‘KIRO CUCUK’ AD VELES
RASTANSKI PUT BB

S T U D Y

OF THE PERFORMED INDUSTRIAL TRIAL IN THE REGULAR PRODUCTION OF CLAY POROUS BLOCKS, MADE OF BASIC CLAY RAW MATERIALS WITH THE ADDITION OF SOLUTION OF CALOXAN

V E L E S

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I N T R O D U C T I O N

With the appearance of the energy crisis that started with higher price of crude oil, economic requests for saving energy, as well as saving other production resources also appeared. Saving energy, raw materials and labor must not put to question the quality and quantity of production, but quite the opposite, we have to find the appropriate way to increase physical extent of production, and at the same time to have the above requests fulfilled. In order to achieve something like that, it is necessary to make a trial on already existing machinery, with the existing equipment and measuring instruments that would show the crude oil consumption during the production process. Apart from that, for the successful trial it is also necessary to have expert staff and highly responsible business executives during the whole trial period.

REPORT ON PERFORMED INDUSTRIAL TRIAL USING CLAY AS A RAW MATERIAL WITH THE ADDITION OF CALOXAN SOLUTION

1. 3% of prepared Caloxan solution was added to the clay in the two-axle filtermixer.
2. 20,000 pieces of clay porous blocks – dimensions 400x250x160mm were made of this mixture.
3. Technological process from preparation of raw materials to obtaining finished clay porous products, was followed by laboratory trials throughout the whole production process in the 'KIRO CUCUK' AD factory.
4. Checking out of baked porous clay blocks, as well as of their physical-mechanical properties (hardness on pressure and water permeability) was done at The Institute of Civil Engineering 'Macedonia' AD Skoplje.

PRODUCTION OF POROUS CLAY BLOCKS WITH THE ADDITION OF CALOXAN SOLUTION IN THE WORKING UNIT 'MONTA' AT 'KIRO CUCUK' AD VELES

This industrial trial started on 21 February, 2007 in one of the factory sections of 'KIRO CUCUK' AD VELES, where there is a continual production of porous clay blocks.
Clay was examined (on chemical contents, granulometric-sieve analysis, humidity of raw material and its elasticity) in the laboratory of 'KIRO CUCUK' AD VELES.

a) Chemical content of clay was as followed:
   CaO – 1.56%
   MgO – 0.8%
   Al 2 O3 – 21.5%
   Fe2O3 – 8.2%
   SiO2 – 60.3%
   Temperature loss on 1000 deg. C = 5.5%

b) Raw material humidity W=16.2%
   Elasticity = 2.9%

c) Granulometric-sieve analysis:

Diameter of the Sieve (mm)	2.5	1.0	0.25	0.125	below 0.063
%	0.1	4.2	8.3	3.9	83.5

First, additive Caloxan is prepared. It consists of three solutions: R01, R02 and R03. Then the mixture of appropriate ratio between Caloxan and water is prepared in the barrel of 200 lit. as follows:
R01-12 kgs + R02-52.6 kgs + R03-2.4 kgs + 160 kgs of water

A 3-ton tank is filled with the above ratio of the prepare solution (Caloxan and water), so that the solution of clay and Caloxan would be homogenous during the whole process. Clay in the two-axle filter mixer is being wetted by the prepared Caloxan solution, and during mixing good homogenization of Caloxan solution and clay is obtained. Thus prepared mass is transported to the pressing machine model VA-600 Super.
After mixing, a sample of the mass (clay with Caloxan sol.) was taken for lab. Trial, and an analysis was also done in the laboratory of 'KIRO CUCUK' AD plant. And the following mass characteristics were obtained:
W = 19.3%
Elasticity = 2.8%

After pressing on the press VA-600 Super, we got a clay porous block of the following Dimensions:
Length: L = 415mm
Width: B = 261.5mm
Height: H = 167.2mm

Weight: G = 13.6kgs

Vacuum value in the press was about 82%, relative humidity in the working room was about 60% and temperature was 7 deg. C.

Thus obtained clay porous block was put on the movable rack (shelves holder) and brought into the tunnel drying space where diffusers for extracting humid air were opened: D1 = 25% and D2 = 100%.
Parameters of the tunnel drying space were:

a) Drying space entrance: T1 = 21 deg.C, humidity W1 = 98%
b) Drying space exit: T2 = 51 deg.C, humidity W2 = 32%

After 29 hours of drying, dry clay porous blocks started coming out, and they were of the following dimensions:
Length: L = 397mm
Width: B = 251mm
Height: H = 159.9mm
Weight: G = 10.920kgs

Total production was 20,000 samples which were, after drying, put on the palettes and on the freight cars and thus prepared for the transport to the tunnel furnace.
Parameters of the tunnel furnace were:
T1 = 640 deg.C; T2 = 810 deg.C; T3 = 710 deg.C;
T4 = 890 deg.C; T5 = 850 deg.C; T6 = 840 deg.C;
T7 = 890 deg.C.
Temperature on the chimney = 60 deg.C.
Temperature loss on the furnace T = 180 deg.C.
First recuperator T = 120 deg.C; Second recuperator T = 190 deg.C.
Temperature loss after the interchamber T = 180 deg.C.
Temperature of the main tunnel of the tunnel drying space T = 130 deg.C.

After 32 hours we got baked porous clay blocks of the following dimensions:
Length: L = 398mm
Width: W = 251.7mm
Height: H = 160mm
Weight: G = 10.290kgs

Physical-mechanical trial (hardness on pressure and water permeability) were performed at The Institute for Civil Engineering “Macedonia” AD Skopje. The Report is included to the Study.

Besides drying in the tunnel drying space, we left one rack with 240 samples of porous clay blocks in the working room for the natural air drying.
Relative humidity of the air in the working room was about 60%, and temperature was 7-10 deg.C.

Natural drying began on 21 February, 2007 and lasted for 12 days total, until 5 March, 2007. And samples dried this way were baked in the tunnel furnace under normal baking conditions for 48 hours.

TABLE SURVEY OF THE RESULTS FOR NATURAL DRYING IN THE WORK-ROOM WITH RELATIVE AIR HUMIDITY AROUND 60% AND TEMPERATURE 7-10 DEG. C FOR THE CLAY POROUS BLOCK (400X250X160mm):

Time Date	Weight G (kg)	Length L (mm)	Width B (mm)	Height H (mm)
21.2.2007. At 12:00h	13.140	399/402	259.1	166.5
At 20:15h	13.040	398/400	258.8	165.1
22.2.2007. At 08:00h	12.950	395/398	257.4	162.3
At 12:30h	12.860	394/396	257.0	161.8
At 16:00h	12.780	396	256.8	160.1
At 20:00h	12.640	393/395	256.1	160.1
23.2.2007. At 08:00h	12.580	392/395	255.3	160.0
At 19:00h	12.360	393	254.3	160.0
27.2.2007. At 20:00h	11.560	390	251.5	160.0
05.3.2007. At 20:00h	11.340	390	251.0	159.6

C O N C L U S I O N

On the basis of obtained parameters concerning this industrial trial with CALOXAN, we can conclude the following:

- Rational use of all sorts of clay, from the one with low percentage of elasticity to the one with harmful addition (carbonates), can give a product – hollow clay block which is in accordance with the standards for this type of products.
- Clay porous block has no deformities during pressing (forming), drying and baking.
- Vacuum in the press VA-600 has not changed in spite of the changes in humidity and elasticity of the clay with Caloxan solution.
- At the same time, it was obvious that it did not come to the excessive load in the Press VA-600, and it could be perceived by monitoring performance of the electric motor, i.e. through the amperage measuring devices.
- We got the even, homogenous mass which did not harm the inner parts of the press and filter mixer.
- Percentage of raw debris decreased below 1%, while before it was about 3-5%.
- Percentage of dry debris decreased down to 1%, while before it was 3-15%, and sometimes even 20%.
- Drying time decreased for 20%. Since we have had some holdups during our working process (while the blocks were dried), we think that drying time can be reduced and up to 50%.
- Baking time was decreased for 33-50% and we got clay porous blocks pale red in color which did not influence the quality, but only the appearance of the block. Regarding physical-mechanical properties, blocks baked this way show great hardness on pressure, greater than the required minimum according to the standard for this type of products.

From everything stated before (both in the text and table survey of results), it can be Concluded that CALOXAN Solution has great importance in the production of clay hollow blocks, and it means a great future for the companies that produce clay blocks.

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