Journal of Engineering and Applied Sciences
MEDWELL PUBLICATIONS SINCE 2000

The Development of Structures and the Search of Physical Mechanical Properties of the Foam Concrete Depend on the Techno-Genic Raw Materials in Iraq

Noora Ayad Al-Harby
Department of Civil Engineering, Bilad Al-Rafidain University College, Baghdad, Iraq

Key words: Compressive strength, concrete and natural limestone, dense structure, buildings, technology

Abstract: Traditionally, internal and external walls of the buildings and facilities used to be built of heavy concrete and natural limestone and brick made of ceramic each type has dense structure. In Iraq it is necessary to adjust temperature during the year except for 2-3 months in residential houses and social buildings to create comfortable conditions. For a period of three months buildings must be heated and over 6 months they must be cooled. The cost of heating and cooling processes is very high. In cellular concrete technology as an adhesive used mainly cement, lime and silicon components. Now, intensive work taking place in Iraq in the restoration of buildings destroyed during the war and there are large reserves of mineral raw materials in construction places that can be recycled effectively as a result of x-ray analysis of these materials showed that their structures contain, silicon, calcium oxides and clinker materials. A sample of the materials contained separate pieces of heavy concrete as well as gravel of circular shape. These samples were collected and converted into molds within 28 h. The crusts were cut to remove the models and were then placed in pressure vessel at a temperature of a temperature of 180-200 for a period of 12 h and the pressure 10-20. Experimental studies have shown that the replacement of 30% of calc-siliceous binder with technogenic raw materials of the Republic of Iraq makes it possible to produce aerated concrete of class B1 which can used as a thermal insulation and for the installation of external walls of frame buildings.

Corresponding Author:
Noora Ayad Al-Harby
Department of Civil Engineering, Bilad Al-Rafidain University College, Baghdad, Iraq

Page No.: 2522-2528
Volume: 15, Issue 12, 2020
ISSN: 1816-949x
Journal of Engineering and Applied Sciences

INTRODUCTION

Rospects for the development of cellular concrete technologies: Cellular concrete is an artificial porous material based on mineral binders and silica component containing uniformly distributed pores of three types: cellular, capillary and gel. For cellular concrete is characterized by a highly porous cellular structure. Cellular concrete is divided into two types: non-auto claved or non-autoclave, providing steaming, electric heating or other types of warming at normal pressure and autoclave which harden at elevated pressure and temperature. The method of hardening is reflected in the name of cellular concrete, for example, steamed gasolosilicate, etc.[1]. The average density of cellular concrete is determined by the density of the inter-porous material (silicate stone in concrete) and the total volume of voids formed as a result of air entrainment, artificial mass porosity and evaporation water evaporation[2, 3].

The average density of the silicate stone of concrete varies depending on the raw materials used. For cellular concrete on ash, the average density is 2000-2100 kg m^{-3} and on quartz sand -2,600-2650 kg m^{-3}. The building properties of cellular concrete are largely determined by the value of the total porosity and pore characteristics, etc.[4, 5]. The strength of cellular concrete depends largely on the moisture content in them[5, 6]. The compressive strength in the dry state is 20-40% higher than the strength of the water-saturated material. The greatest decrease in strength is observed when the cellular concrete is moistened to 7% (by mass) which corresponds to the value of sorption humidification[7, 5]. Depending on the technology used (injection molding or complex vibration), the moisture content of the cellular concrete after autoclave treatment varies between 15-35% weight.

MATERIALS AND METHODS

In the Republic of Iraq work is currently underway to restore buildings destroyed during the war. On the construction sites there are significant reserves of man-made mineral raw materials which was formed as a result of the destruction of buildings during military operations. This raw material can be processed quite efficiently and used to make new wall materials for the research, typical samples of such raw materials were selected. Samples of materials contained both individual pieces of heavy concrete and gravel fragments of round shape (Fig. 1 and 2). A laboratory mill for grinding materials is shown in Fig. 3.

These devices significantly shorten the duration and improve the accuracy of the results of the analysis, reduce the errors of a subjective nature, due to the participation of the operator in the performance of measurements and calculations. The finely dispersed raw materials of the Republic of Iraq were investigated on a microsayer. Laser particle size analysises Microsizer 201 are fully

Fig. 1: Locations of sampling material for research in Iraq

Fig. 2: Typical fragments of the selected material

Fig. 3: A laboratory mill for grinding materials

Fig. 4: Device for determining the specific surface of the PSC-10

automated devices (Fig. 4 and 5). This method is based on the phenomenon of X-ray diffraction on a three-dimensional crystal lattice (Fig. 6).

The study of the properties of aerated concrete was carried out using samples measuring 3×3×3 cm. The dosage of the components was carried out on analytical scales. For mixing and molding, standard laboratory equipment was used (Fig. 7 and Table 1).

Samples were held in the molds for 28 h, the horns were sheared and then steamed for 12 h in an autoclave at a temperature of 180-200°C and a pressure of 10-12 atm. The last series of samples was not autoclaved and was maintained under normal conditions for 28 days (Fig. 8).

After extraction from the autoclave, the samples, were measured, weighed tested for compressive strength. The change in the average density and compressive strength of aerated concrete samples (MPa), depending on the content of technogenic raw materials is shown in Fig. 9.

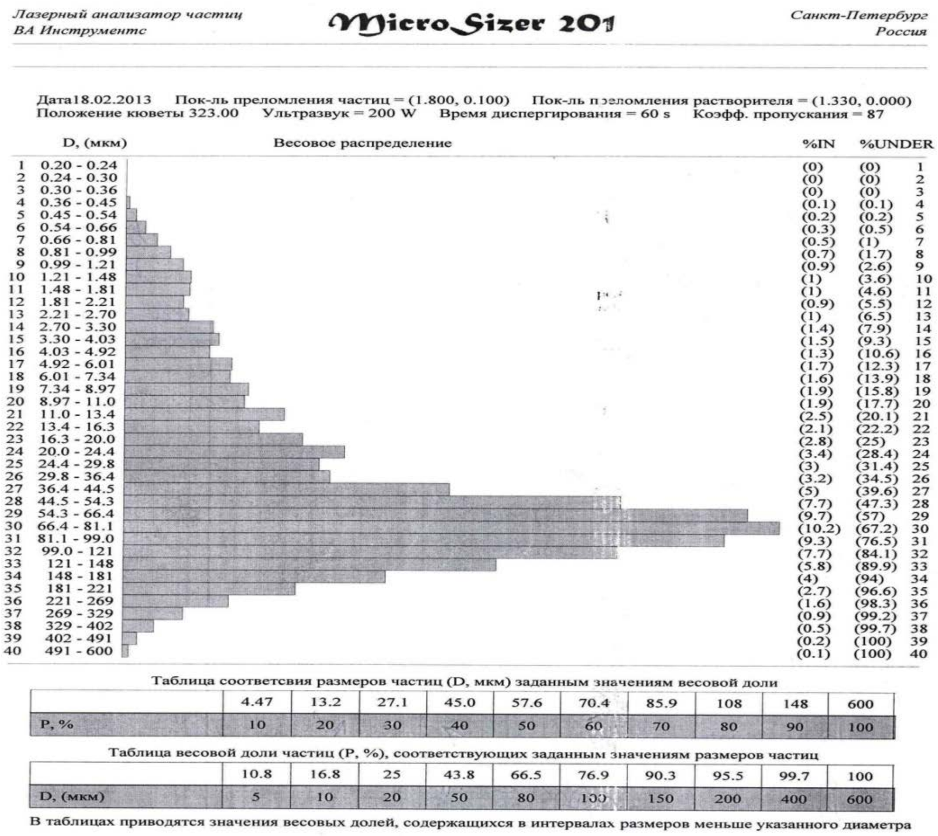

Fig. 5: Results of the study on a microsayer of the material obtained from milling samples from the Republic of Iraq

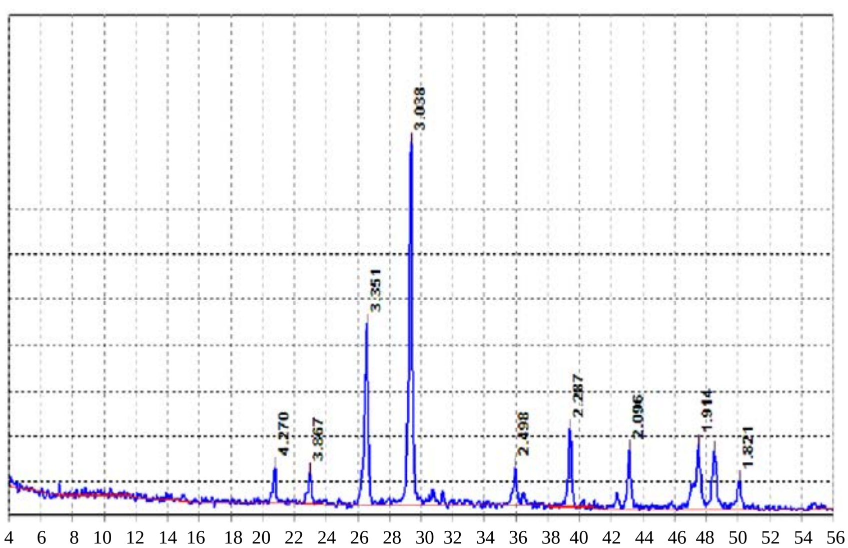

Fig. 6: X-ray diffraction pattern of samples of the Republic of Iraq materia

Table 1: Aerated compositions used in the experiment

Limesiliceous binder (kg m^{-3})	Portland cement brand 400 (kg m^{-3})	Technogeni material (kg m^{-3})	Water (kg m^{-3})	Aluminum paste (kg m^{-3})
360	115	-	216	0,07
180	115	180	216	0,07
240	115	120	216	0,07

Fig. 7: Extrusion of aerated concrete samples in molds

Fig. 8: Aerated concrete samples aged 1 day

Fig. 9: Compressive strength tester

Table 2: The sample was made with the complete replacement of Portland cement

The average density	The compressive strength
0,68	1.35
0,53	0.93
0,52	1.25

The replacement of 30% of calc-silicium binder with technogenic raw materials (3) results in a slight drop in compressive strength of 8-10% but up to 25% of the decrease in the average density of the material is observed (Table 2).

The composition of this raw material includes fragments of cement stone, containing not completely hydrated grains of Portland cement which experimental studies have shown that the replacement of 30% of calc-siliceous binder with technogenic raw materials of

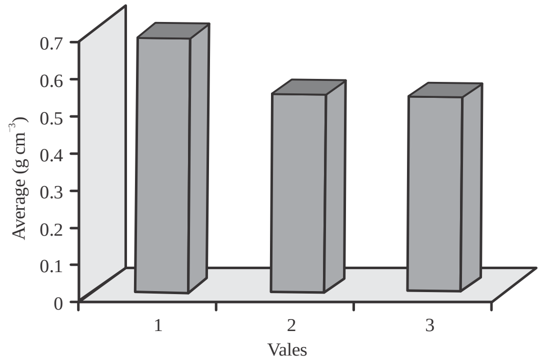

Fig. 10: Average density of aerated concrete samples on composite astringents using technogenic raw materials of the Republic of Iraq

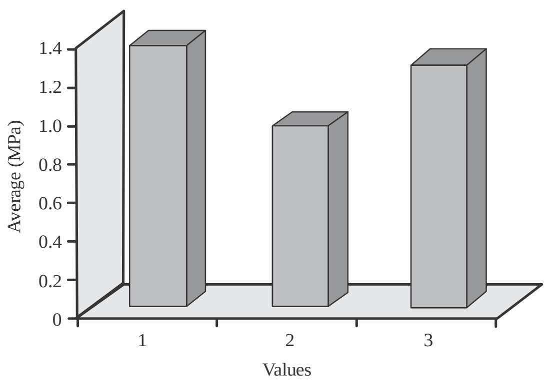

Fig. 11: Compressive strength of aerated concrete samples

the Republic of Iraq makes it possible to produce aerated concrete of class B1 which can used as a thermal insulation and for the installation of external walls of frame buildings (Fig. 10 and 11).

RESULTS AND DISCUSSION

The most important characteristics of foam concrete is the light weight it has many benefits:

- Compared to other methods used in the production of lightweight concrete, foam concrete is less expensive
- The foam concrete has excellent operating capacity allowing for different surface treatments
- Additional cost savings
- Reducing the load and transportation costs of prefabricated pre fabricated units due to their light weight
- Rapid implementation rates
- Reduce labor force
- Good thermal insulation: Foam concrete can achieve thermal insulation similar to the advantages of concrete. Using only 20% of the raw materials required for the production of conventional concrete
- Benefits of energy conservation due to the characteristics of good thermal insulation and thus, reduce the cost of conditioning (heating, cooling)

CONCLUSION

Aerated concrete is currently one of the most promising types of building materials. having good functional characteristics, they are designed for the construction of walls of various types and purposes.

Such materials have proven themselves in countries with a cold climate. But they can also be highly efficient in hot countries where a significant amount of electricity is expended on air conditioning an important direction in the development of the energy saving strategy in the Republic of Iraq is the use of highly effective enclosing structures in buildings and structures that minimize heat losses in the winter and heat in the premises during the hot season and therefore, reduce energy costs for air conditioning. Intensification of works on the restoration of buildings and structures destroyed during military operations requires the search for economically viable sources of raw materials for the production of building materials.

The raw material for recycling can become in the newly built up territories fragments of destroyed buildings and structures. Recycling allows the utilization of construction waste without harming the environment with the introduction of technologies for the recycling of man-made building materials directly at the site of demolition and new construction, considerable savings can also be achieved and a significant economic effect is obtained, since, raw materials for the production of building materials are already on the site. The milling and homogenization of the technogenic raw materials of the republic of Iraq allowed to obtain a fine powder, the study of its properties showed. At the same dispersity of powders of traditional lime-silica an astringent and technogenic raw material, the granulometric composition of raw materials is more even; the main phases of SiO_2-quartz (3.35'), CaCo3-calcite (3.03), clinker minerals (2.78, 2.76) and CA (OH) 2-portlandite are represented in technogenic raw materials which can actively participate in the formation of gas silicate complete replacement of calc-siliceous binder with simultaneous increase in portland cement consumption leads to a significant increase in average density, especially, samples not subjected to heat treatment.

Replacement of half of the calc-siliceous binder with technogenic raw materials of the republic of Iraq leads to a decrease in compressive strength by 35-40%. Replacement of 30% lime-silica binder with technogenic raw materials results in a slight drop in compressive strength of 8-10% but up to 25% decrease in the average density of the material is observed. The use of technogenic raw materials formed as a result of the destruction of the building during military operations is very expedient and economical for manufacturing cellular concrete and their use in the construction of external and internal walls of buildings in the Republic of Iraq.

REFERENCES

01. Butt, Y.M., M.M. Sychev and V.V. Timashev, 1980. Chemical Technology of Binders. Higher School of Economics, Moscow, Russia, Pages: 472.
02. Shannag, M.J., 2011. Characteristics of lightweight concrete containing mineral admixtures. Constr. Build. Mater., 25: 658-662.
03. Akcaoglu, T., M. Tokyay and T. Celik, 2004. Effect of coarse aggregate size and matrix quality on ITZ and failure behavior of concrete under uniaxial compression. Cem. Concr. Compos., 26: 633-638.
04. Sulimenko, L.M., 1972. Technology of Mineral Binders and Products Based on Them. Higher School of Economics, Moscow, Russia,.
05. Takiguchi, K. and Abdullah, 2001. Shear strengthening of reinforced concrete columns using ferrocement jacket. ACI. Struct. J., 98: 696-704.
06. Jiang, L.M., F.H. Tang and M.L. Ou, 2011. Experimental research on the strengthening of RC columns by high performance ferrocement laminates. Adv. Mater. Res., 243: 1409-1415.
07. Sakharov, G.P., 2011. Porous concrete in the post-crisis pre-era. Sci. Tech. Zbirn. Vip., 40: 161-161.