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قســـم الـــري و الهندســـة المدنيـــة
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Registration Number :

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Domain: ST
Sector: Civil Engineering
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Theme :

Influence of partial substitution of cement by olive pomace ash on the physico-mechanical characteristics of self-compacting concrete

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by:
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DEDIATIONS

I *dedicate this graduation to the owners of the glowing hearts and burning vigor,to those who sacrificed their money, souls and blood for their faith,to those who faced the devil of evil and the devil of craving, to Al-Aqsa Intifada martyrs and all the martyrs of Palestine, to those who loved Palestine as a home land and peace.*

I dedicate this graduation to the country of martyrs, the country of a million martyrs, Algeria, which embraced me throughout my study period, this country, whose people I did not meet with ill-will, thank you for this great country.

I dedicate this graduation first to my mother and father (Narges and Mouaz), had it not been for their psychological and moral support, I would not have reached this day. You are a crown on my head.

I dedicate this graduation to my older brother who spared no effort and whenever I needed him I always found him.

I dedicate this graduation to my young brother (Momen). I dedicate this graduation to my second family here in my second country, Algeria (Anes, Al-aya, Safia, Rachida, and Uncle Belaid).

To my best friends in particular Jalil,HammadiHossam.

I dedicate this graduation to my brothers who gave me exile, my brothers who my mother did not give birth to (Jalil, Karim).

I dedicate this graduation to my dear Bushra, who supported me in this work.

I dedicate this graduation to my partner in this work (Dalia)

To all of them,

I dedicate this work

Sami

Dedications:

I dedicate this modest work:

To my mother who has been by my side and supported me throughout my life, and my father who sacrificed his whole life in order to see me become what I am, thank you very much my parents.

To my dear brothers ***Boudjmaa Salah Aissa Islam***

To my little sister ***Nadia***

To my best friends in particular ***ManelImaneChourouk*** *and to all those who are dear to me without exception.*

*My colleague**Sami***

To all those I have worked with during my studies as teachers and students.

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Finally many heartfelt thanks go to my struggling parents, dear brothers, and friends who helped me in this modest work and fight all difficult conditions to reach this situation.

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الملخص:
وصل الإنتاج العالمي للزيتون سنة 2019 الى 3.2 مليون طن، و بلغ انتاج دول حوض المتوسط ما نسبته 90 % من الإنتاج العالمي، دولتي فلسطين والجزائر وباعتبارهما من دول حوض المتوسط حيث تشهد زراعة الزيتون نشاطا كبيرا الا أن المشكل الؤرق المشترك هو الكميات الكبيرة من مخلفات الزيتون الذي تولده معاصر زيت الزيتون.
ان الهدف الأساسي من هذه الدراسة هو تثمين مخلفات الزيتون باستخدامها في العناصر غير الإنشائية وذلك باستبدال مسحوق الجفت مع الأسمنت في الخليط الخرساني ذاتي الضغط.
هذه الدراسة مبنية على عدة تجارب واختبارات وذلك لدراسة مدى تأثير استبدال مسحوق الجفت مع الأسمنت على الخليط الخرساني على المدى البعيد, وبناء على ذلك تم الاعتماد على الاختبار بشكل أساسي والمقارنة بين نتائج استبدال مسحوق الجفت بنسب 5 %، 10 % ثم 20 % قي الخليط الخرساني.
في النهاية فان النتائج التي تم الحصول عليها من هذه الدراسة تشير الى انه كلما زادت نسبة الاستبدال للجفت في الخليط الخرساني ذاتي الضغط فان ذلك يؤدي الى ضعف على المدى البعيد في قوة الضغط و الشد للخرسانة, لكن كما ذكر مسبقا فان هذا الخليط بشكل أساسي غير مصمم للعناصر الانشائية الأساسية, وباعتبار ان الجفت يعتبر مستخرج من مادة عضويةفانه أيضا لا يتعارض ولا يؤثر سلبا على العناصر المكونة للإسمنت المستخدم, وعليه فإن تأثير الجفت على الخصائص الميكانيكية والفيزيائية للخليط الخرساني غير ملحوظ.

Abstract:
The global production of olives in 2019 reached 3.2 million tons, and the production of the Mediterranean countries reached 90% of the world production, the countries of Palestine and Algeria, as they are among the countries of the Mediterranean basin, where olive cultivation is witnessing a great activity, but the common problem is the large quantities of olive waste Produced by olive oil mills.
The main objective of this study is to value olive residues by using them in non-structural elements by replacing peat powder with cement in the self-stressed concrete mixture.
This study is based on several experiments and tests in order to study the effect of replacing peat powder with cement on the concrete mixture in the long run, and accordingly the test was mainly based on and comparison between the results of replacing peat powder at rates of 5%, 10% and then 20% in the concrete mixture .
In the end, the results obtained from this study indicate that the higher the percentage of peat replacement in the self-compressing concrete mixture, this leads to a long-term weakness in the compressive and tensile strength of concrete, but as mentioned earlier, this mixture is basically not designed For the basic structural elements, and considering that peat is extracted from an organic material, it also does not conflict and does not negatively affect the constituent elements of the cement used, and therefore the effect of peat on the mechanical and physical properties of the concrete mixture is not noticeable.

Résumé :
La production mondiale d'olives en 2019 a atteint 3,2 millions de tonnes, et la production des pays méditerranéens a atteint 90% de la production mondiale, les pays de Palestine et d'Algérie, comme ils sont parmi les pays du bassin méditerranéen, où la culture de l'olivier est connaît une grande activité, mais le problème commun est les grandes quantités de déchets d'olives produites par les moulins à huile d'olive.
L'objectif principal de cette étude est de valoriser les résidus d'olive en les utilisant dans des éléments non structuraux en remplaçant la poudre de tourbe par du ciment dans le mélange de béton auto plaçant.
Cette étude est basée sur plusieurs expériences et tests afin d'étudier l'effet du remplacement de la poudre de tourbe par du ciment sur le mélange de béton à long terme, et en conséquence le test était principalement basé sur et la comparaison entre les résultats du remplacement de la poudre de tourbe à des taux de 5%, 10% puis 20% dans le mélange de béton.
Lles résultats obtenus à partir de cette étude indiquent que plus le pourcentage de remplacement de la tourbe dans le mélange de béton auto plaçant est élevé, cela conduit à une faiblesse à long terme de la résistance à la compression et à la traction du béton, mais comme mentionné précédemment, cette mélange n'est pas conçu Pour les éléments structurels de base, et étant donné que la tourbe est extraite d'un matériau organique, il n'entre pas non plus en conflit et n'affecte pas négativement les éléments constitutifs du ciment utilisé, et donc l'effet de la tourbe sur la mécanique et les propriétés physiques du mélange de béton ne sont pas considérables

General Introduction:

In recent years, the interest for environmental protection has grown faster, the most pursued objective is to reduce emissions of greenhouse gases (e.g., carbon dioxide, nitrous oxide and methane), which are responsible for the greenhouse effect. In particular, the cement industry contributes about 5%of global anthropogenic CO2 emissions, as the production of the binder is a highly energy-intensive and emitting process. Since the cement industry is one of the industries that produce high carbon emissions, this posed a challenge to researchers in order to reduce the use of cement or the use of green cement, which we will learn about later, as global cement production is about 2.2 billion tons annually, and it is expected that this amount will double. To reach 4.2 billion tons in 2050, this increases the industry's contribution to carbon dioxide emissions by 10%.

So from this point of view, the idea of our project was to use olive waste, which is almost useless, and use it in self-pressing concrete instead of cement in percentages starting from 0% to 20%, and to identify the extent of its impact on compressive and tensile strength in the long term, and to know if this would succeed experience or not. The Problem Statement on which the project is based is influence of concrete that mixed with the olive waste ash on the strength of concrete that is not treated by sulfate resisting additives under different condition curing. And to compare the compression and tensile strength of self-compacting concrete replaced Olive to the self-compacting concrete mixed.

In the first chapter we will talk about self-competing concrete in detail and about the history of its development and the reasons that led us to that etc. Then in the second chapter we will learn about green concrete and the use of agricultural waste in concrete mixtures instead of cement and we will learn about examples of them and then we will learn about olive waste In detail, on how to prepare its ashes, on the components of olives in general, and on its impact on the environment, etc. Then in the third chapter we will learn about the materials that we will use in preparing the concrete mixture and the experiments that we will do on these materials to know the extent of their readiness.Then in the last chapter we will see the results of the compressive and tensile strength of the samples that we will prepare it.

Chapter I

SELF COMPACTING CONCRETE (SCC)

I.1 Introduction:

Self-compacting concrete was first developed in 1988 to achieve durable concrete structures. Since then, various investigations have been carried out and this type of concrete has been used in practical structures in Japan, mainly by large construction companies.

Investigations for establishing a rational mix-design method and SSC methods have been carried out from the viewpoint of making SSC a standard concrete.

This chapter provides a detailed overview of SSC in terms of its definition, development, and the main reasons for its use.

I.2. Definition:

Self-compacting concrete (SCC) is a special type of concrete mix that can be cast without compaction or vibration. It is applied at sites where vibration is very difficult or even impossible (such as underwater). SCC is quick to apply, leading to savings in staff costs. Overall costs savings are realized even when the addition of super plasticizer is taken into account. Although very fluid, SCC is also very cohesive and has a low tendency of experiencing segregation and bleeding. **(1)**

I.3. History of self-compacting concrete:

The idea of self-compacting concrete was launched in the mid-1980s by researchers at the University of Tokyo, and then was quickly taken up by large Japanese industrial groups (Kajima, Taisei, Obayashi, etc.) for projects of scope. The significant development of this type of concrete is justified by the fact that they have two technical and commercial interests:

- Ease of implementation: reduction in production time, reduction in staff and therefore in the cost of labor; as well as the possibility of using complex and high density reinforcement formwork.
- Improvement of the quality of the concrete (resistance and durability), which is independent of the know-how of the workers.

The interest of other countries in this type of concrete only became apparent after a few years. In France, the CLBR (Central Laboratory of Bridges and Roads) looked into the question at the beginning of the 90s. The first full-scale applications were carried out at the beginning of 1988, in Brest, on the extension site of the park. Ocean polis leisure center for high curved sails heavily scrapped. Also during the construction of a college whose facades are inclined, with complex geometry, and non-repetitive shapes excluding any possibility of prefabrication. Japanese researchers and industrialists did not immediately publish their research. The viability of self-compacting concrete had to be proven. Several research and development teams have dedicated themselves to this. Real-life achievements have confirmed the work carried out in Japan for more than ten years. **(2)**

The current challenge is to master the formulation of self-consolidating concrete in several strength classes for a competitive price, taking into account on the one hand the specifications integrating the rheological performance and on the other hand the techniques and materials available.

Figure (I. 1) self-compacting concrete

Figure (I.2) Note in the picture how each concrete intervention easily between iron bars

I.3.1. Advantages of Self Compacting Concrete:

The main advantages of self-compacting concrete are:

1. The permeability of the concrete structure is decreased.
2. SCC enables freedom in designing concrete structures.

3. The SCC construction is faster.
4. The problems associated with vibration are eliminated.
5. The concrete is placed with ease, which results in large cost saving
6. The quality of the construction is increase.
7. The durability and reliability of the concrete structure is high compared to normal concrete structures.
8. Noise from vibration is reduced. These also reduce the hand arm vibration syndrome issues.

I.3.2. Disadvantages of Self Compacting Concrete

SCC constructions face the following limitations:

1. There is no globally accepted test standard to undergo SCC mix design.
2. The cost of construction is costlier than the conventional concrete construction.
3. The use of designed mix will require more trial batches and lab tests.
4. The measurement and monitoring must be more precise.
5. The material selection for SCC is more stringent.

I.4. Principles of formulation The SCC:

the SCC must have great fluidity and be able to flow under their own weight with a sufficient flow rate without external energy input (without vibration) through confined areas (reinforcements, formwork of complex shapes) in the presence of obstacles and set up in high formwork, The formulation principle aims to reduce the shear threshold of the concrete while keeping it a sufficient viscosity to avoid any risk of segregation and bleeding.

Formulating a Scc therefore consists in reconciling a priori contradictory properties: fluidity, stability, resistance to “dynamic” segregation (movement in scraped areas) and to “static” segregation (no bleeding, no settling) once the concrete in place (the suspension of the various grains that constitute it must remain homogeneous until the material sets

The studiesof the SCC formulation optimization studies are to obtain a reliable and robust formula that can be easily checked on site. To do this, the formulation of SCC for Four fundamental principles:

- fluidization
- limitation of friction between aggregates to promote flow and fluidity
- stabilization of the mixture
- maintaining rheology

I.4.1. The criteria for the composition of SCC

To achieve the required combination of properties in fresh SCC mixes:

• The fluidity and viscosity of the paste is adjusted and balanced by careful selection and proportioning of the cement and additions, by limiting the water/powder ratio and then by adding a super plasticizer and (optionally) a viscosity modifying admixture. Correctly controlling these components of SCC, their compatibility and interaction is the key to achieving good filling ability, passing ability and resistance to segregation.

• In order to control temperature rise and thermal shrinkage cracking as well as strength, the fine powder content may contain a significant proportion of type l or ll additions to keep the cement content at an acceptable level.

• The paste is the vehicle for the transport of the aggregate; therefore the volume of the paste must be greater than the void volume in the aggregate so that all individual aggregate particles are fully coated and lubricated by a layer of paste. This increases fluidity and reduces aggregate friction.

• The course to fine aggregate ratio in the mix is reduced so that individual coarse aggregate particles are fully surrounded by a layer of mortar. This reduces aggregate interlock and bridging when the concrete passes through narrow openings or gaps between reinforcement and increases the passing ability of the SCC.

I.4.2. Formulations of existing The SCC

Multiple approaches have been developed around the world for the formulation of SCC . In the following, a general discussion of the main approaches

I.4.2.1 Japanese approach:

Considered as the general method of formulation, the Japanese approach was developed at the University of Tokyo. In general, this approach consists in first fixing the dosage of gravel in the concrete and that of sand in the mortar, then to proceed to the optimization of the cement paste in order to give the resulting concrete the best performance and to satisfy the workability criteria.

The volume of the gravel is set at the height of 50% of the volume of solids contained in the concrete. According to the authors, this percentage helps to avoid the risk of blockages, provided that the concrete mortar correctly meets the tested workability criteria. Indeed, to ensure good workability, the volume of sand is set at 40% of the total volume of mortar. However, the volume of gravel in this method is generally undersized in order to avoid the risk of blockages, which can lead to shrinkage problems (the volume of the paste being large). The concrete obtained is thus far from an economic optimum. As a result, several modifications and various developments are made to this method. Indeed, Edamatsu have succeeded thanks to the use of mineral additions (limestone fillers, fly ash, blast furnace slag) to increase the proportion of sand in the mortar and therefore to reduce the volume of paste, and particularly cement, in concrete.

I.4.2.2. Approach CBI (Swedish)

The Swedish formulation method is developed by CBI (Cement ochBetongInstitutet). This approach is based on the assessment of the risks of aggregates blocking in scrap environments. It makes it possible to optimize the maximum size of the aggregates in relation to the spacing between the reinforcements, and the volume of the aggregates in the concrete. For each size of aggregate, the authors have shown that there is a critical volume content of aggregates below which the risk of blocking is zero and above which blocking is systematic. This critical volume content is a function of the spacing between the reinforcements (in relation to the size of the aggregates), and of the shape of the aggregates (rolled or crushed). added a volume of the pulp to ensure a minimum spacing between the aggregates in order to reduce friction between the aggregates.

I.4.2.3. Approach of the LCPC central laboratory for bridges and roadways (France)

This approach, developed in France at LCPC by de Larrard and Sedran, is based on the compressible stacking model which involves optimizing the porosity of the system formed by solid grains. Optimal arrangement of the granular backbone provides better strengthand greater workability. The model makes it possible to predict the compactness of the granular skeleton from the characteristics of the constituents such as the bulk density, the proportions of the mixture, the granular distributions and the inherent compactness. The authors modeled the behavior of concrete in the fresh state from the compactness of its granular skeleton.This approach is based on a software (BétonlabPro 2) which makes it possible to determine formulations of different types of concrete (high performance concrete, ordinary concrete, dry concrete for immediate release, self-compacting concrete).

I.5. Developing SSC mixes:

SCC mixes must meet three key properties: **(3)**

1. Ability to flow into and completely fill intricate and complex forms under its own weight.
2. Ability to pass through and bond to congested reinforcement under its own weight.
3. High resistance to aggregate segregation.

I.6. Self-compacting concrete testing method:

A concrete mix can only be classified as self-compacting concrete if the requirements for all the following three workability properties are fulfilled. **(3)**

- Filling ability:

It is the ability of SCC to flow into all spaces within the formwork under its own weight. Tests, such as slump flow, V-funnel etc, are used to determine the filling ability of fresh concrete.

- Passing ability:

It is the ability of SCC to flow through tight openings, such as spaces between steel reinforcing bars, under its own weight. Passing ability can be determined by using U-box, L-box, Fill-box, and J-ring test methods.

- Segregation resistance:

The self-compacting concrete must meet the filling ability and passing ability with uniform composition throughout the process of transport and placing.

The European evidence gave three basic experiments to verify the previous properties**(Slump flow test, L Box Test** and Sieve stability)، In addition to the use of other experiments that are useful in confirming the previous characteristics of SCC:

I.6.1. Slump flow test:

The slump flow test is used assess the horizontal free flow of self-compacting concrete in the absence of obstructions. It was first developed in Japan for use in assessment of underwater concrete. The test method is based on the test method for determining the slump. T is the diameter of the concrete circle is a measure for the filling ability of the concrete.

I.6.1.1 Assessment of slump flow test:

This is a simple, rapid test procedure, though two people are needed if the T50 time is to be measured. It can be used on site, though the size of the base plate is somewhat unwieldy and level ground is essential. It is the most commonly used test, and gives a good assessment of filling ability. It gives no indication of the ability of the concrete to pass between reinforcement without booking, but may give some indication of resistance to segregation.

It can be argued that the completely free flow, unrestrained by any foundries, is not representative of what happens in concrete construction, but the test can be profitably be used to assess the consistency of supply of supply of ready-mixed concrete to a site from load to load. **(3)**

I.6.1.2 Equipment for slump flow test:

- Mould in the shape of a truncated cone with the internal dimensions 200 mm diameter at the base, 100mm diameter at the top and a height of 300 mm.
- Base plate of a stiff non-absorbing material, at least 700mm square, marked with a

circle marking the central location for the slump cone, and a further concentric circle of 500mm diameter.

- Trowel.
- Scoop.
- Ruler.
- Stopwatch (optional).

Figure (I.3) Equipment for slump flow test.

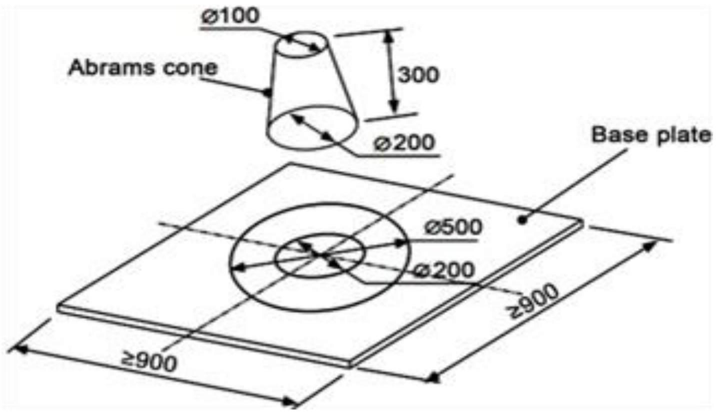


Figure (I.4) Dimensions of equipment used in the slump flow test.

I.6.1.3. Procedure of slump flow test on self-compacting concrete:

About 6 liter of concrete is needed to perform the test, sampled normally. Moisten the base plate and inside of slump cone, place base plate on level stable ground and the slump cone centrally on the base plate and hold down firmly. Fill the cone with the scoop. Do not tamp, simply strike off the concrete level with the top of the cone with the trowel. Remove any surplus concrete from around the base of the cone. Raise the cone vertically and allow the concrete to flow out freely. Simultaneously, start the stopwatch and record the time taken for the concrete to reach the 00mm spread circle (This is the T50 time).floatable test, might be appropriate. The T50 time is secondary indication of flow. A lower time indicates greater flow ability. The BriteEuRam research suggested that a time of 3-7 seconds is acceptable for civil engineering applications, and 2-5 seconds for housing applications. In case of severe segregation most coarse aggregate. **(3)**

Figure (I.5) Procedure of slump flow test.

Will remain in the center of the pool of concrete and mortar and cement paste at the concrete periphery. In case of minor segregation a border of mortar without coarse aggregate can occur at the edge of the pool of concrete. If none of these phenomena appear it is no assurance that segregation will not occur since this is a time related aspect that can occur after a longer period.

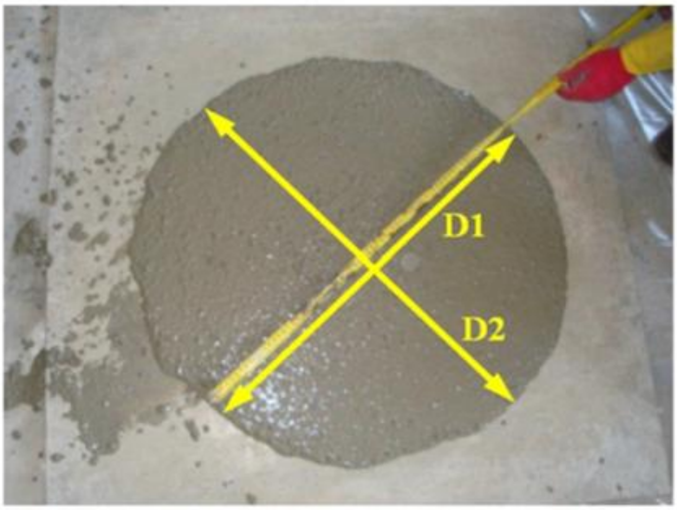


Figure (I.6) Concrete spread in the slump flow test

I.6.1.4. The results of the test:

This test allows us to find:

The spread of flow is calculated from the relation:

$$\boldsymbol{SF = \frac{D1 + D2}{2}}$$

Table (I.01) Categories flow.

Category	Categories flow(mm)
SF1	550-650
SF2	660-770
SF2	750-850

SF1 (550-650 mm): is appropriate for: **(7)**

- unreinforced or slightly reinforced concrete structures that are cast from the top with free displacement from the delivery point (e.g. housing slabs)
- casting by a pump injection system (e.g. tunnel linings)
- Sections those are small enough to prevent long horizontal flow (e.g. piles and some deep foundations).

SF2 (660 -750) mm: is suitable for many normal applications (e.g. walls, columns).

SF3 (166-850 mm): is typically produced with a small maximum size of aggregates (less than 16mm) and issued for vertical applications in very congested structures, structures with complex shapes, or for filling under formwork. SF3 will often give better surface finish than SF 2 for normal vertical applications but segregation resistance is more difficult to control.

I.6.2. L Box Test:

This test for self-compacting concrete is based on a Japanese design for underwater concrete, has been described by Peterson. The test assesses the flow of the concrete and also the extent to which it is subjected to blocking by reinforcement. The apparatus is shown in the figure.

The apparatus consist of rectangular section box in the shape of an ‘L’, with a vertical and horizontal section, separated by a movable gate, in front of which vertical length of reinforcement bar are fitted. The vertical section is filled with concrete, and then the gate lifted to let the concrete flow into the horizontal section. When the flow has stopped, the height of the concrete at the end of the horizontal section is expressed as a proportion of that remaining in the vertical section. It indicates the slope of the concrete when at rest. This is an indication passing ability, or the degree to which the passage of concrete through the bars is restricted. The horizontal section of the box can be marked at 200mm and 400mm from the gate and the times taken to reach these points measured. These are known as the T20 and T40 times and are an indication for the filling ability. The section of bar con be of different diameters and are spaced at different intervals, in accordance with normal reinforcement considerations, 3x the maximum aggregate size might be appropriate. The bar can principally be set at any spacing to impose a more or less severe test of the passing ability of the concrete. **(3)**

I.6.2.1 Assessment of test:

This is a widely used test, suitable for laboratory and perhaps site use. It asses filling and passing ability of SCC, and serious lack of stability (segregation) can be detected visually. Segregation may also be detected by subsequently sawing and inspecting sections of the concrete in the horizontal section. Unfortunately there is no arrangement ton materials or dimensions or reinforcing bar arrangement, so it is difficult to compare test results. There is no evidence of what effect the wall of the apparatus and the consequent ‘wall effect’ might have on the concrete flow, but this arrangement does, to some extent, replicate what happens to concrete on site when it is confined within formwork. Two operators are required if times are measured, and a degree of operator error is inevitable.

I.6.2.2. Equipment for L Box Test:

- L box of a stiff non absorbing material.
- Trowel.
- Scoop.
- Stopwatch.

Figure (I.7) Equipment for L box test.

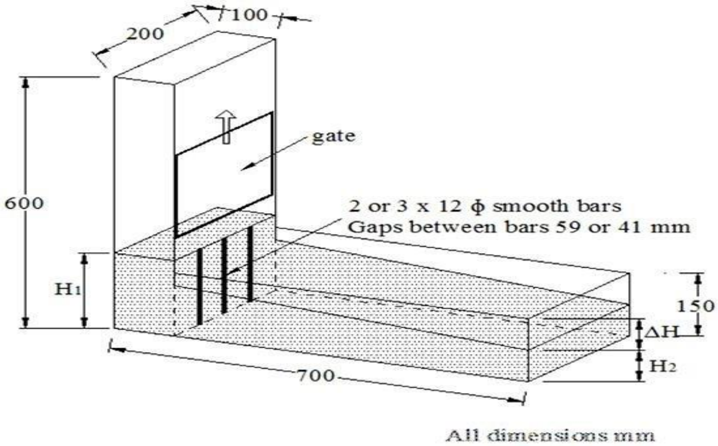


Figure (I.8) Dimensions of equipment used in the L-box test.

I.6.2.3 Procedure of L Box Test:

About 14 liter of concrete needed to perform the test, sampled normally. Set the apparatus level on firm ground, ensure that the sliding gate can open freely and then close it.

Moisten the inside surface of the apparatus, remove any surplus water, fill the vertical section of the apparatus with the concrete sample. Leave it stand for 1 minute. Lift the sliding gate and allow the concrete to flow out into the horizontal section. Simultaneously, start the stopwatch and record the time for the concrete to reach the concrete 200 and 400 marks.

When the concrete stops flowing, the distances ‘H1’ and ‘H2’ are measured. Calculate H2/H1, the blocking ratio. The whole has tom performed within 5 minutes.

Figure (I.9) Procedure of L box test.

I.6.2.4. The results of the test:

This test allows us to calculate the passing ability (PA).which is calculated from the relationship: **PA**=$\frac{H2}{H1}$

Table (I.02)Categories (PA)

Category	passing ability
PA1	≥ 0.8with 2 bars
PA2	≥ 0.8with 3 bars

I.6.3. Sieve stability test:

To determine the segregation to resistance and are suitable for laboratory and site.**(3)**

I.6.3.1. Assessment of test:

It can be used at the stage of the study of the formulation of self-leveling concrete in the laboratory, Or to check the stability of the concrete delivered to the site.

This test complements the tests Allow the assessment of mobility in a confined or unconfined environment, thanks to the characterization of stability.

I.6.3.2. Equipment for Sieve stability test:

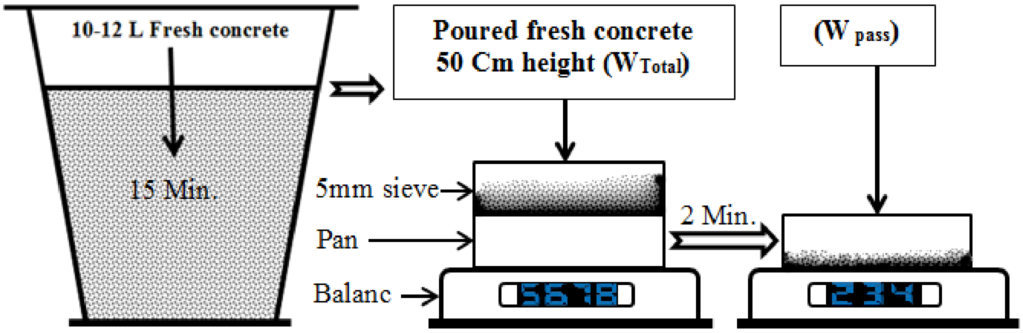
This test consists of the use of a 10 L bucket with a lid, a sieve of 5 mm in diameter, 315 mm deeper and a rocker with a minimum capacity of 20 kg and 20 g precision.

I.6.3.3. Procedure of Sieve stability test:

The operating mode according to the recommendations of the [AFGC] is as follows:

At the end from mixing, ten liters of concrete are poured into the bucket. After fifteen minutes, a 4.8 kg sample is poured from the bucket onto the sieve, two minutes later the amount of paste (laitance) that has passed through the sieve. The percentage by weight of milt per compared to the weight of the sample gives the segregation index the measure of this index Leads to classify the SCC formulas as follows: **(3)**

- $0 \leq \pi \leq 15$ % satisfactory stability.
- 15 % $< \pi \leq 30$ % critical stability, the test to be repeated in situ.
- $\pi > 30$ % very poor stability, unusable concrete.



Figures (I 10) Procedure of L box test.

I.6.3.4. The results of the test:

This test aims to qualify the self-compacting concrete with regard to the risk of separation.

Recommended values for A.F.G.C tests:

$$SR=\frac{PMILT}{Psample}\times 100$$

Table (I.03) Categories (SR).

Category	segregation resistance
SR1	≥ 20%
SR2	≤ 15%

I.6.4.V Funnel Test:

V funnel test on self-compacting concrete is used to measure the flow ability. But the flow ability of concrete is affected by its other properties as well which may affect the flow ability of the concrete during testing. **(3)**

I.6.4.1. Assessment of test:

Though the test is designed to measure flow ability, the result is affected by concrete properties other than flow. The inverted cone shape will cause any liability of the concrete to block to be reflected in the result if, for example there is too much coarse aggregate. High flow time can also be associated with low deformability due to a high paste viscosity, and with high inter-particle friction. While the apparatus is simple, the effect of the angle of the funnel and the wall effect on the flow of concrete is not clear.

I.6.4.2. Equipment:

- V-funnel.
- Bucket (±12 liter).
- Trowel.
- Scoop.
- Stopwatch.

Figure (I.11) Equipment for V-Funnel test.

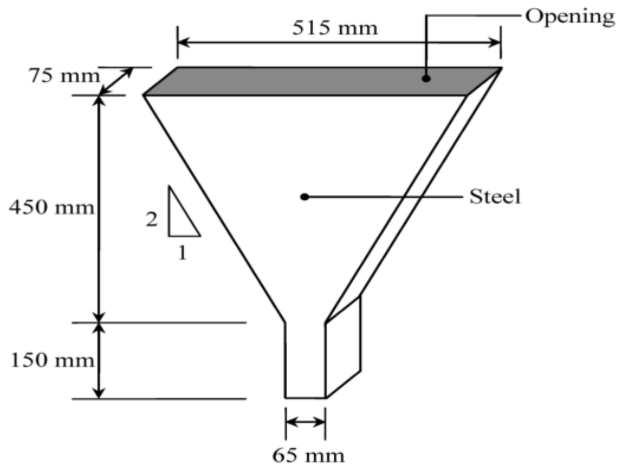


Figure (I.12) Dimensions of equipment used in the V Funnel test.

I.6.4.3. Procedure flow time:

About 12 liter of concrete is needed to perform the test, sampled normally. Set the V-funnel on firm ground. Moisten the inside surface of the funnel. Keep the trapdoor to allow any surplus water to drain. Close the trap door and place a bucket underneath. Fill the apparatus completely with the concrete without compacting or tamping; simply strike off the concrete level with the top with the trowel. Open within 10 sec after filling the trap door and allow the concrete to flow out under gravity. Start the stopwatch when the trap door is opened, and record the time for the complete discharge (the flow time). This is taken to be when light is seen from above through the funnel. The whole test has to be performed within 5 minutes.

Figures (I.13) Procedure of L-box test.

❖ **Procedure flow time at T5 minutes:**

Do not clean or moisten the inside surface of the funnel gain. Close the trapdoor and refill the V-funnel immediately after measuring the flow time. Place a bucket underneath.

Fill the apparatus completely with concrete without compacting or tapping, simply strike off the concrete level with the top with the trowel. Open the trapdoor 5 minutes after the second fill of the funnel and allow the concrete to flow out under gravity. Simultaneously start the stopwatch when the trap door is opened and record the time discharge to complete flow (the flow time at T5 minutes). This is to be taken when light is seen from above through the funnel.

I.6.4.4. The results of the test:

This test measures the ease of flow of concrete, shorter flow time indicates greater flow ability. For SCC a flow time of 10 seconds is considered appropriate. The inverted cone shape restricts the flow, and prolonged flow times may give some indication of the susceptibility of the mix to blocking. After 5 minutes of settling, segregation of concrete will show a less continuous flow with an increase in flow time.

I.7. Study in the hardened state:

The concrete must be subjected to various mechanical characterization tests:

I.7.1. Compression tests:

Self-compacting concrete with a similar water cement or cement binder ratio will usually have a slightly higher strength compared with traditional vibrated concrete, due to the lack of vibration giving an improved interface between the aggregate and hardened paste. The strength development will be similar so maturity testing will be an effective way to control the strength development whether accelerated heating is used or not. A number of concrete properties may be related to the concrete compressive strength, the only concrete engineering property that is routinely specified and tested. The compressive strength measurement tests are carried out on 7×7×28 cm specimens in accordance with the requirements of the standard.

This test provides the compressive force [N] which causes the sample to break (). The compressive stress at break [MPa] is deduced from this force by dividing by the area of the requested section. **(3)**

Figures (I.14) Compression machine.

I.7.2. Tensile test:

Self-compacting concrete may be supplied with any specified compressive strength class. For a given concrete strength class and maturity, the tensile strength may be safely assumed to be the same as the one for a normal concrete as the volume of paste (cement + fines + water) has no significant effect on tensile strength. In the design of reinforced concrete sections, the bending tensile strength of the concrete is used for the evaluation of the cracking moment in prestressed elements, for the design of reinforcement to control crack width and spacing resulting fromrestrainedearly-age thermal contraction, for drawing moment-curvature diagrams, for the design of unreinforced concrete pavements and for fiber reinforced concrete. In prestressed units the splitting tensile stresses around the strands as well as their rate of drawn-in (slippage) in the end section when releasing the prestressing forces are related to fact, the compressive strength at release.(7) Cracks due to splitting tensile stresses should generally be avoided. This widely used test makes it possible to simulate the most common type of stress in the elements of structures.The specimens used for this type of test are suitable only for mortars; they are prismatic dimensions 7x7x28cm .The bending tensile strength is obtained by applying the following material strength formula:

Figures (I.15) Bending tensile tests.

I.8. Summary:

In this chapter, we learned about self-pressure concrete, which is basically modern and the world still does not use it mainly. For example, Algeria and Palestine are still using regular concrete in building construction projects. Anyway, at first we got acquainted with self-pressure concrete by definition, and then we learned about the history of the development of self-pressure concrete from its discovery in Japan in 1986 until it was applied for the first time in the construction of the Akashi-Kaikyo Bridge, and we learned about the main reasons that led to its development. And its discovery, and since one of the most important reasons for its development is its high fluidity, which gives it the advantage of access to all corners of the most difficult complex building structures easily and without effort to mention, then we got acquainted with the advantages and disadvantages of self-pressure concrete and we got acquainted with the formulas of self-pressure concrete. As the benefit of our study is a prelude to the main goal of this research, which is to replace the ash of olive waste with cement with a variable percentage in self-pressure concrete.

In the next chapter, we will learn about agricultural waste in general, which we will talk about in semi-detail.

Chapter II

The use of green waste - agricultural - in the field of construction

II.1. Introduction:

The cultivation of olive trees and the production of olive oil are considered a heritage of the Mediterranean region. This habit represents a very important benefit to many nations in terms of wealth and health. However, huge amounts of by-products and residues are produced during olive oil production. This presents a serious environmental impact on terrestrial and water bodies if not handled properly. The extraction of olive oil results in two types of waste: liquid waste represented in olive press treatment water directed into sewage channels, which is considered highly polluting and toxic to plants, and solid waste called olive pomace. Our study aims at evaluating olive pomace as an alternative to cement with proportions of 5%, 10% and 20%,and studying its effect on self-compacting concrete.

II.2. World olive oil production:

World olive oil production is about 3.2071 million tons in 2019, as reported by (International Olive Council 2020), and 90% of world production is made up of Spain, Italy, Greece, Turkey, Tunisia, Morocco, and Portugal. It is one of the main agricultural industries in the Mediterranean countries, producing a significant amount of residual biomass; 100 liters of liquid waste (olive mill wastewater) and 35 kg of solid waste (olive oil cake) are generated from 100 kg of processed olives . Such large amounts of by-products can have adverse effects on the environment, as evidenced by several studies of the negative effects of these byproducts on aquatic ecosystems, on microbial soil populations, and even on air . The economic costs of biomass and the impact on the environment can be reduced by recycling it (Rajamma et al. 2009).

II.3. Olive waste ash:

Olive waste ash (OWA) or "olive fly ash" as it is called in some previous studies, is produced by burning the waste from olive mills at high temperatures over a long period. This material can be used in the building industry as one of the components of concrete, as a cement filler or cement replacement. As more cement is replaced with OWA, the compressive strength and flexural strength of the mortar decreases. The setting time and workability of the mortar also decrease with an increase in OWA content, but when OWA is used as a partial substitution for sand, the mechanical properties of the mortar improve with an increase in its content (Al-Akhras and Abdulwahid 2010). The production of original fly ash from olive biomass (FAOB) content mortars is effective by substituting either FAOB or $CaCO_3$ filler for cement. Up to 10% of cement can be substituted in this way without reducing the mechanical characteristics of the mortar. The agricultural and industrial economies of many of the countries in the Mediterranean Basin are primarily based on olive processing and olive oil production. A huge problem that affects the environmental sustainability of the extraction operation presents the elimination of residual material such as husks and vegetation water. Regardless of the industrial operation, the disposal of industrial waste from olive oil is an environmental problem. This problem is especially acute in the larger centers producing olive oil, as at certain periods of the year, they generate more quantities of wet pomace than the plants can process. In addition, problems arise with transportation of wet pomace, which is cheaper when dry. Finally, the wet pomace must also be stored in ponds for several weeks or months.

II.4. Definition:

Green Concrete (GC): is defined as a concrete that utilize a waste material for at least one of its component. The production of GC has been increasing due to the drawback of conventional concrete that create many environmental problems. In the world the amount of waste generates from agricultural and construction industries were increasing every year. Hence, one of the solutions to reduce the impact of conventional concrete and limited landfill spaces due to excessive waste is by utilizing it in concrete. Green Concrete also has the potential to reduce environmental pollution and solve the depletion of natural sources. The result from this review shows that the addition of agricultural waste in concrete indicates positive and satisfactory strength when compared to normal concrete. **(4)**

II.5. Examples of the use of agricultural wastes in concrete:

II.5.1. Describes the waste product of sugar industries (Bagasse ash):as a cement replacement in concrete. The results indicated that bagasse ash (BA) is an effective mineral admixture and pozzolana with the original ratio of 20% cement which reduced the chloride diffusion by more than 50% without any adverse effects on other properties of the hardened concrete. **(14)**

Figure (II.2) Stages access to Bagasse ash

II.4.2. The palm oil fuel ash (POFA): Palm oil industry is one of the major agro-industries in counties like Malaysia and Thailand, and this industry produces a large amount of waste in the forms of empty fruit brunches, fibers, and kennel.**(15)**

As huge number of waste produce from this industry, the by-products then have been used as fuel to heat up boiler to generate electricity at temperature of about 800-1000˚C. The results suggested that ground POFA could be used as a pozzolanic material and could also improve the sulphate resistance of concrete.

3a:Original POFA after sieve 300µm (POFA)

3b: after initial grinding and before heat treatment (500 °C)

3c: POFA-after heat treatment (T-POFA)

3d: POFA-after heat treatment and re-grinding (U-POFA)

Figure (II.3) Stages access to palm oil fuel ash

II.4.3. Rice husk ash (RHA):a by-product that gains by incinerating the husks of rice paddy. During the milling of paddy, about 78% of weight is received as rice; broken rice and bran (see figure. 4). The rest of 22% of the weight of paddy is received as husk. The husk contains about 75% of volatile and another 25% was converted into RHA due to the firing process. Due to the excessive amount of waste generate from the mill processing has make RHA as an environmental hazard **(16).** RHA contain high amount of non-crystalline silica that can be used to partially replaced cement in concrete. The high specific surface area of RHA is accountable to its high pozzolanic activities he high reactivity silica content depends on the burning temperature, it is reported that 95% of silica could be produce after heating at 700˚C.

Figure 4Stages access to rice husk ash.

II.4.4. Corn cob ash (CCA):utilized CCA as a pozzolanic material for cement production. Factory production of the CCA blended cement was carried out by replacing ordinary Portland cement clinker with CCA. The developed blended cement in this study investigated the effects of BA content as partial replacement of cement on physical and mechanical properties of hardened concrete .The properties of concrete investigated include compressive strength, splitting tensile strength ,water absorption, permeability characteristic, chloride diffusion and resistance to chloride ion penetration. The test results indicate that BA is an effective mineral admixture, with 20% as optimal replacement ratio of cement. **(16)**

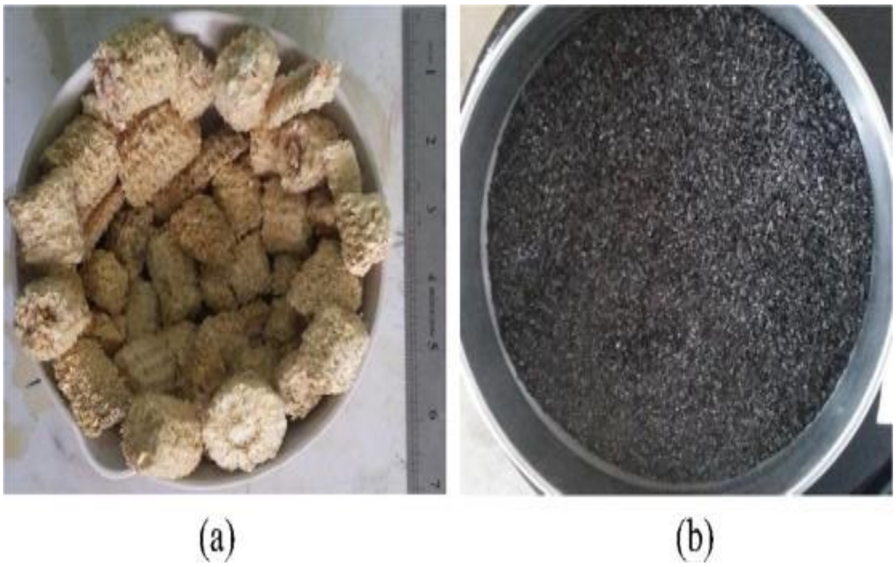


Figure (II.5)Stages access to corn cob ash.

II.5. Applications of Agro-Waste Materials in Concrete:

The form of application of agro-wastes in concrete is roughly divided into two parts:

- Without chemical process, usually after physical treatment, such as chopping, cutting, and levitation. These materials are added into concrete in order to partially replace the cement, without variation or deceasing the performance of concrete, through applying agro-wastes.

- Through chemical combustion, where the burned agro-wastes constitute some of the conglutinant substances that could be exploited and partially displace the function of cement. So far, agro-waste admixtures have successfully been applied in Portland cement either with concretes, mortars, or pastes as the supplementary cementitious materials.

II.5.1. Agro-Wastes Ash as an Active Pozzolans for Cement:

Alkaline activated material (AAM), as a kind of binder, is one of latest directions in constructing building materials and structures. From sugar cane straw ash (SCSA) as a solid precursor and alkali-activated binder bases on blast furnace slag (BES), studies have revealed SCSA as an efficient alkaline activated material (AAM) that also served as a silicon source in AAM. **(18)** Bamboo leaf ash (BLA), RHA, and SCBA, obtained by burning the biomass, are known to have an amorphous nature with high silica, and show a high pozzolanic reaction when used as binder to produce concrete. **(19)** In a thorough study, it was found that the pozzolanic nature of SCBA and RHA refines the pore structure in mortar and concrete, which significantly reduces permeability against water, sulfate, and chloride penetration. **(20)** Bagasse ash has also been recommended widely as a pozzolanic material in many studies.

II.5.2. Asphalt Concrete Mixture with Agro-Wastes as Filler:

Environmentally friendly policies encourage increasing the utilization of agro-wastes materials based on their unique performance. Using waste powder, such as bag house fines, municipal solid waste incineration ash, or waste ceramic materials, as mineral filler in mixed asphalt concrete has been studied by several researchers. The development and consumption of waste as supplementary cementitious materials were studied at-large, as the generation of agro-wastes is extremely prevalent in many parts of world. Biomass ashes are suggested as a sustainable replacement to low-cost construction materials, which can also be used as mineral filler in asphalt mixtures. **(21)**

Rice husk ash (RHA) has been evaluated as a filler in hot mix asphalt (HMA) concrete. The results showed that RHA can replace conventional mineral filler, in turn minimizing the numerous wastes from agriculture. Furthermore, two types of biomass ashes, date seed ash (DSA) and RHA, were mixed to replace conventional filler with DSA and RHA fillers. The results suggest that 100% DSA could be regarded as the optimal percentage, and hot mix asphalt (HMA) mixtures with a 75% RHA substitution demonstrated a suitable performance. Overall, the Marshall Stability, stiffness, and rutting performance of asphalt mixtures were enhanced under the application of RHA and DSA. Furthermore, compared with the control mixture, HMA incorporated with RHA and DSA exhibited a particularly improved fatigue resistance, which means that the fatigue life of the resulting concrete will be longer with agro-wastes. **(22)** While comparing 2% cement as conventional filler when preparing asphalt, the different proportions of RHA (2% to 4%) as alternative filler were found to be better than mineral filler by lowering the optimum bitumen amount in an asphalt concrete mix. **(23)**

II.5.3. Application of Agricultural Residues on Building Insulation:

The process of agricultural production leaves behind plenty of residues, which cause disposal problems. However, such bio-based wastes have the natural advantage of having hygrothermal properties, namely thermal and hygric properties, in order to maintain the performance of buildings as insulation materials. They create a breathable wall in construction and also reduce the risk of moisture build-up and the resulting microbial growth. Some research has demonstrated that hemp, straw, and olive residues mixed with concrete have shown excellent thermal insulation properties. The excellent thermal insulation properties of hemp have been reported in many studies. Concrete with a bio-composite of hemp and lime has not only shown good thermal insulation properties and an acceptable mechanical resistance performance, but has also been found to be lighter than common concrete. **(24)** Straw–concrete has also been studied in a mixture of binders of lime with gypsum plaster. The use of olive stone as an additive in cement lime mortar has also widely been investigated for improving thermal insulation. It was observed that amending 70% olive stone resulted in a decrease in the mortar thermal conductance by 76%. **(25)** Concrete containing 10% and 20% of cork was found to lower the thermal conductivity of concrete by approximately 16% and 30%, respectively. With increasing the cork dosage (10–80%) in mortars, a decrease in thermal conductivity was presented by other researchers. **(26)** The addition of barley straw was shown to improve the thermo physical properties of sand concrete by reducing the thermal conductivity and diffusivity by 5.71% and 21.97%, respectively. **(27)**

II.6. The Improved Mechanical Properties of Mixed Agro-Wastes in Concrete:

II.6.1. The Effect of Agro-Wastes on Strength:

Abundant agriculture wastes create advantages for their potential as replacement materials in the construction industry, especially in countries producing a large quantity of agricultural raw materials. For example; coconut shell (CS) has promising application as a coarse aggregate in concrete production, especially in areas where crushed stones are expensive. Coconut shell has widely been used in concrete to study plastic shrinkage and deflection characteristics, using five mixtures with different coconut shell aggregates (CSA), namely, S1 (100% CS), S2 (75% CS and 25% CSA), S3 (50% CS, 50% CSA), S4 (25% CS and 75%

CSA), and S5 (100% CSA) .**(28)** As it turns out, from the summary of cracks and the deflection test, coconut shell played a vital role in reducing plastic shrinkage cracks in the concrete. The mixture with S5m where aggregate was totally replaced by coconut shell aggregate (CSA) in the mortars, achieved the highest compressive strength. Researchers found out that a 20% replacement of industrial ash (sugar cane ashes) and laboratory ash blended with ordinary Portland cement (OPC) could meet the standard of common cement. **(29)** For 20% bio-ash blended cement mortars, the compressive strength was reduced by up to 5.1% with regard to the OPC mortar; however, it complied with the standardized mechanical requirements.

In another study, although compared with OPC, the compressive strength decreased slightly; 25% substituted palm oil clinker (POC) as a coarse aggregate incorporated into the concrete resulted in the best result in terms of compressive strength (6.72 MPa versus control 10 MPa) compared with the other replacements. Meanwhile, the results indicated that POC as a coarse aggregate was not fit for application in construction. **(30)** Similar results were also found by another group of researchers. Rice husk ash (RHA) as a mineral filler mixed into asphalt concrete revealed an almost 10% higher tensile strength compared with that of OPC. **(31)**

In one recent study, the replacement of cement by 7.5% RHA and other Earth materials increased the compressive strength of concrete. **(32)** With this replacement, at 28 days, the compressive strength was 4.1% higher than the concrete containing 100% cement (control).Agro-waste can accelerate C-S-H formation through an effective pozzolanic reaction. Furthermore, the extracted micro-silica (EMS) from RHA as a substituent of cement, by 5% and 15%, was shown to improve the high-density C-S-H phases, resulting in incremental improvements in compressive strength and ultimately a high-performance sustainable cement mortar.**(33)** The EMS with a replacement percentage of 5% and 15% improved the compressive strength of the mortars by 64.2% and 51.6%, respectively, and further increased the flexural strength by 46.8%, and 24%, respectively. The studies suggest that the majority of agro-wastes with incineration processing could serve as fillers in concrete, resulting in sufficient engineering properties in the resulting concrete. Although the increasing content of agro-residues deceased the compressive strength, by contrast, the flexural strength had significant improvements. **(34)** Palm oil fuel ash, one of pozzolanic by-products in the development of oil palm shell geopolymer concrete (OPSGC) was investigated, and resulted in higher values of flexural and splitting tensile strength concrete compared with normal weight geopolymer concrete. **(35)** Indeed, ternary blended-cement-RHA-SCBA was presented as a high-performance concrete, where RHA played a major role in improving compressive strength, owning to its higher pozzolanic activity. **(36)** The concrete obtained using coconut shell aggregates showed a better response in the pulse velocity with a high strength, and was concluded to be a concrete with a long-term performance. **(37)** All of these studies implied the potential structural application of agro-residues, and simultaneously reduced agricultural waste disposal in the environment.

II.6.2. Permeability and Other Durable Parameters:

Chloride–ion penetration resistance reflects the resistance of the permeable capability, often used in the evaluation of the electrical conductance of partially replaced cementitious materials. The performance of various agro-waste ashes, including rice husk ash and palm oil fuel ash, among others, was evaluated in concrete, and most of the results showed a profound effect from these pozzolanic materials for improving the durability of the resulting concrete by lowering the chloride ion permeability. **(38)** Other durability parameters involving some agricultural wastes in cement, such as freezing and thawing resistance, chemical attack, setting time (including initial and final), carbonation, water absorption, and expansion tests, were also researched. The expansion percentage also reflects that cement or cement with mixtures under the condition of a sulfate solution or acid solution show a matrix volume shift. Because of the intrinsic characteristics of agro-wastes, research states that a higher replacement of agricultural wastes could increase the ratio of water/binder, thus the blended cement has a lower resistance when attacking sulfate or chloride. **(39)** However, adding fine agro-wastes through grinding into cement has been confirmed to have a better ability to resist CO2 ingression. **(40)** The presence of additional silica particles provided by agro-cement can accelerate the pozzolanic reaction and create a consolidated cement matrix that can resist the attack of supercritical CO2. The capability of freeze–thaw resistance indicates part of the concrete durability. Investigations have indicated that more fine particles of agro-residues add more improvement to the freezing and thawing counteractive ability. **(41)**

Some of the significant parameters are listed below:

II.6.2.1 Chemical Attack:

The ability of concrete to resist diverse aggressive environments is a key durability issue that influences the performance of concrete structures, especially attacking from ambient sulfate and acid, which form a chemical attack. The porous structure of concrete allows for the acid substance to enter, in conjunction with the hydrated product, e.g., Ca (OH) 2 and C–S–H, and form gypsum and ettringite, which expand in their natural state and eventually lead to the deterioration of the concrete surface. Generally, once the cement matrix with an alkaline nature encounters an HCl acid attack, the progressive neutralization develops soluble CaCl2 salt and water. Accordingly, the mechanism is exhibited as follows in Equations (1) and (2): **(42)**

$$Ca(OH)_2 + 2HCl \rightarrow CaCl_2 + 2H_2O \quad (1)$$

$$C–S–H + HCl \rightarrow CaCl_2 + Si(OH)_4 + H_2O \quad (2)$$

Hence, it is necessary to study the acid and sulfuric acid resistance of concrete. One study exploited an impressed voltage for off-white rice husk ash-cement in an accelerated corrosion test that provided the value information of the permeation characteristics of the concrete. **(43)** The tests indicated that 15% replacement with cement had the optimum resistivity for preventing erosion. An investigation on a recycled concrete aggregate found that it is more susceptible to get damaged with acid and sulfate attack compared with a normal aggregate, because of its higher porosity. However, after being modified and replaced with rice husk ash (RHA), palm oil fuel ash (POFA), and palm oil clinker powder (POCP), there was nearly 30% minimal concrete deterioration under a hydrochloric acid (HCl) and magnesium sulfate ($MgSO_4$) solution. **(42)** It has been confirmed by research that cement mortars containing black rice husk ash (BRHA) can improve resistance to sodium sulfate attack, and can also impair resistance to magnesium sulfate attack. **(44)** In general, replacing 20% cement by BRHA leads to the successive reduction in the corrosion of concrete under both HCl and H_2SO_4 attack. In addition, sulfate ions can react with other calcium compounds in a cement matrix, which leads to more permeation and easy corrosion in concrete. **(45)** In a rapid chloride permeability test (RCPT), because of the fineness and rate of reactivity of sugarcane bagasse ash (SCRHA) in concrete, agro-cement enhanced the resistance of chloride penetration in concrete at concentration up to 25% SCRHA. **(46)** It was also found that the reaction of SCRHA with free lime in Portland cement produced an additional C–S–H gel. **(47)** Apart from simply using biomass wastes from agriculture, mixing this with waste polypropylene carpet fibers has the advantage of being very lightweight, having superior resistance to sulfate and acid attacks, and possessing a hydrophobic nature from the carpet fibers, in addition to facilitating in disposal of textile and carpet industrial waste.

II.6.2.2. Water Absorption:

The susceptibility of concrete to the penetration of water depends on capillary suction, which affects the performance of structures. The partial replacement of cement with various percentages and types of agro-waste ash has shown their effectiveness in reducing water absorption of concrete. **(48)** The partial replacement of cement with various percentages and types of agro-waste ash has shown their effectiveness in reducing water absorption of concrete. Off-white rice husk ash (OWRHA), with 15% replacement by weight, showed a reduction in the coefficient of water absorption for the OWRHA blended concrete compared with the 0% benchmark concrete. **(43)** When basic oxygen furnace slag (BOFs) and RHA were utilized in the partial replacement of cement, water absorption increased considerably. However, high substitution-rate composite cement mortar with RHA and BOFs showed an adverse performance in terms of water absorption with a replacement of more than 60% by the weight of the binder. **(49)** The mortars containing extracted micro-silica (EMS) from RHA at a replacement percentage with cement of 5% and 15% were found to have a lower porosity by 6.3% and 5.1%, respectively, at 14 days, while they were 5.4% and 3.1% lower than that of the control mortars, respectively, at 28 days . **(34)** The effects of polypropylene fibers and rubber particles on the mechanical properties of a cement composite with rice husk ash resulted in lower water absorption values due to the rice husk ash being finer than the cement. **(50)** In another study, concrete made with 10% RHA achieved the minimum water absorption in a chemical process supplemented with microbial calcite precipitation. **(51)** Furthermore, RHA blended with metakaolin was also used in concrete, which showed slightly reduced water absorption compared with only OPC or RHA, because of the production of an additional calcium silicate hydrate (C–S–H) gel. **(44)** With the addition of an extra super plasticizer, RHA was effective in reducing the water absorption of concrete, even at a high amount. The micro filler effect and additional C–S–H products filling the pores lead to a reduced volume of large pores, and the water binder ratio caused decreasing water absorption in such cases. **(52)**

II.6.2.3 Setting Time (Initial and Final Setting Time):

The curing time of the concrete in the partial replacement of Portland cement Type I with palm oil fuel ash (POFA) was investigated. The results revealed that both the initial and final setting time increased with the addition of POFA in addition, the results also depended on the fineness and degree of replacement of POFA. **(53)** Furthermore, large particles with a high porosity of non-combusted palm fiber increased the water-to-binder ratio of concrete, thus leading to high setting times. Other researches obtained a similar behavior with longer setting times of POFA concrete through using other pozzolans, like fly ash and sawdust ash. The hydration of the cement setting time is usually slower than the pozzolanic reaction between pozzolan and calcium hydroxide. The setting time also increased when the cement was partially replaced with other agro-wastes, including sawdust ash (SDA) and sugarcane bagasse ash (BA). The initial setting time of the cement with SDA (10–30%) increased and ranged from 1 h 30 min to 2 h 05 min compared with 1 h 26 min for the only cement paste, while the final setting times were 3 h 56 min to 4 h 20 min, and 3 h 35 min, respectively.(54)By replacing the cement with 20% SCBA, the initial and final setting times of the cement increased by 7 and 24 min, respectively, compared with the cement paste. (47)

II.7. Interaction between Agro-Cement and Cement Matrix:

Agricultural wastes as agro-cement have a pozzolanic property that helps improve the mechanical properties of concrete. The lignin and cellulose present in agro-cement can be converted to silica and can provide pozzolanic reactions. When agro-cement is mixed with Portland cement, it reacts with lime and decreases the amount of lime required; however, it increases the amount of C-S-H gel, thereby improving the cement quality. The fine agro-cement particles have been shown to reduce the porosity and density of the cement matrix during chemical reactions between, which increased the compressive strength of the resulting structure. Agro-cement could give rise to an increasing number of nucleation sites in the cement matrix and cause additional C-S-H gel formation. It helps produce strong bonds inside the matrix that increases the compressive strength of concrete. In brief, the increased C-S-H formation during the reaction between agro-cement and Portland cement continuously fills more pores (microfiling) with hydration, and forms a denser structure in the cement matrix. (55) The partial replacement of cement with agro-cement, allows for a slow but long-term increment in the durability of concrete, due to the pozzolanic reaction. Further, the mesoporous nature of agro-cement particles results in a reduction of the effective water–binder ratio in the cementitious matrix, which ultimately improves the compressive strength of concrete.(56) As agro-cement contains a high amount of silica, it enhances the potential in the cement matrix to react with water molecules to form Ca (OH) 2, which can improve the concrete strength. Additionally, another reaction product of same reaction, calcium silicate hydrate (3CaO · 2SiO2 · 3H2O), formed around sand particles, influences the pore size distribution of the matrix. (55) The agro-cement containing fine particles of SiO2 improves the porous structure of concrete, because these particles become uniformly distributed in the cement–aggregate matrix. (57)

II.8. Olive waste:

II.8.1. Olive waste In Palestine:

there is many types of wastes are also still dumped in the common regions without any restrictions or limitations due to absence of an environmental law, which leads to resources being exposed to pollution and problems of extinction. One of these wastes is olive oil waste either solid (Husk or Ash).This type of waste is available in large quantities in Palestine due to the high dependency of people on agriculture, especially olive trees planted in many Palestinian cities (districts) and villages. Palestinian areas are characterized by dense local agricultural and industrial products especially in villages and towns. Since the Palestinian areas and the Middle East, in general, depend on agricultural side on the olive oil products which in-turn generates from these agricultural products. High amount of waste requires relatively high cost in processing for environmental protection. Owners of olive trees will not benefit from these wastes produced from olive oil. This will result in disposing wastes in the common and residential areas which may cause pollution for both human health and the environment. Olive wastes consist of solid wastes (Husk). The industrialization of agriculture is accompanied by an increase in production of organic wastes. Disposing olive wastes as Husk, oil sludge, causes environmental and health problems as pollution, bad odors, spread of diseases to the neighboring regions, etc. **(58)**

II.8.2. Olive wastes in Algeria:

It is one of the country's most famous in the southern Mediterranean region in the field of olive cultivation, as thousands of hectares of its agricultural lands are devoted to the cultivation of olive trees (1.68 million hectares). If we exclude the countries of the European Union and the Republic of Tunisia, Algeria will become one of the leading countries in the olive oil sector. In fact, Algeria is currently making major efforts to restructure and modernize this sector in order to improve the quality of olive oil and increase the area allocated for the cultivation of olive trees. **(59)**

Figure (II.6)the olive waste**.**

II.8.3. Components of olives:

The olive itself consists of pulp (75-85% weight), nut (13-23% weight) and seed (2-3% weight). The chemical composition of the olive is shown in Table is the characteristic of by-product of olive-oil production. **(60)**

Table (II. 1) Chemical composition of Olives.

Constituents	Pulp	Nut (stone)	Seed
Water	50-60	9.3	30
Oil	15-30	0.7	27.3
Constituents	2-5	3.4	10.2
Containing	3-7.5	41	26.6
Nitrogen	3-6	38	1.9
Suger	1-2	4.1	1.5
Cellulose	2-2.25	0.1	0.5-1
Minerals	-	3.4	2.4
Polyphenol			
Value in percent by weight (%)			

II.8.4. Effects of Olive waste on Environment:

The agricultural and industrial economies of many of the countries in the Mediterranean Basin are primarily based on olive processing and olive oil production. A huge problem that affects the environmental sustainability of the extraction operation presents the elimination of residual material such as husks and vegetation water. Regardless of the industrial operation, the disposal of industrial waste from olive oil is an environmental problem. This problem is especially acute in the larger centers producing olive oil, as at certain periods of the year, they generate more quantities of wet pomace than the plants can process. In addition, problems arise with transportation of wet pomace, which is cheaper when dry. Finally, the wet pomace must also be stored in ponds for several weeks or months. As shown, large amounts of this waste are generated annually, but without any use (consumption for useful purposes), efforts need to be made to find simple and economical methods to use as an alternative to disposing of this waste in traditional ways. **(61)**

II.8.5. Olive waste ash (OWA):

Olive waste ash (OWA) or “olive fly ash” as it is called in some previous studies, is produced by burning the waste from olive mills at high temperatures over a long period. This material can be used in the building industry as one of the components of concrete, as a cement filler or cement replacement. As more cement is replaced with OWA, the compressive strength and flexural strength of the concert decreases. The setting time and workability of the concert also decrease with an increase in OWA content, but when OWA is used as a partial substitution for sand, the mechanical properties of the concert improve with an increase in its content.

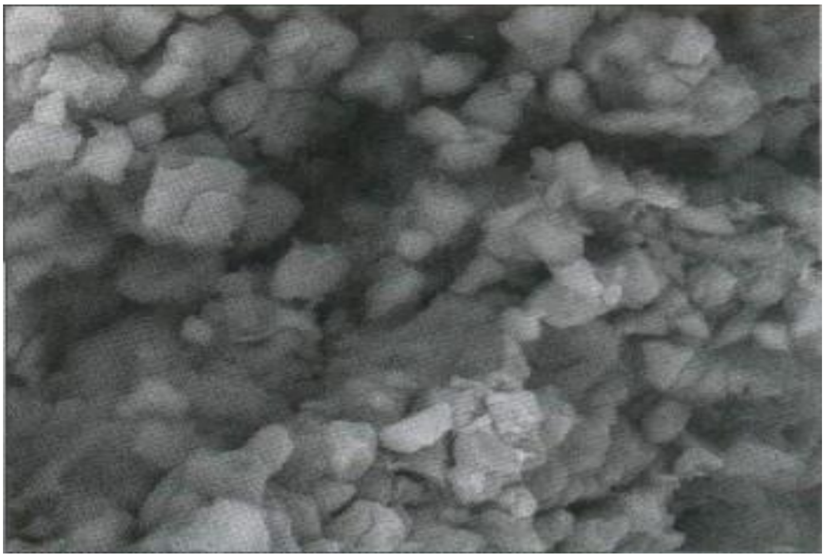


Figure (II.7) Scanning electronmicrograph of OWAparticles.

II.8.6. How to prepare (OWA):

The OWA was obtained by incinerating Carpe amounts (80 kg) of olive waste in an oven at a temperature of 800“C for a period of 8 h.

Figure (II.8) olive waste ash.

II.9. Summary:

In this chapter, we learned about agricultural waste in general, and we learned about the definition of green concrete, and we learned about the properties of Agro-Waste, which is one of its most important properties that provided its presence in nature and its continuous renewal. As a result of human dependence on agriculture to provide the basic requirements of life, and then we learned examples of the use of these wastes in concrete and their use replacement of cement. We took, for example, PA, POFA, RHA and CAA, and saw how to turn them into ash. This study was based on previous studies conducted by researchers.

Then we learned about The Improved Mechanical Properties of Mixed Agro-Wastes in Concrete, then we got acquainted with the main part of our topic which is air and olive waste, where we got to know and evaluate it on the environment and olive components Generally.

Chapter III

Characterization of materials

III.1.Introducton:

In this chapter we present the different stages which made it possible to formulate these composites by going through the characterization of the materials used, as well as the tests carried out on concrete in the fresh state.

III.2 The materials used:

III.2.1. Cement:

The cement chosen in this study is of the CEM II 42.5 (Awted) type produced by the Laghout plant in Algeria. The chemical and mineralogical characteristics of this cement are presented in the Table.

Table III.1 The characteristics physical and chemical of cement

Characteristics	Standard	Rusalt	Unit
SiO_2	NA 5042	21.28	%
Al_2O_3		4.19	%
Fe_2O_3		5.18	%
CaO		63.35	%
K_2O		0.27	%
Na_2O		0.06	%
Na_2O- Epu		0.24	%
Pert au feu	NA 5042	2.03	%
MgO		1.29	%
SO_3	NA 5042	1.97	%
Chloure	NA 5042	0.010	%
SSB	NA 231	3039	cm^2/g
IST	NA 230	245	Min
FST		410	Min
Expansion		0.00	Min
C3A		2	%

Table III.2 Mechanical characteristics on standardized mortar.

Characteristics	Standard	Rusalt	Standard	Unit
2 days	NA234	15.90	≥10	MPa
7 days		32.20	/	
28 days		49.80	≥42.5-≤62.5	

III.2.2.Gravel:

The gravel used is crushed gravel composed of two granular classes: class 3/8 and class 8/15. The two gravel from the GHARDAIA quarry We have found it useful to favor the quantity of class 3/8 over that of class 8/15 to avoid any risk of blockage and segregation.

III.2.3.The Sand:

The sand used comes from the region of LAGHOUT. The size of these aggregates is between 0 and 5 mm. The grain size curve of the sand used is given in figure. The properties of the sand are shown in the table below:

Figure III.1 the sand used

III.2.4.Ajouts cimentaire:

The olive waste ash used from the press in the Ghardaia the chemical characteristics of OWA are presented in table.

Table III.3 The chemical compound the OWA

Chemical compound	The olive waste
Loss(pert to the fire)	63.27
SiO_2	9.25
CaO	9.31
MgO	0.97
Fe_2O_3	0.84
Al_2O_3	1.88

III.2.5.Superplasticizers:

In this study, the superplasticizer used is SikaViscoCrete Tempo12 it is designed based on polycarboxylates which considerably improves the properties of concrete:

III.2.6. Mixing water:

The water used for making the mixture is laboratory tap water free from impurities.

III.3 Characteristics of the materials used:

III.3.1.Tests of Aggregates (sand and gravel):

III.3.1.1. the sieve analysis NF P94-056(Mars 96):

- **Definitions:**

Particle size analysis is the identification of soil particles of very different size from a granulometric point of view. It therefore makes it possible to determine the percentages of the grains according to their diameters. It is obtained by two successive operations which are as follows:

- Sieving for grains greater than 0.08mm.
- Sedimentation for particles smaller than 0.08mm, of which the passers at 0.08mm are more than 20%.

- **REFUSAL:** the amount of material that remained on the sieve.

- **TAMISAT**: the amount of material that passes through the sieve.

- **Cumulative refusal**: It is the sum of all the refusals, that of the sieve itself plus all the refusals of the larger mesh sieves. It can be expressed in grams or in% of cumulative refusals

- **Principale of the test:**

The test consists in dividing, by means of a series of sieves, a material into several granular classes of decreasing size. The mesh dimensions and the number of sieves are chosen according to the nature of the sample and the expected precision. The masses of the various rejects or those of the various sieves are related to the initial mass of material, the percentages thus obtained are used, either in their numerical form, or in a graphic form (grain size curve).

Figure III.2SieveSeries

- **Dimensions of the sieves used:**
- ➢ For the Gravel 3/8 we used the sieves : (10 ; 8 ; 6.3 ; 5 ; 4 ; 3.15 ; 2.5 ;2)
- ➢ For the Gravel 8/15 we used the sieves : (20 ;16 ; 12.5 ; 10 ; 8 ; 6.3 ; 5 ;4)
- **Expression of results:**

The results of the analysis are presented in the tables:

Table III.4 Sieve analysis of fin aggregate.

the weight (g)	**Sieve size (mm)**	**Wight retained (g)**	**Cumulative Wight retained (g)**	**Cumulative Wight retained% (g)**	**Cumulative Wight passing %**
1200g	10	3	3	0.25	99.75
	8	18	21	1.75	98.25
	6.3	24.8	45.8	3.81	96.19
	5	23.7	69.5	9.79	94.21
	2.5	29.3	148.8	12.4	87.6
	1.25	69.7	218.5	18.20	81.8
	0.63	105	323.5	26.95	73.05
	0.315	574.3	897.8	74.81	25.19
	0.160	246	1143.8	95.31	4.69
	0.080	41.5	1185.3	98.77	1.23

Table III.5 Sieve analysis of a Gravel 3/8.

The Wight	Sieve size (mm)	Wight retained (g)	Cumulative Wight retained (g)	Cumulative Wight retained%	Cumulative Wight passing %
3200g	10	5	5	0.15	99.85
	8	6	11	0.34	99.66
	6.3	612	623	19.46	80.54
	5	955	1578	49.31	50.69
	4	752	2330	72.81	27.19
	3.15	296	2626	82.06	17.94
	2.5	362	2988	93.37	6.63
	2	209	3197	99.90	0.1

Table III.6 Sieve analysis of Gravel 8/15.

The Wight	Sieve size	Wight retained	Cumulative Wight retained %	Cumulative Wight retained %	Cumulative Wight passing %
2500g	20	0	0	0	100
	16	258	258	10.32	89.68
	12.5	357.429	615.429	24.61	75.39
	10	1022	1637. 429	65.49	34.51
	8	738	2375. 429	95.01	4.99
	6.3	114	2489.429	99.57	0.43
	5	6	2495.429	99.81	0.19
	4	3	2498.429	99.93	0.07

III.3.1.2. Determination of Fineness Modulus of Sand (NFP 18 540):

To determine the fineness modulus, we need standard sieves.

- **Test procedure – Fineness Modulus of Sand:**

Take the sieves and arrange them in descending order with the largest sieve on top. If mechanical Balanceis using then put the ordered sieves in position and pours the sample in the top sieve and then closes it with sieve plate. Then switch on the machine and shaking of sieves should be done at least 5 minutes.

After sieving, record the sample weights retained on each sieve. Then find the cumulative weight retained. Finally determine the cumulative percentage retained on each sieves. Add the all cumulative percentage values and divide with 100 then we will get the value of fineness modulus.

MF = (cumulative % retained) / 100 =

(5.79+12.4+18.20+26.95+74.81+95.31)/100= 2.33

Mf=2.3 we are in the presence of preferential sand.

III.3.1.3.the apparent density (the bulk density) NF P18 554

- **Definitions :**

The apparent density of a material is the density of one cubic meter of the material taken in a pile, comprising both permeable and impermeable voids of the particle as well as voids between particles. The apparent density of a material may have a different value depending on whether it is determined from a compacted or non-compacted material. It is therefore necessary to specify: apparent density in the compacted state or apparent density in the uncompacted state.

- **Principale of the test:**

It suffices to fill a container, the volume of which is known, take great precaution to avoid any parasitic phenomena that the settlement could cause, in fact too much or too little settlement would give an erroneous result. To limit this risk of errors, the test will be carried out on several weighing, with which an average will be made. The sample is then weighed, taking care to deduce the mass of the container. Finally, the mass of the sample is divided by the volume of the container. The final result therefore gives us the value of the apparent density of the material.

- **Equipment use:**

- Mechanical scale.
- Container.

- Sand 8/15 3/8 .

- **Operating mode:**

The method consists of filling a container and weighing the corresponding sand we weigh the mass of the empty container, denoted M0.

Fill the container with dry sand prepared by the laboratory. The sand is leveled with the leveling base the container filled with sand is weighed; we will repeat this operation three times.

- **Expression of results:**

We calculate ρ ' :

$\rho' = M / V$ (g /cm²), and : $M = Mt - M0$

The results of the sand are presented in the table :

Table III. 7 The results of apparent density the sand.

	The Sand			
M0	3797.6	3797.6	3797.6	3797.6
Mt	11958.1	12065	12077.4	11896.3
M=M0 –Mt	8160.5	8267.4	8279.8	8098.7
V	2000	2000	2000	2000
ρ'	4.080	4.133	4.139	4.04
ρ'/4	4.098			

The results of gravel are presented in the tables:

Table III.8 the results of apparent density the Gravel.

	Gravel 8/15			**Gravel 3/8**		
M0	3797.6	3797.6	3797.6	3797.6	3797.6	3797.6
Mt	10272.7	10380	10278.4	7101.7	7038.8	7055.7
M=M0 –Mt	6475.1	6582.4	6480.8	3304.1	3241.2	3258.1
V	2000	2000	2000	2000	2000	2000
ρ'	3.237	3.291	3.240	1.652	1.620	1.629
ρ'/3	3.256			1.633		

III.3.1.4.Specific gravity of aggregate (NF P18 555):

- **Definition:**

Is the mass of the unit volume of the fully compacted substance (without pores).

- **Principale:**

It consists in determining the absolute mass of gravel and sand on the basis of which and the density we can calculate the porosity and compactness of these materials.

- **Operating mode:** (Balloon method)

This method of determining densities is more precise provided that a certain number of precautions.

• Determine with precision the mass m1 of the flask filled with water.

• Determine with precision the mass m2 of a sample of dry material.

• Introduce all of the material into the flask, fill with water.

• Check that there are no air bubbles.

- Expression of results:

The results are presented in the tables:

For example:

P1: weight the aggregate P1= 599.4g

The weight of a full bowl of water P2=2183g

P3= P1+P2= 599.4+2183=2782.4g

P4= the weight of the bowl + aggregates + water=2551.6g

Volume the aggregates V=P3-P4=2782.4-2551.6=230.8cm

Specific gravity P1/V=599.4/230.8=2.59 (g /cm)

Table III.9 the results of Specific gravity of aggregate.

Typeof aggregate	P1(g)	V (cm)	ρ'(g /cm)	ρ'/3 (g/cm)
Sand	599.4	230.8	2.59	2.52
	701.1	269.3	2.36	
	406.7	153.6	2.64	
Gravel 8/15	688.5	259.2	2.65	2.51
	538.3	203.5	2.64	
	414.6	184.8	2.24	
Gravel 3/8	288.3	399.6	0.72	2.86
	510.8	409.2	1.24	
	40.5	449.4	0.90	

III.3.1.5. The sand equivalent test (NF EN 933-8 Mars 2012)

- **Definitions :**

The sand equivalent test commonly used to evaluate the cleanliness of the sands used in the composition of concrete is also used for soils, but its importance is less, the most significant parameter being value of the soil. This test consists in separating the fine particles contained in the soil from the coarser sandy elements. A standard procedure helps to determine a sand equivalent coefficient which quantifies the cleanliness of that.

- **Principal of the test:**

The test is carried out on the 0/5 mm fraction of the sand to be studied. The sample is washed, according to a standard procedure, and allowed to stand. After 20 minutes, the following elements are measured:

- Height h1: clean sand + fine elements,
- Height h2: clean sand only.

We deduce the equivalent of sand which is equal to:

- E S (equivalent to sand, short) measure with the piston.
- E S V (visual sand equivalent) measured at sight.

Table III.10 Recommended value for the equivalent Sand

ES	ESV	Nature and quality of sand
ES < 65	**ES < 60**	Clayey sand: risk of shrinkage or swelling to reject for quality concrete.
65 ≤ ES < 75	**60 ≤ ES < 70**	Slightly clayey sand of acceptable cleanliness for concrete of current quality when shrinkage is not particularly feared.
75 ≤ ES < 85	**70 ≤ ES < 80**	Clean sand with a low percentage of fine argillaceous material, suitable for high quality concrete (optimum value ES piston = 75; ES at sight = 80).
ES ≤ 85	**ES ≥ 80**	Very clean sand: the almost total absence of fine clayey materials risks causing a lack of plasticity in the concrete, which must be remedied by increasing the water dosage.

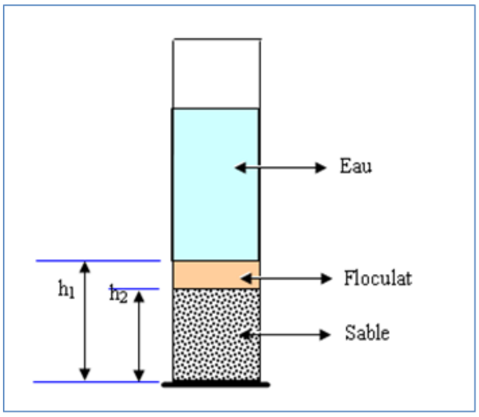
- **Materials used:**

- Sand.
- Agitator machine.
- Tarred piston.
- Burette.
- Washing solution.

Fingure(III.3) The sand equivalent test.

- Operating Mode

1) Fill a test tube with the washing solution up to the lower mark.
2) sand into the test tube using the funnel.
3) Give the test tube a few gentle shakes in order to remove the few remaining air bubbles and the solution + sand mixture is left to stand for 10 minutes.
4) At the end of the 10 minutes the test tube is placed on the stirrer and the 90 cycles are carried out in 30 seconds.
5) After removing the stopper, the walls of the test tube are rinsed with the washing solution and the washing tube is pushed to the bottom of the test tube to bring up the clay elements.
6) Let the tap run so that the solution reaches the upper mark, and leave to stand for 20 minutes.
7) Measure h1 and h'2 using a ruler.
8) Lower the tare piston until it rests on the sediment.
9) Read h2.



FiugerIII.4 the heights of water, sand

- **Expression of results:**

According to standard EN 933_8, this parameter retained in the classification and to distinguish between soils which are little by little clayey, the results obtained are presented in the following table.

Table III. 11 the result of equivalent sand test

The sample	**Test N °1**	**Test N°2**
Total height H1(cm)	11.5	11.3
Height the sand H2(cm)	7.1	7.2
ES=$\frac{\boldsymbol{H2}}{\boldsymbol{H1}} \times \mathbf{100}$	61.73	63.71
ESAverage(%)	62.72	

III.3.1.6. Los Angeles abrasion test (N.F. P18.573)

- **Definition:**

Abrasion test is carried out to test the hardness property of aggregates. The principle of Los Angeles abrasion test is to find the percentage wear due to relative rubbing action between the aggregate and steel balls used as abrasive charge.

- **Principle of the test**

It consists in measuring the quantity of elements smaller than 1.6 mm produced by subjecting the material to the impact of balls and reciprocal friction of the Los Angeles machine.

If M is the mass of the material tested and m is the mass of the elements smaller than 1.6 mm produced during the test, the resistance to impact fragmentation is expressed by the coefficient Los Angeles LA:**LA=**$\frac{\boldsymbol{m}}{\boldsymbol{M}} \times \mathbf{100}$

M: the mass of the material tested.

M: the mass of the elements smaller.

- Materials used:
  - Balance.
  - Sieves.
  - Los Angeles Testing Machine.
  - Abrasive Charges.

Figure (III.5)Los Angeles abrasion test

- **Operating mode:**

Placement of the sample in the machine as well as the load balls relating to the selected granular class. Replace the cover and tighten the mounting bolts. Starting the test by having the machine carried out 500 rotations at a regular speed between 30 and 35 rpm for all classes except 25-50 class mm where the number of rotations is 1000. Remove the aggregate after testing. Collect the aggregate in astray placed under the appliance, taking care to bring the opening just above this bin, in order to avoid losses of aggregate.Sieve the material in the tank over the 1.6 mm sieve.

- **Expression of results:**

Calculation the (LA) for gravel l8/15:

- LA= $\frac{5000-3852.9}{5000} \times 100 = 23\%$

Calculation the (LA) for gravel l3/8:

- LA= $\frac{5000-3822.4}{5000} \times 100 = 23.6\%$

TableIII.12 Coefficient classification for LA

Los Angeles coefficient	Appreciation
< 15	very good
15 to 25	good to medium
25 to 40	medium to low

- ✓ for our sample is good to medium

III.4 concrete tests:

III.4.1 Introduction:

SCC must have great fluidity and be able to flow without external energy input (vibration) through confined areas (reinforcements and formwork). They must therefore offer good resistance to “dynamic” segregation (in the casting phase), but also to “static” segregation (once in place), in order to guarantee the homogeneity of their characteristics, and not to present any penetrant or settling and to guarantee optimal filling of the formwork. Three main tests are used to characterize and control the rheology of SCC and their properties in the fresh state it is:

- Slump flow test.
- Lox test.
- Sieve sterility.

The purpose of this part is, first of all, to develop the formulation stages and making different concretes. Then, to focus on concrete tests, allowing thus characterizes their physical and mechanical performance and assess the behavior of SCC compared to traditional vibrated concrete. For this we have chosen to vary a few parameters such as the nature of the fines (powder of OWA) for the same type of material and a dosage of cement constant. The water dosage was not changed during the development of the SCC.

- ✓ **Prepared concrete:**

1. SCC0 Vibrated concrete (witness).
2. SCC1 with addition of powder the olive waste ash (OWA) 5% .
3. SCC2 with addition of powder the olive waste ash (OWA) 10%.
4. SCC3 with addition of powder the olive waste ash (OWA) 20%.

In our work, were made:

- 32 test tubes (7 × 7× 28) cm, 8 for each type of concrete, for the measurement of strength at 2 days and 7 days and 28 days and 60 days.

III.4.2 Concrete preparation:

Table III. 13 present the different formulations of the concrete that we havemade during our research.

Table III.13 Composition of mixtures the SCC

Compositions (g)	**Designation of local concretes**			
	SCC0	**SCC1 (5%)**	**SCC2 (10%)**	**SCC3 (20%)**
Cement CPJ 42.5	7404	7033.8	6663.6	5923.2
OWA	-	370.2	740.4	1480.8
Sand	13008	13008	13008	13008
Gravel3/8	6504	6504	6504	6504
Gravel8/15	6504	6504	6504	6504
Water	3164	3164	3164	3164
Super plasticizer	111.04	148.08	185.12	222.16
Grave rolled	740.4	740.4	740.4	740.4
E/C	0.5	0.5	0.5	0.5

❖ **Preparing the concrete mixture:**

The mixer Machine used for the manufacture of concrete has a vertical axis .

1) Prepare molds for various tests, check their number and paint w, in order to facilitate removal andCheck that all the materials are available.
2) Prepare the amount of water needed. The superior plasticizer is added to the first half of the mixing water.
3) Weigh the dry materials, put them in a mixer machine them 10% mixing water.
4) Start the mixer for 30 minutes Seconds and Leave the mixer running and add the first half of the water gradually (which contains theSuper plasticizers) and mix for 1 minute 30 seconds.
5) Gradually insert the rest of the water and knead for two minutes.
6) Immediately perform characterization tests on fresh concrete.

Figure III.6 the concrete mix.

III.5. Test Methods for Workability of Self Compacting Concrete:

Test methods to determine workability of Self Compacting Concrete are:

III.5.1 Slump flow test :

The slump flow test is done to assess horizontal flow of concrete at the absence of obstructions. It is the most commonly used test and gives a good assessment of filling ability. It may be used at the site. The test also indicates the resistance to segregation. ()

- **Equipment for Slump Flow Test :**

1. Trowel.
2. Scoop.
3. Ruler.
4. Stopwatch (optional).
5. Base plate of a stiff non-absorbing material.

Figure III.7 Cone

- **Operating mode**

Needed to perform the test, was sampled normally. Moisten the base plate and inside of slump cone, place base plate on level stable ground and the slump cone centrally on the base plate and hold down firmly. Fill the cone with the scoop. Do not tamp, simply strike off the concrete level with the top of the cone with the trowel remove any surplus concrete from around the base of the cone. Raise the cone vertically and allow the concrete to flow out freely.

Figure III.8Slump Flow Test

The spread value of a SCC (referred to as the Receiving Spread Range: FER) can be defined

- On the basis of a target value between 600 and 750 mm (with an allowable variation in general of + or - 50 mm).
- By the designation of a category (SF1, SF2, SF3).

Table III.14 set a category of the Slump flow test

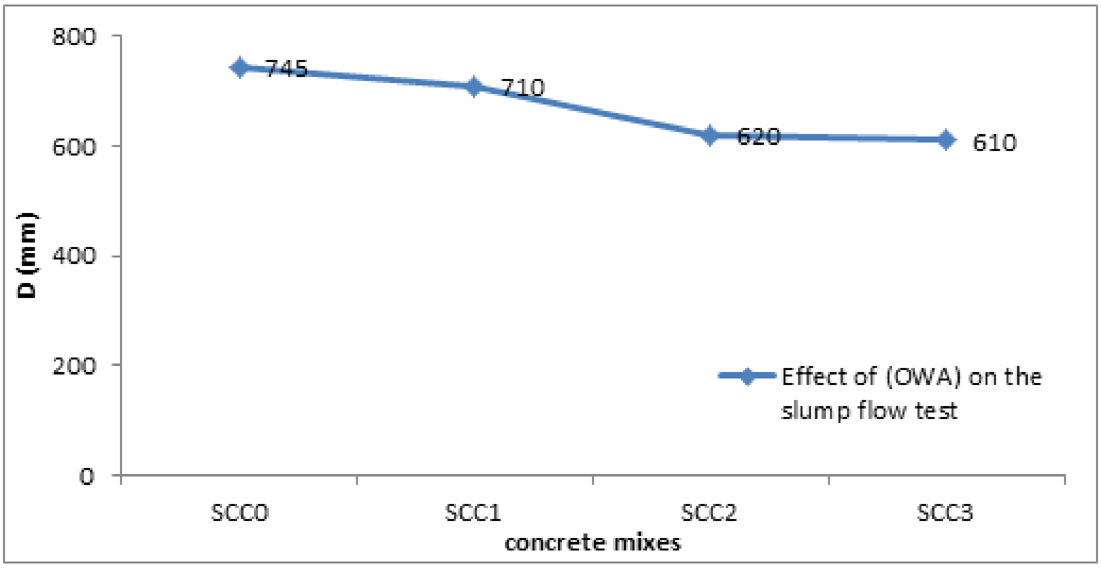
Consistency classes	Spreading in mm
SF1	550 à 650
SF2	660 à 750
SF3	760 à 850

- **Expression of results:**

Table III.15 In the table shows that this requirement of the specifications has been suitably fulfilled by this concrete (SCC).

Table III.15 the results the Slump flow test

SCC	D1 (mm)	D2 (mm)	D (mm)
SCC0	760	730	745
SCC1	700	720	710
SCC2	600	640	620
SCC3	600	620	610



FiugerIII.9Effect of (OWA) on the slump flow test

5.2. L-Box Test:

The L-box test is used to measure the filling and passing ability of self-compacting concrete. This test was originally developed in Japan for underwater concrete, the test is also applicable for highly flow able concrete.

- **Equipment for L Box Test :**

➢ L Box.

Figure III.10 L box

- Operating mode

Make sure to place the box on a horizontal support and moisten the inside. The vertical part of the crate is completely filled with concrete (the required size about 13 liters). After leveling, the concrete is left to rest for a while accurate.

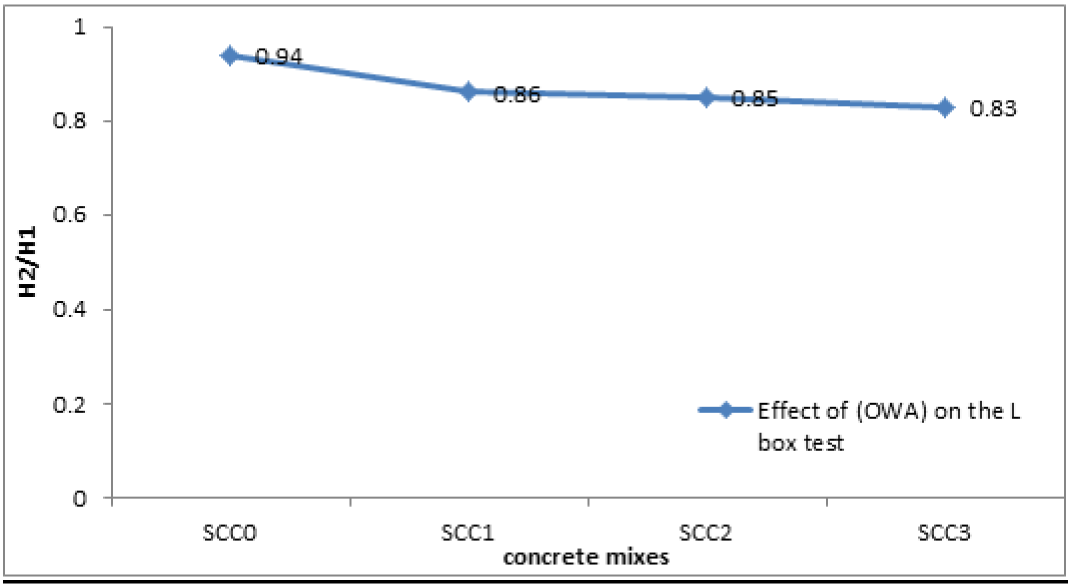
Then we lift the hatch and let the concrete flow into the horizontal part of the box through the reinforcement. When the concrete stops, we measure the heights H1 and H2

- Expression of results:

The results are collated in Table III.16

Table III.16 results of L box test

SCC	H1	H2	H2/H1
SCC0	90	85	0.94
SCC1	95	82	0.86
SCC2	85	100	0.85
SCC3	90	75	0.83



FiugerIII.11 Effect of (OWA) on the L box test

III.5.3. Sieve stability test (NF EN 12350-11 November 2010)

This test to qualify self-compacting concrete with regard to the risk of segregation. He can be used in the formulation study phase of a self-compacting concrete by laboratory, or for checking the stability of concrete delivered to the site. This test complements the tests allowing mobility to be assessed, in a confined environment or no, by characterizing the stability.

- **Equipment for Sieve stability test**

1. Bucket.
2. Sieve 5 mm.
3. Balance.

- **Operating mode**

To carry out this test, 10 liters of SCC must be poured into a bucket and covered to protect it from drying out for 15 minutes. After 15 minutes, it is necessary to pour 4.8 kg 0.2 kg of concrete on the sieve at a drop height of 50 cm 5 cm and note the mass of concrete passing through the sieve. The percentage of milt is calculated according to the following expression:

SR=$\boldsymbol{\frac{PMILT}{Psample} \times 100}$

- **Expression of results:**

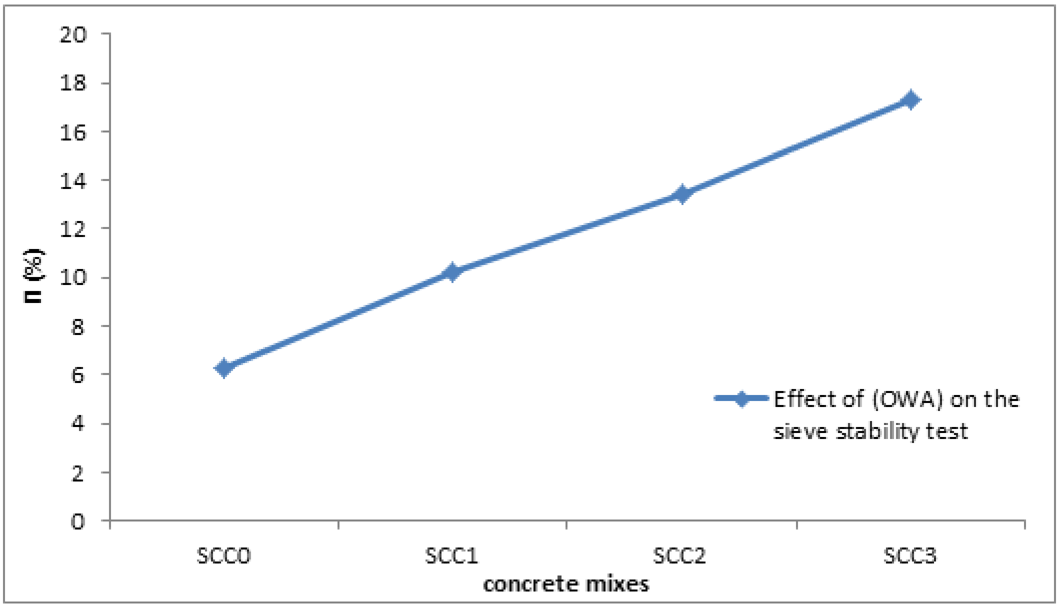
From a formulation of a SCC are divided into three classes:

- 0% ≤П% ≤ 15%: satisfactory stability.
- 15% <П% ≤ 30%: critical stability.

- Π %> 30%: very poor stability.

Table (III.17) The result of sieve stability test

SCC	Π (%)
SCC0	6.25
SCC1	10.25
SCC2	13.41
SCC3	17.29



FiugerIII.12 Effect of (OWA) on thesieve stability test

III.5.4. Preservation of samples:

We used rectangles to determine the compressive strength of concrete. The dimensions of the rectangle are 7 cm ×7 cm x 28 cm. Initially, the rectangle mold is prepared by connecting it correctly with the nuts and bolts. Then it applies well with grease in every nuke and mold corner.

It is allowed to be placed for 24 hours until it dries completely, then it is disassembled and then kept in a room of 97 °C and 28 °C.

Figure III.13 Concrete samples

III.6. Summary:

In this chapter, we used local materials, available on the Algerian market cement, aggregates, and super plasticizers and study your properties.

The tests carried out during this study were carried out on self-compacting concretes. To determine their rheological characteristics (Slump flow test. sieve stability tests, L-Box).Then to know the effect of OWA on SCC whether fresh.

Chapiter IV

TESTS, RESULTS AND DISCUSSION

IV.1. Introduction:

Concrete's resistance to tensile or compression is affected by several factors, including the properties of the materials that make up the mixture (sand - cement - water.....) in addition to the proportions of these materials in the mixture.

In this chapter, the effect of the type of filler and its proportion on the strength of concrete (SSC) will be studied, by studying the effect of the ash of olive waste, in addition to verifying the development of this resistance according to age, in addition. For its effect on strength and pressure resistance and to complete this study, 32 samples were poured.

IV.2. Experiments results:

In this paragraph, we will mention the results of the experiments obtained from (SSC) mixtures, which are considered successful according to the European guide:

IV.2.1. Compressive Strength Rectangular Mixtures (SCC):

After the concrete mixes (SCC) are confirmed (according to the European manual, rectangular samples of dimensions are poured). (7 x 7 x 28) cm to test its resistance to pressure at ages 2, 7, 28 and 60 in a device with a compressive strength of 3000 KN.

Figure (IV.1.) compressive strength machine.

Table IV.1 shows the rectangular compressive strength of mixtures (SSC) at ages 2, 7, 28 and 60 days.

Table IV.1. The rectangular compressive strength.

Sample age		2 Days	7 Days	28 Days	60 Days
Mix name	**The percentage of (OWA) %**	**Rectangular compressive strength (MPA)**	**Rectangular compressive strength (MPA)**	**Rectangular compressive strength (MPA)**	**Rectangular compressive strength (MPA)**
SCC 0	_	27.046	37.664	58.109	64.464
SCC 1	5%	30.139	33.359	40.225	54
SCC 2	10%	17.56	23.453	36.50	42
SCC 3	20%	13.246	16.050	17.374	22.66

Figures IV. (2 and 3) shows a comparison of the compressive strength of the (SSC) that does not contain (OWA) and the (SSC) that contains (OWA) in different percentages at the age of 2 and 7 days.

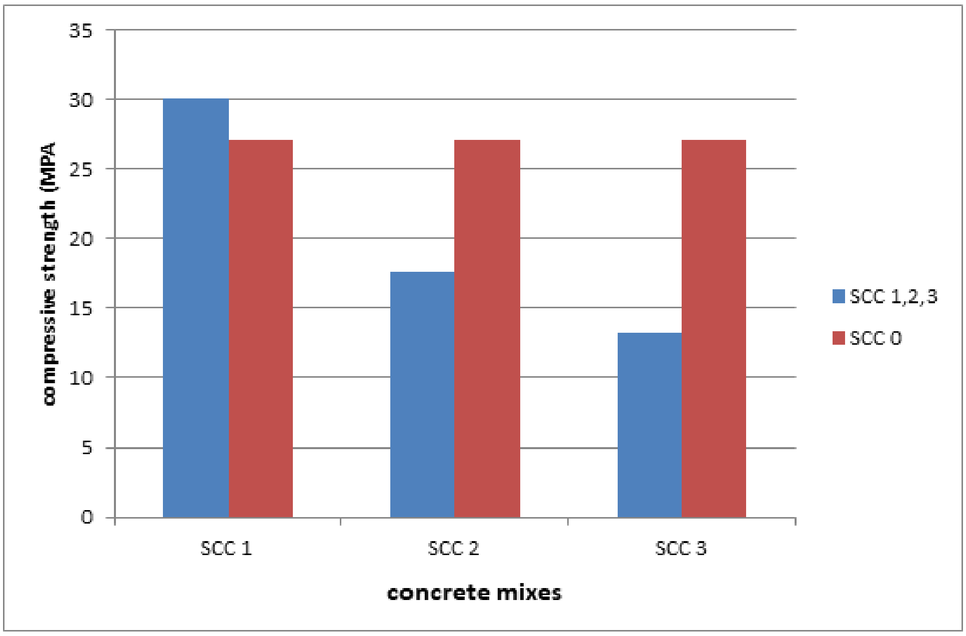


Figure (IV.2) the compressive strength of the (SSC) that does not contain (OWA) and the (SSC) that contains (OWA) in 2 days.

We note in Figure (IV.2) the compressive strength of the two-day-old concrete mix that contains 5% of (OWA) how close it is to the strength of the mixture that does not contain(OWA), and this is considered a good thing. We also note that the higher the percentage of (OWA), the lower the concrete compressive strength.

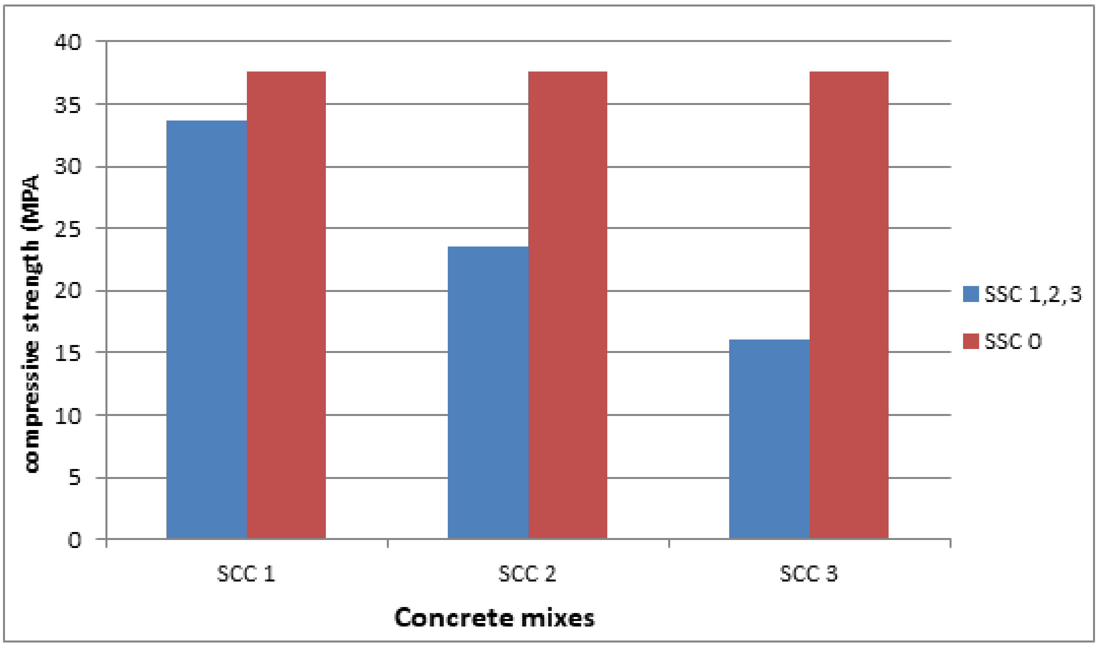


Figure (IV.3) the compressive strength of the (SSC) that does not contain (OWA) and the (SSC) that contains (OWA) in 7 days.

We note in Figure IV.2 the compressive strength of 7-day-old concrete mix containing 10% (SCC 2) of (OWA) was somewhat reduced when compared to (SCC 0).

Figures IV. (3 and 4) shows a comparison of the compressive strength of the (SSC) that does not contain (OWA) and the (SSC) that contains (OWA) in different percentages at the age of 28 and 60 days.

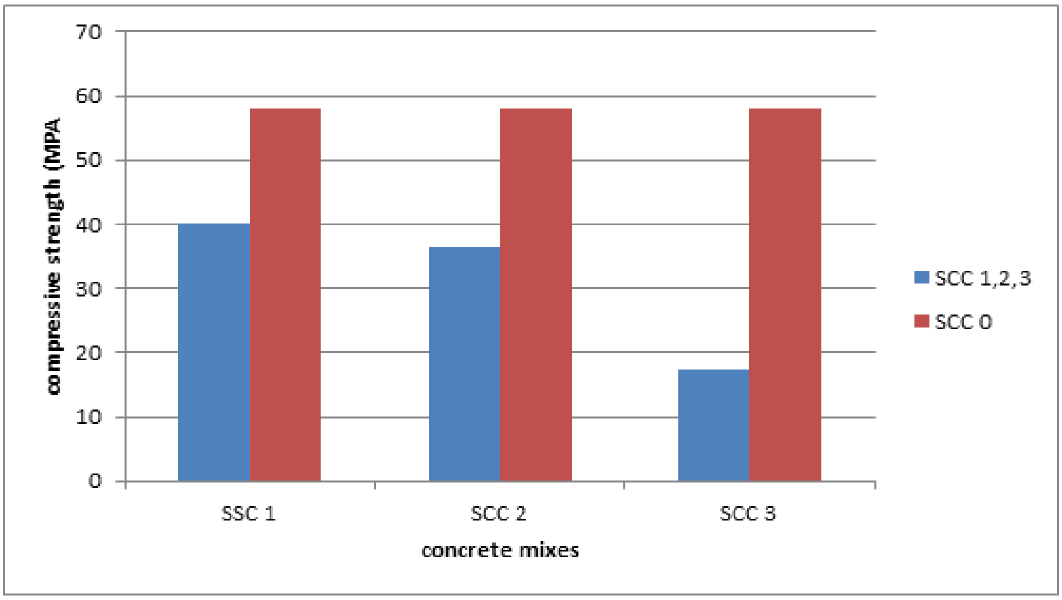


Figure (IV.4) the compressive strength of the (SSC) that does not contain (OWA) and the (SSC) that contains (OWA) in 28 days.

We notice in Figure (IV.3) that all 28-day-old concrete mixes that contain (OWA) have a tensile strength, compared to (SCC 0), which does not contain (OWA), especially the mixture (SCC 2) which contains 20% of (OWA).

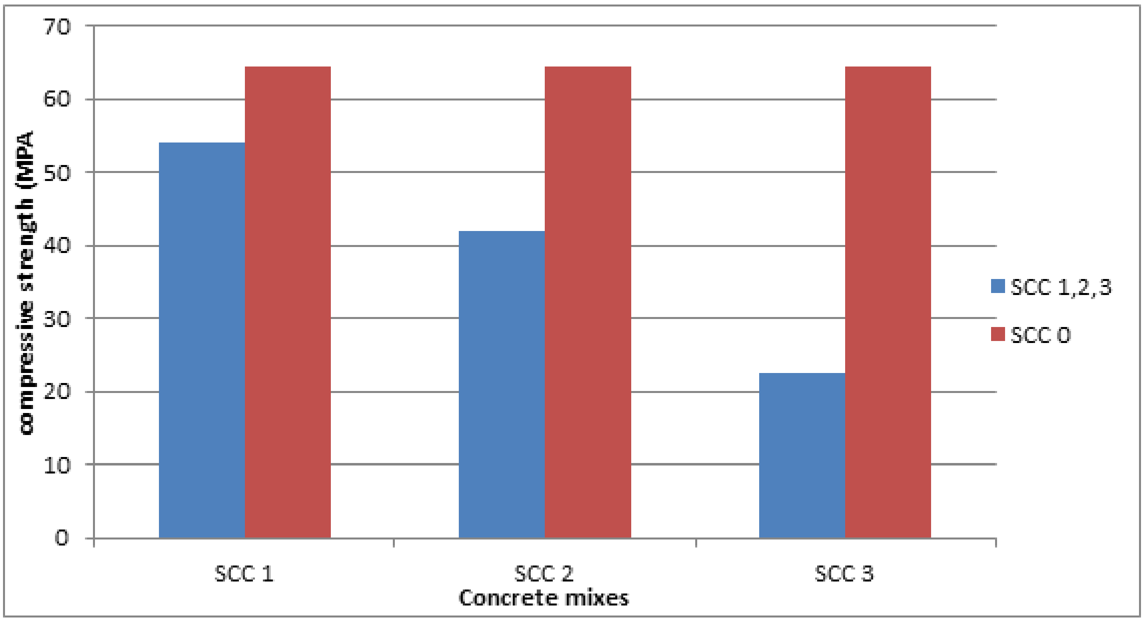


Figure (IV.5) the compressive strength of the (SSC) that does not contain (OWA) and the (SSC) that contains (OWA) in 60 days.

We note in Figure (IV.3) that all 60-day-old concrete mixes containing (OWA) have lower compressive strength, compared to (scc 0), which does not contain (OWA), except for the mixture (SCC 1), which is not Since the difference between it and (SCC0) is not considered significant.

In the following figure (IV.4) is a graph showing the effect of (OWA) on the four concrete mixtures.

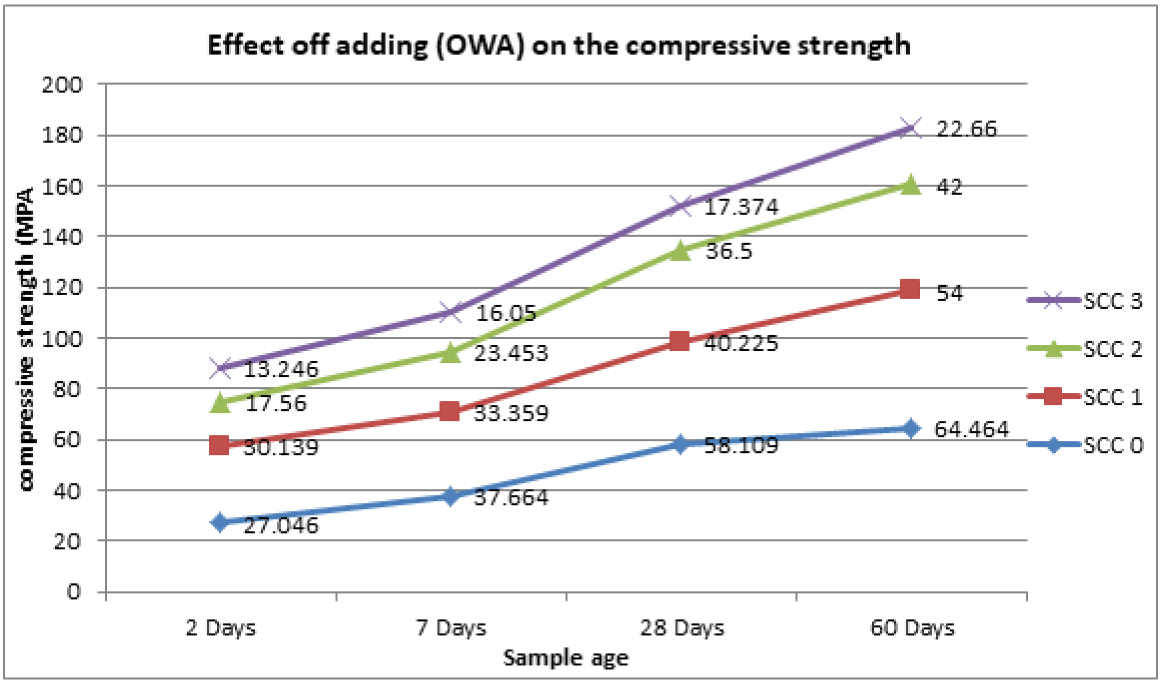


Figure (IV.6) Effect off adding (OWA) on the compressive strength.

The previous figure shows the effect of (OWA) on the compressive strength of concrete mixtures over a period of 60 days, where we observe how close the compressive strength of (SCC 1) containing 5% of (OWA) is to (SCC 0) containing no OWA. This means that it is possible to use this ratio in construction and we also note the compressive resistance of (SCC2), which is somewhat reduced, compared to (SCC 0), which contains 10% (OWA), and we also note that (SCC 3), which is considered weak, compared to (SCC 0) which contains 20 % of (OWA).

IV.2.2 Tensile Strength Rectangular Mixtures (SCC):

The experiment is usually conducted on a prismatic concrete sample, where it is placed on two supports and two concentric forces are applied to it at a distance of one third from the supports.The dimensions of the concrete sample that we will make are (7 × 7 ×28)cm, where this sample is subject to the influence of the two central forces, the intensity of each of which is ($\frac{\boldsymbol{Pmax}}{\mathbf{2}}$), and the force gradually increases until the fracture occurs in the central section of the sample under the influence of tension as shown in Figure (IV.6). tension from the following relationship: $\textbf{Tensile Strength} = \frac{\mathbf{F \times L}}{\mathbf{D^3}}$

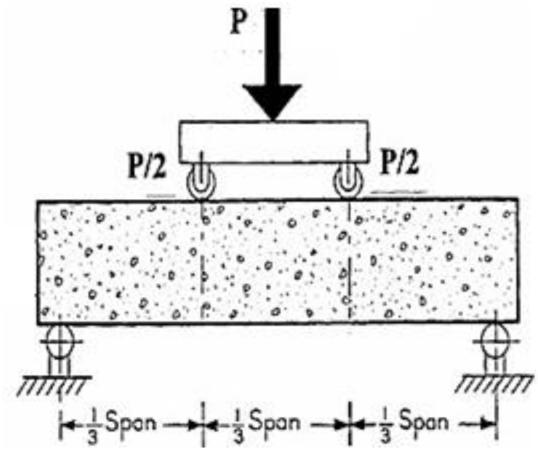


Figure (IV.7) Schematic form the sample during the tensile test.

Figure (IV.8) Schematic form the sample during the tensile test.

Table IV.2 shows the rectangulartensile strengthof mixtures (SSC) at ages 2, 7, 28 and 60 days.

Table IV.2. The rectangular tensile strength.

Sample age		2 Days	7 Days	28 Days	60 Days
Mix name	**The percentage of (OWA) %**	**Rectangular tensile strength (MPA)**	**Rectangular tensile strength (MPA)**	**Rectangular tensile strength (MPA)**	**Rectangular tensile strength (MPA)**
SCC 0	_	0.679	0.979	1.179	1.657
SCC 1	5%	0.66	1.16	1.24	1.47
SCC 2	10%	0.50	0.67	0.80	0.95
SCC 3	20%	0.32	0.36	0.53	0.68

Figures IV. (2 and 3) shows a comparison of the tensile strength of the (SSC) that does not contain (OWA) and the (SSC) that contains (OWA) in different percentages at the age of 2 and 7 days.

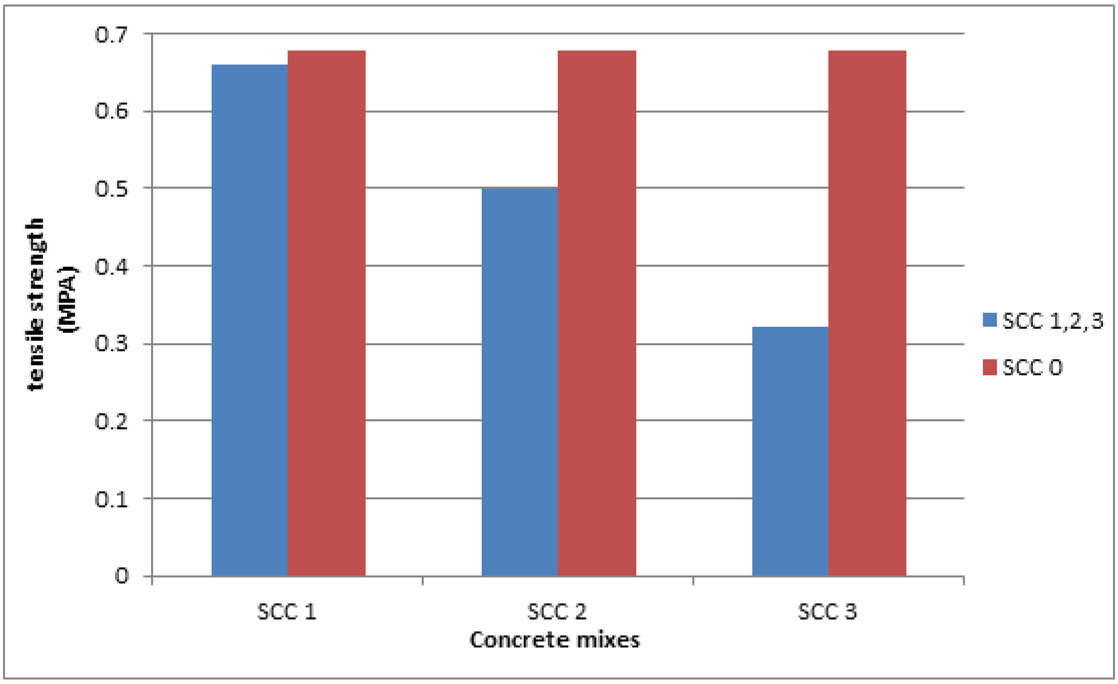


Figure (IV.9) the tensile strength of the (SSC) that does not contain (OWA) and the (SSC) that contains (OWA) in 2 days.

We note in Figure (IV.9) the tensile strength of the two-day-old concrete mix that contains

5% of (OWA) how close it is to the strength of the mixture (SCC 0) that does not contain (OWA), and this is considered a good thing. We also note that the higher the percentage of (OWA), the lower the concrete compressive strength.

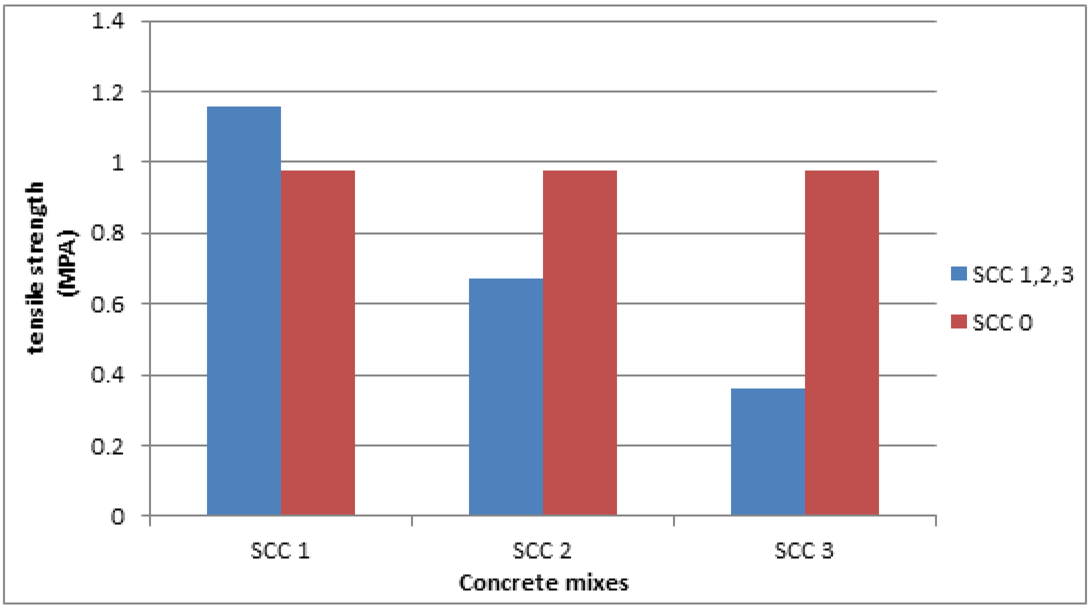


Figure (IV.10) the tensile strength of the (SSC) that does not contain (OWA) and the (SSC) that contains (OWA) in 7 days.

We note in Figure (IV.10) the tensile strength of 7-day-old concrete mix containing 10% (SCC 2) of (OWA) was somewhat reduced when compared to (SCC 0).

Figures IV. (11 and 12) shows a comparison of the tensile strength of the (SSC) that does not contain (OWA) and the (SSC) that contains (OWA) in different percentages at the age of 28 and 60 days.

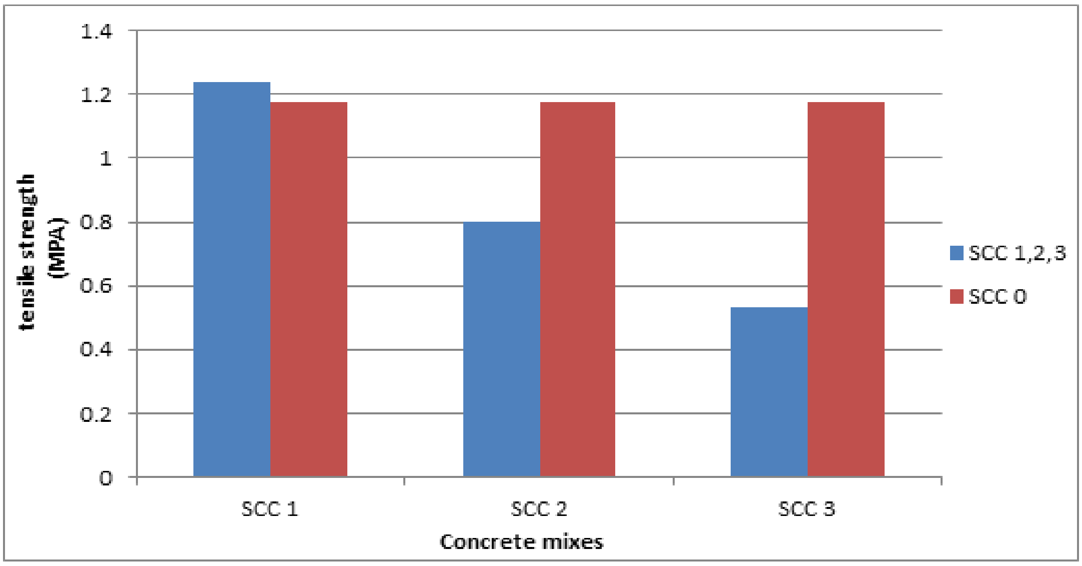


Figure (IV.11) the tensile strength of the (SSC) that does not contain (OWA) and the (SSC) that contains (OWA) in 28 days.

We notice in Figure (IV.11) that all 28-day-old concrete mixes that contain (OWA) have a tensile strength, compared to (SCC 0), which does not contain (OWA), especially the mixture (SCC 2) which contains 20% of (OWA).

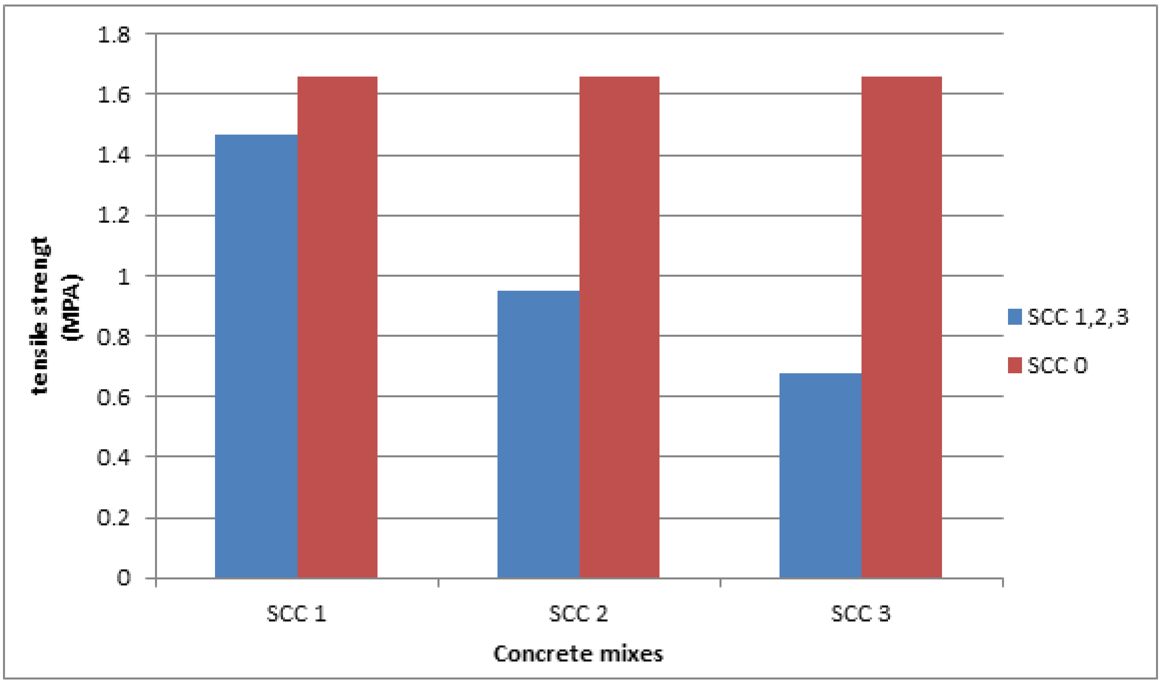


Figure (IV.12) the tensile strength of the (SSC) that does not contain (OWA) and the (SSC) that contains (OWA) in 60 days.

We note in Figure (IV.12) that all 60-day-old concrete mixes containing (OWA) have lower tensile strength, compared to (SCC 0), which does not contain (OWA), except for the mixture (SCC 1), which is not Since the difference between it and (SCC0) is not considered significant.

The following four figures show the effect of (OWA) on the tensile strength of concrete mixtures when the percentage of (OWA) is increased.

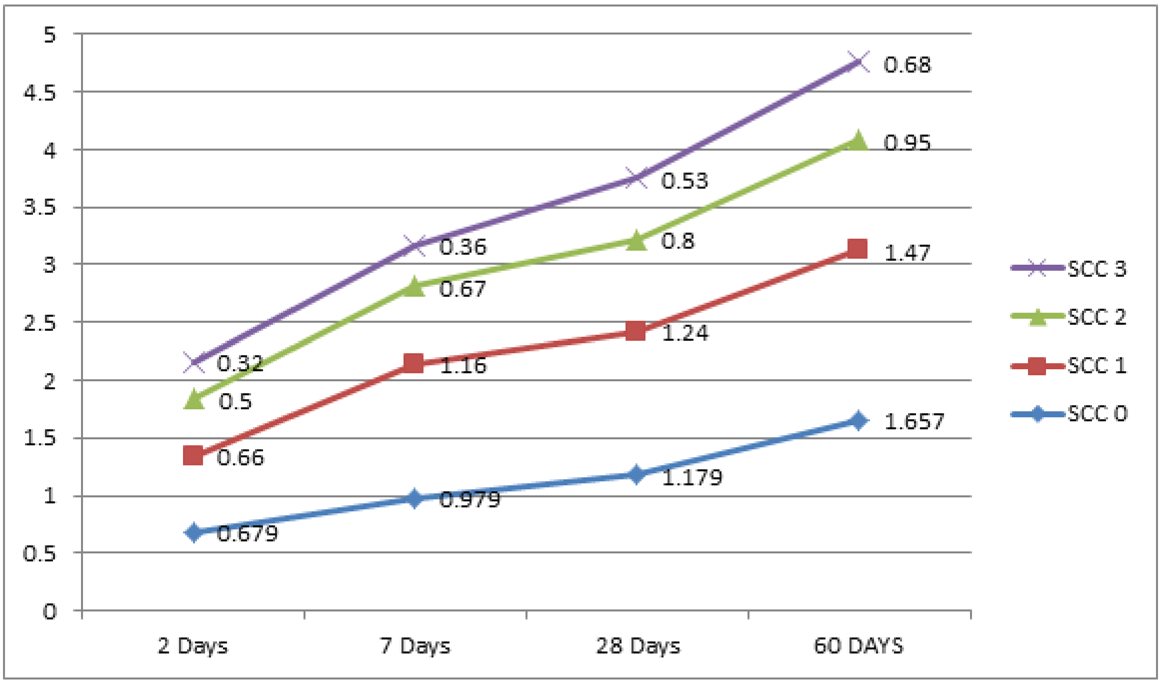


Figure (IV.13) Effect off adding (OWA) on the tensile strength.

The previous figure shows the effect of (OWA) on the tensile strength of concrete mixtures over a period of 60 days, where we observe how close the tensile strength of (SCC 1) containing 5% of (OWA) is to (SCC 0) containing no OWA. This means that it is possible to use this ratio in construction and we also note the tensile resistance of (SCC2), which is somewhat reduced, compared to (SCC 0), which contains 10% (OWA), and we also note that (SCC 3), which is considered weak, compared to (SCC 0) which contains 20 % of (OWA).

IV.3. Summary:

In this chapter, the results of experiments were discussed to find out the effect of (OWA) on the compressive and tensile strength of self-compacting concrete mixtures when replaced with cement in different percentages (5%, 10% and 20%) and it was found that the higher the percentage of olive ash ash, the lower the compressive and tensile strength.

Conclusion and recommandations:

The possibility of utilization of OWA as a substitute forcement in concrete has been investigated. For this purpose, concrete mixtures with OWA replacement (5, 10, 20%)were made and the properties in fresh and hardened state were tested. A review of the literature with the behavior of concrete with OWA has also been provided in order tocompare the obtained results. The following conclusions can be drawn from the experimental results and/or comparison with the existing results from similarresearches.

Based on the results achieved and analysis discussed as a part of thisresearch thesis for Olive Mill Wastes Ash, the following are concluded.

- Olive waste burnt at temperatures exceeding 800°C is rich in CaO and MgO, which are slowly hydrated.
- The concrete’s unit weight made by partially replacing cement with OWA is approximately unaffected.
- Generally, it can be concluded that an increase in the proportion of OWA means a reduction in concrete compressive and tensile strength, mostly as a result of the reduction in the amount of cement in the cement paste.
- The compressive strength of concrete made with 5% OWA almost met the target strength of 54 MPa at 60 days, while the 20 % OWA mix significantly failed to reach this value.
- The tensile strength of concrete made with 5% OWA almost met the target strength of 1.47 MPa at 60 days, while the 20 % OWA mix significantly failed to reach this value.
- Despite the indication of low initial strength that is shown in cement tests and previous studies, the initial compressive strength of OWA concrete differs, i.e., it increases over time, decreases, and then increases again. The values of the strength after 7 and 28 days are similar.
- At 5% and 10% of replacement process, the sample can give the required stress, of compressive and tensile strength.
- At 20% of adding Olive Waste Ash, this is an impotent point for try to make some different using of material like use it with plaster and Tiling mixes, because the ration of workability approximately doesn't decrease.
- The Olive Waste Ash contains high oil and water content due to the high, because it is perfect dry material.
- There is No curing or improvement for self-compacting concrete when Replacement

of Olive Waste Ash, because it has enough moisture.

- As percentage replacement of cement Olive Mill Wastes Ash, the color of concrete, will be darker.
- The modulus of elasticity is very low, especially when you replace 20% of the cement with olive waste ash, it dries very quickly.
- Waste olive ash does not affect fresh self-stressed concrete tests (slump flow, L-box test ....).

Recommendations:

Based on the all these results and outcome of tests, so each of the the following can be recommended:

- It is recommended to use 5% or10% adding of (OWA) to the concrete, in order to protect the environmental of this material, because the existence of this article is a waste.
- This type of concrete can be used for non-structural concrete, for the parts of structure that is not exposing to direct load, such as (blocks in roofs, walls, behind insulating walls, side walk blocks, and walls over cantilevers).
- It is possible to use new super plasticizer materials, in order to improve the ability of self-compacting concrete.
- It is recommended to use samples with sizes larger than (7 × 7 × 28)and ensure that samples are made of iron to obtain more accurate results.
- For the following research on the same work, it is recommended that you conduct experiments on ordinary concrete instead of self-compacting concrete.
- For the following research on the same work, it is recommended that you conduct experiments on cement mixtures, which I think will give us more positive results than concrete.
- It is recommended to use mix sample of olive ash form olive wood, and OWA, together on concrete. As a replacement of fine aggregate, or cement then study its effect on the physical properties of concrete.

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