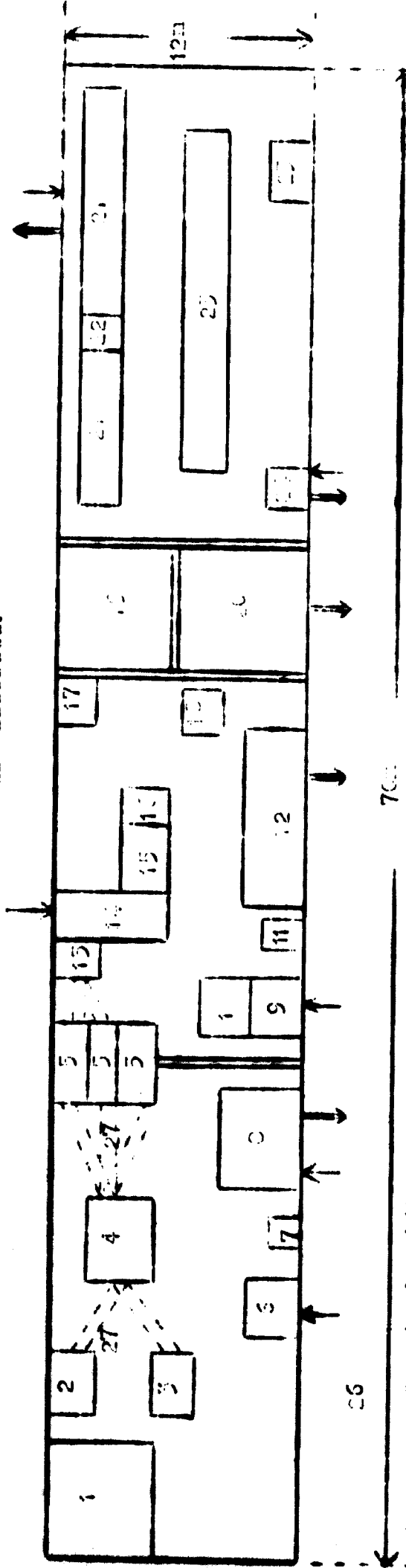
When the expert agreed to utilize the recommended hut for the Pilot Plant, the Government started with all the necessary improvement such as new painting of the hut from outside as well as from inside, with fixing glass to the windows, with repairing of power lines and erection of a **new** transformer etc. The expert prepared the layout of the Pilot Plant (see picture No.7) based on the following principles.

- i) The body preparation shop which is rather noisy and dirty is divided by the wall from other parts of the Pilot Plant.
- ii) The production lines especially the production line for the heavy clay products and line for the fine ceramic products are composed in such a way to be as much as possible complete in order to avoid labourers power consuming work.
- iii) A separate space has been fixed for the open air drying of the produced goods in the very beginning. This space is expected to be used later for the erection of an artificial dryer.
- iv) A separate room was recommended to be used as "Casting section" and preparation of plaster of Paris moulds.
- v) Glazing machines and firing kilns are allocated close to each other in a separate section which is expected to be without any dust and without any vibration which may be developed from the machines in the body preparation section.
- v) The main point which the expert had in his mind was an easy conversion of the Pilot Plant to the ordinary plant when the Pilot Plant finishes its basic task, it means when the Pilot Plant finishes all the expected large

scale trials. /...

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1. Place for disperse material for cross section

- 2. Jaw crusher
- 3. Cyl. crusher
- 4. Machine for calcined mill
- 5. Silos for raw materials
- 6. Silos for waste glass preparation
- 7. Air compressor
- 8. Belt conveyor for body preparation
- 9. Filter for body preparation
- 10. Machine for body preparation
- 11. Machine for body preparation
- 12. Filter press
- 13. Machine for body preparation
- 14. Machine for body preparation
- 15. Machine for body preparation

- 16. Machine for body preparation
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- 27. Machine for body preparation

scale trials. The easiest way would be to start with the production of wall tiles accessories (tray dishes, shelves, toilet-paper holders etc) using the same body composition as the basic plant for wall tiles if erected in future in Malta either under private supply or under the Government ownership.

Another possibility is to produce glazed wall tiles, mosaic, floor tiles or decorative ceramics etc. The Pilot Plant will also continue with the production of the dressed ceramic body for local craftsmen the consumption of which is expected to be about 30 tons per year in the very beginning and may increase up to 50 tons of dressed clay per year in the future.

In any case the Pilot Plant converted later to the production plant and being economically a separate unit must also be feasible and must run with the profit. Therefore, the expert was asked by the Government to prepare a simple pre-feasibility study for the Pilot Plant only after its conversion to the production plant. The pre-feasibility study is attached to this report as Annex No. 1.

From the pre-feasibility study it is evident, that the locally available production machinery and equipment which is now in the Government's hands is not sufficient to produce different ceramic items and run the plant economically. With the existing machinery only facade tiles (unglazed) and decorative fence articles may be produced. Clay for local craftsmen as the substitution for the imported clay which will be one of the main tasks of the production plant in future may be produced with the existing equipment only when the Plant will be supplied with finely milled grog from other factory (e.g. Small Scale Industry).

However, the addition of a ball mill to the existing production machinery will improve the situation and will enable to produce the clay for local craftsmen independently on the supply of finely milled grog from outside as well as production of decorative ceramics and wall tiles accessories by the casting process to the plaster of Paris moulds.

Further addition of a hydraulic press and edge runner mill to the existing machinery and the ball mill will again improve the production possibilities and will enable to produce except the above-mentioned articles also glazed wall tiles mosaic or glazed wall tiles and bring the Pilot Plant after its conversion to the production plant to a good economical level. However, it means to spend approximately another £M40.000 - (108.400 U.S. \$) for the machinery.

The feasibility study presumes that all the new equipment mentioned above will be available in the production plant and in such a case shows that the production will be feasible. For further details see Annex No. 1.

Regarding /.....

Regarding the equipment and production machines which the Government took from the local Court it may be said that all of them are in good condition. After a careful search of the dismantled machinery, it is possible to say that the following machines are available on the spot:

- 1) clay crusher (hammer mill) based on rotating hammers in the manganese steel shell. The clay falls to the machine from above in pieces of about 5cm big. The clay is crushed by rotating hammers and screened through 1cm screen fixed on the lower part of the steel shell. The size of the crushed clay should be approximately below 6-8m/m. The capacity of clay crusher is estimated to be about 5 tons per hour of crushed clay with moisture about 6-8%. The price was estimated to be about £M2.500 - (U.S. \$6.775). The machine seems to have never been used in the production before.
- 2) horizontal vacuum wormpress (pu-mill) with separate mixer and spare worm parts. The mixer mixes the body composition with the water and makes a plastic body from the components. From the mixer the pieces of the plastic body are cut and fall to the press which is equipped with a vacuum chamber and the mouth allowing to produce shapes up to the size 30x30cm. The capacity of this machine varies according to the size of produced shapes and is envisaged to be 10 to 20 tons per shift. Price was estimated by the expert to £M18.000 (U.S. \$49.000). The machine is a new one and has never been used before.
- 3) filter press marked CFC 520/70 (Officine e Fonderie di Cavassale) with spare filtercloth. Actually two filterpress are there on the spot. The filtersheets have diameter 560m, the same for both presses. One of those presses have been used before in the production while the second one is new. However, some parts of the filter presses are missing up to now, especially the membrane pump and the frames holding the filter-sheets. The local authorities believe to find them. The price of one filterpress was estimated to be about £M5000 - (U.S. \$13600) and its capacity to be about 500kg per one charge.
- 4) propeller for slurry mixing Two big propellers with motors and two small propellers with rotating pumps and motors are available. All of them have been used before. The estimated price for the big ones is £M600 - (US \$1600) and for small ones £M200 - (US \$550).
- 5) glazing machine is about 70m long and contains all the necessary belts and motors as well as rotating brush for wall tiles surface cleaning including wall tiles edges cleaner. However, the glaze fall equipment is not there and it seems that the tiles have been glazed by spray glazing. The glazing machine was already in operation. The price is estimated to be £M7000 - (US \$18,900).
- 6) silk screening decoration machine is a fully automatic one and the output is estimated to be about 6.000 pcs per shift. Also spare screens and chemicals are available with the machine.

The machine /.....

The machine which was used before is still in a good condition. However, a careful cleaning of its mechanism before its putting into operation will be necessary. The estimated price including new silk screen preparation equipment is £M3000 - (US \$ 8.100).

7) tunnel kiln - electrically heated up to the temperature 1700°C consists of four parts: pre-heating zone, firing zone, cooling zone and cooler. The length of the kiln is 12m and including cooler (tunnel of the same size like the kiln produced from steel sheet) 16m. The inner sizes of the kiln are 35 x 35cm. The kiln is also equipped with a chimney and a control electric panel which enables the temperature control in heating and cooling zone. The output of the kiln is envisaged to be about 300 tons of once fired product. The kiln is also equipped with a pusher which pushes the refractory slide (34 x 28cm) through the kiln. The kiln was already in operation. However, it is not clear enough how the refractory slide through the kiln without rollers. In such a case the slide or wall at the bottom of the kiln will be worn out very soon. The estimated price together with the control electric panel and pusher is £M15.000 - (US \$ 41.000).

8) stationary kiln - An electric kiln up to the temperature 1000-1050°C the sizes of which are 100 x 60 x 100cm. The output of the kiln is envisaged to be about 200kg per one firing cycle which is expected to last for 48 hours. The price of this kiln is estimated to £M3.500 - (US \$ 9.500). It does not seem to have been used before.

9) vibratory sieves - one oval 500 x 300mm and one rectangular 600 x 300mm with 450 Watt vibrator for the sieving of slurries without the permanent magnet device. In the bigger one the frame holding the screen has not yet been found. Both vibratory sieves have been used before. The estimated price is £M400 - (US \$ 1025).

10) Cutting machine - RIVANI - for cutting of the pugged products. This machine has never been used before. It may cut products from 135mm only to 1900mm and the maximum production is 150m of cut products per hour. The maximum size of the product is 570mm x 300mm. The machine does not seem to be in good condition. The price of this machine is estimated to £M1.000 - (US \$ 2.710).

11) refractory saggars, slabs, various motors and spare parts, racks etc. Equipment useful for the running of the Pilot Plant and in plant transport. Estimated price £M2000 - (US \$ 5.500).

It is evident that the value of the equipment already available locally is rather high. The recapitulation shows that the total value is as follows:

/.....

Item	No. of pieces	Estimated	Total value
filterpress	2	£M 10.000	US \$ 27.100
clay crusher	1	2.500	6.775
glazing machine	1	7.000	18.970
silk screening decoration machine	1	3.000	8.130
horizontal vacuum press w with mixer and spare parts	1	18.000	48.780
tunnel kiln	1	15.000	40.650
stationary kiln	1	3.500	9.485
vibratory sieves	2	400	1.085
propeller for mixing	2	1.200	3.252
cutting machine	1	1.000	2.710
saggers, motors, racks etc	1	2.000	5.420

Total: £M 63.600 US \$172.357

It will be a pity not to complete the existing equipment by adding a ball mill, wall tiles press and edge runner mill, the total value which is about £M40.000 and utilise it after conversion to a production plant for the ordinary production of different ceramic items.

Shelter No. 1 /

Chapter No. 3 - Large scale trials of selected products

The large scale trials of selected products are expected to be completed by the end of the year.

i) Large scale trials in the Pilot Plant. As mentioned above the preliminary design for the plant are at this time (finalized in Dec 1975) under reconstruction. It had already started with the building of foundations to the specific machines. However, the complete erection of the Pilot Plant will need little more time and it is expected to be completed during the follow-up project. Therefore, the large scale trials in the Pilot Plant may also be done during the follow-up project.

ii) Large scale trials abroad. It is expected that large scale trials in the production of wall tiles and on the production of ceiling elements will be done abroad under the UNICE financial help. The expert together with the local authorities will be responsible for the preparation of a 6 tonne clay sample which should be a representative sample of the local clay. Instructions have been given how to prepare and send the clay sample in case the expert will not be present. The expert has prepared the Draft of "Terms of Reference" for Contract Specification for the tests of the Malta Blue Clay which has been discussed also with the local authorities. The Draft is also included in this report as Annex No. 2.

Chapter No. 4 /.....

Chapter No. 4 - Further activities by the Expert

Except the activities described before, further activities by the expert were as follows:-

- i) preparation of twelve variations of pre-feasibility study for a plant producing glazed wall tiles and ceiling elements.
- ii) first, second and third revision of a follow-up Project Document.
- iii) Study of the documentation of machines and equipment which the Government has in hand.
- iv) Draft Job Description for the expert for a follow-up Project.

i) The expert has been asked to prepare different variations of a pre-feasibility study for a plant producing glazed wall tiles and ceiling elements, because the Government of Malta is very interested in the production of these two products. Twelve different possibilities in production of 2.000tons, 4.000tons and 6.000tons of wall tiles and 10.000 tons, 20.000tons of ceiling element were prepared. After recommendation of a most suitable capacity for the country (4.000 tons of wall tiles and 10.000tons of ceiling elements) the interest shown in this field stopped. Probably the Government authorities are waiting with the final decision if the results of the large scale trials (abroad and in the Pilot Plant) will be satisfactory and will certify all the assumptions made for the local clay. This is understandable, because the investment costs (machinery and buildings) for the recommended factory are about 3,5 million US \$ (approx. £1.3 m).

ii) The Project Document which has been revised by the expert was based on the Draft Project Document prepared by the Chemicals, Pharmaceuticals and Building Materials Industries Section of UNIDO. The first revision of the Draft Project Document recommended a complete solution of the ceramic problems in Malta including erection of a fully equipped Pilot Plant, training of local people abroad as well as complete large scale trial productions abroad. Of course, the total sum of the Project increased and the expert was recommended to prepare Revision II in order to drop down the sum of the Project to a reasonable value.

Also the sum of the second revision of the Project seemed to the Ministry of Trade, Industry and Tourism to be high because of lacking money in the Malta Country programme.

Therefore, Revision III was prepared by the expert in such a way that only U.N. expert for 18 months, large scale trials abroad and laboratory equipment remain as far as UNIF/UNIDO inputs are concerned. The value of the Project dropped down to US \$ 71.250. Such a revised project has been submitted by the Ministry of Trade, Industry and Tourism to the Office of the Prime Minister for approval.

Revision III which is actually a simple project now and which would cover all the activities connected with the drilling in ceramics in Malta may be revised when the new Malta Industrial Cycle starts in 1977.

....

ii) The Draft Project Document - Revision III is attached for information of Annex E. 3.

iii) As the local expert released all the documentation of the project and concerning factory, the expert had the responsibility to search and select the useful literature which is connected with the machines and equipment available locally. He sorts out the literature according to the specific machines and equipment and studied the drawings. According to them, no recommendation to build necessary foundations for the horizontal vacuum press, clay crusher etc. The literature was obtained by the Malta Crafts Centre, Department of Industry, St. John Square, Valletta.

iv) Draft Job Description for the activities of an expert in the following project was also prepared. It is enclosed to this report in Annex E. 4.

Conclusions

All the expert's findings during his assignment in Malta may be summarised at the following points.

1. It was certified in a small scale trial that the local clay is suitable for the production of wall tiles and ceiling elements. However, the production of wall tiles needs addition of 27% of quartz to the body composition.
2. A suitable deposit as far as tourism, agriculture and water reserves are concerned has been found about 2 miles (3km) far from the Pilot Plant.
3. The core drilling of the selected deposit has not yet been done because the drilling machine was booked for other important job. However, the core drilling of the blue clay deposit should be done as soon as possible to ensure the sufficient industrial reserves for minimum 20 years of production.
4. The core drilling machine recommended for clay samples drilling by the Water Works Department seems to be suitable for our purpose.
5. The chemical laboratory of the Governmental "Standard Laboratories" is fully equipped to make chemical testing of drilled blue clay samples in accordance with the ISO Standard. The technological laboratory can also make the basic tests such as firing of briquettes to 1,000°C, testing of water absorption, natural humidity, shrinkage and Harkort test. However, it is not possible to test the particle size (Andreason test), porosity, strength of rupture and other more complicated tests.

6. A suitable building (a hut with corrugated steel sheets roof) was released by the Government for the Pilot Plant. However, its repair and improvement should be done.
7. The layout of the Pilot Plant was prepared in such a way to suit the production line for the heavy clay products as well as for the fine ceramic products.
8. A transformer of the capacity of 250KW will satisfy the consumption of the Pilot Plant, because the tunnel kiln has the nominal input of 30KW, the stationary kiln of 5KW and the horizontal vacuum press of about 40KW together with the mixer. Other machines have smaller nominal input which in total will not exceed 100KW.
9. The ceramic machinery and equipment is more of a production than of a semi-large scale size. Actually it should be so, because some of it was used before in the production plant producing wall and floor tiles with the imported biscuit body.
10. The machines and equipment was partly used and partly was not yet in the production process. The clay crusher (hammer mill), horizontal vacuum press, one filterpress and the cutting machine were never used before. However, because of several transport during the last few months some parts of the machines and equipment were lost or broken. Up to now, it has been found that the membrane pump is missing, the slurry vibrator screen is without the frame holding the screen, the filterpresses are without the side arms and the silk screens preparation equipment is without the cover. It is expected that other parts may also still be missing in time when the machines are to be completed in the Pilot Plant.
11. In spite of the fact mentioned in para 10, the total value of the equipment and production machinery, which the Government of Malta already has in hand is about U.S. \$ 170,000 - (€M53,000).
12. The pre-feasibility study shows that the Pilot Plant may be converted to a production plant in future after having finished its basic tasks and will also be profitable if it is equipped with additional equipment such as ball mill, hydraulic press and roller mill.
13. The production of clay for craftsmen which will be the main task of the Pilot Plant and in future of the production plant may be done without the ball mill only when the plant is supplied with the finely milled grog (below 10,000 openings/cm²) from any other source.
14. It is recommended if somebody from the Department of Industry, who is helping in the organisation of the ceramic project will be present on the spot during the time of testing of local clay. It will give him the basic idea about the production and the machinery as well as the organisation of a ceramic plant.

10. Revision III of the Draft Project Document gives the responsibility to continue in the ceramic project in Malta. However, it does not cover all the activities connected with the trial problems in ceramics in the country and it is recommended to be revised when the second rainy season cycle starts.

Recommendations

To the Government of Malta

1. To start as soon as possible with the core drilling in the selected deposit of clay. To provide first drills 100 mm, and 2 in. each way, that the clay is sampled every 10 (2) meters or when the quality of clay visually changes. The drills should reach the base of the clay layer, if possible.
The clay samples transferred to the Standard Laboratories and test the chemical and technical quality. According to the results obtained evaluate the clay deposit as industrial reserves for minimum 20 years.
2. To send 6 tons clay sample abroad according to the instructions received from UNIDO.
3. To continue with the repairing of the released hut at Ta' Qali as well as with the building of foundations for the machines. The layout of the Pilot Plant is in this report.
4. To approve the Draft Project Document - Revision III and submit it to the UNDP/UNIDO through the Resident Representative Office in Geneva for further dealing. It must be understandable that U.N. also need few months for clearance of the Project and recruitment of the expert.

TO the UNDP/UNIDO

1. To start with the bidding for large scale trials abroad as soon as the Government of Malta submits the follow-up Project. Terms of Reference for contract specification is in Annex No. 2. Evaluate the bids and instruct the Government of Malta (Malta Crafts Centre, Department of Industry, St John Square, Valletta) on sending the six tons clay sample abroad.
2. To accept the Revision III of the Draft Document and make all the necessary steps for its quick clearance in order to enable the presence of the expert in Malta as soon as possible, but not later than September 1, 1975. Then it will be enough time for him to assist in supply of about 50 tons of clay from the deposit to the Pilot Plant before the rainy season comes. The clay will be necessary for the first trials in the end of 1975 and early 1976.

Pre-feasibility study on the production of
different ceramic items in the Pilot PlantI. Origin of the Study

This study was prepared by Eng. Dr. Kvetoslav Engelthaler, UNIDO expert for the Government of Malta and should be used:

- i) As a guide for selection of ceramic items which may be economically produced in the Pilot Plant after his conversion to an ordinary plant when all the expected large scale trials are completed.
- ii) As a reference at the stage when further machines and equipment will be ordered to bring the production of the plant in all its sections to the same production level.

The study is intended to substitute imports of ceramic wall tiles, statuettes and ornaments for interior decoration. Also flower pots may be produced. The imports value of these goods is rather high and according to the Malta Trade Statistics the amount in 1973 was more than £M120.000.

It is also expected that the consumption of these goods will slowly go up in the next few years.

II. General Description

Products: A variety of ceramic products may be produced in the plant. The items expected to be produced there are as follows: dressed clay (body) for local craftsmen, flower pots unglazed, flower pots decorated, wall tiles accessories, decorative ceramics, decorative fence, glazed mosaic tiles, wall tiles, facade tiles unglazed and floor tiles glazed. The porosity of the products except facade tiles, unglazed and glazed floor tiles should be about 25-30%. Porosity for facade tiles and floor tiles will be lower 12-16%. Various kinds of decoration according to the use are applicable. The clay for craftsmen is expected to be the basic material for their production while other above mentioned goods are used either in agriculture or from decorative and hygienic point of view in bathrooms, W.C's, kitchens, corridors, shops, laundries, garages, halls, in public buildings, at home, in hotels, restaurants etc.

Major Input Materials:

The plant can use the local clay combination green-calcined for the biscuit production. For some items such as wall tiles and wall tiles accessories quartz (approximately 25% of the body composition) should be imported. Glasses, dies and pastes will also be imported ready made.

Technology: The technology for the production of flower pots, decorative tiles and facade tiles is based for all other than the conventional ball milling, filter pressing, drying, the pressing powder or casting slip preparation, drying or casting, firing, glazing, glaze firing, checking, and preparation should be also included in the production process. The only raw material available - the plastic clay - is not possible to be used itself and should be mixed with approximately 40% of ball mill product which may be prepared from the same clay by firing to 120-130°C. It should also be mentioned here explicitly that the recommended biscuit firing temperature is 105°C while the glaze firing temperature should be 150-160°C. For the production of flower pots, decorative fence and facade tiles clay and glaze milling below 1.0 mm, mixing, drying, shaping and firing at the temperature 1050-1050°C technology was adopted. Clay for craftmen will be prepared in the same way as the body for decorative ceramics or wall tiles according and after filter pressing or puging sold to the craftsman for further use.

Location factor: The plant (in previously the Pilot Plant) will be located at the same area and equipped with electricity, water etc. The deposit of the clay selected about 2 miles far from the factory site. However, in the time when this study was under preparation the quality of the clay in the clay deposit was not yet known. But it is expected that the clay, when mined will contain about 25% of water (natural humidity and chemically bonded water) and volatile matters (organic matters and CO₂ etc).

General assumptions: Because, as mentioned before, the plant will be totally converted to the ordinary production from the established Pilot Plant this study adopts the following assumptions:

- i) Semi-large scale trials which have been done in the Pilot Plant will specify the correct addition of grog and quartz to the body mixtures. However, for the time being the assumption has been made that 40-50% of the used clay should be calcined to the temperature 1020-1050°C.
- ii) Raw material costs are based only on the actual costs which are necessary for mining and transport of the clay without any profit.
- iii) Adequate power and water are available at the plant site.
- iv) The plant operates for 8 hours daily, 5 days per week and 52 weeks per year; however, the kiln firing operation will require 24 hours attendance, 7 days per week.
- v) Labour costs are based on the average level in Malta, it means £M16.5 per week which corresponds to £M862 per year = U.S. \$ 2334 per year.

Production capacity/....

Production capacity: The production plant is expected to use the production equipment of the Pilot Plant which will be composed from the equipment bought by the Government from the Local Court and from the equipment supplied in future by UNICEF. However, every ceramic factory has a limiting factor as far as production is concerned. This limiting factor is usually the firing equipment - firing kilns - because the kiln(s) works usually 24 hours per day while other machines are used for one and sometimes for two shifts only. It means, that increase of the production in these machines is possible through the operation in second or third shift while this way is not valid for firing kilns and quicker firing may bring increase of rejection.

The pilot plant and therefore also the future ordinary plant will be equipped with one tunnel kiln the size of which is 35x35x1200cm. It means that the size of the tunnel is 35x35cm only. The documentation of this tunnel kiln as well as documentation of other locally available equipment were studied and according to the expert's knowledge the capacity of the tunnel kiln is estimated to be maximum 350 tons per year.

Grog will also be produced in this tunnel kiln. The capacity of the plant may be about 220-250 tons of finished once fired products. Of course, if some products such as decorative ceramics, wall tiles accessories etc must be fired twice (biscuit and glost firing) the production capacity will simultaneously drop down to a half.

Another limiting factor may be the ball mill. If the Pilot Plant will be equipped with a ball mill of size MB 1600 to ME 2000 the milling capacity will be enough to cover the existing kiln capacity.

From the above reasons the maximum capacity of the production plant adopted in this study is 250 tons of finished once fired products.

III. Direct materials

The basic raw material for the manufacture of all ceramic items in question will be the local clay. Its amount necessary for the production as explained above should be increased by approximately 25% because of natural humidity, chemical water and loss on ignition. The following direct materials are necessary:

Item	Unit	Number Units	Unit Cost £M	Estimated Annual £M	Cost US \$ *
Clay green	ton	450	2.0	900	2.439
firing expenses for firing the clay to calcined clay. **	ton	150	13.0	1.950	5.285
glaze opaque	ton	20	200.0	4.000	10.840
Pastes & stains	ton	1	1800.0	1.800	4.878
kiln furniture	ton	2	150.0	300	813
plastic sacks, paper boxes etc.				300	813
Total:				9.250	25.068

* £M corresponds to 2.71 US \$

/ **

** for firing to 1000°C if necessary
0,65kWh per kg of raw clay. Cost
per kWh is £10.020.

IV. Supplies

Item	Estimated Annual Cost £M	US \$
Spare parts and maintenance material gas, oil and maintenance for car and forklift truck	1.800	4.878
Lubricants	400	1.084
Pyrometric cones for temperature checking	100	271
Office supplies	50	136
	650	1.761
Total:	3.000	8.130

V. Direct Labour

Job description	Number	Estimated Annual Cost £M	U.S.\$
Heavy plant driver	1	900	2.439
Labourers*	14	11.396	30.883
Pilot Plant cleaning	1	800	2.168
Watchman	1	860	2.331
Total:		13.956	37.821

* 4 male kiln firing and loading
2 male grog grinding, ball mill charging,
pugmilling.
2 male filterpressing
2 male shaping
2 female casting section
section
2 female glazing

VI. Indirect Labour

Job description	Number	Estimated Annual Cost £M	U.S.\$
Technical manager	1	1.500	4.065
Secretary	1	936	2.537
Technician	1	936	2.537
Total:		3.372	9.139

VII. Production machinery

Item	Estimated £M	Costs U.S.\$
machinery & equipment available locally	7.500	20.325
installation costs	6.000	16.260

/.....

ball mill	6.000	16.260
automatic hydraulic press and edge runner mill	35.000	94.850
Total:	54.500	147.695

VIII. Furniture & others

Item	Number	Unit Cost	Estimated £M	Cost US \$
Desk and chair	3	70	210	569
calculating machine	1	50	50	136
typewriter	1	80	80	217
filing cabinets	2	30	60	162
Total:			400	1084

IX. Buildings

Estimated price including new paints, windows etc	£M	US \$
Total:	10.000	27.100

X. Power

	£M	US \$
free capacity of kilns after firing prog is 200 tons in tunnel kiln and 20 tons in stationary kiln. Firing of 220 tons of goods when calculated 1KWh per 1 kg and price 0.02£M per KWh	4.400	11.924
power for production process (350kWh per ton)	1.540	4.173
Total:	5.940	16.097

XI. Water

1kg of clay = 1L of water + cleaning water	Total: £M	US \$
	50	136

XII. Depreciation

Item	Estimated Costs	Years Life	Estimated £M	Costs US \$
Building	10.000	20	500	1.355
prod. machinery	54.500	10	5.450	14.770
furniture & others	400	10	40	108
Total:			5.990	16.233

XIII. Manufacturing /

XIII. Manufacturing overhead

Item	Estimated £M	Cost US \$
Depreciation	5.990	16.233
Indirect labour	3.372	9.133
Power	5.940	16.097
Water	50	136
Supplies	3.000	8.130
Total:	18.352	49.734

XIV. Manufacturing cost

Item	Estimated £M	Cost US \$
direct materials	9.250	25.068
direct labour	13.956	37.821
manufacturing overhead	18.352	49.734
Total:	41.558	112.623

XV. Fixed Assets

Item	Estimated £M	Cost US \$
Buildings	10.000	27.100
Production machinery	54.500	147.695
Furniture & others	400	1.084
Total:	64.900	175.879

XVI. Working capital

Item	Time	Estimated £M	Cost US \$
direct material	1 year	7.300	19.783
direct labour	30 days	1.163	3.152
manufacturing overhead	30 days	1.529	4.144
reserve for sales	30 days	5.000	13.550
Total:		14.992	40.629

XVII. Capital requirements

Item	Estimated £M	Cost US \$
Fixed assets	64.900	175.879
Working capital	14.992	40.629
Total:	79.892	216.508

XVIII. Recapitulation /....

115.5 tons of green clay from: 20 tons of quartz
 60 tons of calcined clay
 (correspond to 83 tons of
 green clay)
115.5 tons of green clay
 Total: 210.5 tons

- It means: (i) 20 tons of quartz per year should be supplied from the mine, initially from lignite.
 (ii) 20 tons of green clay should be brought by trucks from the mine to the factory. In case of 5 tons trucks 4 trucks per year will be necessary.
 (iii) 3 tons of green clay from total 20 tons should be calcined to 1150°C to frog per year. This will give 60 tons of frog.

All raw materials should be ground separately below 2m/m or 3m/m in the clay crusher and/or roller mill and stored in silos.

Body preparation section:

All body compositions, it means wall tiles body composition composed of 45% of green clay, 27% of quartz and 28% of frog, decorative ceramics and clay for craftsmen body composition composed of 5% of green clay and 50% of frog will be prepared in the ball mill.

In case of using the ball mill NB 2000 is the production 600kg of the body mix per charge which takes about 12 hours including loading and unloading.

For the production of 210.5 tons, 351 charges of the ball mill will be necessary, which means that the ball mill should work 169 working days one charge per day and 91 working days two charges per 24 hours.

The ball mill charging will be done periodically by labourers after weighing the correct body composition composed from raw materials stored in silos.

The slurry after the milling in the ball mill will be transferred to the slurry tank with propeller using the compressed air. From there, the slurry will be pumped by membrane pump giving the pressure of 10kg/cm² to the filterpress, where water will be removed. The filterpress operation last about 4 hours and one filterpress will cover the full production.

Wall tiles body filterpress cakes should be dried to moisture of 3.5 to 4.5% and grind to the pressing powder (grain size below 1.5m/m, without dust as much as possible) which will be stored in the bin above the press.

The clay for craftsmen will be supplied to local producers in the shape of cakes without any further treatment (moisture of the body will be about 18-22%). The cakes of the decorative ceramic body will be used for the casting slurry preparation which means that 0.2% of sodium silicate and 0.12% of sodium carbonate as well as about 20-25% of water will be mixed together with the body in the casting slurry tank. The casting slurry will be used in the shaping section for casting to the plaster of Paris mould.

Shaping section:

Wall tiles are to be pressed in a hydraulic press with the pressure of 250-300kg/cm² which means in case of two cavities press the total pressure should be 150-200tons, and in case of one cavity press it should be about 100tons.

The production of 125 tons corresponds to 550,000pcs of wall tiles (44pcs per m²), 550,000pcs + 10% rejections = 605,000pcs green tiles should be pressed per year, which corresponds to 2327pcs per day. The theoretical output of one cavity press is about 10,000pcs per 8 hours shift (22pcs per one minute) while the practical output is about 6,000 - 7,000pcs per shift. The two cavities press will of course give double production. However, the one cavity press will in our case work theoretically 105 minutes and practically about 3 hours per working day.

The pressed tiles will be transferred to the drying and firing section.

The decorative ceramic body actually the casting slurry will be either transported through pipes and pumping or simply brought in canes to the casting section and casted to the plaster of Paris moulds. For the production of 7,000 - 10,000pcs per year 27-39pcs should be casted daily. The casting cycle is approximately 2 and a half to 3 hours. Two castings may be done daily and 14 to 20 moulds will be necessary. Because the plaster of Paris mould last approximately for 180 castings the moulds should be removed every 4 months. For it about 600-900kgs of plaster of Paris will be necessary.

The shaping section should be also responsible for finishing of casted products in so called leatherhard stage. This operation consists of removing of marks left on the casted product by the mould, smooth finishing of the whole surface as well as pasting of all parts of the product together, if necessary.

The finished products will be transferred to the drying and firing section.

Drying and firing section:

The products, green pressed wall tiles as well as green finished decorative ceramic products should be dried in a separate room in open air till the body moisture will be below 1%. No products with higher moisture are allowed to be fired to the biscuit body.

The biscuit body firing as well as glast firing of decorative ceramic is expected to be done in the stationary electric kiln. The firing time including loading and unloading is expected to be in average 48 hours. About 150-180kgs of goods may be loaded as one charge to the kiln to satisfy the production of 14 tons of decorative ceramic per year. However, firing should continue also during Saturdays and Sundays. Firing temperature should be 1050°C.

The dried tiles /.....

The dry wall tiles will be fired to the biscuit body in the electric tunnel kiln in the same way as glaze firing. Saggers should be used for glaze firing while biscuit firing should be done without them. The stacks of each tile, separately supported by saggers.

Since we do not know too much about the firing tunnel kiln at the time being, it is difficult to say anything about the firing time which may vary from 170 minutes to 36 hours. However, the firing temperature for the biscuit body as well as for the glaze firing should be 1050°C.

The tunnel kiln is also expected to produce necessary area for all three body conditions. Rejected biscuit fired wall tiles as well as tiles pugged in the vacuum press and fired in the tunnel kiln at 1050°C in the same way as pressed wall tiles should be crushed and milled to prog. For the pugged tiles only an en fine milled clay will be used. The tunnel kiln should work continuously.

Glazing section:

All products, decorative ceramic items as well as wall tiles should be glazed and decorated after biscuit firing.

Decorative ceramic is recommended to be glazed in the glazing booth through spray glazing and further decorated, if necessary, after glaze firing and fired again in the electric stationary kiln.

Wall tiles will be glazed on the glazing machine which will be equipped with silk screening decoration machine. 2158 pcs of wall tiles should be glazed daily. Because the glazing machine gives usually the output of 1800 pcs per hour, it is evident that in course of the machine will work for about 80 to 100 minutes daily.

1kg of glaze is necessary for glazing of 1m² (44 pcs) of tiles. 2158 pcs correspond to 49.2m² which indicates, that 50kg of glaze should be prepared daily. For the glaze preparation also glazing section will be responsible. This operation consists of charging of ready made glaze from sacks to the ball mill for glaze preparation together with water, porcelain pebbles and colours (stains), if necessary. Milling in the ball mill should continue for approximately 2 hours. After milling screening through the screen 10.000 openings/cm² and transport to the glazing section should be done.

Pastes for silk screening decoration should be supplied ready made from abroad.

The glazed and decorated products should be fired in tunnel kiln to the temperature 1050°C.

Plaster of Paris moulds Sections

About 60 plaster of Paris moulds will be necessary per year. The moulds will be prepared in ordinary way, it means the

design mother copy-mould by the laboratory assistant.

It is necessary to have minimum 10 plaster of Paris spare moulds in stock in order to replace immediately those which should be rejected from the production process.

The designs should be changed from time to time to satisfy the local market.

Laboratory:

Laboratory control is necessary for the smooth production. In the production of wall tiles and decorative ceramics the following tests should be done.

- i) Residue on the screen 10.000 openings per cm^2 of the ball milled body. The residue should be below 5%. Every charge should be tested.
- ii) Moisture of the pressing powder. The moisture should be minimum 3.5% and maximum 4.5%. Should be tested minimum twice a day. In case the moisture of pressing powder is lower the fired tiles will have low strength; in case the moisture of pressing powder is higher, laminated tiles will be pressed. Also the sizes of finished tiles vary with different moisture.
- iii) Sizes of pressed green tiles, dried tiles and fired tiles should be checked. Final products are allowed to be $150\text{m/m} - 0.3\text{m/m} + 0.2\text{m/m}$. Should be tested daily.
- iv) Litre weight of the glaze. The litre weight of ready glaze before its transport to the glazing section should be $1750 \text{ grams} \pm 10 \text{ grams}$. This test will ensure the same thickness of the glaze on the wall tiles body.
- v) Ratio solid-liquid of the casting slurry. The ratio should be 55% solid and 45% liquid as minimum. However, the ratio 62 solid and 38 liquid is better. This test is connected with the duration of plaster of Paris moulds.
- vi) Moisture of green clay before its charging to the ball mill. The body must be recalculated according to the test results. Should be tested daily.
- vii) Firing temperature. The correct firing temperature is 1050°C and fluctuate maximum $\pm 10^\circ\text{C}$.
- viii) Harbort test. Ready tiles as well as decorative items should be heated to the temperature 180°C in the oven and cooled in cold water. No cracks in glaze should appear.

Conclusion

It is evident, that the locally existing production machinery and equipment is not sufficient to produce different ceramic items because of lacking of a ball and roller mill, edge runner mill and a good press. With the existing machinery only

facade tiles /....

façade tiles (unglazed) and decorative fence articles may be produced. Clay for local craftsmen as the substitution for imported clay may be produced only when the Small Scale Industry will supply the Pilot Plant with finely milled grog (below 10.000 openings/cm²).

However, the addition of a ball mill to the existing production machinery enables:

- i) production of clay for local craftsmen independantly on the Small Scale Industry Section;
- ii) production of decorative ceramic by the casting process to the plaster of Paris moulds;
- iii) production of wall tiles accessories by the casting process to the plaster of Paris moulds.

Further addition of a hydraulic press and edge runner mill to the existing machinery and the ball mill enables:

- i) production of glazed wall tiles or glazed wall tiles mosaic;
- ii) production of all the above-mentioned items.

Because, according to the Malta Trade Statistics, the highest import to the island is in wall tiles and decorative ceramics, it will be recommendable to equip the Pilot Plant with both, the ball mill and the press. It means to spend approximately another £M40.000 for the machinery and bring the Pilot Plant after its conversion to an ordinary plant to be profitable as shown in this report.

TERMS OF REFERENCE

for contract specification for the tests of
Malta Blue Clay

A. Background Information

The geology of Malta is overwhelmingly dominated by three kinds of sediments, all of marine origin, which occur in important quantities. They are: sandstone, "blue" clay and limestone and of these the latter is by far predominating. Therefore, the only locally produced building material is limestone blocks, while all other building materials have to be imported or produced locally from the imported raw materials.

However, the "Blue Clay Formation" found in the Northwestern part of Malta and on Gozo Island has attracted the interest of the Government as a possible basis for an industrial building materials and ceramic manufacture. It was established during a one-month UNIDO exploratory mission in October 1974 that the clay is expected to be satisfactory quality for the manufacture of a range of building materials and ceramic products including hollow blocks, ceiling elements, flower pots, facade tiles, glazed wall tiles and decorative ceramics. The sample laboratory trials which have been done recently, support also the idea that the local dressed clay is suitable for the production of heavy clay building materials and glazed wall tiles.

However, much wider experiments are required to serve as conclusive evidence of the clay's suitability for ceramics and heavy clay products manufacture before any steps in the investment will be done.

B. Aim of the tests

The aim of the large scale trials is to specify conditions for the production of ceiling elements and glazed wall tiles and in such a way to give the clear picture to the Government of Malta for future steps in developing of the heavy clay products and ceramic industries in the island. Establishment of the heavy clay and ceramic industries will create the possibility of employment of local people as well as cut down the export of these items as much as possible.

C. Description of the activities

The supplier is expected to make the large scale trials in the production of ceiling elements and in the production of glazed wall tiles. He is especially expected to:

1. grind the green clay (approximately 6 tons) below 2 m/m grain size.
2. pug approximately 2.5 tons of ceiling elements from the ground green clay without addition of any other components.

3. /.....

3. fire the dry ceiling elements to the temperature of approximately 950-1000°C (not more than 1100°C and not less than 900°C).
4. Evaluate the fired products as far as shrinkage, strength, number of rejections, etc. are concerned.
5. prepare the report on ceiling elements production in case if the percentage of rejections will be 10% or less (in this case, para 6 to 9 will be cancelled).
6. grind all the fired ceiling element products below 1.5mm in case, if the percentage of rejections is high in order to obtain one for further tests.
7. prepare approximately 3 tons of ceiling elements using the body composed from 60% of green clay and 40% of grog (see para 6).
8. fire the dry ceiling elements (prepared under para 7) to the temperature of approximately 950-1000°C (not more than 1100°C and not less than 900°C).
9. evaluate the fired ceiling elements as far as shrinkage, strength, number of rejections, etc. are concerned and prepare the report on their production.
10. prepare about 1.5 tons of the wall tiles pressing powder according to the formula:
 - 45% of green clay
 - 25% of grog (as grog use either rejections and partly also products, if necessary from para 5), or grog prepared under para 6).
 - 27% of quartz (quartz sand) of local origin
 and press the 150 x 150mm tiles.
11. biscuit fire, glaze and glost fire the pressed and dried wall tiles as follows:
 - i) biscuit firing: in stacks in unheated kiln gas or oil heated
in stacks in muffled kiln gas or oil heated
in one layer on the supporting slabs
in electric kiln
 - ii) glost firing: in saggars in electrically, oil or gas heated kiln
in one layer in electrically heated kiln
 - iii) two different silk screening decorations should be used in such a way to obtain about 100m² of each decoration.
12. evaluate the production trial of wall tiles according to the used firing process (see para 11) in sizes, strength, porosity, Harkort test as well as in number of rejections and elaborate the report on the production of glazed wall tiles.

13. make a trial (about 5m² only) on the production of once fired glazed mosaic (2 x 2cm) using i) the green clay only
ii) composition of 60% of green clay and 40% of grog.
14. wrap and pack all the trial products (ceiling elements, wall tiles and mosaic) and arrange their sending to the address: Malta Crafts Centre, Department of Industry, St John Square, Valletta, Malta.

During the large scale trials the presence of the expert appointed for the Project in Malta is highly recommendable because it is expected that many technical problems may arise during the trial production and the above instructions should be changed immediately on the spot in accordance with the possibilities of development of ceramic industry in Malta. The supplier should, therefore, make the trials in close collaboration with the expert and according to his instructions.

D. Tentative Time Schedule

1. The six tons sample of the blue clay should be supplied in June 1975 under the Project TS/MAT/75/002/A/01/37. Funds for sea and land transport are already available in that Project.
2. Trial production on ceiling elements and wall tiles are expected to be done during July and August 1975.
3. The reports on the trial productions are expected to be finished on September 15, 1975.
4. Packing of the trial products should be done from 1 to 15 September 1975.
5. Transport of products back to Malta is envisaged to be between 15 and 30 September 1975.

E. Tentative Budget

	U.S. \$
Transport of clay sample from Malta to the supplier and of ready products back to Malta.	2,000 (already approved under SIS project)
Testing of clay	<u>5,000</u>
Total:	5,000

DRAFT
(Revision III)

UNITED NATIONS DEVELOPMENT PROGRAMME
PROJECT OF THE GOVERNMENT OF
KALTA

Title: Clay refining and glazed tiles manufacture
Project numbers: MAT/75/..... Durations: 18 months
Sector: Industry (35)
Subsector: Establishment of manufacturing industry (3521)
Government
Co-operative Agency: Ministry of Industry
Executing Agency: United Nations Industrial Development
Organization (UNIDO)
Date of submission: Starting date: 1st July, 1975
Government contribution: UNDP contribution: \$ 71.250
RM10.000 = \$ 27.100

Approved: _____
on behalf of the Government
(signature)

Date: _____

Approved: _____
on behalf
of Executing Agency (signature)

Date: _____

Approved: _____
on behalf of UNDP (signature)

Date: _____

I. BACKGROUND AND SUPPORTING INFORMATION

A. Justification for the project

The geology of Malta is overwhelmingly dominated by sedimentary limestone deposits and the only locally produced building material is limestone blocks, while all other building materials have to be imported.

However, the "Blue Clay Formation" found in the Northwestern part of Malta and on Gozo Island which is presently being exploited for artisanal pottery manufacture, has attracted the interest of the Government as a possible basis for an industrial building materials manufacture. It was established during a one-month UNIDO exploratory mission in October 1974 that a thorough investigation of the clay is warranted since it is expected that it will be of satisfactory quality for the manufacture of a range of ceramic items and building materials including glazed wall tiles, hollow blocks, flower pots, facade tiles and decorative ceramics.

The sample laboratory trials which have been done recently in Czechoslovakia indicate that the local dressed clay is suitable for the production of wall tiles and heavy clay building materials. However, much wider experiments are required to serve as conclusive evidence of the clay's suitability for ceramics manufacture.

In terms of the current UNIDO SIS Mission MAT/75/002/A/01/37 (April-June, 1975) machinery and equipment capable of processing local clay has been procured by the Government and the selection of a site for a new factory in Ta'Qali has already been recommended by the Expert. Steps have already been taken with Malta Development Corporation for the re-erection of factory buildings on the selected site, which is expected to be completed by October/November 1975. A full reappraisal of the machinery and equipment required over and above that what has been processed locally by Government, has been made by the expert and a new pre-feasibility study for the pilot plant only has been prepared as a basis for the formation of the prepared Company which, in view of changed circumstances, will be either fully owned or with a majority holding, of the Malta Development Corporation.

As only a very limited range of testing results were available the expert has had to select areas of clay deposits for comprehensive testing in order to ascertain the suitability of locally refined clay required during the manufacturing operation. Drilling on the selected deposit of clay started under the direction of UNIDO expert in May 1975. The samples are expected to be tested and evaluated during the present project.

The clay investigation will be conducted in several stages expected to lead within the present project to a pilot manufacture of a range of products, which will solve all technical problems prior to the establishment of an industrial manufacturing plant.

B. Institutional framework

The Government Co-operating agency for the project is the Department of Industry in the Ministry of Trade, Industry and

Tourism. The Department is responsible for the development of all kinds of small industry in the Country. Adequate provision has been made for premises, counterpart staff, administrative support, personnel, equipment and operation maintenance of equipment. Details are given in the Project Budget covering Government Counterpart Contribution.

The project will be carried out in close co-operation with the Malta Development Corporation which is responsible for assistance to industries - large and medium size - and for export promotion measures.

C. Provisions for Government follow-up

The project will lead to the preparation of feasibility studies of one or more industrial ceramic plants. The expert will also assist as the Government representative in the ordering of further production machinery, factory erection and machines installation, etc.

In view of the Government's sincere interest in establishing a clay refining and glazed tile manufacturing factory, full support in the implementation of the proposals of the project is assured.

D. Other related activities

The project is also expected to support the position of local ceramic craftsmen through the supply of a correct body composition and in this way to reduce or stop the import of clay from abroad.

E. Future UNDP assistance

A follow-up project aimed at completion and assisting in the initial operation of the Pilot Plant to be installed is envisaged. The details of the project will be worked out in the course of the present project.

II. Objectives of the Project

A. Long-range objectives

The project is intended to provide all the necessary steps for the establishment of a ceramic industry in Malta, which in turn will create a number of new employment possibilities, make optimum use of local natural resources and lead to a substitution of imported glazed wall tiles and partly also cement by local tiles and building materials, thereby saving foreign exchange while, at the same time, making reasonably priced clay based building materials (ceiling elements) available to the local construction industry.

B. Immediate objectives

1. The project's immediate objectives are as follows:
 - i) To establish a laboratory for the testing of ceramic raw materials and products, especially clay, clay based building materials and ceramic products.

- ii) To investigate in detail the local clay deposit and determine the suitability of the clay for industrial ceramics manufacture.
- iii) To start with the establishment of a ceramic pilot plant in order to operate this pilot plant with a view to develop suitable body compositions and production technologies for a range of ceramic products, later to be produced at an industrial scale. The completion of the Pilot Plant is expected during the follow-up project after the UNDP/UNIDO review mission in September 1976.
- iv) To develop a suitable body composition which will help the local craftsmen to reduce or stop the import of clay from abroad and to produce it in sufficient quantity in the Pilot Plant which will be equipped at the beginning with locally available machines only.
- v) To train local staff in ceramic technology and production, thus enabling them to operate efficiently future industrial production units.

2. This project has a direct investment potential.

III. Work Plan

A. Description of project activities

<u>Project activities</u>	<u>Location</u>	<u>Proposed duration and starting date</u>
1. Erection of the Pilot Plant building at Ta'Qali including drainage for waste water and electricity supply (actually work has already commenced).	Ta'Qali	July-November 75. 5 months
2. Installation of the locally available equipment in the Pilot Plant	Ta'Qali	2 months December 1975 - January 1976
3. Plant procurement of the extra plant and machinery		5 months January-May 1976
4. Production trials in the Pilot Plant according to locally available equipment already installed.	Ta'Qali	12 months January 1976 and continuing
5. Production of suitable amount of dressed clay for local craftsmen in the Pilot Plant and advice to local clay products firms on improvement of production techniques.	Ta'Qali	12 months January 1976 and continuing
6. Large scale trials performance abroad in the production of glazed wall tiles, glazed mosaic and other items as the base for	Abroad & Vienna	3 months July-September 1975.

ordering of production machinery for the ceramic Pilot Plant as well as for the expected ceramic plant.

- | | | |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|-------------------------------------------------------------|
| 7. Establishment of a technological laboratory for testing of drilled clay samples and clay products, including equipment procurement through UNDP/UNIDO. | Vienna
&
Valletta | 6 months
July - December
1975 |
| 8. Chemical and technological testing of drilled clay samples in the locally established laboratory (chemical laboratory already established). The tests in future will not be limited to pure clay samples but also cover body compositions for a range of ceramic products, using if required smaller amounts of foreign raw materials; | Msida
&
Valletta | 12 months
(and continuing)
January-December
1976 |
| 9. Evaluation of testing results and the clay deposit, the clay of which will be used in the Pilot Plant for large scale trials in ceramic items and heavy clay ceramics. (Drilling of clay started May 1975). | Msida
&
Valletta | 6 months
July-December
1975 (and
continuing) |
| 10. Practical training of local staff in ceramic testing and ceramic technology and product identification, product diversification and product development, in the established technological laboratory and Pilot Plant. | Ta'Qali | 18 months
July 1975 -
December 1976
and continuing |
| 11. Detailed specification of equipment and other facilities required for a completely equipped Pilot Plant (considering locally available equipment already installed) which will be included to a follow-up project. | Valletta
&
Ta'Qali | 3 months
August-October
1976 |
| 12. UNDP and or/ UNIDO review mission and assistance in preparing follow-up activities. | Valletta | 1 month
September 1976 |

For a complete view see the attached Work Plan Schedule - Annex III

B. Description of UNDP inputs

1. Assignment of international staff

Expert in ceramics technology

The expert should be a chemical or ceramic engineer with

considerable practical experience in research and development as well as manufacture of a wide range of ceramic products, including heavy clay building materials as well as fine ceramics. He should also have some experience in preparation of feasibility studies as he will be responsible for all aspects related to the development of a ceramic industry in Malta.

The expert will start his duty on or about 1st July 1975 for a period of 18 months. Duty station will be Valletta with travel within the country. He will be also present in the country making large scale trial abroad.

2. Provision for subcontractual services

A subcontract estimated at U.S. \$ 5,000 for the large scale trials abroad in glazed wall tiles, glazed mosaic and other items as the base for ordering of production machinery for the Pilot Plant as well as for the expected ceramic plant.

3. UNDP - provided supplies and equipment

Non-expendable equipment

Delivery date

Project car	\$ 2,500	July 1975
Laboratory equipment (as per annex I)	9,750	July/December 1975

C. Description of Government inputs

1. Prerequisite activities

Not applicable

2. Assignment of national staff

- i) For the work in the laboratory and later in the pilot plant suitable counterpart staff will be provided.
- ii) Skilled labour and technicians will be provided to the laboratory and pilot plant as required.
- iii) Necessary secretarial and other services will be made available at the time of arrival of the team-leader for use as required.

3. Government-provided supplies and equipment

- i) The project's laboratory will be accommodated in suitable premises to be provided by the Ministry of Industry.
- ii) A suitable building with necessary service facilities will be provided to house the pilot plant.
- iii) Any laboratory or semi-industrial scale production equipment presently available locally will be placed at the disposal of the project as required. A list of such equipment is provided in the Final Report dated 7th November 1974 of UNIDO expert Dr. K. Engelthaler and attached to this document as Annex II.
- iv) For the raw material survey a drilling rig with necessary accessories will be provided.
- v) The project will have full access to the facilities of the Ministry of Industry, such as offices, lecture rooms, reproduction facilities, etc.

Country: Malta
 Project number:
 Title: Clay refining and glazed tiles manufacture

Project Budget Covering UNDP Contribution

	Total				1975		1976	
	m/m	£	m/m	£	m/m	£	m/m	£
10. <u>Project Personnel</u>								
11-01. Expert in Ceramic Technology	18	54.000	6	18.000	12	36.000		
19 Component total	18	54.000	6	18.000	12	36.000		
20. <u>Subcontracts</u>								
21-01. Subcontracting of large scale trials abroad	-	5.000	-	5.000				
29 Component total	-	5.000	-	5.000	-	-		
40. <u>Equipment</u>								
42. Non-expendable equipment (see Annex I)	-	12.250	-	12.250	-	-		
49 Component total	-	12.250	-	12.250	-	-		
99 Grand Total U.S. \$	18	71.250	6	35.250	12	36.000		

Project Budget Covering Government Counterpart Contribution
 in Kind

Country: Malta
 Project Number:
 Title: Clay refining and glazed tiles manufacture

(in local currency £M)

	Total		1975		1976	
	m/m	£M	m/m	£M	m/m	£M
10. <u>Project Personnel</u>						
Government Counterpart	18	1.800	6	600	12	1.200
19. Component total	18	1.800	6	600	12	1.200
10. <u>Equipment</u>						
Non expendable equipment (see Annex II)	-	7.500	-	7.500	-	-
49. Component total	-	7.500	-	7.500	-	-
50. <u>Miscellaneous</u>						
51. Operation and maintenance of laboratory	-	500	-	300	-	200
53. Sundry	-	200	-	100	-	100
59. Component total	-	700	-	400	-	300
99. Grand total £M	48	10.000	6	8.500	12	1.500



Nonexpendable equipment - UNDP supply

Laboratory equipment

Item	Quantity	Description	Tentative Price
1	2	Andresen apparatus for particle size testing	90
2	1	Electric kiln to 1350°C, Sillite elements 30cm x 20cm x 40cm	2,500
3	1	Set of sillites for item 2	300
4	1	Laboratory grinding machine	2,000
5	1	Laboratory pugmill 80cm/h with various extrusion discs	2,500
6	1	Cutting saw for sample preparation with 20pcs spare cutting discs.	1,200
7	1	Electric hand-operated potters wheel with jigger and different profiles	1,200
Total			<u>10,790</u>

The laboratory equipment given in Annex I is listed according to the priority.

Non-expendable equipment - Government supplyPilot Plant equipment

Item	Quantity	Description	Estimated Price
1	1	Clay crusher (desintegrator) capacity about 10 tons/hour	
2	1	Horizontal vacuum press (pugmill) capacity about 5 tons/hour with mixer	
3	1	Glazing machine, capacity about 25.000 pcs of tiles/shift	Purchased by £27,500
4	1	Stationery electric kiln 60x 60x100x100cm up to 1000°C	
5	1	Electric tunnel kiln 35x35cm, 12m long	
6	1	Automatic silk screen decoration equipment	
7	1	Filterpress	

Refractory saggers, plates and slabs, refractory tile storage
benches, silk screen protectors, waterproof solutions etc are
counted under expendable equipment.

1976

1975

	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	
1.																			
2.																			
3.																			
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11.																			
12.																			

1. Erection of the Pilot Plant building at Ta'Qali including drainage for waste water & electricity supply.
2. Installation of the locally available equipment in the Pilot Plant.
3. Plant procurement of the extra plant and machinery.
4. Production trials in the Pilot Plant according to locally available equipment already installed.
5. Production of suitable amount of dressed clay for local craftsmen in the Pilot Plant.
6. Large scale trials performance abroad in the production of glazed wall tiles, glazed mosaic and other items.
7. Establishment of a technological laboratory for testing of drilled clay samples and clay products including equipment procurement through UNDP/UNIDO
8. Chemical and technological testing of drilled clay samples in the locally established laboratory.
9. Evaluation of testing results and the clay deposit, the clay which will be used in the Pilot Plant.
10. Practical training of local staff in ceramic testing and ceramic technology.
11. Detailed specification of equipment and other facilities required for a completely equipped Pilot Plant which will be included to a follow-up project.
12. UNDP and UNIDO review mission and assistance in preparing follow-up activities.

Request from the Government of Malta for
Technical Assistance

Job Description

Post Title: Expert in Fired Clay Building Materials and
 Ceramics

Duration: One and a half year (18 months)

Date required: 1st September 1975

Duty station: Ta' Qali, Msida and Valletta

Duties: The expert will be assigned to the Department of Industry and should assist in establishing a ceramic industry based on local clay. In particular, the expert will be expected to:

- i) evaluate the laboratory tested drilled clay samples and the clay deposit and calculate the total industrial reserves available for the production.
- ii) advise in the establishment of a laboratory for testing of ceramic raw materials and products, especially clay, clay based building materials and ceramic products.
- iii) continue with the establishment of a ceramic pilot plant and conduct the production trials in this plant according to locally available equipment already installed.
- iv) develop a suitable body composition which will help the local craftsmen to reduce or stop the import of clay from abroad and to produce it in sufficient quantity in the Pilot Plant which will be equipped at the beginning with locally available machines only.
- v) prepare a detailed specification of equipment and other facilities required for a completely equipped Pilot Plant which is expected to be converted in future to a production plant.
- vi) train local staff in ceramic technology and production, thus enabling them to operate efficiently further industrial production unit(s).
- vii) assist in the preparation of a follow-up project document, if required.

Qualifications:

Ceramic or chemical engineer with experience in the research and manufacture of fired clay building materials and ceramics especially in wall tiles, decorative ceramics and elements for ceiling construction.

Language: English

Background Information:

In 1966 a UNIDO exploratory mission has shown that the local clay deposits might be suitable for the manufacture of fired clay building materials and ceramic products. In 1974 a one month mission certified that in spite of the fact, that the local clay has not been tested satisfactorily may build a good base for local production of some of these products. Another SIS three months mission certified by small scale tests, that the clay is suitable for the production of glazed wall tiles when quartz is added to the local clay as well as for the production of ceiling elements and other pressed products.

During the last mission a suitable deposit of the blue clay was selected. It was also started with the building of foundations for the locally available production equipment.

After finishing the installation of the equipment and evaluation of the clay industrial reserves it is expected to make semi-large scale trials of different ceramic items and produce the most promising from economic and technological point of view in a mass production.

Malta imports except quick lime and limestone building blocks all other materials, which are necessary for the building activity and tries to find a way how to decrease these imports to the minimum.

RE/MLG

List of interviewed and contacted personsMinistry of Trade, Industry and Tourism

Mr Paul Xuereb	Hon. Minister of Trade & Industry
Mr R. Stivala	Secretary, Minister " "
Mr J. Cassar Pullicino	Director of Industry
Mr V. Gatt B.Sc. B.Pharm	Chief Laboratory Officer
Mr G. Pace	Officer i/c Malta Crafts Centre
Mr S. Portughese	Industrial Projects Officer
Mr A.K. Mitra	UNIDO Expert

Malta Development Corporation

Mr M.E. Galea B.Sc. BE & A, A & CE	Head of Technical Division
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Public Works Department

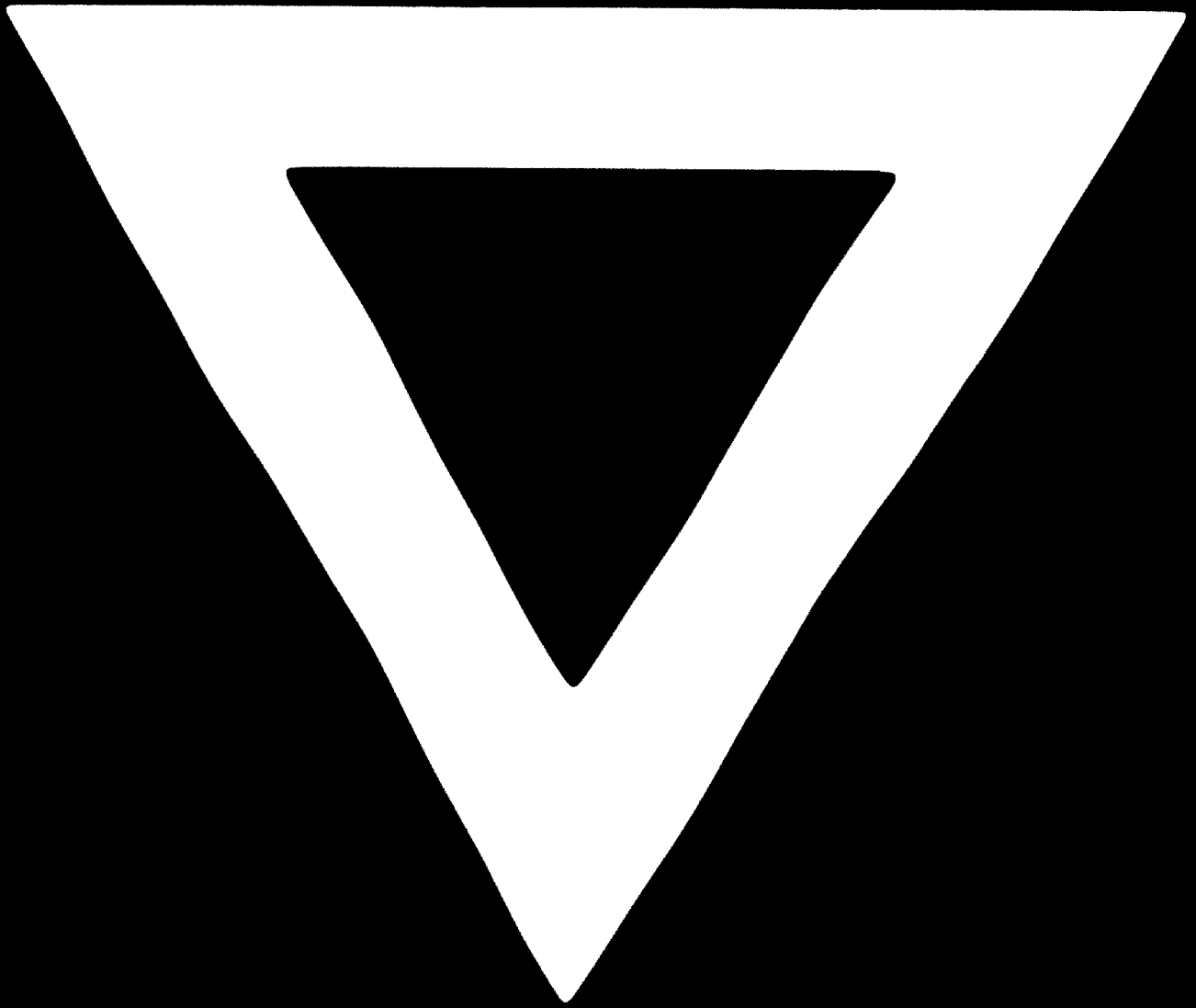
Mr G. Drago BE & A, A & CE	Deputy director
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Department of Education

Prof. P.M. Mayo	Headmaster, Malta School for Craftsman
Mr J. Bonnici	Master in charge " "

Also officers from Small Scale Industry, Office of the Prime Minister and several craftsmen.





76.02.03