Procedure for Making a Cement Mixture with Recycled Plastics Applicable to the Manufacture of Building Elements

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Abstract: This review is about the Argentina Patent number AR 047617B1 published on August 12, 2008. Its inventors are Gaggino Rosana, Arguello Ricardo and Berretta Horacio. The topic is a procedure to make new constructive elements (bricks and plates) by using these recycled plastics:

- Low-density polyethylene (LDPE), recycled out of discarded soft drink packs.

- Polyethylene-terephthalate (PET), recycled out of discarded soft drink bottles.

- Several plastics, from the printed films used, like packages of candies (remainder of production plant by faults of inked or thickness).

These conveniently grounded plastics were taken as aggregates to be mixed with Normal Portland cement, replacing heavy sand and gravel habitually used in these mixtures. These materials can be used in constructive elements such as bricks and plates for economic houses closures or traditional construction. The developed constructive elements offer high thermal insulation, so they can be used in closures with a smaller thickness than conventional bricks and blocks. Besides, they have a lower specific weight than these traditional constructive elements. Recycling means lowering costs, making part of the environment contaminating waste useful and providing the unemployed and/or unqualified work force with jobs through uncomplicated technologies. Therefore, it has an economical as well as ecological and socially concerned proposal.

Keywords: Constructive elements, mortar for construction, ecology, recycled plastics, social housing.

INTRODUCTION

This invention refers to a procedure for manufacturing new building elements (bricks and slabs) using low density polyethylene obtained from crushing used garbage bags or food and beverage packaging; polyethylene-terephthalate (PET) obtained from crushed disposable beverage containers; and various plastics obtained from crushing the printed films used as wrapping for candies, production plant waste due to thickness or paint defects (See Figs. (**1**), (**2**) and (**3**)).

The recycled materials mentioned above are used in cement mixtures, taking the place of the aggregates usually used in these mixtures (sand and gravel), after being subjected to different treatments in accordance with what material is involved.

The developed materials can be used in building elements such as bricks and slabs for side closures of low - cost houses, or traditional construction, using less thickness than traditional building elements since they offer high thermal insulation.

Besides, they are lighter than other building elements, so the movement of these elements from one place to another is cheaper, and also the structure of the construction.

Fig. (1). Low-density polyethylene (LDPE), recycled out of discarded soft drink packs.

These elements are more environmentally friendly than those used traditionally in the construction market to fulfill the same purpose (side closure for houses) because waste is used in their fabrication.

It is therefore an improvement on the ordinary solid brick made of baked soil, used for building walls, whose means of production is by extracting habitually the fertile topsoil (hu-

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Fig. (2). Polyethylene-terephthalate (PET), recycled out of discarded soft drink bottles.

Fig. (3). Various plastics, from the printed films used like packages of candies.

mus), and later baking it in large open kilns, in many parts of the world. Actually, it is disputed because it produces desertification, air pollution (from the smoke), and the felling of trees for the firewood needed to fuel the kilns.

STATE OF THE TECHNIQUE AND DIFFERENCES WITH THE TECHNOLOGY DEVELOPED IN CEVE

A number of compositions using recycled plastics in building materials are known, such as those patented in the USA and summarized below. The differences with the technology developed in CEVE are described.

US Patents 1991 - 2001

The patent US5030287 [1] makes a known method for building slabs containing cement, inert materials and additives (fluidizers), reinforced by a plastic mesh. It differs from the building elements developed in this invention and plastic is used as a reinforcement mesh, not as an arid crushed into particles.

The patent US5422051 [2] describes a method for making cement mixtures to be applied on building products, incorporating plastics crushed into particles. It differs from the building elements developed in this invention on account of the difference in dosage, since the amount of plastic is 25% of the total volume of the concrete, and of the incorporation of different constitutive materials: sand and gravel.

The patent US5691050 [3] is a method for making cement mixtures which incorporates plastics crushed into particles, especially resistant to acid corrosion, impermeable to liquids and gases, highly stable mechanically, produced by pressure moulding in extruders. They are used mainly in constructing buildings, roads, bridges and in civil engineering generally, in particular for underground water pipes. They differ from the building elements developed in this invention because they use a different manufacturing procedure (pressure moulding in extruders), a different design (the moulded elements are neither slabs nor bricks as in this work) and different properties (resistant to acid corrosion and impermeable to liquids and gases).

The patent US5816005 [4] makes a known method for making construction panels that consist of compressed layers of different materials on a rigid plastic membrane base (for example PVC) on which a "foundation" of cement mortar is applied. It differs from the building elements developed in this invention because it does not crush the plastic into particles as an aggregate, but uses it as a membrane serving as a base for other constitutive materials; and because it uses other constitutive materials: metals, fragments of ceramic roof tiles, fragments of granite or marble.

Another document prior to this is Patent US5921046 [5] which describes a method of manufacturing panels with a foam core and a covering of plastic and Portland cement applied to each face to provide rigidity. These panels are 7.3152 meters long, 1.2192 meters wide and 0.1016-0.2032 meters thick. They use a different manufacturing procedure and a different design from this invention.

The patent US5948827 [6] is for the manufacture of building elements and automobile accessories using crushed tires as raw material, in quantities varying between 66 and 77%, with particles of between 18 and 30 microns, 15 to 22% of ground plastic of the same particle size. All of this is mixed together and solvents, such as toluene or methyl isobutylene cetane along with lactic, phosphorus or formic acid are added with the aim of making a malleable paste. It differs from the building elements developed in this invention because it uses a different dosage, it incorporates other constitutive materials and has a different design.

Another antecedent in the state of the art is patent US5983585 [7] about a building system in which bricks are built from cement and mud during the first stage, then a plastic mesh is used as a support for placing the bricks on the wall. To finish with, this plastic mesh is covered with cement on one side and with an insulating layer on the other. It uses a different manufacturing procedure and a different design from this invention.

The patent US6205729 [8] refers to the manufacture of plastic insulating panels, which have a foam core (made of PSE or expanded P.Ur.). The outer face is covered in plywood or plaster or cement mixtures. The inner face is papered with adhesive impregnated plastic coverings, which increases its mechanical resistance. It differs from the building elements developed in this invention because it uses a different manufacturing process; it incorporates other constitutive materials, a different dosage and has a different design.

Patent US5789477 [9] is for a material used in construction, made up of recycled high-density polyethylene and glass fibers with a thermoplastic covering. This mix of extruded materials makes it possible to manufacture products with high mechanical resistance. It is used for railway sleepers. It differs from the building elements developed in this invention because it incorporates other constitutive materials, a different dosage; it uses a different manufacturing process and has a different design.

The patent US5073416 [10] uses raw material P.E., P.P., polycarbonate resins, PVC, ABS, acrylics, PET and others, all recycled from industrial and home waste. All these materials are ground together resulting in a particle size of 0.3 x 0.8mm. to which fibers are added with a diameter of 2-2.5 microns, and a length of between 0.00635 and 0.01905 meters. All of this is mixed with water and forms a paste which is placed in molds, dried in vacuum ovens and subjected to pressure and temperature in order to fuse at least 50% of the mixture. It differs from the building elements developed in this invention because it incorporates other constitutive materials, it uses a different manufacturing process, a different dosage, and has a different design.

The patent US4427818 [11] describes the composition and method for manufacturing building elements moulded into any desired shape. As raw materials it uses contaminated plastics of greatly variable compositions which are ground, supplemented with 25% sand, left to dry and then heat fused in a mould. It is then cooled and removed from the mold. It differs from the building elements developed in this invention because it incorporates other constitutive materials, it uses a different manufacturing process, a different dosage, and has a different design.

The patent US4795603 [12] deals with a method for producing composite materials for a variety of purposes. Rubber and plastic materials are used as raw materials, mostly recycled, all finely ground and heated for the plastics to fuse. This pasty mixture is injected into moulds, then left to cool and removed from the moulds. It differs from the building elements developed in this invention because it incorporates other constitutive materials, it uses a different manufacturing process, a different dosage, and has a different design.

The patent US4058406 [13] deals with a type of composition for use in building elements. The composition described is: 1 to 4 parts ground polyethylene, 2 to 8 parts selected aggregates (sand, cement, volcanic ash, hay and dust leftovers, perlite and vermiculite), 1 to 2 parts cement and 1 to 4 parts water. It differs from the building elements developed in this invention because it incorporates other constitutive materials, a different dosage, and has a different design.

The patent US4034861 [14] refers to physical methods of separating plastic and metal waste and by means of a hydrocyclone. It differs from the building elements developed in this invention because it uses a different procedure, and has different purposes.

The patent US5075057 [15] describes a method for manufacturing building elements using recycled plastics. It works with plastics from a variety of recycling processes which are then molded using heat and pressure. It differs from the building elements developed in this invention because it incorporates other constitutive materials, it uses a different manufacturing process, a different dosage, and has a different design.

The patent US5302331 [16] deals with the manufacture of construction blocks using household waste. The plastic waste is finely ground and mixed with other materials. Dosage: 10 parts plastic waste, 10 parts water, 1 part calcium carbonate, 3 parts Portland cement and 2 parts sand. The mixture is poured into moulds heated to 26.6°C for 2 hrs. and then removed from the moulds. It differs from the building elements developed in this invention because it incorporates other constitutive materials, it uses a different manufacturing process, a different dosage, and has a different design.

US Patents 2002 - 2008

The patent US0149625 [17] is a process for recycling plastic material to form plastic particles, providing a susceptor agent to the plastic particles, which imparts a dielectric property to the plastic particles, providing a bonding agent to the plastic particles and treating the plastic particles with microwave energy to form a useable plastic material. It differs from the building elements developed in this invention because it incorporates other constitutive materials, it uses a different manufacturing process, and has a different applications.

The patent US6488766 [18] is about an aggregate for use in cementitious building materials, such as recycled plastic scrap of diverse types and abrasive, inorganic grit particles. The plastic scrap is impregnated with a grit, such as sand, glass or other inorganic material. The plastic will then bond with a cementitious binder. It differs from the building elements developed in this invention because it incorporates other constitutive materials, and it uses a different manufacturing process.

The patent US0266904 [19] is a construction element of different forms, e.g. paving stone, blocks, floor tiles, coatings, bricks, pallet, panels, platforms among others, that it is composed mainly by non-recyclable waste material. Such non-recyclable materials comprise a combination of any of the elements as aluminum, paper, polyamide, polyester, polypropylene, cork, paper and even marc or any other inert matter. It differs from the building elements developed in this invention because it incorporates other constitutive materials.

US Patents 2009

The patent US7559535 [20] is about a block used to space guardrails from support posts. This block is made of virgin or recycled plastic, virgin or recycled rubber, and other elastomeric materials. It differs from the building elements developed in this invention because it is formed by low-pressure injection moulding.

The patent US7497051 [21] is a framework of a greenhouse, made of recycled plastic. Basically comprises bearers and linear connectors, forming the roof and walls of a greenhouse. These constructive elements differs from the ones developed in this invention because they incorporate other constitutive materials, they use a different manufacturing process, and have a different design.

The patent US7478797 [22] is a moulded decorative fence panel made from a polymeric resin material such as thermoplastic or thermoset resin, and can be made from olefins, styrenes, nylons, or mixtures of these polymeric families. The mixture of different plastic granules simulates other materials such as rock, wood, brick or stone. It differs from the building elements developed in this invention because it incorporates other constitutive materials, it uses a different manufacturing process, and has a different design.

Also parts of the documentation prior to the current invention are the building elements which have not been patented but have been published and marketed, such as:

The materials manufactured with wood fibers bound with fused polymers (both waste materials) developed by the architect Juan Giaccardi of the Federal School of Lausanne, Switzerland [23]. They differ from the building elements developed in this invention because they incorporate other constitutive materials, they use a different manufacturing process, a different dosage, and have different designs.

The small beams or blocks made of sand and PET from disposable containers, produced by the company Eco & Red in Esteban Echeverria, Province of Buenos Aires, Argentine [24]. They differ from the building elements developed in this invention because they incorporate other constitutive materials, a different dosage, and they have a different design.

Garden furniture, banisters, road signs, etc. made from plastic recycled from packaging by Empresa Innovaciones Plásticas de Madrid [25]. They differ from the building elements developed in this invention because they incorporate other constitutive materials, they use a different manufacturing process, a different dosage, and have different designs.

The TEPLAK slabs made from ground disposable Tetra Pak containers bound with heat fused polymers, widely marketed in the Argentine [26]. They differ from the building elements developed in this invention because they incorporate other constitutive materials, they use a different manufacturing process, a different dosage, and have different designs.

The bricks developed in the E.E.U.U. by the Ecological Construction Movement [27]. They differ from the building elements developed in this invention because they incorporate other constitutive materials, and have a different dosage.

The specimens tested in the National Technology University of Cordoba, Argentine, with various plastics agglomerated with cement. They differ from the building elements developed in this invention because they extrude the plastics turning them to pellets, before their application in cement mixtures [28].

There are several studies of the mechanical and chemical properties of polymer mortars here, we mention the principals:

The study of Betioli, Silva, Gleize, Roman and Gómez, about the degradation of PET fibers in materials based on Portland cement [29].

The studies of Rebeiz about the time-temperature properties of polymer concrete using recycled PET [30] and the precast use of polymer concrete using unsaturated polyester resin based on recycled PET waste [31].

The study of Fareed, Asif and Abbas about the phisiochemical properties of polymer mortar composites using resins derived from post-consumer PET bottles [32].

DETAILED DESCRIPTION OF THIS INVENTION

This Patent AR047617A1 [33] developed in CEVE proposes a procedure for manufacturing bricks and brick slabs in which recycled materials are incorporated in cement mixtures, replacing the sand and gravel ordinarily used.

Materials

- Common Portland Cement.
- Plastic particles.

Types

- Low density polyethylene (LDPE).
- Polyethylene-terephthalate (PET)
- Various plastics (PPBO, PVC, PE).

- Thick sand of river (only in the case of bricks made of various plastics).
- A polymeric additive (a solution of latex paint in a 1:2 ratio to water, in proportion to the volumes).

Procedure

The plastics are ground in a machine to obtain small particles. Sizing: 2 - 7mm., thickness: 0.1 - 0.4mm.

The dosage is different for each kind of constructive element:

In bricks made of LDPE there is a 70% of Portland Cement and 30% of the plastic particles (proportional to the weight).

In bricks made of PET there is a 35% of Portland Cement and 65% of the plastic particles (proportional to the weight).

In bricks made of various plastics there is a 38% of Portland Cement, 17% of plastic particles and 45 % of thick sand.

The cement is added dry, and this is mixed until it becomes evenly distributed among the plastic particles.

A polymeric additive is added to water, to improve the adherence of the particles to the cement. There is a 0,7% of the additive (proportional to the weight of the cement).

Water is added and mixed until a uniform consistency is obtained.

The mixture is poured into the oiled molds of a compressing machine, and then bricks are made over the ground. They are left to rest for 24 hours, and after this, they have to be removed from the ground and placed in water to be cured.

They can be used for walling or brick slabs 28 days after their manufacture. See Figs. (**4**), (**5**), (**6**)

Fig. (4). Machine used to make bricks with recycled plastics.

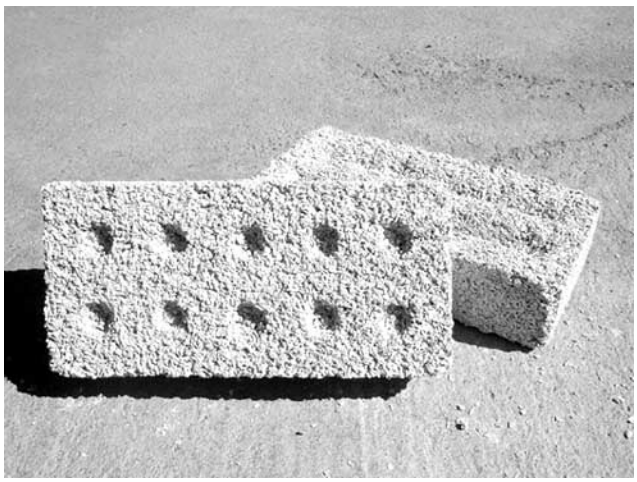


Fig. (5). Physical aspect of bricks made of recycled plastics herein described.

In another application of the procedure of the present invention, various recycled plastics are heated with a torch as the mixer turns so as to crumple them. This procedure improves the adherence of the particles to the cement.

Fig. (6). Wall masonry constructed with bricks made of recycled plastics.

However, it is also possible to make the cement mixture without this burning process, which saves time and fuel (natural gas) but the mechanical resistance obtained is lower because the mechanical lock between the particles is less.

The procedures mentioned can be used to fill and manufacture slabs similar to those patented in AR0226-794A1 [34]; this slab was made of ordinary solid baked soil bricks, focusing us on the manufacture of the same slab made of bricks produced with recycled or waste materials.

In both slabs, the procedure is like follows:

A sheet iron or wooden mould is therefore used. It must be placed on the ground, level and adequately insulated. The bricks are placed in the mould. In the case of AR0226794A1, bricks are the ordinary ones made of baked soil. In the case of AR047617A1, bricks are made of recycled plastic materials. The joints are strained to half the height of the bricks using ordinary bricklayer's mortar consisting of a mixture of cement and sand in a proportion of 1 : 3 volumes. An iron mount structure is placed over the mortar joints. The mortar described above is then placed over the structure, completing the height of the joints. The excess mixture is then spread over the surface of the slab with a wet broom. After 4 hours the slab is removed from the mould and left to rest for 24 hours before being stowed away and cured. It can be used for building one week later. See Fig. (**7**).

In another application of the present invention, recycled materials were incorporated into the cement mixture in order to manufacture monolithic slabs with prepared cement mixtures. See Fig. (**8**) and (**9**).

A sheet iron or wooden mould is used. It must be placed on the level ground, and adequately insulated. The cement mixture with recycled materials is made according to the formula of the bricks, described in each case. A first layer of the mixture is applied to the mold, up to 1cm. high. A "grill" type iron mount structure is laid and the rest of the mixture is poured to complete the height of the mold. It is then smoothed with a piece of wood. It is removed from the mold after 4 hours. The slab can be moved after 3 days to be taken

Fig. (7). Bricks slab made of recycled plastics.

Fig. (8). Monolithic slab made of recycled plastics.

Fig. (9). Finished slab made of recycled plastics.

for storage and curing. Curing consists in wetting the slab with water so that it remains damp (it can be covered with plastic film in such a way that it loses less humidity). After 28 days it can be used for building.

RESULTS

All the developed constructive elements were tested in the laboratories of the National University of Cordoba, Argentine, and in the National Institute of Industrial Technology (Buenos Aires, Argentine). Principal properties of them:

Brick Made with LDPE

Dimensions: 5.5cm. x 12.5cm. x 26.2cm.

Apparent Density: 1130kg/m3.

Compressive Strength: 1.3Mpa.

Water Absorption: mass 6.5%.

Thermal Conductivity Coefficient: 0.18W/mK.

Brick Made with PET

Dimensions: 5.5cm. x 12.5cm. x 26.2cm.

Apparent Density: 1150kg/m3.

Compressive Strength: 2.00Mpa.

Water Absorption: mass 19.1%, volume 214kg/m3.

Thermal Conductivity Coefficient: 0.15W/mK.

Acoustical resistance: 41db., in closures 0.15m. of thickness, both sides plastered.

Plastering adherence: 0.25MPa.

Brick Made with Various Plastics

Dimensions: 5.5cm. x 12.5cm. x 26.2cm.

Apparent Density: 833kg/m3.

Compressive Strength: 0.8Mpa.

Water Absorption: mass 24%, volume 389.08kg/m3.

Thermal Conductivity Coefficient: 0.18W/mK.

Acoustical resistance: 48db., in closures 0.15m. of thickness, both sides plastered.

Slabs

The properties of the different slabs are showed in Table **3**.

Other Properties of these Constructive Elements

They are highly chemically inert against environmental agents; as they are not biodegradable their maintenance is almost non-existent. The bricks and slabs exposed to weather conditions during three years did not undergo dimensional alterations or apparent damage.

They have good capacity to be conventionally plastered. Because of their superficial wrinkled condition, an ordinary mortar, made with cement, lime and sand can easily adhere,

for which reason the final appearance can be the same as that of the traditional man-made brick wall.

They are easy to be nailed and sawn. As a consequence of these properties, they can be used principally in non-modular building systems.

They are resistant to the fire. Its classification is: RE2: Combustible material with low flame propagation. This value was obtained from Test Laboratory of the National Institute of Industrial Technology (Buenos Aires, Argentine).

COMPARISON WITH OTHER CONSTRUCTIVE ELEMENTS

The building materials herein described, are characterized by their low apparent density which is profitable as far as low-cost transportation and easy-work manipulation are concerned. The apparent density for different constructive elements can be seen in Table **1**.

They show a lower mechanical resistance than other traditional constructive elements like the ordinary brick made of baked soil or the conventional block made of cement mortar. These constructive elements are suitable for non-structural housing closings. The compressive and flexural strength values for bricks and slabs can be seen in Tables **2** and **3**.

They have a lower Thermal Conductivity Coefficient than most of the conventional closures, for which they are suitable to solve thermal insulation, and can be used in closures with a smaller thickness. The Thermal Conductivity Coefficient of the common brick masonry is five times higher than the PET brick masonry. See Thermal Conductivity Coefficient (λ) values in Table **4**.

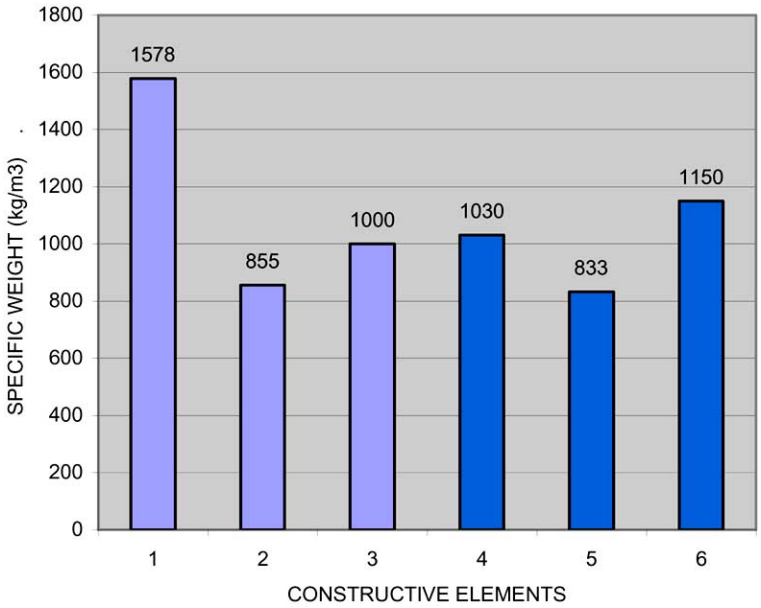
The percentage of water absorption of the PET brick is 11 % minor than the ordinary brick made of baked soil. See Water Absorption values in Table **5**.

CONCLUSIONS

The grounded recycled plastics used in this research work are good materials to make a mortar for the manufacture of building constructive elements.

Besides, these constructive elements made with recycled plastics replace ordinary burned bricks. In this way a double environmental benefit is achieved: on the one hand, the plastics are recycled and on the other, fertile soil desertification due to the use of humus and wood as combustible in burned bricks is avoided, in many parts of the world.

Table 1. Apparent Density for Constructive Elements

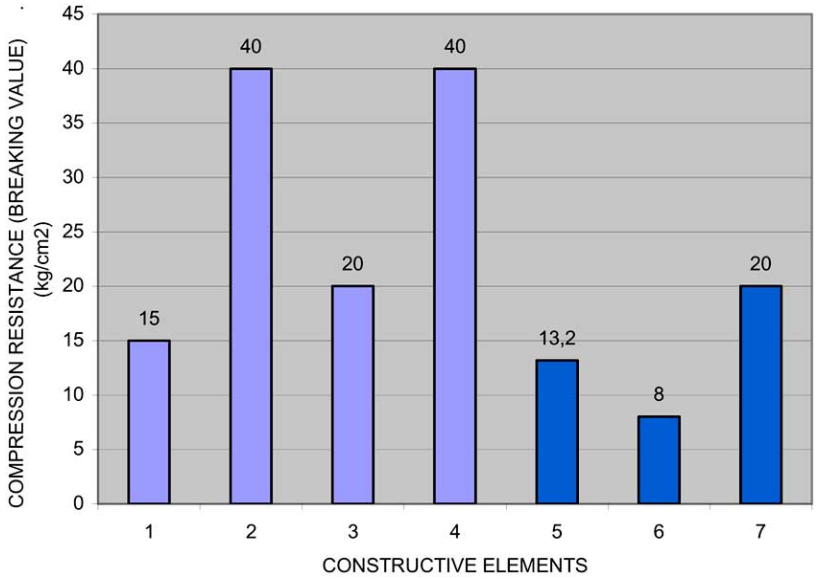


References:

1. Conventional baked soil bricks.
2. Conventional ceramic hollowed blocks.
3. Conventional cement mortar blocks.
4. Bricks made of recycled low-density polyethylene and cement.
5. Bricks made of recycled several plastics from packaging and cement.
6. Bricks made of recycled polyethylene-terephthalate and cement.

NOTE: These values were obtained from Test Laboratory of Structure Department, Faculty of Exact Physical and Natural Sciences, National University of Cordoba, Argentine; and follow IRAM Norms. The Table was made by the authors.

Table 2. Compressive Strength Values for Constructive Elements



References:

1. Conventional ceramic hollowed blocks.
2. Conventional baked soil bricks.
3. Conventional cement mortar non structural blocks.
4. Conventional cement mortar structural blocks.
5. Bricks made of recycled low-density polyethylene and cement.
6. Bricks made of several recycled plastics and cement.
7. Bricks made of recycled polyethylene-terephthalate and cement.

NOTE: These values were obtained from Test Laboratory of Structure Department, Faculty of Exact Physical and Natural Sciences, National University of Cordoba, Argentine; and follow IRAM Norms. The Table was made by the authors.

Table 3. Mechanical Properties for Slabs

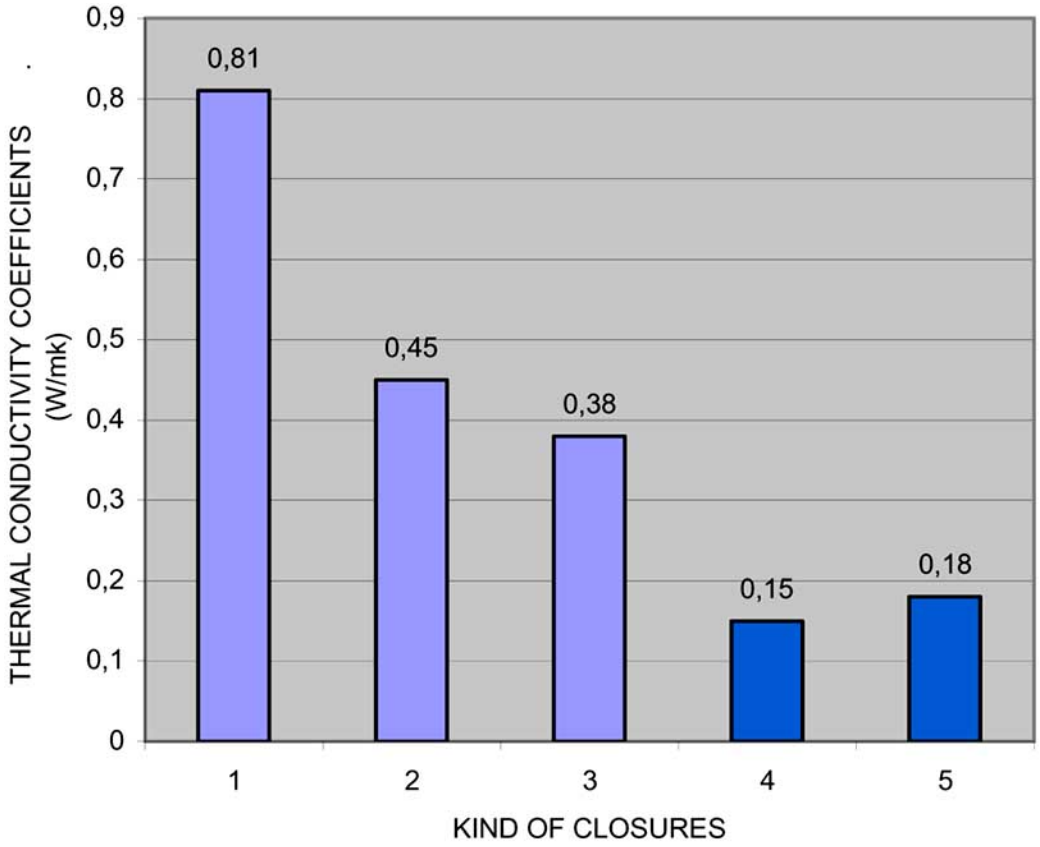
Name	Characteristics	Dimensions (cm)				Compressive Axial Strength[3] (kg)	Flexural Strength[4] (kg)	Hard Crush Strength[5] (mm)	Apparent Density (kg/m^3)
		Lenght	Width	Thick.1[1]	Thick. 2[2]				
1	Slab made of bricks with low-density polyethylene	240	28	7.5	6	7600.0	141.7	18.0	880.9
2	Slab made of bricks with various plastics without fire treatment.	240	28.5	7.5	5	6600.0	103.0	27.0	886.93
3	Slab made of bricks with various plastics with fire treatment.	240	43	6	2.5	8400.0	113.0	27.0	678.29
4	Monolithic slab made with polyethylene-terephthalate	240	41	5.6	3	2040.0	91.7	28.0	671.45
5	Slab made of bricks with polyethylene-terephthalate	240	28	5.6	4.8	3468.0	147.5	29.0	820.44
6	Conventional slab made of bricks with baked soil	240	28	5.5	4.9	3465.0	166.0	24.0	1758.65

References:

1. Thick.1: Total thickness of the slab, with plaster.
2. Thick. 2: Thickness of the brick.
3. Breaking value.
4. Breaking value.
5. Diameter of the hollow produced by the steel sphere falling from 2 mt. height. Diameter of the steel sphere: 51 mm.

NOTE: These values were obtained from Test Laboratory of Structure Department, Faculty of Exact Physical and Natural Sciences, National University of Cordoba, Argentine; and follow IRAM Norms.
The Table was made by the authors.

Table 4. Thermal Conductivity Values (λ) for Different Closures



References:

1. Conventional soil bricks masonry.
2. Conventional ceramic hollowed blocks masonry.
3. Conventional cement mortar blocks masonry.
4. Conventional closure made with wood tables.
5. Bricks made of recycled polyethylene-terephthalate and cement masonry.
6. Bricks made of recycled low-density polyethylene and cement masonry.

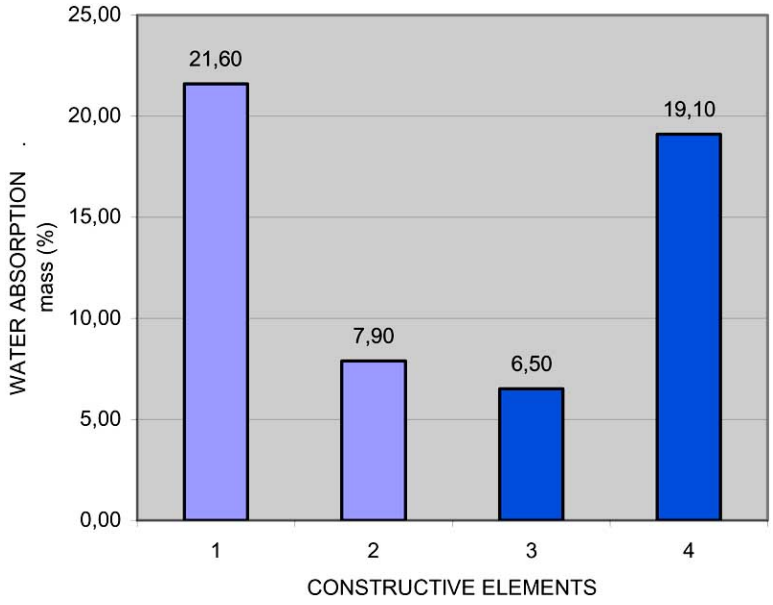
NOTE 1: All these closures are plastered both faces.
NOTE 2: These values were obtained from Test Laboratory of the National Institute of Industrial Technology (Buenos Aires, Argentine); and follow IRAM Norms.
The Table was made by the authors.

The newly obtained constructive elements have good technical properties, so they can be used like non structural closures. They show good mechanical resistance, low specific weight and good thermal insulation in relation to other traditional.

They can also adhere well to plasterings for which it can be conveniently covered for its finishing.

It is also worth mentioning that the development of these good physical properties, low cost, simple technology building elements make them suitable for low-cost, housing self-construction, easily accessible to big low-income social sectors unable to have access to funds for house construction.

Table 5. Water Absorption Values for Constructive Elements



References:

1. Conventional soil bricks.
2. Conventional cement mortar non structural blocks.
3. Bricks made of recycled low-density polyethylene and cement.
4. Bricks made of recycled polyethylene-terephthalate and cement.

NOTE: These values were obtained from Test Laboratory of Structure Department, Faculty of Exact Physical and Natural Sciences, National University of Cordoba, Argentine; and follow IRAM Norms. The Table was made by the authors.

This is an issue of concern and interest to our institution (CEVE) which is permanently fostering the development of these little explored technological areas, trying to meet social-economic and environmental needs, an important and positive impact on the community.

CURRENT & FUTURE DEVELOPMENTS

The search team reached acknowledge of the material (cementitious mortar with recycled plastics), its advantages and limitations. The developed constructive elements have form and dimensions similar than other traditional used for the same function (housing closure), but they have different composition and manufacture procedure.

The next stage will be to make the most with the material, considering its lightness and low thermal conductivity, in components with different dimensions and form than other traditionals.

The search will focus on the development of constructive elements with a width and length greater than the conventional brick, but with smaller thickness. With these elements, a faster construction may be done respecting a traditional brick masonry, using less manpower and joint material, reaching the same level of thermal confort.

ACKNOWLEDGEMENTS

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CONFLICT OF INTEREST

There is not a conflict of interest with any other person or institute.

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