Production method overview products from foamed ceramics

For the decarbonization of the EU construction industry, along with measures such as building renovations, energy transition in the field of heating and cooling, circular economy and other measures, energy efficient construction materials (external walls) are needed. The most effective material, foam glass, has not received widespread use due to its high cost. However, there is a cheap alternative - foam ceramics - a porous material for making energy-efficient, comfortable building products from local raw materials.

In Russia, the first research at the Department of Glass Technology of the Moscow Institute of Chemical Technology. DI Mendeleev to produce foamed ceramics from low-melting clay made it possible to manufacture 2300 m3 of building products in the factory.

Subsequently, the Research, Design and Technological Institute of Concrete and Reinforced Concrete: <u>http://www.niizhb-fgup.ru/</u> determined, among other things, the main technical characteristics of ceramic foam products:

Таблица 5.11

	Основные	строительно-технические	свойства	порискерамических	ище-
лий					

Марка по средней плотно- сти, кг/м ³	Средняя проч- ность при сжатии, МПа	Приз- менная проч- ность, МПа	Мо- дуль упру- гости, МПа х 10 ³	Коэффи- циент теп- лопровод- ности (W=0%, T=20° C), Вт/м°С	Моро- зостой- кость, марка	Сорбционная влажность при 97% влажности воздуха	Водопо- глощение по мас- се,%
200	0,8	0,75	0,6	0,06	F25	9,8	18,4
300	1,0	0,9	0,8	0,09	F35	9,7	15,0
400	3,0	2,1	2,0	0,11	F50	9,5	14,7
500	4,0	3,3	2,8	0,13	F50	8,8	13,8
600	6,0	5,4	4,1	0,14	F50	8,5	12,3
700	7,0	7,2	4,6	0,15	F50	8,3	11.5
800	10,0	9,0	5,1	0,16	-	8,1	11,2

Strength characteristics of ceramic foam products in comparison with lightweight concrete.

Таблица 5.5

Деформативно-прочностные свойства пористокерамических изделий в внении с легкими бетонами (по СНиП 2.03.01 [276] и ГОСТ 25485 [90])

Плот- ность, кг/м ³	Прочность при сжатии, МПа				Модуль упругости, МПа х 10 ⁻³			Призменная проч- ность, МПа		
	пк	ячен- стый бетон	керам- зито- бетон	керамзитобе- тон Черкес- ского завода	пк	ячеи- стый бетон	керам- зито- бетон	пк	ячен- стый бетон	керам- зито- бетон
200	1,0	-	-		-		-	0,8		*.
250	1,3	-			0,8		*	0,9	-	-
300	1,8	0,9		1,1	1,3		-	1,5	0,6	-
400	3,0	1,9	1,2	2,2	2,0		ж.	2,1	1,3	*
500	4,0	2,4	1,9	2,9	2,8	1,4	*	3,3	1,6	1,5
600	6,0	3,3	2,7	4,0	4,1	2,1		5,4	2,2	2,1
700	8,0	4,6	3,5		4,6	2,9	3,9	7,2	3.1	2,8
800	10,	6,9	5,5		5,1	4.0	4,5	9,0	4.6	4.5

The pilot production methods of these organizations were primitive and ineffective. In addition, the density of manufactured products ranged from +/- 12-15 units from the baseline.

In Europe and the USA, research was also carried out on the ZYTAN THERMOCHEM VERFAHREN technology. There are patents for information, including: <u>https://patents.google.com/patent/US3745201A/en?assignee=ZYTAN+THERMOCHEM+VERFAHREN</u> <u>https://patents.google.com/patent/US4174089A/en?assignee=ZYTAN+THERMOCHEM+VERFAHREN</u>

The new material was in the early stages of research and was not considered in the context of the Kyoto agreement on the reduction of greenhouse gas emissions, so the innovations of that period were not implemented.

Today's agenda for achieving the EU 2050 target is impossible without the introduction of carbon-free technologies in the construction industry.

We propose for consideration and implementation the idea: **<u>goo.gl/GMrabP</u>** which will contribute to the creation of non-traditional, compact enterprises, without additional infrastructure costs with the possibility of using <u>high-temperature solar ovens</u> in certain territories. The technological concept guarantees exact compliance with the density and actual dimensions of the products according to the planned parameters.

With a synergistic approach to the implementation of the idea, the following problems can be solved by 2030:

	Production	Energy GJ / m3	Note		
1	Foam ceramics	0,97	calculated, density 500 kg / m3		
2	Expanded clay concrete blocks	3,4	calculated, dense body		
3	Brick lightweight blocks - at/de/it	1,1 – 1.9	BAT - CER BREF August 2007		
4	Foam glass	1,98	Ecological assessment Fraunhofer		

- to reduce the use of fossil fuels in the production of expanded clay, cement and other products:

- reduce the impact on the environment by minimizing greenhouse gas emissions, nitrogen oxides, dust and noise.

- resource saving - land for agriculture, water, oxygen is not required.

<u>- a high degree of participation in the circular economy. / Construction Carousel (CC) "Social Urban</u> Mining" - potential for providing 100% of raw materials, including for cement production. /

- reduction of transportation costs.

- an economical method of production, the price of products, a smaller volume of products in the structure of the walls and, accordingly, a lower load on the foundation, seismic resistance.

In a long list of methods to produce foamed ceramics, the minimum number of components is 3-4 names, in our technology there can be only one component - slate with a fraction of 0.5-20 mm or industrial waste suitable for obtaining expanded clay.

Strength characteristics of ceramic foam products in comparison with lightweight concrete:

Плот-	Прочность при сжатии, МПа				Модуль упругости, МПа x 10 ⁻³			Призменная проч- ность, МПа		
ность, кг/м ³	пк	ячен- стый бетон	керам- зито- бетон	керамзитобе- тон Черкес- ского завода	пк	ячеи- стый бетон	керам- зито- бетон	пк	ячеи- стый бетон	керам- зито- бетон
200	1,0	-	-	-	-	-	-	0,8	-	*
250	1,3	-	-	-	0,8	-		0,9	-	
300	1,8	0,9		1,1	1,3	-	-	1,5	0,6	-
400	3,0	1,9	1,2	2,2	2,0	-		2,1	1,3	-
500	4,0	2,4	1,9	2,9	2,8	1,4	-	3,3	1,6	1,5
600	6,0	3,3	2,7	4,0	4,1	2,1	-	5.4	2,2	2,1
700	8,0	4,6	3,5	-	4,6	2,9	3,9	7,2	3.1	2,8
800	10,	6.9	5.5	*	5.1	4.0	4.5	9.0	4.6	4.5

According to the European Expanded Clay Association (EXCA), the production of expanded clay in 2007 was 7 million cubic meters per year. If 20% of the expanded clay was supplied to produce expanded clay blocks, its volume is 1,400,000 m3 these are 30-40 enterprises to produce ceramic foam products in the EU.



Idea: goo.gl/GMrabP was studied until 2016, then we collected quite a lot of information about other studies. Undoubtedly, as in any other interdisciplinary project, highly professional researchers will have many questions about the details and additional information on the idea, which we are ready to answer by e-mail: <u>ed.kokaia@gmail.com</u>

Eduard Kokaia. engineer, researcher, a new paradigm of energy-efficient, resource-saving and environmentally friendly material for construction and other industries.