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22344

RIEUX REFRACTAIRES

Fabricant de creusets pour Verrerie et Cristallerie
Terres Réfractaires prêtes à l'emploi - sèches ou malaxées
Pièces Réfractaires cuites

Rieux, March 29, 2000

CONTRACT UNIDO / RIEUX REFRACTAIRES

No. 97/126

« Programme for the improvement of the glass industry, Firozabad, Technical assistance in the development of suitable pot bodies »

FINAL REPORT

This report constitutes the final report of the **contract No. 97/126 – Project N° DP/IND/90/010 – activity Code 0730BR.**

This final report covers the works performed in accordance with this above contract. We have established a summary of all the previous reports as follows:

FIRST PROGRESS REPORT

The aim of this study was to set up refractory compositions of clays and grogs in order to make glass pots for several glasses grades.

The first step was to examine a lot of Indian clays and grogs, and to choose the right number of products to be used in the constitution of pots making.

The method used was first to make a chemical analysis with a Philips PW 1660 X-fluorescent spectrometer; then the samples were prepared by melting in a lithium tetrabonate flux.

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Results

With all the chemical analysis performed, we have made a comparison of the results after ignition taking into account the loss on ignition and the chemical composition.

Our selection of clays and grogs have been based upon several criteria, and mainly:

- The alumina content (between 18% to 35/40%)
- Potassium and sodium oxyde contents, which interfere on the behavious of pots body during the first firing and pot's life during glass melting.
- Calcium and magnesium oxyde, which are fluxing agents...

Clays and grogs chosen were:

- CHANDIA CLAY (M.P.)
- KATNI CLAY (M.P.)
- THAN CLAY (GUJRAT)
- GROG 2 (FIROZABAD)
- BALL CLAY, BIKANER (1st GRADE B-21)
- FIRE CLAY (Plastic), DHANBAD, BIHAR (New sample) G.C.
- FIRE CLAY (Plastic), DHANBAD, BIHAR (New sample)
- FIRE CLAY, DHANBAD, BIHAR (New sample)
- GROG (IS - 6 Fire Brick) New sample
- GROG (IS - 8 Fire Brick) New sample

New samples of several kilos have been received in order for us to evaluate the plasticity of several bodies made with these raw materials and undersand what happens during the first firing.

SECOND PROGRESS REPORT

After receipt of the samples, chemical analysis have been made to check their accordance with the first samples received.

Differences have been found, on several clays, and we pointed out the fact that in the future it will be very important to check carefully the analysis on each batch.

We also reminded that the choice of raw materials to make glass pots is always a compromise between several technical criteria, such as:

- Chemical composition (clays)
- Impurities (clays)
- Workability (clays)
- Porosity and grain size (chamotte)

1. CHEMICAL COMPOSITION

Mixes have been prepared according to European basis, which is 50% clay and 50 % grog. Grogs are ground and sieved to:

0.5 / 1 mm	35 %
0.2 / 0.5 mm	25 %
0 / 0.2 mm	40 %

We have worked on three different composition types to obtain acid, semi-acid and basic qualities.

Raw material preparation

- Grogs: grinding, sieving to 0.2, 0.5 and 1 mm and reconstition of the 35 / 25 / 40 % Composition
- Clays: drying and grinding down to 0-2 mm.
- *Compositions*:

ACID 1	GROG 2 FIROZABAD 0/1 mm	50 %
	KATNI CLAY	25 %
	CHANDIA CLAY	25 %
SEMI-ACID 2	GROG IS - 8 0/1 mm	50 %
	BALL CLAY BIKANER 1st Gr.	25 %
	THAN CLAY	25 %
BASIC 3	GROG IS - 6 0/1 mm	50 %
	FIRE CLAY DHANBAT BIHAR GC	25 %
	FIRE CLAY DHANBAT	25 %

Mixing preparation:

- weighing the components dry
- mixing the powders
- wetting
- mixing
- making a cake

Study of the mixes:

For each mix, samples have been dried 48 hours naturally and 24 hours at 110 °C
They have been burnt at 1440°C - 1460°C - 1480°C & 1500°C.

After burning, we perform a visual examination, the open porosity test, and a chemincal analysis.

Results:

- Chemical analysis in agreement with the composition
- Good working capacity with adjusted water content.

The burning trials have given:

Acid N° 1	Better burning around 1440°C. Homogeneous body; this mix seemed to be good for pots-making.
Semi-acid n° 2	Good bahavious at 1460 / 1480 °C. Presence of seveeral small fused dots coming from impurities of the clay.Solution: very fine grinding of the powdered clay to reduce size of each individual particle.
Basic N° 3	Optimum burning temperature is 1480 / 1500 °C. Mix with higher refractoriness (due to higher alumina content) Problems of ferrous inclusions, dangerous for pots. Solution: elimination of the ferrous inclusions by magnetic selection on dry clay powder, or elimination, in the quarry, of the ferrous inclusion richer zones.

2. IMPURITIES

We speak about coarse impurities, when their size is bigger than 0.5 mm.
Impurities can be: quartz grains, iron sulfides, calcium carbonates and sulfates, which are dangerous for (bursts)

Solutions:

- grinding of the clay under 0.5 mm after drying,
- use a dynamic selector like ALPINE up to eliminate all the particles bigger than 0.1 mm.

3. WORKABILITY

Measured by workers hands at the time of pot making.
Nevertheless, measurements of the plasticity can be made by studying the stress / strain of the mixes with several water contents, but the best approach is again the worker opinions.

The mechanical strength in the dry condition must be sufficient to avoid cracking by mechanical shocks.

We can estimate the bending rupture strength to be more than 50 kg/cm² on the dry mix.

4. GROG GRADING

Residual porosity after burning must be of about 6% measured on 2 to 5-6 mm grains. A porous grog facilitates the wet plasticity of the mix and a better dry binder with clay.

The final grading 0/1 mm reconstituted with the ranges: 35% - 25% - 40 % as already explained above, should be constantly made to insure the same workability and behaviour of the pot during its use with molten glass.

First conclusions

We concluded that it is possible to make pots with the raw materials of INDIA, chosen by us, to obtain acid, semi-acid, and basic compostions.

Nevertheless, we pointed out the problems of chemical analysis constancy, impurities and inclusions in the clays.

Finally, we suggested to use the N° 2 and N° 3 compositions which are most confortable for burning and use:N° 2 for crystal and n° 3 for other glasses.

THIRD PROGRESS REPORT

This report has been established after the visit of Mr TIWARI, from Center for the Development of Glass Industry, FIROZABAD, from April25, 1999 to May 5, 1999.

First of all, Mr TIWARI spent 5 days RIEUX REFRACTAIRES. He made the visit of the factory and the saw the different workshops.

He also witnessed to the different steps of closed pot making, and attend the making of 2 open pots made from a mould.

We explained him also the drying process.

Secondly, Mr TIWARI visited the Clérac factory's installations.

During the two days of visit, we had a technical meeting and discusses about the second report and particularly:

- Raw material supply
- Raw material checking
- Making-of the refractory mixes
- Fabrication checking
- And relations between AGS-BMP and RIEUX REFRACTAIRES.

All the details are stated in the third report.

DRAFT FINAL REPORT

The subject proposed by UNIDO has been treated according to the methods normally used to prepare the refractory mixes and to make the pots since 50 years.

We have taken into account our good experience and the very good technical relations that we have with our main customers which are the most prestigious crystal companies in EUROPE.

The Indian party has been a little bit disappointed because they thought to a more scientific approach of the problems.

We must explain our position.

POTS FOR CRYSTAL

The problems of pots for crystal is very simple to explain.

Normally, during the use of the pots, the molten glass dissolves slowly the inside of the pot and the products coming into the crystal (or glass) must be eaten by the liquid easily and quickly.

Due to that, it is necessary to have a not too much refractory composition without high alumina level particles because these particles will not dissolve in the glass.

So, normally, the whole composition of the pot is chosen just to have a refractoriness above the molten glass, not to melt itself.

One can understand, in these conditions, that the composition of the pots must be very precise and also the homogeneity of the pot itself, and also that the raw materials must be submitted to a very tight checking.

All these parameters are more important than the mechanical green strength of the pots for example, because the wall thickness is chosen to be sure to have a sufficient mechanical resistance.

Also, if we speak of high temperature creep of the pot, we can say that we have very few occasions to see a creep distorsion of the pots during the use and here again a tight checking of composition and homogeneity is necessary.

RAW MATERIALS FROM INDIA

The first report shows that many materials coming from India as a small sample are convenient to make pots on the sole composition point of view either in the clays and in the grogs.

The second report is the most important, on our point of view because, if the conclusion says that it is possible to set with the Indian clays and grogs three mixes:

- ACID N° 1,
- HALF ACID N° 2
- and BASIC N° 3,

several things must be said with the chosen raw materials.

a) We notice some big differences in the alumina, calcium oxyde and/or iron oxyde between the first and the second samples of the same raw material. That is not acceptable considering pot making, and these raw materials must be checked batch per batch.

b) Some heterogeneity have to be noticed such as calcium carbonate or ferrous oxydes or sulphides which are very dangerous for pot life. These raw materials must be checked batch per batch and grinded carefully.

It is absolutely necessary to make consistant pots, not only to check the raw materials batch per batch and to compensate for small changes, but also to prepare the raw materials as indicated on the second report, drying and grinding the clays down to 0.2 mm and grinding and sieving the grogs in between 0.2, 0.5 and 1 mm.

MAKING OF THE REFRACTORY MIXES

The third report gives a summary of the AGS-BMP visit and of all the discussions we have had with Mr TIWARI and concerning refractory mixes preparation.

We can give below the main parameters to illustrate this final report:

- Selection and checking of clays batch, low alumina, controlled alkalin oxydes, good workability after wetting.
- Calcination of clay to make a special low alumina grog.
- Mixing the different elements in a clean millstone with only one part of the water.
- Add just the necessary water for optimum workability.
- Mixing again 15 mn.

- Give the shape of mix lots in an extruding machine.
- Cutting 13 kg lots and fully wrapp in plastic foils.
- Check each batch for chemical analysis and water content.
- Acceptance or rejection of the batch.

MAKING OF POTS

The third report gives the main points of interest of the visit (5 days) of Mr TIWARI.

No report can be better that 5 days to see pot-making.

If open crucibles could be made by pressing, there is no other way than hand-making for closed crucibles.

Most of the different parameters are very important in pot-making and Mr TIWARI has seen all these problems at RIEUX REFRACTAIRES.

We can remember and insist on:

- Be carefull with the dimensions of the bottom and of the walls.
- Be carefull with the drying cycle which is a matter of experience: not too quick to avoid cracking or even incipient crackings.
- Be carefull for packing, also to avoid crackings or other damage when the pots are carried to the glass factory

USE OF POTS

During the discussions between Messrs TIWARI and LEUK, all the process of firing a pot for the first time and beginning of use has been described and Mr TIWARI has been able to consult our documentations.

POT HOUSE BUILDING

We have taken into account the drawing of the Pot House Building given with the contract, as well as the List of Pot Making & Testing Equipments provided by Mr TIWARI on the occasion of his visit in April-May 1999.

We understand that the Pot House Building should include the shop for preparation of the mixes, the room for pot production and also the drying room to store the pots when they are finished.

According to the above information, we have done our utmost to submit you what we think the more rational due to the available space, but if you can have a bigger place, it would be better.

You will find enclosed the sketch of Pot House Building dully completed. We also enclose copy of the List of Pot Making & Testing Equipments given by Mr TIWARI.

- ***Pot House Building***

  On the sketch of Pot House Building, you should note that we have modified the walls and added 2 extra doors in the pot production room.

- ***Pot Production & Drying Room***

  Also, it would be judicious to plan some shelvings, all around the production and drying rooms; this could allow to increase the quantity of pots to be dried.

  These shelvings could be on 1 or 2 levels, depending of the type of pots (open or closed) and depending of their heights.

  Mr TIWARI saw these arrangements in our shops at Rieux's factory.

- ***Room for preparation of mixes***

  In a way of being functional, as you can see on the sketch of the Pot House Building, we propose you to install the different equipments the one after another.

  On the right side, we have set all the equipments corresponding to clays; on the left side, all the equipments corresponding to calcined clays / grogs.

  The mixing being realised at the end of the line, on the right side. Then you could install the de-airing equipment.

  The available space at the bottom of this room should be kept, for storage of the mixed clays in small blocks / lots, such as Mr TIWARI saw in Rieux's factory.

These blocks of mixed clays and grogs shoud be kept during minimum 3 weeks to 1 month before use, to let the clay aging which is good for plasticity. This rest participates also to the fermentation of the organic substances in the clays, and allow the obtaining of a mix with a good plasticity. This is well known by ceramists.

- ***Room 3000 x 3000***

This room is the one located between the place for mix storage, and the toilets. We supposed that it will be a room for employees (refectory and/or locker).

- ***Laboratory***

We think better to leave it to you to install the testing equipments of the laboratory to your convenience.

CONCLUSIONS

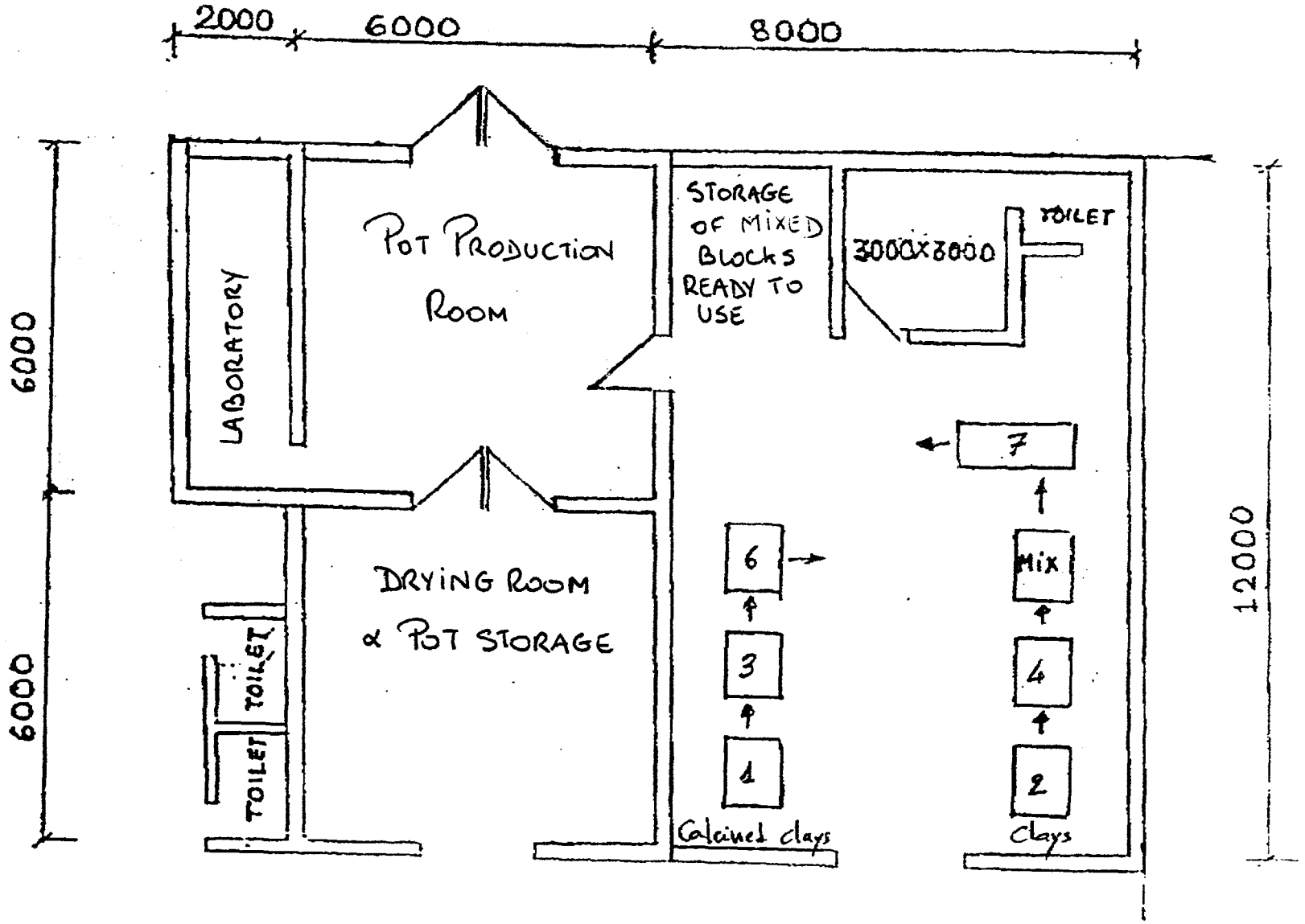
We have given, with our reports and during the visit of Mr TIWARI, the best of our experience to make pots and to discuss with customers for the use of pots.

We have described a situation which works, we can say, nearly perfectly between AGS-BMP, RIEUX REFRACTAIRES and the European customers.

We hope that our method to transmit to the Indian party and to Mr TIWARI our knowledge has been good and successfull.

-ooOOoo-

Enclosures: Pot House Building sketch
List of Pot Making & Testing Equipments



POT HOUSE BUILDING

HEIGHT 4500

SCALE 1:100

RIEUX REFRACTAIRES
B.P. 10 - 60870 RIEUX
Capital 700.000 F
SIRET 319 998 365 00013

CENTRE FOR THE DEVELOPMENT OF GLASS INDUSTRY
FIROZABAD

LIST OF POT MAKING & TESTING EQUIPMENTS WITH CDGI

1- JAW CRUSHER - 6 X 3 (CHANNEL BASE)

For crushing calcined clay lumps and grogs

The body is made of steel electricity welded. The corrugated jaw is pressed on the fixed jaw by eccentrics to effect crushing. The jaws, made of Mn. Cast steel are both replaceable and reversible. To maintain uniformity of speed and ensure momentum too, a pair of well balanced fly wheels are keyed with driving shaft on both sides. One of the fly wheels is designed as V-pulley.

Specification

Model	:	JC-63
Type	:	V.B.
Size of mouth	:	6"X3"
Material	:	Clays, Grogs etc.
Feed size	:	4" (Max)
Product size	:	8-10mm
Capacity	:	400-500 kg/hr
Motor	:	2 HP, 1440 RPM, SQ, CAGE, TEFC,AC
Full speed	:	250 RPM

2 DISINTEGRATOR

The impact pulveriser is suitable for crushing hard and medium type of materials and other friable materials. The basic design of the equipment is to reduced the material in 4 ways like impact, attrition, shearing and compression with minimum power consumption. The machine is fitted with Shear Pin Safety Device and trap metal arrangement to catch the small iron particles and hard materials during operation.

Specification

Rotar Size	:	500x400mm
Materials to be crushed	:	Calcined Clay & Grogs
Capacity	:	2 Ton/Hr
Motor	:	15 HP

3. EDGE RUNNER MILL ERS 48

With granite stone base and rollers. Used for crushing small pieces of calcined clay material and grogs to powder. To avoid iron content, the machine is made suitable by using hard granite stones at the bottom and runner and is fitted with MS Pan very strongly built.

Specification

Base	:	1200mm X 300mm face
Runner	:	750mm dia X 225mm face
Capacity	:	500 - 600 kg/hr
Motor	:	7.5 HP

4. BALL MILL

Suitable for batch type wet grinding and dry grinding of clays and calcined materials. Design to make porcelain lining to prevent iron contamination during grinding and to discharge under gravity through discharge mouth with suitable cock..

Specification

Size	:	1200 X 1300mm
Motor	:	10 HP

5. SCREW BLUNGER

The machine is widely used for making and churning of ceramic slurry/slips after ball milling operation to keep the dry ground materials of suspension of water and keep it constantly homogenous.

Specification

Size of the Vat	:	2250 X 1800 deep
Dia of Propeller	:	500mm
Capacity	:	5000 Ltrs
Speed	:	250 - 300 RPM
Motor	:	5 HP

6. VIBRATING SCREEN

Suitable for screening of dry clay and other friable materials. Special type of screen, the body is made of hard wood to avoid iron contamination with material during screening.

Specification

Deck	:	Double
Screen Net	:	Mode of Steel Grade-IS:304 Replaceable (90X60Cm)
Motor	:	2 HP

7. DEAIRING PUG MILL

The machine is widely used for shaping pugging and extruding of clay and pot mix by plastic process where deairing is necessary. This consists of three chambers in one line feeding and mixing, vacuum chamber and auger chamber.

Specification

Motor for Machine	:	7.5 HP
Motor for Vacuum Pump	:	2 HP
Capacity	:	700 - 900 kg/hr

8. MOR TESTING MACHINE

For determination of MOR (Modulus of rupture) of material. It has heavy metallic frame with pressure dial gauge built in hydraulic press, fixture for holding the sample.

9. LIQUID LIMIT DEVICE

Liquid Limit Device is with ASTM Casagrande growing tools and gauge block, hand operated with counter, IS:2720 (Part-V) for the determination of plasticity of the clay.

LIST OF EQUIPMENTS (CHEMICAL LABORATORY)

1. Fume Cup Board (2)
2. Micro 2 pH/Ion Meter
3. Flame Photometer (2) Chemito (with Li, Ca., K, Na filters)
4. Lambda 2 UV/VIS Spectrophotometer
5. Bomb Calorimeter
6. Auto Clave
7. Electronic Balance
8. Muffle Furnace (Temp 1100 deg./C)
9. Muffle Furnace (Temp 1650 deg/C)
10. Water Distillation Plant (2)
11. 3100 Atomic Absorption Spectrophotometer
12. Radiation Pyrometer
13. Hot Plate (2)
14. Water Bath (2)
15. Electric Oven
16. Globar Furnace (Temp. 1450 deg.C)
17. Vacuum Pump
18. Testo 33 Flue Gas Analyser
19. Stack Monitoring Kit
20. High Volume Sampler and Wind Monitor

LIST OF EQUIPMENTS (PHYSICAL LABORATORY)

1. Refractometer
2. Density Comparator
3. Polariscope
4. Polarising Microscope
5. Hot Air Oven
6. Vernier Callipers
7. Thickness Gauge
8. Grinding & Polishing Machine
9. Dilatometer
10. Thermal Shock Machine
11. Apparatus for measurement of Softening point
12. Apparatus for measurement of Glass viscosity in annealing
13. Electronic Balance
14. Optical Pyrometer
15. Gradient Furnace for devitrification studies
16. Glass Cutting Machine