



TOGETHER
for a sustainable future

OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.



TOGETHER
for a sustainable future

DISCLAIMER

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries, or its economic system or degree of development. Designations such as “developed”, “industrialized” and “developing” are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of firm names or commercial products does not constitute an endorsement by UNIDO.

FAIR USE POLICY

Any part of this publication may be quoted and referenced for educational and research purposes without additional permission from UNIDO. However, those who make use of quoting and referencing this publication are requested to follow the Fair Use Policy of giving due credit to UNIDO.

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org



and

BRITECH INDUSTRIES LTD

· A · TOTAL · CONCEPT · IN · PROJECT · MANAGEMENT ·

19287

PROJECT NO: DP/CPR/85/060/11-5

CONTRACT NO 89/90

between

THE UNITED NATIONAL INDUSTRIAL DEVELOPMENT ORGANIZATION

(UNIDO)

and

BRITECH INDUSTRIES LTD

VISIT BY ANDREW WATSON AND BERNARD MOORE

TO CHINA,

XJANYANG RESEARCH & DESIGN INSTITUTE

APRIL/MAY 1991

CONTENTS

	<u>Page</u>
ABSTRACT	3
INTRODUCTION	4
CHAPTER 1 - BATTERY CASTING DEVELOPMENTS AT XIANYANG	6
CHAPTER 2 - CASTING AT XIANYANG DURING VISIT	10
CHAPTER 3 - DEMONSTRATION OF CASING AND BLOCK MAKING	14
CHAPTER 4 - RECOMMENDATIONS	18
APPENDIX 1 - Terms of Reference	20
APPENDIX 2 - Covering letter to UNIDO	21
APPENDIX 3 - Filler and Safety Precautions	23
APPENDIX 4 - Photographs	24

ABSTRACT

The visit to Xianyang Institute and the report of Mr Bernard Moore in July 1988 led to recommendations concerning battery casting - see report of that date. A team from Xianyang Institute visited UK in December 1988 to visit several supply companies in the British ceramic industry. At this visit they commenced negotiations with the company, Britech Industries, in Stoke-on-Trent in association with Bernard Moore to undertake work further to advance the technology of battery casting at the Xianyang Institute.

The present contract and work deriving from these negotiations can be summarised as follows (see Appendix 1, Terms of Reference - also covering letter, Appendix 2):-

1. Supply of test battery cast unit (BCU) from Britech to Xianyang Institute together with two block moulds of agreed model (see accompanying letter, Appendix 2).
2. Visit of Mr Bernard Moore and Mr Andrew Watson to Xianyang for one month to install and commission the BCU.
3. During this visit to instruct the Xianyang staff in case and block mould making using the supplied block moulds and resin case materials supplied.
4. To advise Xianyang Institute team on the improvement of slip.

INTRODUCTION

The project commenced in UK where an agreed w.c. model (European type) was developed by Britech Industries (Mr Andrew Watson) to produce two block moulds for transmission to Xianyang. The model originally intended for this exercise by the Xianyang Institute did not arrive due to faults in addressing and transmission. Substitute by agreement of a similar European model was made in agreement with UNIDO as mentioned in Terms of Reference, Appendix 2.

First casts were carried out on one of the block moulds with the test battery casting unit at Britech headquarters before despatch. The two moulds with trials casting unit were then sent to Xianyang together with casing material and accessories for demonstration and manufacture of a case mould at Xianyang. During the visit of Bernard Moore and Andrew Watson the trial casting unit was assembled and product cast.

Some changes in casting slip formulation were tested and detailed comments on this aspect are found later in this report.

Two case moulds and one block mould were made during the visit under the supervision and instruction of Mr Andrew Watson. These case moulds can now be used for the production of block or working moulds. Full photographic support of the casing and model making demonstrations are available with this report (see Appendix 4).

The Britech test closet casting unit (BCU) two mould capacity was also supplied to Xianyang for demonstration of the system. The second block mould supplied was used for these casting trials. The casting sequence and commentary is covered in a later chapter.

The visit to the Institute by Mr Bernard Moore and Mr Andrew Watson from 22.4.91 involved 20 working days on site. Staff in control of the project at Xianyang were Mr Yang Hong Ru, Director, and Mr Liu Jiang, Project Leader.

This report should be read in conjunction with the supporting letter, Appendix 2.

CHAPTER 1

BATTERY CASTING DEVELOPMENTS AT XIANYANG INSTITUTE

1. Visit and report of Bernard Moore in July 1988 clearly sets out the benefits of battery casting compared with the classical mould layouts. Significant space and effort saving with consequent improvement in productivity and reduced energy consumption are primary advantages.
2. Battery casting now has been widely applied to most sanitaryware models worldwide. The principal of horizontal railway to assist mould movement with added central clamping, lifting assists and central slip feed is well appreciated.

Xianyang Institute originally developed their own version for lavatories and later, following the visit of BM in July 1988, have developed a prototype drain cast bowl unit which has been applied in full production at one of their plants near Beijing in China. Slip developed specially for this at the Xianyang Institute displayed most of the properties necessary for satisfactory BCU operation.

3. The company Britech offer a range of units for lavatories, bowls and tanks, and other shapes. They have supplied many leading sanitaryware makers in several countries of the

world, including the UK. Full size units of course include added assists compared with the basic trial unit supplied to Xianyang. E.g. curtain driers for double casting, elevated walkway between units to facilitate rim cutting and pressure control units to regulate the speed of slip supply from central slip storage. High productivities are regularly achieved.

4. In addition to selection of a battery casting unit supplier it is necessary to commission the design for the first moulds to be used on the units concerned, e.g. lavatory bowl or tank. Specialist knowledge in fitting moulds to battery casting unit is required and in the Britech Group of Companies this knowledge is offered by the Ceramic Design Services headed up by Mr Andrew Watson. Mr Watson has 17 years experience with two of the leading manufacturers in the UK in the design and modelling of sanitaryware pieces and the adaptation of battery casting process. The Group has designed all types of moulds for battery casting units with successful operation at low loss and high productivity.

5. With this present project and visits of Bernard Moore and Andrew Watson, Xianyang Institute has now taken a second step in seeking the technical assistance to improve application of battery casting. Its own in-house development of a battery casting unit for drain cast bowls came directly from the previous visit of Bernard Moore. The

battery casting unit developed by Xianyang Institute has many good features and should form the basis for further developments, combined with the knowhow now transmitted from Britech Industries.

Furthermore, in achieving a battery cast process for sameday emptying of floor mounted drain cast bowls, a new slip has been developed at Xianyang using a higher percentage of plastic clays, and lower rock kaolin (which has low plasticity and is currently included at 33% in the Xianyang factory recipe). The corresponding cast from the Xianyang factory slip has insufficient green strength to support the floor mounted model.

Inspection of the trial unit and pieces made by the Xianyang Institute some months ago show that the revised slip is certainly more suitable for BCUs of the Britech design. Unfortunately, due to other priorities in the mixing department of the Institute at the time of this latest visit, this modified slip was not available for tests on the BCU until the last week of the visit. However it was possible to demonstrate the method of filling, draining and emptying the mould on the BCU and to obtain sound pieces during the last three casts using the revised slip. (See photos)

It is clear that a combination of the Britech system with a correct slip will achieve finished results equivalent to those seen on the BCU test unit which was cast at the

Britech headquarters in England before despatch to Xianyang and using one of the block moulds that was eventually also shipped to Xianyang.

CHAPTER 2

CASTING AT XIANYANG DURING VISIT

1. The Britech universal casting unit (BCU) supplied is designed for closet production but could be adapted to cast basins, pedestals and tank lids with the necessary mechanical assists added.

The equipment supplied consisted essentially of gravity slip tank, 4" slip feed, end mould supports, three full and two half carriers, closing screw and finally main railway carrying the moulds, all with appropriate support structures. On the carriers are positioned rim clamps as required and on the overhead structure are tensator springs for the lifting of the rim section of the mould (photographs).

2. The operation of the unit is as follows. Mould halves and foot core together with lifting setter are located on the appropriate carriers. They are closed together by the clamping screw and the rim moulds secured in place at the moment of casting. Slip fill through the foot core follows the required casting cycle and after draining, when the piece is sufficiently firm (depending on the slip), the rim mould is removed. The mould halves are separated on the carriers as soon as the piece is sufficiently hard and the piece itself removed on the setter by lifting off the foot core.

This whole process should occupy less than four hours with an appropriate slip and further comments will be found later in this report in relation to Xianyang factory slip and a revised version later supplied.

3. The casting unit was assembled and put through a dry run during the first five days of the visit. During these tests slip was obtained from the Xianyang Factory.
4. As anticipated in the report of Bernard Moore of 7/88, the low plastic content and high water percentage (1.77 density compared with 1.82 normally applied in Europe) gave continued difficulties in emptying good casts. Due to low green strength the 4-5 hour cycle needed for successful BCU operation could not be achieved due to excessive soft-ness of the body and resultant cracking and distortion on emptying. Still using the Xianyang factory slip, variations were made in casting time and emptying schedules and some slight change in deflocculant addition, without success. This result confirms the Xianyang Institute attempts to use this slip previously in their own battery casting trials. It was therefore concluded that a change in slip recipe would be needed to make progress in casting on the BCU.
5. The current Xianyang factory recipe, containing only 18% of ball clay and 33% of rock kaolin, was then substituted by a recipe previously utilised satisfactorily on the Institute battery cast test unit. The new body contains $13 + 8 = 21\%$ of ball clay, $5 + 5 = 10\%$ kaolins (a total of 31% of clays with plasticity) and only 22% of the hard non-plastic rock

kaolin previously included. The recipe also includes (as normal) 30% of quartz, 17% of felspar and 1% of talc. Deflocculants used were .3% ash and .2% silicate. Although this slip still contained, at a 1.77 density, probably 3% more water than slip at the density normally preferred in Europe of around 1.82, the increased modulus of rupture (green strength), probably 50%, ultimately resulted in achieving good casts during the last days of the visit.

Using this revised slip, it was found possible to achieve the four-hour cycle of filling and emptying the mould that would be applicable to double casting routines using the appropriate curtain or equivalent driers normally supplied with Brittech equipment. The substitution of the increased ball and china clays described in the paragraph above clearly forms the basis for the establishment of a regular battery casting slip, but it is realised that there is now useful experience in sanitaryware factories in China elsewhere than Xianyang where useful experience is being gained in this respect.

6. In selecting the model for tests in this project, the product supplied was adopted in agreement with UNIDO and the Xianyang Institute after the non-arrival of the piece and mould originally selected by the Xianyang Institute. It was not, of course, possible to test the pieces cast from this model for contraction, firing distortion and functional (i.e. flushing) characteristics, since local manufacturing conditions in China could not be reproduced in England. In

fact to do that a tank and fittings would be necessary and conformity with local water and standard regulation would have to be incorporated. In any case, during the achievement of sound product from the original block mould it is always possible that minor changes in shape and contour to achieve correct distortion would be necessary. This would be a normal procedure in any modelling exercise in a sanitaryware plant anywhere in the world. Thus to achieve a product commercially saleable in China these exercises will have to be carried through. In order to achieve the results of the project it has not of course been possible to offer or to model a corresponding tank. This could be done, but it would involve substantial extra cost. It is now advised that the staff at Xianyang Insitute can continue having received instruction in the modification of block moulds on the mould cases produced to achieve the necessary extension to commercial sale of the bowl in question in China.

CHAPTER 3

DEMONSTRATION OF CASING AND BLOCK MAKING

(Both activities are illustrated in the photographs supplied - see Appendix 4)

1. According to contract materials were supplied for the production of case moulds as follows. Gel coat EL5 50kg, hardener EHT3 40kg, gel coat ET17 20kg. Also one roll of fibreglass matting and one roll of silk fibreglass cloth. In addition, 50kg of inert filler and miscellaneous accessories including natches, filler tubes, cleansing cream. These quantities were sufficient for the production of more than one case mould but the reader is referred to Appendix 2 (copy of the covering letter - paragraph 4).

Safety and health regulations referring to resin case mould material are also described in Appendix 3.

2. Case moulds were produced from the side mould and rim mould of the spare block mould supplied. The set up of these two pieces of block mould is shown in the accompanying photographs and consists of the provision of surrounding ground-work and cottles to provide a matching pair of back and front half case moulds.
3. A first gel coat is applied to the block mould and surrounding set-up and is allowed to harden for 4 - 6 hours before a second similar coat is applied. These first two

coats consist of three parts of ET17, one part of EHT3 hardener and one part of inert filler.

4. Immediately after the application of the second gel coat squares approximately 15cm x 15cm of glass fibre silk are pressed firmly into the painted shell to cover evenly and closely the contours of the block mould underneath.

Following the two first gel coats, four successive coats of a thinner mix (EL5 instead of ET17 and hardener) are applied by soaking squares of the fibreglass matting in the above mix and pressing in the way described above into the contours of the block mould already covered by the first two coats of gel. Once again, 4 - 6 hours is allowed to elapse between the application of successive coats.

5. When complete on the face part of the block mould, the complete block mould assembly and new face part case are turned over for the application of the same six case-forming layers to the block mould back (or the outside of the rim or side mould).
6. When the back half case is finished, the whole assembly is trimmed and separated into its two halves. A final outside coat of gel mixing is painted on the outside of the two case halves to cover the otherwise rough surface. The two halves of the new case mould are now fitted together and natches and pegs trimmed to give an accurate fit. Working mould can now be made from these cases (see photos).

7. In applying resin to plaster block moulds, release agent used is soap size. In applying resin to resin surfaces during this case mould production a mineral oil is used as a release agent.

8. Cases made in this way have great strength and hardness but retain a measure of elasticity to absorb the expansion of plaster. Treated with care, they should deliver thousands of working moulds. However, the advantage of this method is that repairs and alterations to case moulds can be easily made as demonstrated during this visit. The section of the case mould to be altered is cut out and after clean-up the original block mould is fitted tightly to the case. A new gel coat is then applied to the repair area and this is finally ground and polished to give a smooth surface. The method applies to minor repairs as well as to larger alterations such as change of rim depth or water inlet system sometimes required in adjustment of model to conform to standard requirements.

9. Demonstration was also made of the production of a block mould from a model using a typical European style wash basin.

DEMONSTRATION OF MODELLING AND BLOCKING

1. Firstly plaster batts, 13mm thick, were produced. These were used for all sections including overall plan of the basin bowl and bowl sections, cut to the required shape (photo 31).
2. These sections were then set to form a framework as demonstrated.
3. Between the bowl sections, plaster was placed followed by 25mm of plastic clay smoothed to a good finish. This was painted with shellac and a plaster mould run over the top. This was turned over and all sections and clay removed (photo 32).
4. When cleaned, this mould was prepared with soap and water and a second mould run inside (to be the face part of the block mould). Outside sections were then attached to the block (photo 33).
5. Between these sections, plaster was added to form the back of the model. The model was dressed with soap in preparation for the pouring of the back of the block mould.
6. After setting, the two halves of the block mould were separated and all sections and plaster removed. The block mould was cleaned and smoothed (photo 35) and can now be used for clay piece or plaster cast.

CHAPTER 4

RECOMMENDATIONS

1. During this project a new construction of closet mould has been demonstrated on a Britech casting unit. Experience of this together with the existing in-house developments at Xianyang Institute of an alternative battery system should lead now to an extension of battery casting technology in plants in China.

This is the recommended route for cast shop modernisation in today's state of the art.

2. The correct choice of bowl design is important as product develops in China. The open rim double cast version gives lower cost than box rim, separate or cast-on style. The bowl can be low level, high level or close coupled. It is the version used for more than 60% of bowl production in Europe, and many other countries except the US (where water saving has only relatively recently emerged). For US market of course, syphonic units are still required and in this situation the cast-on box rim is the best approach.
3. Instruction and demonstration in resin case making was given by Mr Andrew Watson. The method can now be used to improve production in existing sanitaryware plants in China, and could also be applied as an in-house revenue earner for the Institute in making quality cases for the industry. Advice

from Mr Watson in case making design has been valuable in teaching new methods to the Xianyang Institute team, but to get full benefit across a whole range of sanitaryware further consultations would be necessary with skilled modellers including of course Mr Watson. Consultation could take the form of planned visits to China or engineering advice from afar in written and illustrated form applied to other mould types and designs.

4. A visit to the new Xianyang factory covering around 42,000m² of floor-space over six floors indicates the need for up-to-date advice on other specialist engineering aspects of sanitaryware production, in particular in glazing and kilns to achieve lowest cost and highest quality from the forthcoming production. Comparison of quality and cost aspects of current European practice could provide significant improvements in this new project.

Such specialist advice is of course available in various places in the world, but the company Britech is staffed with a wide range of specialists in sanitary ware technology. The visit of Mr Andrew Watson of Britech and Mr Bernard Moore to install and commission the unit and test for closets, and to instruct the Xianyang staff in the techniques of case making with the special materials supplied has formed a useful base, but there is still much to do to bring sanitaryware production to modern standards of technology, quality and cost.

APPENDIX L

October 1989

TERMS OF REFERENCE

Messrs Britech Industries Ltd/UK (contractor) will assign a two-man team (Mr. B. Moore and Mr. A. Watson) to the project. The team will carry out the following activities in the UK and in China at the Xianyang Ceramic Research Institute, Xian, China:

a) Services to be rendered in the UK:

- Using a new working mould and fired piece to be supplied by Xianyang Institute, two block moulds of a European model similar to Xianyang model will be made at the premises of the contractor (Ceramic Products Development Section of Britech Industries Ltd., Stoke-on-Trent, England).

Duration: 2 experts

Mr. B. Moore - 1 week

Mr. A. Watson - 4 weeks

- The contractor should upon award of the contract, inform China, list of auxiliaries and equipment required to facilitate the installation and commissioning work.
- Block moulds and two meter long proto-type battery casting unit (BCU) to be developed in the UK, will be sent by the contractor to Xianyang, China, together with the necessary support elements to commission the proto-type BCU. The contractor will also supply sufficient case making material for manufacturing of one case mould in China.

b) Services to be rendered in China:

Four weeks after the delivery of despatched block moulds to China, the two experts will visit Xianyang for four calendar weeks each and will install and commission the battery casting unit for WC bowls and in this connection, they will carry out the following activities:

- Training of local technicians in producing on-site castings from final block mould.
- Supervising and training of the Chinese technicians in making a second block mould.
- Recommendations to improve the performance of the BCU with specific focus on slip, moulds and machinery.

Duration in China:

Mr. B. Moore - 4 weeks

Mr. A. Watson - 4 weeks

Reporting: The team to be assigned to the project will prepare a joint report upon completion of their work in China. The report should provide technical specifications and information on the proto-type casting unit to be developed in the UK and despatched to Xianyang, technical instructions provided to Chinese technicians in casting of the block mould. The report should also describe the methods introduced for block and case making and for operation of battery casting units.

The report should be made available to UNIDO, three (03) weeks after the completion of the work in China.

Travel arrangements: The team's timely travel to project in China will be arranged by the contractor. The contractor will provide return air tickets to the members of its team.

APPENDIX 2

Page 1

**BRITECH INDUSTRIES
Weston Coyney Road
Longton
STOKE-ON-TRENT
ST3 5JU**

United Nations Industrial Development Organisation

Dear Sirs,

**PROJECT NO: DP/CPR/85/060/11/05
CONTRACT NO 89/90**

This letter accompanies the report of Britech Industries (Mr A. Watson and Mr B. Moore) to the Xianyang Institute in China. During the final discussion at the Institute after the visit a number of points were raised on which we would like to offer the following comments:

1. As explained in the report, the model selected finally for the tests was a European shape similar to the Xianyang product, mould of which did not arrive due to transport errors. This change was agreed with UNIDO in advance.
2. In order to bring this bowl finally to commercial production it would have to be tested and, usually, in European practice, the block or case mould somewhat modified to conform with local codes. As explained in the text of the report this would require a matching tank and fittings which was not of course included in the original contract. It is suggested that the Xianyang Institute could make these if they require to apply this model commercially in China. This aspect is referred to in detail in the report, Chapter 2, paragraph 6.
3. Included with this report is a general arrangement drawing of the closet casting machine supplied. Dimensions and tolerances will be evident from this paper. Also accompanying the report are safety and health precautions in handling the resin case materials.
4. In the contract and terms of reference it was agreed to supply materials for and to manufacture one case mould in China. In fact, material was supplied and demonstration made of the manufacture of two case moulds (side and rim) and it may be that some confusion exists in that this did not comprise the five case moulds necessary to equip a full model. Nevertheless, without commitment Britech will supply free of charge, a further 20kg of the gel coat ET17 on receipt of shipping instructions from Xianyang. Further supplies of this and other materials will of course have to be sought by the Institute locally or in other markets.

Continued . . .

APPENDIX 2

-2-

With the ten copies of the text of the report is included one numbered copy of the photographs and the appropriate negatives.

If wa can be of further assistance in any of these matters, please let us know.

Yours faithfully,

APPENDIX 3

FILLER FOR CASE MAKING

The filler demonstrated at the Institute was calcium carbonate, but others can be used such as talc, silica flour, slate dust or plaster.

SAFETY AND HEALTH PRECAUTIONS FOR CASE MAKING RESIN

Accompanying this report is a copy of product safety data from suppliers, Delta Resin Products Ltd, Stockport, Manchester, who market the Borden materials necessary for this process.

APPENDIX - Photographs

CASTING

1. BCU installed
2. Mould on BCU
3. Piece emptying
4. Piece on setter
5. Cast pieces

RIM CASE

6. Rim case set up
7. Rim case set up
8. Back half after gel
9. Finished case mould before split
10. Splitting case
11. Finished case
12. New mould from case
13. New rim block

SIDE MOULD CASE

14. Block mould open
15. Ready for set up
16. Side mould case set up
17. Set up prior to first gel
18. Set up prior to first gel (2)
19. Side case after first gel
20. Matting application
21. Fibreglass application
22. Cleaning with wet and dry
23. Side case end cottle set up
24. End cottle
25. Top cottles
26. Completed case
27. Partly opened
28. Finished case
29. New mould from case
30. New mould from case

MODEL

31. Layout
32. Prepare face part
33. Build up of back part
34. Model prior to running back half
35. Completed wash basin block



**BRITECH
INDUSTRIES**

Britech Industries Limited
Cinderhill Trading Estate
Weston Coyney Road
Longton
Stoke-on-Trent
Staffordshire ST3 5JU England
Telephone: 0782 599290
Fax: 0782 599279
Telex: 367160 CERDRIG

