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Use of Structural Waste in the Construction of Roads Pavement in Order to Protect the Environment

Emhemmad A. Basha [1*], Aya Alkhweldi [2] and Abdullah E. Basha [3]

[1] Department of Civil Engineering, Gasar Ben-Gasher Higher Institute for Comprehensive Professions, Tripoli-Libya.

[2] Department of Civil Engineering, Gasar Ben-Gasher Higher Institute for Comprehensive Professions, Tripoli-Libya.

[3] Libyan Academic, Department of Civil Engineering, Janzor, Tripoli-Libya.

*Corresponding author email id: dr.basha2003@yahoo.com

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***Abstract* – Most cities suffer the consequences of the phenomenon of the spread of construction, demolition, maintenance and road wastes. These wastes are estimated at millions of tons, so their accumulation has become a burden on the environment and disposal of the most complex environmental problems facing the world today, therefore the aim of this study was to eliminate these wastes and to make use of them and to achieve this goal, where were chosen for use in road paving (base or sub base) as an alternative to natural aggregate. As for the compaction importance of the first major role in the construction of roads, the testing of the compaction was examined mainly. Cement, site soil and natural aggregates were used as additives to the constructional wastes, each with different weight ratios. Through the results find the best density was obtained when the cement is added to the construction waste and then when added local soil. This study indicates the possibility of taking advantage of the construction and demolition wastes as an alternative to natural aggregate for road paving. It is also possible to take advantage of it in many different civil engineering applications such as treadmills for floors, pedestrian paths, parks, public gardens sidewalks, etc. These wastes may be less than the cost of disposal by traditional methods and have good environmental and health benefits at least in the long run.**

***Keywords* – Ordinary Portland Cement, Natural Aggregate, Construction Waste, Local Soil and Compaction Test.**

I. INTRODUCTION

The development of mental and civilized human was related to the increase of his exploitation of the various possibilities and energies of the environment. With the continuous population growth and development, explore of wealth and various energy materials, new living patterns have emerged that directly contributed to the emergence and multiplicity of different environmental pollutants. In today's era, environmental pollution has become the biggest and most serious problem faced by human today. Pollution has spread to all elements of the environment (water, air and soil), the problem of the environment, pollution and how to confront it become the concern of many scientific bodies.

The increasing problem of disposal of solid waste and the identification of its sources, quantities, physical and chemical properties led to the search for how to manage them by true environmental and healthy methods, all of these due to the increase in quantities and the multiplicity of sources. Solid waste has become a major environmental problem, which has a direct and indirect impact on human health and environment. The most important solid pollutants are structural waste of various types which have a great deal of damage to the health and safety of humans and also environment, as well as for their extensive use in various activities for humans. Structural waste is defined as solid waste generated from the construction, demolition, development and maintenance activities of construction, buildings, roads, bridges, etc. The different materials in the site include a

-sphalt, concrete, plastic, wood, glass, aluminum, iron, isolates, pipes, wires and others.

Construction waste management means recycling and reuse of these wastes in a way that can be used in other construction works. This is a practice to reduce the amount of waste generated, and reuse or recycling of structural waste is the largest component of sustainable development, Therefore; conducted and continues to conduct a lot of researches in many countries in the world for how to manage and evaluate the construction wastes to exploit and benefit it by safe and effective manner [1-6].

Contaminants are divided into several types which are radioactive, biological, chemical organic and inorganic; these pollutants are transmitted to the human body either directly or through air and contaminated water or indirectly by eating contaminated plant and animal foods; the harmful substances are transferred to the lung, stomach and then to the rest of the body during blood circulation. And many diseases related to the pollution such as cancer and organ failure to function as renal and hepatic failures, as well as immediate poisoning to death, and this situation requires studying current events and reducing pollution in order to preserve lives and property [7].

For example, the primary estimates refer of US Environmental Protection Agency (USEPA), the direct cost of treating waste diseases and contaminants of building materials is around $ 30 billion, and the indirect cost is more than $ 100 billion annually due to the interaction and degradation of some building materials and associated fumes with air and the nature of the available, and here can understand the fear of the rapid rise in the proportion and quality of some health diseases, especially respiratory diseases, asthma, cancer, allergies, kidney failure, liver disease and others. The US Environmental Protection Agency estimated that 136 million tons of construction and demolition debris were generated in the United States in 1996 and the great part of these wastes comes from the demolition and restoration of buildings and the remainder comes from the new construction [8].

According to non-integrated statistics for the US Environmental Protection Agency, that the amount of construction waste resulting from the demolition of old buildings of each year about 200 million tons of construction of houses in towns and villages, resulting in the establishment of new buildings on an area of 2 billion square meters per year waste construction of 120 to 100 million tons, and can to have a bad effect on the groundwater of the city water, and cause obstruction to the healthy development of the city significantly, this act does not protect the environment and will not achieve recycling and the use of effective construction waste, therefore experts say that it cannot delay treatment works construction waste, but this took out a serious new hot market for to provide the best service for the treatment of construction waste cities [8].

Today, the population of the Earth is about 7 billion nm, producing about 27 billion tons of solid waste worldwide and is expected to rise from 70% to 80% in the coming decades, leading to an increasing amount of solid waste. The total volume of solid waste in EU countries is 1300 million tons, 40% of which or 520 million tons of demolition and construction waste. The most extractive countries are the United States 325 million tons followed by Japan producing 77 million tons, then India and China [9].

According to especial information from the National Association of Home Builders (NAHB), the average waste disposal cost of building 100 homes is estimated at US $ 50,000. The US Environmental Protection Agency (USEPA) estimates that the bulk of these residues are in concrete materials and stone breaking up to 50 percent of the total building waste, while a report by the National Association of Housing Construction in America indicates that the cost of disposal of construction or medium-sized housing is about US $ 511 [10].

The reuse or recycling of construction waste and demolition is one of the largest components of sustainable development. The US Environmental Protection Agency (EPAUS) has estimated the percentage of materials in construction and demolition waste at the following rates: concrete and stone breaking mixture 40-50%, wood 20 -30%, ready cutters 5-15%, asphalt surfaces 1-10%, metals 1-5%, bricks 1-5%, plastics 1-5% [8]. The US Environmental Protection Agency (USEPA) also estimated the amount of waste generated by some different types of facilities as shown in table (1).

Table 1. Average Amount of Construction and Demolition Waste Generated from Several Types According to the US Environmental Protection Agency (USEPA, 1998).

S.N	Type of project	Weight of waste (lb/ft^2)	Ton/5000 of project
1	Construction of residential buildings	4.38	10.95
2	Construction of non-residential buildings	4.02	10.05
3	Demolition of residential buildings (single accommodation for each family)	111.3	278.25
4	Demolition of residential buildings (the buildings contain multiple dwellings)	127	317.5
5	Waste of demolition of residential non-buildings	155	387.5
6	Waste of restoration of residential non-buildings	17.7	44.25
7	Waste of restoration of residential buildings	Vary by type project	Unlimited

II. Methods of Waste Disposal

2.1. *Burn*

It is more method widely used today for the disposal of solid waste, although this method greatly harms the environment and human, and cause many health problems, including asthma, skin allergies, leukemia, lung and liver. The burning to get rid of solid wastes leads to several very toxic gases such as hydrogen chloride gas emissions (HCl) which cause economic and environmental damage, in addition to health damage where is consider as carcinogenic gas. Also emits carbon dioxide (CO2) and the rising rate of atmospheric air and reduces the oxygen concentration in the closed places and cause choking, it is also primary responsible the occurrence of global warming and rise in temperature, carbon monoxide (CO) is also emitted from burning processes, especially in the presence of a small percentage of oxygen, it is considered a poisonous and deadly gas, where this gas combines with hemoglobin in the red blood cells to form the carbon oxide hemoglobin, this reduce of transfer of oxygen to the organs of the body and is deadly in the case of high concentration. In addition to the ash and rise in temperature to more than 1000^{o}C during the burning, dioxin compounds are considered the most dangerous gases to the environment and public health, where exposure to dioxins even in small proportions leading to the human weakness of resistance against diseases where caused by bacteria, viruses and parasites, also cause cancer in humans, and also the exposure of pregnant women to dioxin leads birth children are suffering from a lack of male hormone levels and decreasing the number of sperm at puberty stage in addition to congenital defects [11-13].

2.2. *Landfill*

This means the process of burying solid waste underground, which proved to be ineffective and cause many dangers and huge environmental pollution. These wastes consist of several different materials decomposes in the heart of the landfill to produce toxic substances that cause contamination of soil and groundwater, where one ton of waste pollutes about half a million liters of ground water, which is consumed by humans causing several types of diseases of various cancers in addition to renal failure, liver diseases, venereal diseases and others [14].

2.3. *Recycling*

Recycling process is remaking and use of waste to reduce the impact of these wastes and their accumulation on the environment. The practical experience in this field has confirmed that recycling helps reduce the cost of raw materials and the cost of operation, as well as environmental benefit, previous studies indicated that the recycling rates of some materials may reached 95% [15]. Therefore, the re-use and recycling of construction waste and demolition are the best alternative methods for the benefit of the environment. The progress in the knowledge and requirements of civil engineering applications such as roads, industry, cement bricks, as well as in concrete production in large quantities in various constructions works.

In this era makes it possible to use waste demolition and construction to increase savings in economic terms, so conducted several separate researches on the scope of [16-19], or using recycled aggregates in highway base layers [20]. On the scale of roads, foundations and soil reinforcement, studies were conducted on the properties of compaction when using solid waste in this area [21-24].

Arinze and his colleagues take two researches separates for studied to use a quarry dust -cement stabilized soils for pavement construction as base and sub-base of rural roads [25-26].

Also, Teerasak Yaowarat and his colleague's takes two researches separates use recycle concrete aggregate modified with PVA and FA. The studied to evaluated compressive and flexural strengths, the results indicates reducing compressive strength for all w/c ratio in both long and short term, while flexural strength increased with increasing p/c ratio, the provide the highest flexural strength [27-28].

III. Advantages of Waste Recycling

1. Preservation of healthy landfill sites at high importance areas, as well as preserving the environment.
2. It is considered a kind of economic income of the country.
3. Reduce the cost of landfills waste, transport fees and other wages.
4. Reduce the depletion proportion of resources and negative impacts on the environment.
5. Saving of cost energy.
6. On-site recycling operation for implementation of large construction projects as a method to avoid the cost of transportation.
7. Money revenues generated from the sale of selected recycled materials.
8. Establish new factories and provide vacant places for employment.
9. Exploitation of local resources by recycling to dispense imported materials.

10. Used in paving the streets of residential neighborhoods and agricultural roads.
11. Use in the construction of gardens and parks.

IV. Objective of the Study

1. Disposal of these wastes by recycling them to the maximum extent possible.
2. Saving land areas occupied by landfills and landfill sites from these wastes.
3. Protecting the environment from the pollution caused by accumulating in landfills.
4. Deeply study scientifically and experimentally for to understand their behavior to try to take advantage of them in wider areas.

V. Testes and Materials Used

5.1 *Materials Used*

5.1.1. *Construction Wastes*

Construction waste was obtained from the construction and demolition results from the city of Qasr Ben-Ghashir area, located 25 kilometers south-east of Tripoli capital. Separated undesirable materials, such as wood, plastic, iron, glass, etc. and were then manually broken, by standard sieves to conform to American and British standards with a maximum of 50 mm.

5.1.2. *Cement*

Cement used in this research is an ordinary Portland cement where obtained from Sooq Alkhames factory which is located southeast of city of Tripoli, a distance of 70 km, which is classified on the strength of 42.5 Newton, according to British specifications.

5.1.3. *Water*

The water used in this research was obtained from the drinking water network of Qasr Ben-Ghashir city, and use in the construction projects according to the Libyan specifications.

5.1.4. *Natural Aggregates*

The natural aggregates used in this research are the result of the fracture of calcareous rocks obtained from the city of Azezia by a local supplier. It is in accordance to Libyan and American specifications with a maximum size of 50 mm granules and wet density of 2.64 g/cm3.

5.2 *Tests Used*

5.2.1. *Sieve Analysis*

This test was done on the soil samples obtained from the sites according to the American specifications (1966-ASTM-D 422) for the classification of site soil, noting that drying in the oven at 110 ° C for 24 hours and then cooling it for 2 hours before testing.

5.2.2. *Atterberg Limits*

Liquid limit (LL), plastic limit (PL), and plasticity index (PI). Tests were conducted in accordance with (ASTM 04318) and according to (AASHTO T89 and T90). The soil was initially dried and then screened through # 40 sieves before tested.

5.2.3. *Specific Weight*

This test was carried out for both on-site soil and for the accumulation of waste and natural aggregates, used tests applications in this research were according to American Standards (ASTM-854-1958).

5.2.4. *Compaction Test*

Standard (ASTM D698-1970) and (AASHTO T90 and 1557) (Standard) were used to determine the maximum dry density (MDD) and the optimum moisture content (OMC) for all soil samples.

VI. Practical Program

The laboratory program of this research, which was planned on the basis for use construction and demolition wastes as the base and sub-base of flexible pavement as an economic step, as well as recycling of construction waste and protection of the environment from pollution.

6.1. *Plan of the Practical Program*

As shown in table (2), the work was divided into four groups, which each sample was tested for each group in order to find the maximum dry density and corresponding optimum moisture contents as follow:

Table 2. Illustrated the Laboratory Program.

Groups	Additives (%)				Notes
	Const. Wastes	Cement	Situ soil	Natural Aggregate	
First	100	0	0	0	In this group is performed compaction test for construction waste with adding cement percent and add a certain percent of water for reaction complete during curing time of seven days.
	97	3	0	0	
	94	6	0	0	
	91	9	0	0	
	88	12	0	0	
	85	15	0	0	
Second	100	0	0	0	In this group is performed a compaction tests for construction waste with adding situ soil without curing time.
	90	0	10	0	
	75	0	25	0	
	50	0	50	0	
	25	0	75	0	
Third	100	0	0	0	In this group is performed a compaction tests for construction waste with adding natural aggregate without curing time.
	90	0	0	10	
	75	0	0	25	
	50	0	0	50	

	25	0	0	75	
Forth	0	0	100	0	In this group is performed a compaction tests for situ soil with adding cement percent with seven days curing time.
	0	3	97	0	
	0	6	64	0	
	0	9	91	0	
	0	12	88	0	
	0	15	85	0	

- First group is addition of cement with different percentages of construction wastes (3%, 6%, 9%, 12%, and 15%).
- Second group is addition of the local soil to the building waste in the following percentages: (10%, 25%, 50%, and 75%).
- Third group is addition of the natural aggregates of the building waste by the following percentages: (10%, 25%, 50%, and 75%).
- Fourth group is addition of cement to the situ soil in terms of the following percentages: (3%, 6%, 9%, 12%, and 15%).

VII. Samples Preparing

All samples to be tested shall be dried as aggregate of construction and demolition wastes, natural aggregates and site soil in the oven for 24 hours at 110° C before use. After cooling for at least two hours, all samples shall be prepared by weight according to the prescribed proportions, where prepare 6 samples for each test whether additive added or not added, so that there are five samples to test the compaction to find the maximum dry density and the optimum water content, the sixth sample will be for other tests such as specific weight, consistency limit and sieve analysis for local soil, and as a precaution at necessary.

VIII. Mixing and Curing Sample

In order to obtain accurate results, the samples mixed well with either water or cement until the materials were distributed and interrelated in a fair manner. The manual method was used to mix all samples. All samples without cement were tested directly without storage. Samples with cement additive were stored for seven days in plastic bags for reactions and to protect them from water loss. It was then dried in the oven for 24 hours and cooled for two hours in the natural air and then tested.

IX. Results and Discussion

9.1 *The Results of Sieve Analysis, Specific Weight and Absorption*

Based on obtained results and according to the AASHTO classification system (1982, part 1, specification, W.D.C. it was concluded the soil type (A3) and its specific weight were 2.68. Table (3) shows the results of the sieve analysis of the soil used and the limits of the Libyan specifications, the size distribution of soil particles shown in figure (1).

Table 3. Shows the Result of Sieve Analysis of Situ Soil.

Sieve No.	8	10	16	30	40	80	100	200
Sieve Opening (mm)	2.36	2.00	1.18	0.60	0.425	0.180	0.150	0.075
Passing percent (%)	99.09	90.46	81.02	70.85	61.78	51.19	29.58	10.87

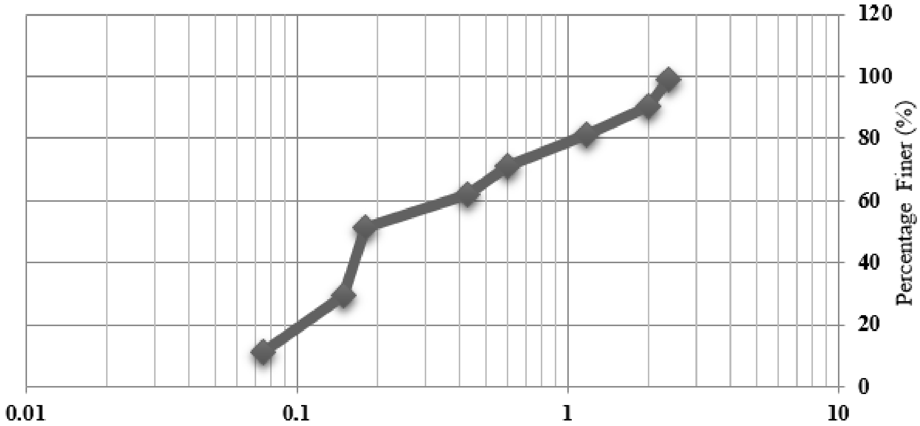

Fig. 1. Grain Size Distribution for Situ Soil Used.

9.2 *Specific Weight*

The results obtained from the laboratory tests for construction waste indicated the specific weight is 2.131, which is less than the natural aggregate where is usually the average 2.65.

9.3. *Absorption*

The absorption of waste aggregates is 11.12%, which is higher than the local natural aggregates which ranges from 0.5% to 1%. This is due to the fact that the porosity ratio of aggregates waste is higher than natural aggregates, which led to a decrease in the specific weight, dry density and increase in the absorption ratio, where was higher than the specifications were 10%.

9.4. *Effect of Cement, Natural Aggregates and Situ Soil Add to the Construction Wastes on the Properties of Compaction.*

9.4.1. *Effect of Cement*

The results for all compaction illustrated in table (4), through figure (2) which represented the relationship between the proportion of cement added and maximum dry density. Note the curve movement slowly decreasing when adding 3% cement, but when the proportion of cement increased the curve start to increase cement proportions up to 12% the dry density reached to 2.04 g/cm^3, and this is the higher value where reached. And when the ratio of cement was increased to 15% the dry density decreased, through the conduction and behavior of curve, especially when taking the fit line of the curve, found the increasing in percentage of cement increasing dry density, and this attributed to two important reasons, first: that the specific weight of cement is greater than the specific weight of construction waste for presence of high porosity. Second: the effort of compacting is reducing the voids percentage, therefore, increase the density.

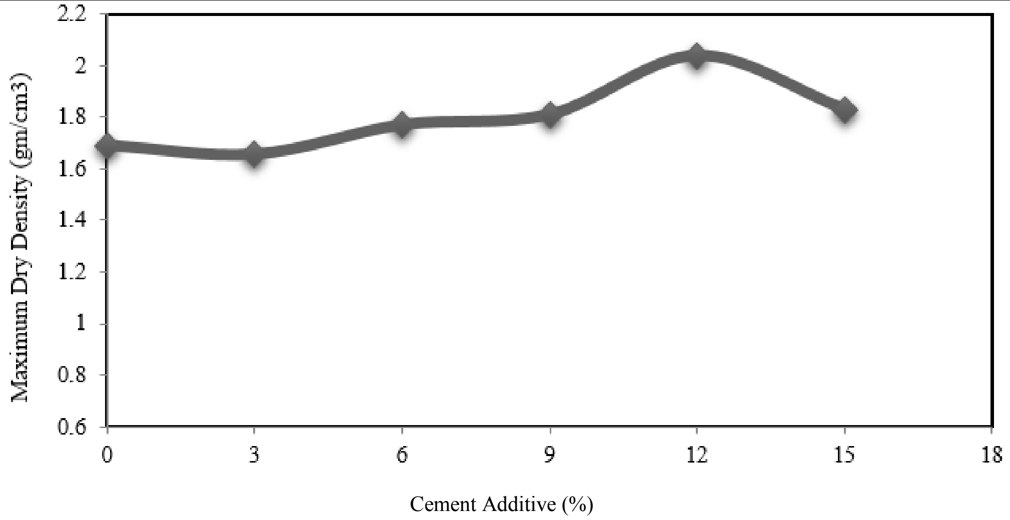

Fig. 2. Relationship Between Cement Additive Add to Construction Wastes and MDD.

Table 4. Illustrated Results of Compaction After Add of Different Additives Types to Construction and Demolition Wastes.

*CDW + Cement (%)	15	0	3	6	9	12
OMC (%)**	15.5	14.0	10.20	18.60	16.50	15.60
*CDW + Situ soil (%)	100	75	50	25	10	0
OMC (%)**	14.9	13.2	15.20	12.65	17.25	14.0
Situ Soil + Cement (%)	100	75	50	25	10	0
OMC (%)**	9.50	10.7	10.70	10.60	9.80	14.0
Situ Soil + Cement (%)	15	12	9	6	3	0
OMC (%)**	13.7	14.5	15.80	12.10	14.00	14.90
*CDW + Cement (%)	15	12	9	6	3	0
MDD****(gm/cm^3)	1.83	2.04	1.81	1.77	1.65	1.69
*CDW + Situ Soil (%)	100	75	50	25	10	0
MDD ****(gm/cm^3)	1.65	1.76	1.91	1.76	1.67	1.69
*CDW + Natural ***Agg. (%)	100	75	50	25	10	0
MDD****(gm/cm^3)	2.02	1.95	1.90	1.71	1.68	1.69
Situ Soil (%) + Cement (%)	15	12	9	6	3	0
***MDD (gm/cm^3)	1.74	1.69	1.652	1.67	1.695	1.651

*CDW: Construction and Demolition wastes, **OMC: Optimum Moisture Content, ***Agg.: Aggregate, ****MDD: Maximum Dry Density.

In contrast, for to looking the curve which is represent the optimum water content with percentages of cement additive as shown in figure (3), note the values of optimum water content it increased in all points compared to the initial point (without adding) except for the first addition of 3% cement, but when taking fit line of the curve find the water content increases as the percentage of cement increase, may be due to several reasons: the first: cement need more water for to complete interaction, second: construction aggregates wastes absorbed high water because it contains a high proportion of pores, and third: compaction requirement of waste aggregate to high amount of water to overcome the large friction between the granules of aggregates, this resulted from the roughness of grain surfaces, through pushing air out of the aggregate granules.

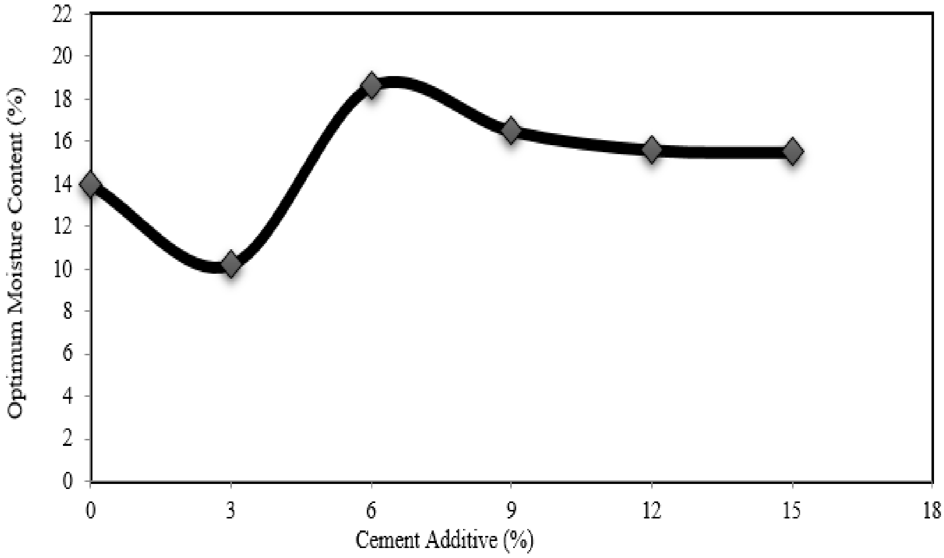

Fig. 3. Relationship between OMC and add of cement proportions to construction wastes.

9.4.2. *Effect of Adding Situ Soil*

The table (4) contains results and the figure (4) represents the relationship between the ratio of the addition of situ soils to the construction waste and the maximum dry density. Through the behavior of the curve, noticed that it low decreased at the first point when adding 10% situ soil to the mixture, when the proportion of soil increased the curve steeply increased at 25% and 50% of situ soil, and when increase the percentage of situ soil to 75% the density is decreased and the path of curve sloping was very sharply. This behavior of the movement of the conveyor in this way may be the explanation the gradient of the mixture was getting better rearranging itself as add the situ soil to reach the best point at the 50% addition. In addition, the best position was able to accumulate grains lock the voids and air out of them, and when the soil increased to more than 50%, the gradual of the imbalance appeared, therefore the mixture start to overcome the amount of site soil and the density started to decrease rapidly, in addition, soil density is less than the density of construction wastes.

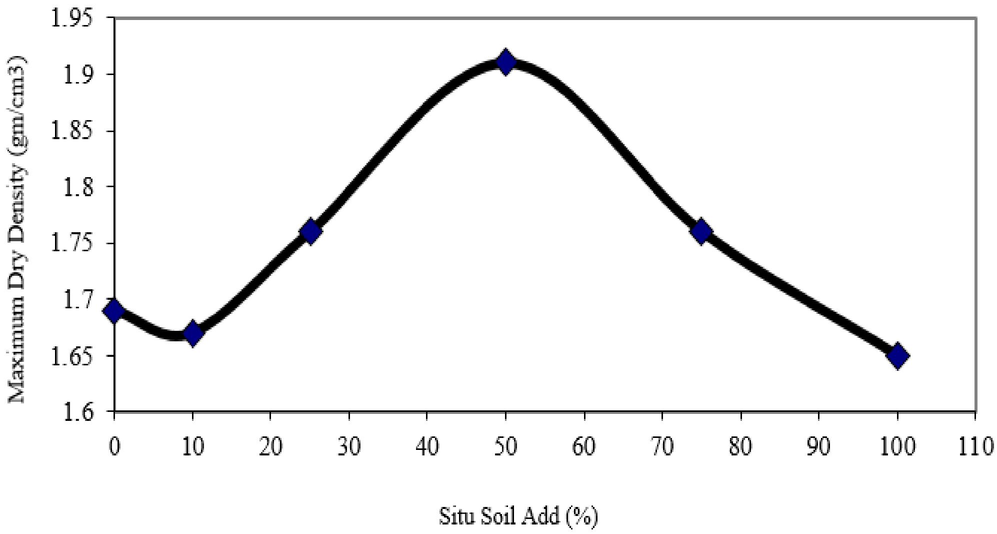

Fig. 4. Relationship between MDD and Add Proportions of Situ Soil to Construction Wastes.

In view of the figure (5) which is represented the relationship between the ratio of the addition of situ soil and optimum water content, find the water content is unstable, where noticed increase in first point and then decreased in the second point, after that came back increase in the best corresponding density and then decreased, at the last point of 100% was increase again, through the curve direction the ideal pathway is almost a straight line or the average water content of the points very close to each other. The interpretation of this phenomenon or of this behavior may be due to the properties of physical sandy soils as they are not as high in their absorption of water compared to silt and clay as is scientifically known in soil mechanics.

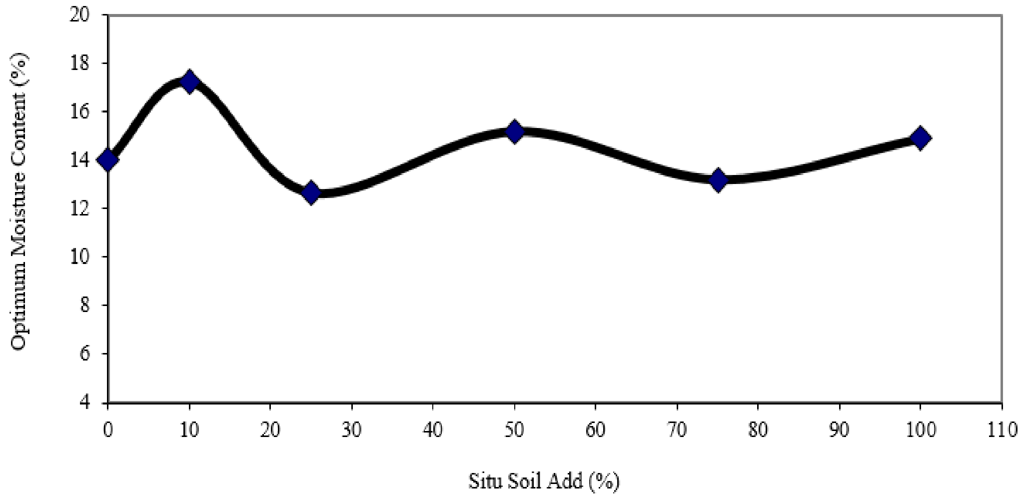

Fig. 5. Relationship between OMC and Add Proportions of Local Soil to Construction Wastes.

9.4.3. *Effect of Natural Aggregates*

The results in table (4) and figure (6) show the increase of natural aggregate to the construction waste increase the density. The reason is specific weight of natural aggregates is higher than the specific weight of the aggregate waste, and this attributed to the pore's percentage of aggregate waste higher than pores percentage of natural aggregate, which led the specific density less. Though the figure (7) which is represented the relationship between optimum moisture content and natural aggregate additive, it is clear from the trend of curve that when increase the ratio of natural aggregate to the mixture decrease the optimum water content, this confirms the above explanation, the higher percentage of natural aggregate in the sample the lower water absorption rate due to the low percentage of pores in natural aggregate compared to waste of aggregate.

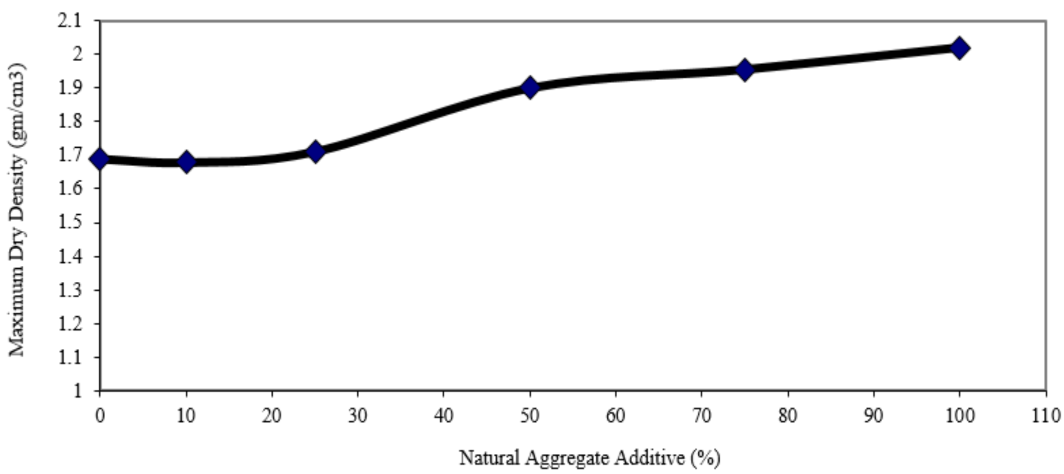

Fig. 6. Relationship between MDD and Add of Proportions of Natural Aggregate to Construction Wastes.

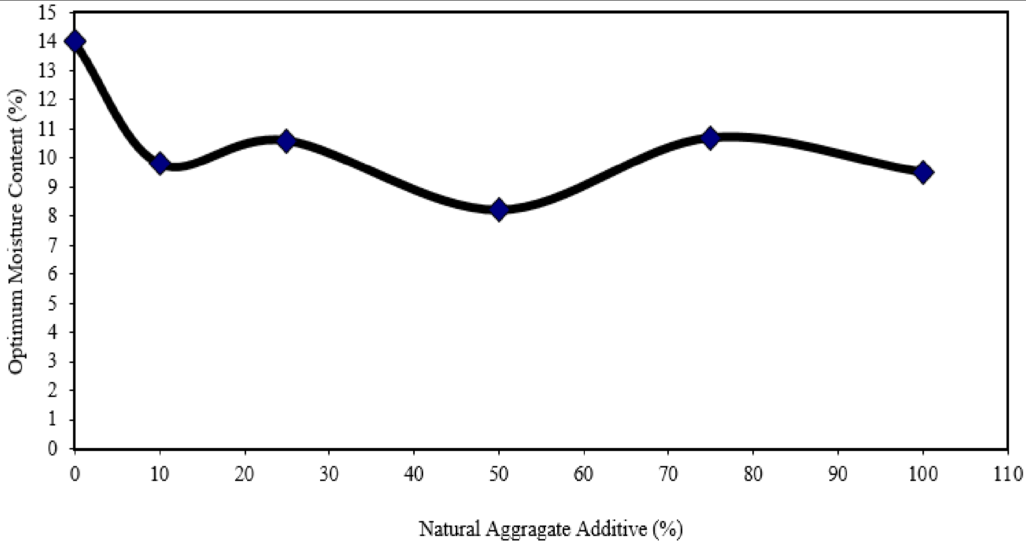

Fig. 7. Relationship between OMC and Add Proportions of Natural Aggregate to Construction wastes.

9.4.4. *Effect of Cement Add to Situ Soil*

The experiment was conducted for two important reasons, first: For comparison of engineering reasons with construction wastes related to the maximum dry density. Second: For economic reasons, it is known the availability and use of on-situ soil in the establishment of any road is more available, free cost and cheaper in terms of transport and purchase price of wastes.

Through results in table (4) and from figure (8) illustrated the relationship between cement additive mix with situ soil and the maximum dry density. It is noted, from the path of curve was unstable at the first ratio added and then decreased with the addition of the following two percentages, then returned increased in the last two points. In fact, when taking the fit line for the path of the curve, it is clear the density increases with increase cement additive to the soil, the explanation may be due to two reasons, first: attributed to specific weight of the cement is greater than the specific weight of the soil. Second: is attributed to the improvement of granular gradient after adding cement and after one week of period time storage.

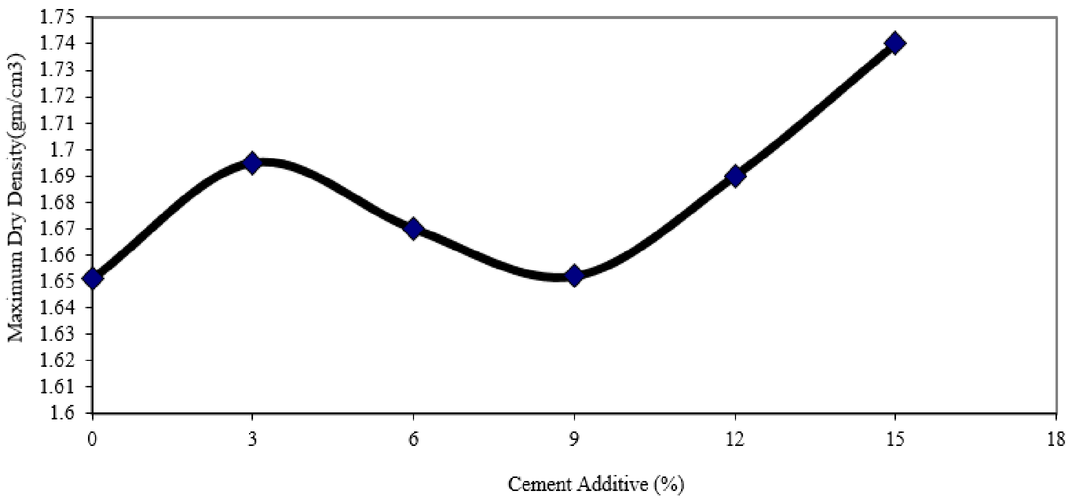

Fig. 8. Relationship between MDD and Add Cement Ratio to Local Soil.

Through looking the relationship between optimum moisture content and cement percent figure (9), found path of curve direction is unstable. However, the curve is very slow decreases, this may be due to the quantity of water added to the mixture is not enough for complete of cement reaction. in addition, to voids increases due to flocculation and agglomeration of grains due to cement reaction and caused to increase of the size of granules and this role led to increase the size of voids between them and acquisition of roughness and need more water to overcome the strength of friction between the grains to lock spaces and expel air.

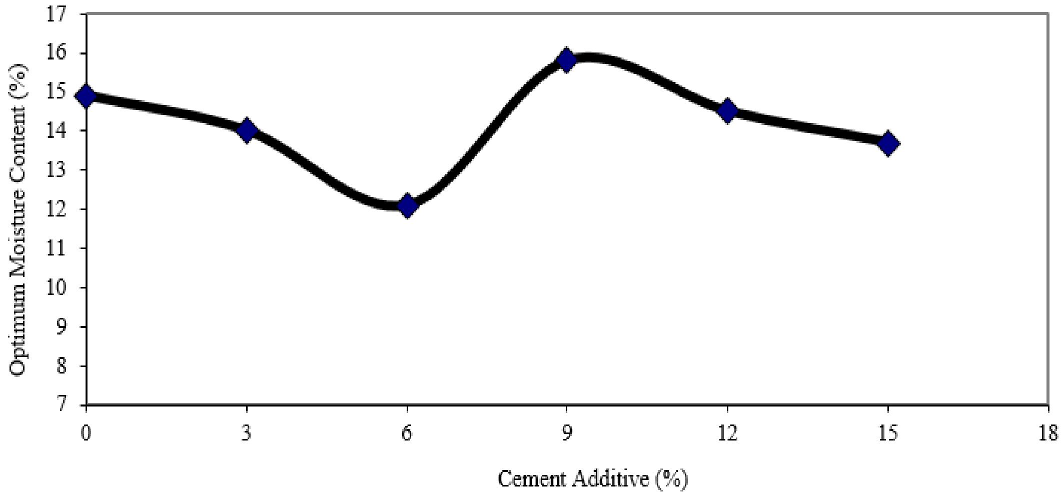

Fig. 9. Relationship between OMC and Add Cement Ratios to Local Soil.

9.4.5. *Compaction of Results*

After comparing all the results obtained from the maximum dry density see table (4), found the biggest value of density was recorded when cement added to the aggregate waste, followed by the addition of natural aggregate to the construction waste, then the local soil to the aggregate waste and the last value was recorded when adding the cement to the local soil, it is following: (2.04 gm/cm^3), (1.955 gm/cm^3), (1.91 gm/cm^3), (1.74 g/cm^3) respectively. As for the comparison of the optimum water content between the groups, found the highest value obtained when cement was added (6%) to the wastes. following added local soil to the wastes, then the cement was added to the local soil, and the results followed: (18.60% at 6% cement, 17.25% at 10% local soil, 15.80% at 9% cement, and 10.60% at 25% natural rubble) respectively.

In terms of economic and engineering comparison, the best group combination may be the situ soil mixture with construction wastes, where these mixtures of all groups are characterized by several advantages and followed by:

1. On-site soil is available at almost every point of the site and without cost, either in terms of price or transport.
2. Disposal of the wastes of construction, maintenance and demolition for the benefit of the environment.
3. The aggregate of construction and demolition wastes is considering less cost than natural aggregates.
4. Can be reuse more than once for the same purpose or the same as.
5. In the case of maintenance and after use does not require high technology or high cost or supply of new materials, and can be maintained at the lowest costs in less time.
6. Does not require heavy equipment's and multiple purposes for used.
7. The uses are saves time and labor because it is available in all locations, especially in cities.

X. Conclusions

Through this study, the use of cement, natural aggregates and local soil to improve the construction and demolition wastes in terms of their effect on dry density and optimum water content using the experiment of the compaction was concluded through the following study:

1. The results showed, the highest dry density recorded when adding 12% cement to the construction and demolition wastes, which amounted to 2.04 gm/cm^3, followed by the addition of natural aggregates to wastes, which amounted to 1.955 gm/cm^3, then at addition of site soil to construction waste, which amount to 1.91 gm/cm^3.
2. The results illustrated, when adding the natural aggregates to the construction waste has improved the dry density and conclude the density increases with increase of each percentage of natural aggregates added except at 10% addition.
3. The results showed, the addition of local soil to the construction wastes has improved the dry density, where the highest value was recorded when adding 50% of local soil to construction wastes, which amounted to 1.91 gm/cm^3.
4. The results illustrated that the maximum value of the water content was when adding cement to the construction waste and then followed by the local soil and natural aggregate to the construction wastes where they were 18.60%, 17.25%, and 10.70% respectively.
5. From the study was concluded, the best additive of construction waste which gave the best value for dry density is cement, but in economic terms the use of situ soil is best and where also the maximum dry density is acceptable.
6. Conclude from the results, the dry density in all groups' increases with the increase in percentage of different additives.

References

[1] Zezhou. W., Honggin. F., and Guiwen. L. "Forecasting Construction and Demolition Waste using Gene Expression Programming". Journal of Computing in Civil Engineering. 2013.
[2] Jian. C, Shwang. L. and Weiwei. H. "Urban Construction Wastes Resource Utilization Inquiry". ICCREM 2014, pp. 382-388.
[3] Tamraz. S.N., Et. Al., "Construction Demolition Waste Management in Lebanon". ICSDC 2011, pp. 375 – 383.
[4] Jing. Z., Et. Al., "Waste Based Management in Residential Construction" Journal of Construction Engineering and Management Apr. 2013, Vo. 131, Vo.4, pp. 423 – 430.
[5] Wei. Z, and Qingmeiwu., "Development Model for Construction Waste Management of China". ICSDC 2011, pp. 421 – 430.
[6] Samanoh. Z, Et. Al., "Environnemental Impact Sassement on Construction Sites" Construction Research congres 2012, pp. 1750 – 1759.
[7] Ahmed Hamza, "Caveats and Environmental Health for the Use and Recycling of Plastic Waste", Arab Seminar to Rotate the Plastic Waste, Cairo - Egypt, 2007, pp. (1- 4, 12-14).
[8] United States Environmental Protection Agency (USEPA). (1998a) "Characterization of Building –Related Construction and Demolition Debris in the United States." Office of Solid Waste and Emergency Response, EPA530-R-98-010. 1998.
[9] N. Scarlat and Et. Al., "Evaluation of Energy Potential of Municipal Solid Waste from Africa Urban Areas. Academic Journal of Renewable and Sustainable Energy Review, 50 (2015) 1260-1286.
[10] Holly L. Story, "The Recycling and Reuse of C&D Débris" American National Association of Home Boulders (ANAHB). Université of South Californie, Institute for Public Service and Policy Research. Vol 3 No 3, www.Iopa.Sc. Edu.
[11] Abdul Hamid Dign, and Others, "Attended the Reasons Many Material Vinyl chloride (PVC)", Scientific Meeting on Science and Environmental Technology, (2004), Tripoli Libya.
[12] Pat Costner, "Dioxin Elimination" Published by Greenpeace International. 2000 Amsterdam, Netherlands.
[13] Bhandere P.S, Lee B.K, and Krishnan K, "Study of Pyrolysis and International of Disposable Plastics Using Combined" TG/FT_IR Technique", Journal of Thermal Analysis, (1997).
[14] Muthanna Abdul Razzaq Age, "Environmental Pollution", Dar Weal for Publication, First Edition, 2000, Amman, Jordan.
[15] European Environmental Agency, "Environment in European Union at the turn of the century", 1999, Environmental assessment report No.2.ISBN 92-9157-202-0. Copenhagen.
[16] Giogio F., Mistuya M., Alberto F., "New Sustainable Technology for Recycling Returned Concrete". Construction and Building Materials. Vol. 67, part C, 30 Sep. 2014, pp. 363 – 659.

[17] Gomes M, De Birto J, and Bravo M., “Mechanical Performance of Structural Concrete with the Incorporation of Coarse Recycled Concrete and Ceramic Aggregate”. J. Materials Civil Eng. 2014, 26(10), 04014076(2014).
[18] Adrinola O.S., and Et. Al.., “Investigating the Suitability of Previous Concrete in Improving Environmental Qualities. Vol. 19, (2014), Bund. H.
[19] Chaojie Yi, Et. Al. “The Recovery and Utilization of Construction Waste: Waste Concrete”. ICCREM 2013: 271 – 279.
[20] Inthikab H, and Et. Al. “Evaluation of the Mechanical Performance of Recycled Concrete Aggregate used in Highway Base Layers”. Geo-Congress 2014, Technical Papers: 3686 – 3694.
[21] Arulrajah A. and Et. Al., “Recycled-Glass Blends in Pavement Base/Sub-Base Applications Laboratory and Field Evaluation”. Journal of Materials in Civil Engineering. July 2014, Vol. 26, No. 7.
[22] James L. H, Et. Al., (2013), “Compaction Characteristics of Municipal Solid waste”. Journal of Geotechnical and Geo environmental Eng. Aug. 2013, 210, Vol. 136 No. 8, pp. 1095-1102.
[23] Udeni P. N, and R. W. U. Nuwansiri., “Compaction Characteristics of Municipal Solid Waste at Open Dump Sites in Srilanka. Geo environmental Engineering, 2014, 110 – 119.
[24] Kennedy Chibuzor Onyelowe., " Crushed Solid Waste Based Geopolymer Cement and Nano-Geomatericals and the Phenology of Treated Soils for Pavement Construction. EJGE. 2018- Volume 23, B3.
[25] Arinze, E. E., and His Colleagues. "Performance of Quarry Dust – Cement Stabilization Lateritic Soil as a Highway Construction Material. EJGE., 2018, Volume 23 – Bin3.
[26] Arinze, E. E., and His Colleagues. "Geotechnical Characteristics Cement – Quarry Dust Stabilized White Clay as Sub-Base of Rural Roads., EJGE., 2018, Volume 23 – B2.
[27] Teerasak Yaowarat and His Colleagues. "Compressive Strength and Flexural Strengths of Polyvinyl Alcohol-Modified Pavement Concrete Using Recycled Concrete Aggregate. JMCE. Volume 30, Issue 4, April 2018.
[28] Teerasak Yaowarat and His Colleagues. "Recycled Concrete Aggregate Compressive Strength Modified With Polyvinyl Alcohol (PVA) and Fly Ash (FA) For Concrete Pavement Applications. JMCE. Volume 31, Issue 4, April 2018.

AUTHOR’S PROFILE

First Author
Dr. Emhemmad A. Basha, Associate Professor, in Department of Civil Engineering, at Gasar Ben-Gasher Higher Institute for Comprehensive Professions, Tripoli-Libya. I completed my B. Sc of in Civil Engineering at University of Tripoli, Libya 1985-86. I have done my MSc. Engg in Civil Engineering at University of Tripoli, Libya 1993-94. And I have done PhD in Civil Engineering at University Malaya, Malaysia 2003-04.

Second Author
Eng. Abdullah E. Basha, Master Student in Department of Civil Engineering, at Libyan Academic, Janzor, Tripoli-Libya. I have done my BSc. Engg. In civil engineering of university of Tripoli, Libya 2017.