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Research Paper

Comparative relevant aspects regarding lightweight concrete containing polystyrene beads

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Generally, the main of this experimental work is to found new resources in materials of constructions, especially with the interdiction of the exploitation of some sea sand careers. Thus, advanced constructors use light products, which is going to represent a primordial advantage in the reduction of the seismic risks, because the seismic strength represents a fraction of the total mass of the construction.

Moreover, the use of lightweight materials and concrete gives a prime advantage in Algeria regarding the earthquake so try to lighten the slabs as much as possible. Lightweight aggregate concrete is characterized by a combination of cement and low-hardness aggregate. These aggregates have the characteristics of high porosity; they can absorb a large proportion of water from fresh concrete, which reflects the water demand of lightweight aggregate. The latter is also seriously affected by the surface structure and shape of the aggregates used. Based on fly ash aggregate and polystyrene concrete, this paper studies the preparation of lightweight concrete with different amounts of polystyrene concrete instead of fly ash sand. The results show that the cement quality and aggregate density affect the workability and lightweight of concrete.

1 Introduction

Concrete is the largest material utilized by the construction industry [1]. In the construction of several studies, a weight reduction is likely to have resulted in general savings. The global concrete industry roughly consumes 7.5 billion tons annually [2].

The use of light aggregates makes it possible to produce concretes for which the density can vary from 0.5 to 2.0. However, the compressive strength of these concretes is even lower for a lower density. It is only 2 to 5 MPa for vermiculite

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concretes of density 0.5 on average but it can reach 40 MPa for clay or expanded shale concretes of density 1.7 to 1.9 made with aggregates lightweight of good quality [3, 4].

Lightweight concretes can therefore be used for the construction of resistant structures (beams, slabs, posts, etc.).

The application of lightweight concrete in buildings is very beneficial in terms of lightweight [5], which provides an opportunity for construction in low-bearing soil and reduces the size of the foundation by reducing the permanent load.

Also, the use of polystyrene in lightweight concrete could become an extremely viable alternative in technical, economic, and environmental terms [6]. Lightweight concrete provides a better solution than conventional aggregate concrete in many cases, such as in the case of seeking heat and sound insulation concrete [6]. This is why all the construction fields in the world tend to replace ordinary concrete with lightweight concrete [7].

Studying the review [8] it can be noted that there is a low number of studies where polystyrene aggregate concrete of structural grade is investigated [9]. As an approval to the note previously mentioned, Sadrmomtazi et al. concluded that the PAC is rarely studied as concrete of structural grade [10].

In addition, will be more particularly used in the manufacture of agglomerates, for non-load-bearing or lightly loaded paved concrete and insulating concrete. The insulation is also better when the density is low. However, it is first necessary to better understand the materials used in the manufacture of these concretes.

Table 1 – Chemical analysis of pozzolan (Laboratory of the chemistry of Cimenterie Zahana).

Composition	SiO_2	CaO	Fe_2O_3	MgO	Al_2O_3	SO_4	Cl	Fire loss
Content percentage (%)	45.21	9.99	9.84	4.38	17.85	//	//	3.91

Identifying the physical and mechanical characteristics of the different materials constituting a given concrete contributes to the understanding of the latter. For this purpose, we carried out experimental tests to better understand the properties of these materials and to know the used ones. The identification of the physical and mechanical characteristics of the different materials constituting a given concrete contributes to the understanding of the latter.

Table 2 – Physical characteristics of pozzolanic aggregates.

	Dry aggregate				**Aggregates Pre-wetted**			**Saturated aggregate**		
Granular expansion	0/3	3/8	8/15	15/20	3/8	8/15	15/20	3/8	8/15	15/20
Apparent density (Kg/m^3)	1090	900	851	822	968	963	983	1020	1009	998
Particle density (Kg/m^3)	2180	1860	1860	1860	1990	1990	1990	2100	2100	2100
Material density (Kg/m^3)	2700	2700	2700	2700	/	/	/	/	/	/
Humidity (%)	2.60 - 3.84				/	/	/	/	/	/
Porosity (%)	/	53.34	56.82	59.15	/	/	/	/	/	/
Sand equivalent (%)	75.00	/	/	/	/	/	/	/	/	/

Unfortunately, in our country, due to the lack of understanding of lightweight aggregate concrete, lightweight aggregate concrete is almost ignored. The purpose of this study is to explore the application of lightweight aggregate concrete in the field of construction.

Table 3 - Los Angeles coefficient of pozzolanic aggregate (Conventional strength [11]: 5.3 MPa, Impact strength (Los Angeles test): NF P 18 573 [12]).

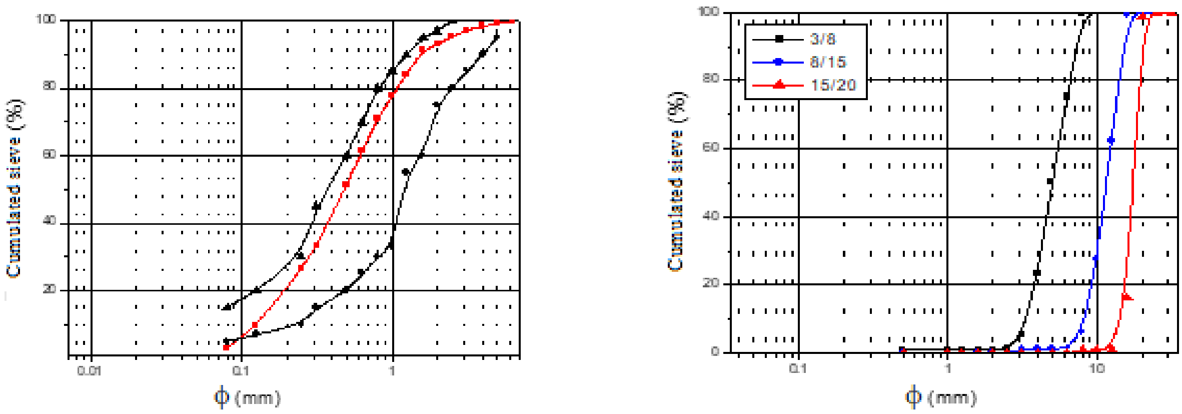
	0/3	3/8	8/15	15/20
LA (%)	/	23.55	29.42	33.76

2 Materials and methods

2.1 Materials used

2.1.1 Pozzolan

The pozzolan used is a natural pozzolan from the Bouhamidi deposit (Béni-Saf). This pozzolan is supplied in the form of crushed rocks of the pumice and slag type of diameters varying between 50 and 100 mm. These rocks are crushed and screened to obtain the granular fourths used in this research, namely crushed sand 0/3, and gravel 3/8, 8/15, and 15/20. Tables 1, 2, and 3 show the chemical, physical and mechanical properties of pozzolanic aggregates. Fig. 1 shows the particle size analysis of pozzolan.



a) pozzolanic sand b) pozzolanic aggregates

Fig.1 – Particle size curve (EN 933-1 et 933-2 [12-14]).

The absorption coefficient CA (NF P 18554 [12, 15]) is the value of soaking time for 24 hours. The most important point is that if the total absorption of 28 days is taken into account, the absorption of volcanic ash particles exceeds 50% of the total absorption in the first 30 minutes. Absorption changes with time, starting fast and then slowly (Table 4).

Table 4 - Absorption of pozzolanic aggregate.

	Immersion time								
Granular expansion	**3 min**	**5 min**	**10 min**	**30 min**	**2h**	**24h**	**48h**	**7j**	**28j**
3/8	1.95	5.5	9.15	14.2	15.3	17.97	18.95	20.97	23.53
8/15	1.45	4.9	8.16	13.88	14.74	16.09	18.16	20.14	21.91
15/20	1.2	5.13	7.53	11.54	12.89	14.16	16.18	19.23	20.95
3/8	0.80	1.50	4.33	6.11	8.47	12.80	14.41	16.98	17.33
8/15	0.90	1.30	3.66	5.95	7.21	10.72	12.22	13.42	15.66
15/20	0.75	1.15	2.56	4.78	6.88	10.53	11.55	12.33	14.13

2.1.2 Polystyrene concrete (Table 5)

Polystyrene concrete is a kind of artificial aggregate. It can be used without changing the traditional concrete rules. It is lighter than natural aggregate, and its particle size ranges from 1.5 to 2.5 mm. It is composed of polystyrene spheres coated with light brown specific adjuvant [16]. Furthermore, the very-rounded shape of the polystyrene beads can improve to some extent the rheology parameters of a cement-based mixture [17].

Table 5 – Technical features (No settlement or crushing of concrete is allowed during transportation, storage, and construction).

Particle size	Density	Elastic modulus	Effective thermal conductivity λ
1-3.5 (mm)	30 (kg/m^3)	100 %	0.045 (w/m°C)

2.1.3 The cement

Cement used for the preparation of the concrete samples of dimension (16 x 32) cm^2 is a Portland cement composed of CPJ 32.5 from ZAHANA. A set of standardized mechanical, physical, chemical, and mineralogical tests were carried out to allow its identification at the level of the Oran public works laboratory (LTPO), LMST laboratory (IGCMO / USTOMB), and finally at the ZAHANA cement plant laboratory. Tables 6 and 7 show physical and chemical properties.

Table 6 - Summary of cement test results.

Type of cement	Anhydrous cement			Cement pastes		
	Apparent density (g/cm^3)	Absolute density (g/cm^3)	Refusal of the 0.1 mm sieve (%)	Normalized consistency (%) NF EN 196-3	NF EN 196-3 Start taking NF EN 196-3	End of taking
CPJ CEM II / B 32.5	1.15	3.05	2.6	26	02h 60min	03h 55min

Table 7 - Chemical composition of cement (Laboratory of the S. CIMENTERIE ZAHANA) (NF EN196-2 [12]) NF EN 196- 2 [18].

Element %	SiO_2	CaO	Al_2O_3	Fe_2O_3	MgO	SO_3	Fire loss	total	Insoluble matter (not bound to SiO_2)	Insoluble matter (free CaO_2)
CPJ CEM II / B 32.5	21.23	64.26	6.42	4.62	0.62	1.05	1.12	99.32	0.67	/

Table 8 below shows the different compositions studied:

Table 8 – Compositions studied.

	Types of concrete Cement	Cement (Kg/m^3)	Water (l/m^3)	Polystyrene concrete (l/m^3)	E/C	Sand	3/8	8/15	15/20	Density
						(Kg/m^3)				
Dry aggregate	SEC	350	206	0	0.59	535	127	290	393	1901
	BPP10%	350	206	25	0.59	482	127	290	393	1849
	BPP20%	350	206	49	0.59	428	127	290	393	1796
	BPP30%	350	206	74	0.59	375	127	290	393	1744
	BPP50%	350	206	123	0.59	267	127	290	393	1637
Pre-wet aggregate	PREM	350	169	0	0.48	535	136	311	420	1921
	BPP10%	350	189	25	0.54	482	136	311	420	1889
	BPP20%	350	165	49	0.47	428	136	311	420	1812
	BPP30%	350	144	74	0.41	375	136	311	420	1739
	BPP50%	350	105	123	0.30	267	136	311	420	1593

2.1.4 Mixing water

The quality of the water plays a vital role in the final grade, the impurities contained in the water can influence the setting of the cement or the strength of the concrete. For these reasons and others, the quality of the mixing water or that used for ripening must be controlled.

We spoiled all the concretes with drinking water from the tap which has an analysis Presented in Table 9, it should be noted that the LTPO carries out the analysis of Oran Public Works Laboratory.

Table 9 – Water chemistry analysis.

Element	Value (mg/l)	NF P 18 303 [19]
Cl	128	< 500 mg
Suspended matter	0.29	< 0.5 %
Organic materials	0.18	< 0.5 %
SO_4	192.12	< 0.1 %
NO_3	0	< 0.05 %
Na	0	< 0.1 %
K	0	< 0.1 %
pH	7.91	> 4

2.1.5 The plasticizer

Plasticizer used is supplied by SIKA OUTRE MER. It is a reducing plasticizer Of water, and for high mechanical resistance, PLASTIMENT BV 40 is compatible with all types of cement and can be diluted perfectly in mixing water. The features provided are as follows [20].

Form: liquid. Color: dark brown without closing. pH: 4.5. Density: 1.18.

It must be incorporated into concrete at doses that must be less than or equal to 5 % of cement weight EN 934 2 [12].

To study the effects of the plasticizer, it is necessary to know what proportion of dry extract contains. For this, we will proceed in accordance with standard NF P 480 8 [21]. After the test, we obtained Ex = 60% dry extract and therefore 47% water, which will be necessary to take into account the real water dosage of the concretes.

2.2 Methods

After determining the principal characteristics of the constituents, several essential parameters were selected in the experimental program on aggregate concrete pozzolanic (Beni-Saf pozzolana): - the initial moisture status of pozzolanic aggregates, - cement dosing, - the proportion of adjuvant, - The W/C ratio, - the cement category.

Regarding the internal humidity state of the aggregate, three cases of concrete will be studied: Concrete is made with dry aggregates in their natural state, with a water content of 2 to 3%. Concrete made with pre-wetted aggregates (immersion for 4 hours). Concrete made with saturated aggregates (immersion in water for 7 days).

As a result, there will be 3 types of concrete: - A concrete with dry aggregates rated SEC. - A concrete with pre-wetted aggregates noted PREM. - A concrete with saturated aggregates rated SAT. In addition, ordinary concrete was also studied in parallel, to serve as a basis of comparison (BO). For the determination of cement, the following dosages have been chosen: 350, 380, 400, and 420 Kg/m^3, which provides us with the following concrete: B350, B380, B400, and B420. Concrete is made with dry aggregates.

To investigate the effect of class and the nature of cement, we developed three types of concrete with three different types of cement. We have: the CPJ 32.5 from ZAHANA, the CPJ 42.5, and CPA 42.5, the last two types of cement come from the MSILA cement plant, so the concretes described above are: BCPJ 32.5, BCPJ 42.5, and BCPA 42.5, the latter are made with dry aggregates. Thereafter, we will have the effect of the nature of the sand and the mass density of the concretes with pozzolanic aggregates on the resistance.

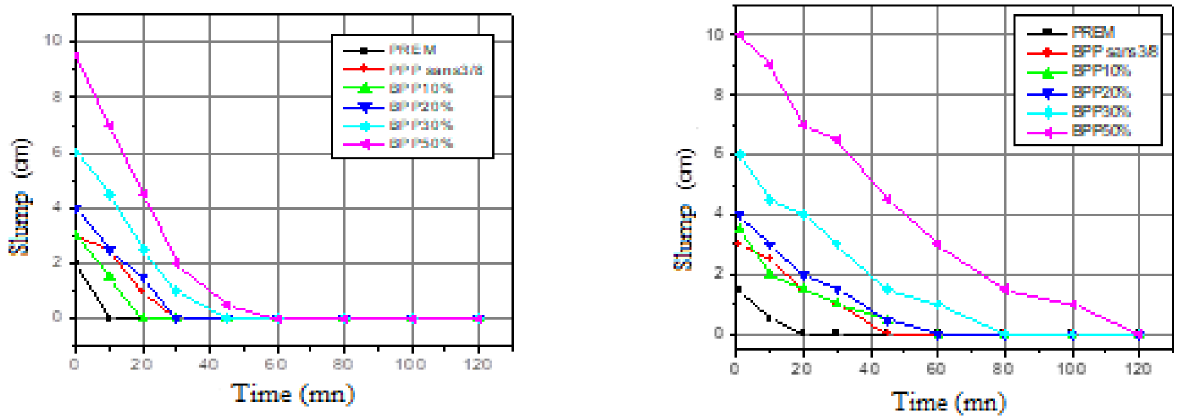
To quantify this, we compared two different types of concrete, one made of pozzolanic sand (0/3) BSP, and the other with ordinary sand (0/3) BSO. As a result, we found ourselves faced with two types of concrete.

To clarify the effect of adding an admixture to aggregate concrete pozzolanic, we first fixed the W/C ratio at 0.50, then we proceeded to the addition of the adjuvant at 3 different dosages 1%, 2%, and 3% of the mass of the cement: in 1st word with dry aggregates and the second word with pre-wetted aggregates. Then we set the quantity of mixture to 3% while varying the W/C ratio of the concretes, W/C = 0.50, 0.45, and 0.40. We can find twelve types of concrete to study: Concrete with dry aggregations: BPA 1%S, BPA2%S, BP3%S, and BPA3%S with W/C = 0.50, 0.45, and 0.40. Concrete with prewet aggregates: BPA1%P, BPA2%P, BPA3%P and BPA3% with E/C=0.50, 0.45 and 0.40.

3 Results and discussion

3.1 Operability study

First, attention should be paid to adjusting the amount of wasted water to ensure that concrete prepared with dry aggregate has the same consistency as concrete prepared with ready-mixed aggregate. It can be seen from Fig. (2a, 2b) and Fig. 3 that the slump values of dry aggregate concrete and ready-mixed aggregate concrete increase with the percentage of concrete added, because concrete is a kind of hydrophobic material, and C to D is drainage. Therefore, using porous aggregate instead of a certain amount of aggregate is helpful to reduce the water absorption of porous aggregate, which has a favorable impact on the workability of concrete.



a-pre-wet aggregate b-dry aggregate

Fig.2 - Change of slump with time.

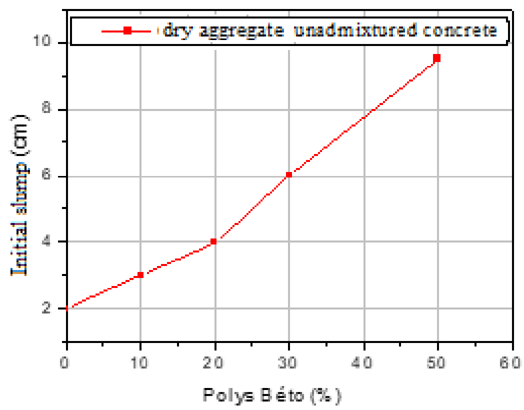


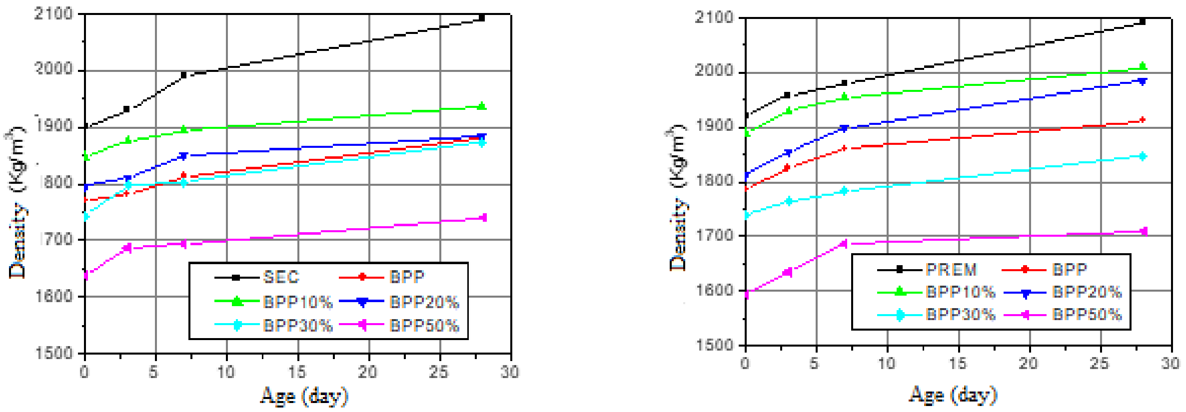
Fig. 3 – Evolution of the initial sag as a function of the percentage of Polystyrene concrete added.

On the other hand, it was observed that despite the high value of the slump (9.5 to 10 cm) for an addition of 50% of Polystyrene concrete by substituting pozzolanic sand, there is difficulty in handling this. Concrete (BBP 50%) breaks during the slump test with the appearance of segregation accompanied by a flow of laitance. This is due to the lack of fine elements (pozzolanic sand), which play a positive role vis-à-vis the workability of concrete by lowering the friction between the large aggregates.

3.2 Density study

As polystyrene concrete is used to make lightweight aggregate concrete, we need to study the density of the concrete, to determine the lightweight of the polystyrene concrete mixed with lightweight aggregate concrete.

It is clear from Fig. (4a, 4b) and Fig. 5 that the density of concrete made from dry and pre-wet pozzolanic aggregates decreases with the increase of the percentage of polystyrene concrete added. This result is completely logical because considering their weight (30 kg/m^3), polystyrene concrete particles tend to reduce the density of concrete. As time goes on, the density changes more and more.



a-pre-wet aggregate b-dry aggregate

Fig. 4 – The change of density with time.

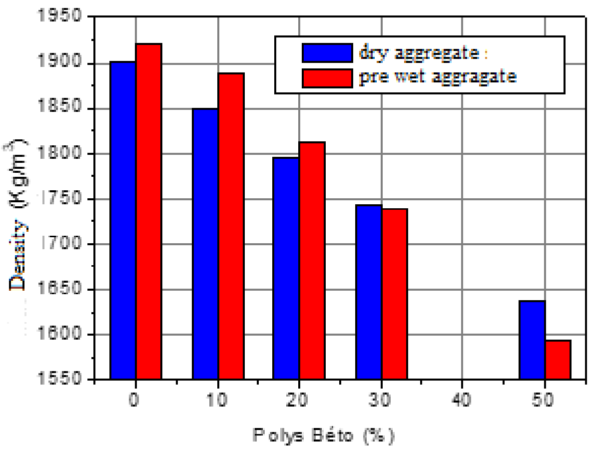


Fig. 5 – The density increases with the decrease in the content.

Fig. 6 shows the lightweight of pozzolanic aggregate concrete with polys concrete instead of pozzolanic sand.

3.3 Workability of the concrete

The presence of voids within the concrete affects its mechanical resistance, for example, the presence of 5% voids in the concrete can reduce the strength by more than 30% and even a percentage of voids of 2% can produce a strength loss of more than 10% [22], which is in accordance with Féret's law which relates the resistance to the quantity of water and air present in hydrated cement paste. The voids inside the concrete are either air bubbles trapped during mixing or spaces left when the excess water contained in the concrete evaporates. Has a lesser degree, there may also be voids created by the rising water during bleeding when this water remains trapped under the coarse aggregates. Air bubbles accidentally drawn into the concrete depend on the grain size of the finest aggregates making up the mixture; they escape more easily from concrete with a high water content than from drier concrete. In our case it is necessary to be careful because of the presence of light aggregates which are sensitive to clamping means, in particular, we have opted for concrete clamping means a vibrating table vibration or pecking depending on the value of the sag.

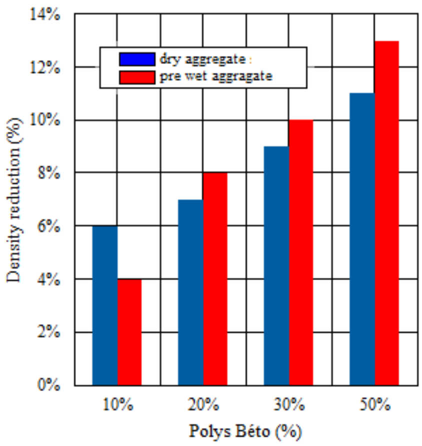


Fig.6 – Lightning is brought to concrete based on pozzolanic aggregates by adding Polystyrene concrete.

3.3.1.1 Concrete without additives

Figures 7 (a,b) represent the evolution of workability as a function of time, we immediately notice that after mixing, the SEC type concrete is firm whereas PREM and SAT concrete (in the case of fixing a quantity of mixing water) is fluid. These results remain logical because the absorption of the aggregates directly influences the loss of maneuverability. In PREM and SAT concretes, since the aggregates are previously moistened, their water absorption is almost negligible, which gives a fluid consistency, on the other hand for DRY concrete the strong absorption of the aggregates makes the drier concrete mortar, which causes a well-known stiffening during implementation [23].

If the consistency of the concretes is fixed, the quantities of water used during mixing were adjusted to give these initial states. In this latter case, the chosen consistency is of the firm type after 20 min all the concretes have a slump equal to (0) (very firm). But for DRY concrete is firm, we have a slump of (0) after 10 min from the end of mixing. For PREM, SAT and BO concrete only becomes firm after 120 min, since it is assumed that ordinary aggregates are not absorbent.

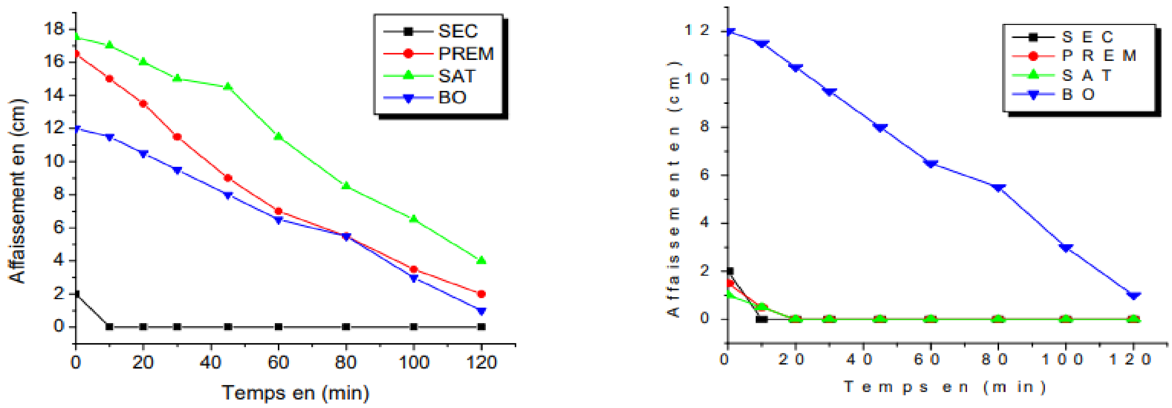


Fig. 7 – Evolution of slump as a function of time.

3.3.1.2 Concrete with additives

It can be seen from figures (3.3, 3.5) that the use of dry aggregates leads to a firm consistency, but for pre-wetted aggregates we know how to face fluid and very plastic consistencies, we also note that the consistency of the concretes has an increasing evolution with the increase in the percentage of adjuvant and the W/C ratio, figures (8 a,b,c,d).

It should be noted that the use of water-reducing plasticizers acts by dispersing (by deflocculating) cement grains, as well as other fine and ultrafine, improves the consistency, but the loss of workability occurs more quickly than in the case of concrete not admixed with the same consistency.

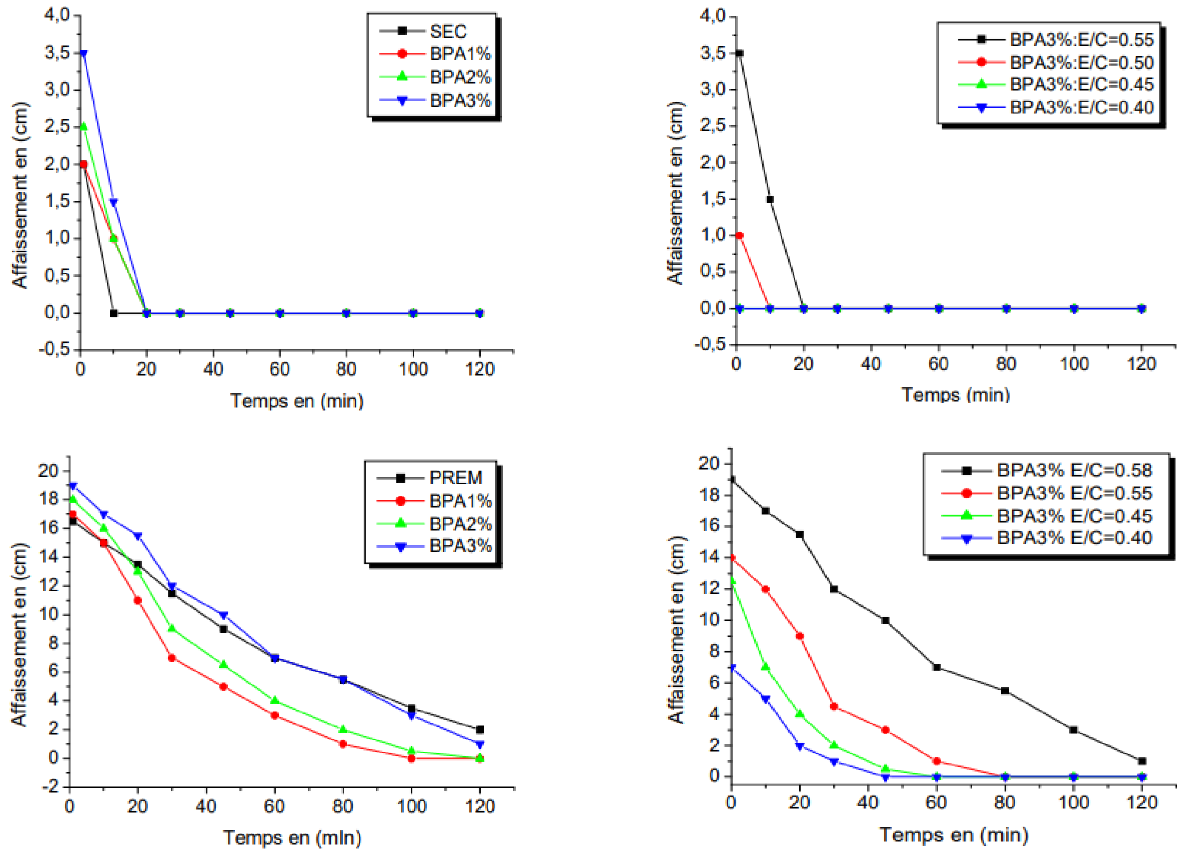


Fig. 8 – Evolution of slump as a function of time.

3.4 Study of the compressive strength

Fig. 9 shows the drop in strength of concrete made from pozzolanic aggregates as a function of the percentage of Polystyrene concrete added.

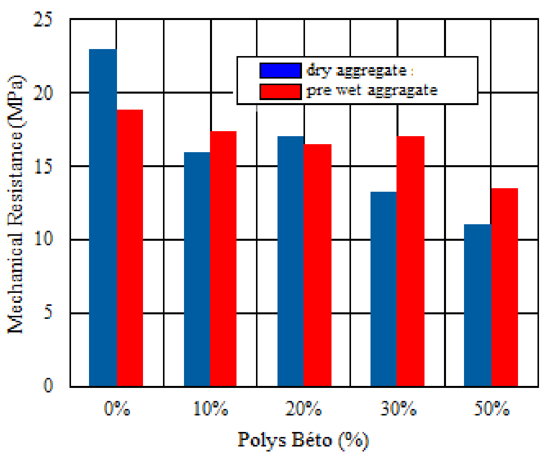


Fig. 9 – The strength of concrete depends on the percentage of polystyrene concrete added.

From Fig. 10 and Fig.11, we can see that the mechanical strength of the concrete decreases as a function of the percentage of Polystyrene concrete added, ranging from 22.93 MPa for concrete (with dry aggregates) without Polystyrene concrete, up to 11.00 MPa for concrete containing 50% of this material as a substitute for pozzolanic sand. The addition of the concrete polys, even with a minimal percentage, has a negative influence on the mechanical resistance, thus favoring the weakening and the brittleness of the concrete.

The polystyrene content influenced positively decreasing the bulk density in decreasing the compressive strength of hardened concrete embedding polystyrene beads [9].

This remark does not prevent the use of this type of concrete in certain applications, which do not require significant mechanical resistance, such as thermal and sound insulation walls, lost formwork elements, decorative elements, etc.

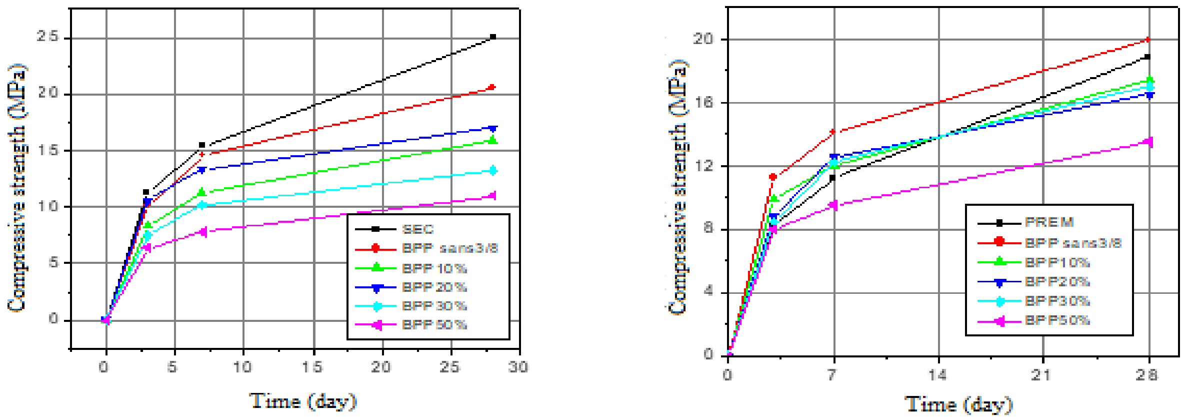


Fig. 10 – Evolution of the mechanical resistance as a function of time.

The comparison of dry aggregate concretes with those produced from pre-wetted aggregates (Fig. 11), allows us to see directly that pre-wetted aggregate concretes have higher mechanical strengths.

It is broadly agreed that the mechanical and physical properties of the concrete containing polystyrene aggregate are highly dependent on the volume of polystyrene aggregate in the mix. From studies to date the higher the volume of polystyrene aggregate the lower the compressive strength for a constant water-to-cement ratio [8, 10, 24, 25].

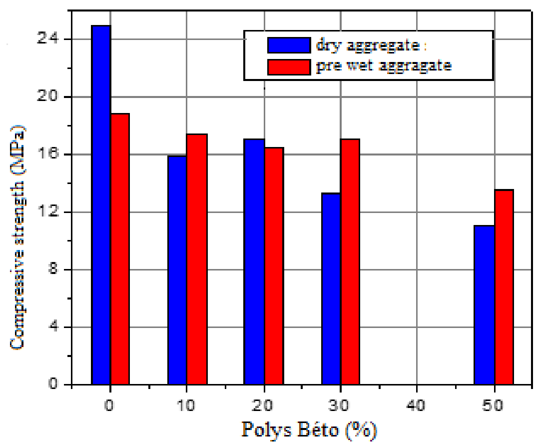


Fig. 11 – Mechanical resistance according to the percentage of Polystyrene concrete (at 28 days).

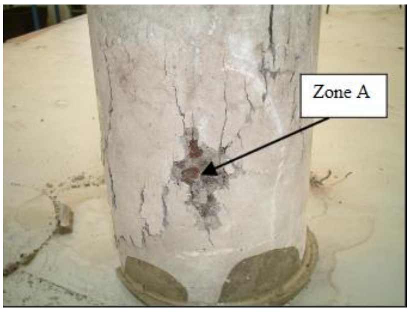
3.5 Failure modes of concrete specimens

3.5.1 Pozzolanic aggregate

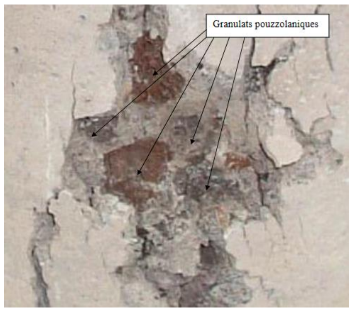
For lightweight aggregate concrete, through the analysis of the compression test of cylindrical specimens, the following conclusions are drawn: when the compression force uniformly transmitted to both sides of the cylinder (lower and upper) reaches a certain value, the cone is formed; It is strongly compressed in three directions under the pallet of each press; The two cones then wedge into the concrete. Along the cone, shear failure occurs in the concrete and tensile failure occurs in the center of the specimen (Fig. 12 a) [26].

In the case of lightweight concrete, aggregates are generally less resistant than mortar. On the other hand, thanks to their porous surface and the resulting bonds, there is very good adhesion between the mortar and the aggregates, breaking, therefore, occurs by breaking the light aggregates (Fig. 12 b, c) [27]. The good adhesion between the aggregates and the hydrated cement paste is explained by several factors. First, the surface roughness of the light pozzolanic aggregates contributes to the good mechanical interlocking of the two materials. There is often the penetration of the cement paste into the open pores located on the surface of the large aggregates. Second, the modulus of elasticity of lightweight aggregates and that of cement paste are quite similar. It does There is therefore no differential stress induced between the two materials, both by the loads applied and by thermal or hygrometric changes. Third, the water absorbed by the aggregates at the time of mixing becomes available over time to hydrate the cement grains that were not yet completely hydrated. As most of this additional hydration occurs at the interface of the cement paste and the aggregate, the adhesion between the aggregate and the matrix is enhanced [22].

a- failure modes of concrete specimens (pozzolanic aggregate concrete).



b- Broken sample



c- enlarged area a

Fig. 12 – Pozzolanic detritus.

Fig. 13 – Mode of failure of concrete specimens (concrete with pozzolanic aggregates).

Fig. 14 – Case of segregation of concrete with pozzolanic aggregates.

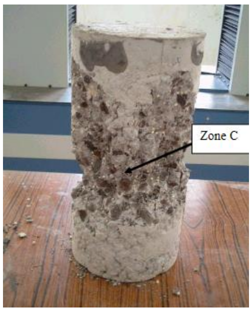
After the crushing tests of cylindrical concrete specimens of pozzolanic aggregates, it can be said that the failure mode is following that of lightweight concrete, even if certain constituents are varied such as the nature and the resistance class of the cement as well as their dosage, the nature of the sand and the addition of adjuvant. However, it sometimes happens that some test specimens do not follow the same failure path although they belong to the ranges of lightweight concrete. For example, from Fig. 13 it is seen that there is an inclined fracture plane along with the height of the specimen. That may be due to improper adjustment of the press plates. Sometimes we obtain test pieces broken by crushing at their upper or lower parts (Fig. 13), which represents the most fragile part of the specimen, caused by segregation in this zone due to a lack of fine elements or even by a leak of laitance (Fig. 14).

In addition, the use of lightweight aggregate concrete with higher consistency, after vibration. The large aggregate tends to be upward [28], which is the weak point of the specimen. If it is considered that the increase of aggregate diameter in this area leads to the parallel increase of porosity compared with other parts of the specimen, the concrete will lose its uniformity, which is harmful to the mechanical strength of lightweight concrete. That is to say, the fracture propagation follows the weakest area in the specimen.

3.5.2 Pozzolanic aggregates lighten with the Polystyrene concrete

In Fig. 15 (a,b), it can be seen that generally the polystyrene beads are evenly distributed, therefore, the segregation effect was insignificant. In addition, as the concrete studied is rich in large aggregates, one can note a tendency for the concentration of polystyrene balls in the spaces between the large particles of aggregate, in particular for a higher percentage of replacement [7]. The method of failure of the test specimens is done in the same way as for the pozzolanic aggregate concretes already described in the previous chapter, but certain differences must be mentioned.

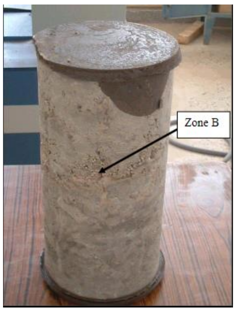
Polystyrene concrete has brought a lightness to our concrete, therefore a reduction in compressive strength, but while keeping the same method of rupture of the test pieces. The surface treatment with special additives gives the grains of Polystyrene concrete the ability to disperse homogeneously in the concrete.

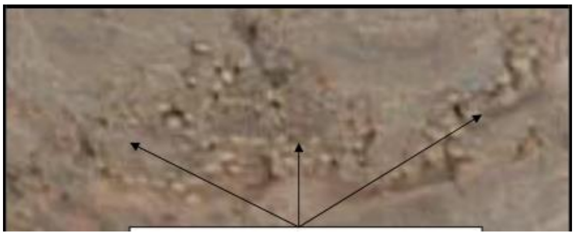


a- Mode of rupture of the specimens b- zone C after enlargement

Fig. 15 – Breakage of the pozzolanic aggregates with the homogeneous dispersion of the grains of Polystyrene concrete, the break follows the storyteller of the grains of Polystyrene concrete .

However, we must be careful when we obtain very plastic or fluid concretes because it will bring the grains of the Polystyrene concrete upwards after the concrete has been placed when the test specimens are filled. Which will subsequently give very fragile layers formed by these grains, after hardening of the concrete, these zones will influence the way of rupture of the test pieces, ie the rupture will be directed by the ruin of these zones (Fig.17a, b). It should be noted that the rupture of the test pieces is done by separation of the grains of Polystyrene concrete which is due to the smooth surface of the latter making their interactions with the concrete mortar a little weak (Fig. 16a, b).





a- formation of a layer of grains of Polystyrene concrete b- zone B after enlargement

Fig.16 – Influence of consistency on the homogenization of pozzolanic aggregate concretes loaded with Polystyrene concrete.

4 Conclusion

From this study we can conclude that: The incorporation of Polystyrene concrete improves the workability of concrete because the grains of Polystyrene concrete completely reject water so no quantity will be absorbed by these grains, which favors the workability of the concrete expressed by a high slump value, compared to concrete which does not contain Polystyrene concrete. Noting also that the evolution of the W / C ratio has a positive effect on the workability of pozzolanic concretes.

To ensure proper placement of pozzolanic concrete, it must have sufficient maneuverability. This workability is influenced by the high absorption aggregates, which leads to a rapid loss of workability. But we can improve the latter by prior humidification of the aggregates in order to stop or slow down their uptake.

The addition of the grains of Polystyrene concrete, which have a very low density, plays a positive role in reducing the density of pozzolanic concretes. The lightweight concrete made using Polystyrene concrete gives the advantage of having concretes at different densities ranging from 1600 kg / m^3 to 2200 kg / m^3. On the other hand, the pre-wetting of the pozzolanic aggregates characterized by high water absorption increases the density of the concrete. The lightness of pozzolanic concretes provided by the incorporation of Polystyrene concrete at different percentages is accompanied by a drop in the mechanical resistance to compression while increasing these percentages.

At the age of 28 days, the compressive strength of aggregate concrete pozzolanic is weaker than those of ordinary concretes, but it exceeds the 20 MPa previously targeted, and this is with dry aggregates and a cement dosage equal to 350 Kg/m^3 , the resistance value obtained is 22.93 MPa.

For pre-wetted and saturated aggregates the compressive strength values are respectively 18.83 and 19.73 MPa, with a value of 37.20 MPa corresponding to the ordinary concrete. So dry aggregates give better compressive strength compared to pre-wetted or saturated aggregates. Increasing the cement dosage from 350 to 380,400 and 420 Kg/m^3 increases also compressive strength values from 22.93 to 24.70, 25.47 and 27.95 MPa, even the resistance class of cement has an effect on the resistance to compression. For a CPJ 32.5 cement, the compressive strength is 22.93 MPa, for a CPJ 42.5 cement, the compressive strength is 27.00 MPa, and that obtained for a CPA 42.5 cement, the value is 27.87 MPa.

The use of a plasticizer and accompanied by an increase in the resistance to compression, for percentages of 0, 1, 2 and 3% of the plasticizer, we obtain how resistance values 22.93, 25.20, 27.60 and 23.67 MPa, the percentage of 2 % of adjuvant gives better resistance values compared to those obtained with percentages of 1 and 3%.

We believe that this new material, "Polystyrene concrete", will play a very interesting role in the future. Not only in the field of the renovation of old buildings, by its lightness on the joists of the slabs, but also in new constructions, by its thermal and sound insulation.

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