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Concrete with by-products and waste materials as aggregate or cement

Betonda çimento ve aggrega yerine kullanılan atık ve ikincil maddeler

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ABSTRACT

Concrete is the most widely used building material in the construction industry. Cement production requires large amounts of energy and has a major role in environmental pollution and emissions of greenhouse gases. Reducing the consumption of cement is one of the ways to protect the environment. Increases in the use of natural aggregate causes the environmental destruction. On the other hand, the waste industrial and by-products materials can be hazardous for the environment. In this review, the majority of natural and industrial wastes used in concrete were briefly mentioned and described and different areas of applications have been given. These waste materials are deposited on open air spaces causing serious environmental problems. The effect of using these wastes, individually or in combination on concrete properties was discussed. This paper investigate some waste materials which are used in concrete as cement or aggregate. The alternative materials tested were, such as fly ash as binder for cement replacement, recycled fine aggregate originating from mixed construction and demolition waste and steel slag as coarse aggregate.

Keywords: Concrete, Industrial waste and by-products materials, Economy and environment

ÖZET

Beton, özellikle çimento inşaat sektöründe en yaygın kullanılan yapı malzemesidir. Çimento üretimi büyük miktarda enerji gerektirir ve çevre kirliliğine sebep olmaktadır. Çevreyi korumanın yollarından biri, çimento üretiminin azaltılmasıdır. Ayrıca çimento veya beton ham maddeleri için doğal kaynaklardan fazla kullanılmaktadır ve böylece çevreye zarar vermekteyiz. Öte yandan endüstriyel atıklar ve sanayi yan ürünleri de artmakta ve bu atıklar arttıkça çevre için tehlikeli olabilir. Bu maddelerın betonda kullanılması ile, doğal kaynaklardan daha az kullanılmakta ve çevre kirlenmemesine sebep olmaktadır. Böylece atıkların depolanması azalır ve çevre sorunlarını azaltmada önemli faydalar sağlar, özellikle CO2 emisyonları da azaltmaktadır. Bu derleme makalede betonun agregası olarak veya çimentonun bir kısmı olarak (hatta klinkerde) bu atık ve alternatif maddeler kullanılmaktadır. Bu atıkların isimleri ve farklı alanlarda kullanılmasından kısaca söz edilmiştir.

Anahtar sözcükler: Beton, Atık ve ikincil maddeler, Ekonomi ve çevre

1. Introduction

Construction industries in many countries witnessed a rapid growth. Concrete is the most widely used building material in the construction industry. Firstly, cement production requires large amounts of energy and have a major role in environmental pollution and emission of greenhouse gas. Reducing the consumption of cement, utilization of natural materials and mineral additives are the ways to protect the environment. Secondly, aggregates are considered as one of the main constituents of concrete since they generally occupy 60% to 75% of the concrete volume and play an important role in concrete properties (1). It is estimated that in the near future, the concrete industry globally will consume 8–12 billion tons annually of natural aggregates after the year 2010

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(2). This growth is jeopardized by the lack of natural resources that are available and causes the environmental destruction. Closed-loop recycling of industrial waste as aggregates is the best sustainable method in order to compensate the lack of natural resources and to find alternative ways of conserving the environment. With increasing environmental pressure to reduce waste and pollution and to recycle as much as possible, the concrete industry has begun adopting a number of methods to achieve these goals (3).

In the other hand, there has been a rapid increase in the industrial waste production. Most of the waste do not find any effective use and cause a waste disposal crisis, thereby contributing to the health and environmental problems. Waste management is a major challenge throughout the world for environmental protection and natural resources conservation. In the last few decades, there has been a rapid increase in the waste production due to the exponential growth rate of population (4), Most of the waste do not find any effective use and cause a waste disposal crisis, thereby contributing to the health and environmental problems (5) so recycling of industrial waste is a logical option to manage this problem. It has been observed that some of these wastes have high potential and can be utilized as the substitute of raw materials in the construction industry. Iron and steel wastes are the most common of these materials. Iron and steel industries represent one of the major constituents of industrial solid waste (6). Scale, granulated slag, and steel chips and other are industrial wastes in the iron and steel industries and cause a nuisance both to the health and environment when not properly disposed of. The increasing environmental pressure to reduce waste and pollution and to recycle as much as possible, have been focused on the reduction of waste production and recovery of usable materials from waste as raw materials as well as recycling of waste as raw materials (4); So the concrete industry has begun adopting a number of methods to achieve these goals (7). The use of industrial solid waste as a partial replacement of raw materials in construction activities not only saves landfill space but also reduces the demand for extraction of natural raw materials (8).

2. Objective of the Investigation

The main objectives of this research are as follows:

i. feasibility of using waste materials as an additive to concrete

ii. effect of waste materials on the properties of concrete

iii. applicability of waste materials for concrete

iv. reducing the cost of concrete construction

v. reducing CO_2 emissions

vi. reducing the problem of global warming and Saving energy

3. Materials Used and Discussions

3.1. Materials

Properties of materials, which are used in the related experiments are given in table1.

3.2. By-Product and Industrial Materials

3.2.1. EAF

EAF steel slag produced which currently account for more than 40% of global steel production is still considered a solid waste by-product that needs to get rid of. Several studies have been carried out to characterize EAF steel slag with respect to its application in the construction industry, such as its attributes as an additive material (9), having high potential for expansion in the presence of cement mineral compounds (10) and its chemical reactivity (11). EAF steel slag was successfully utilized in asphalt mixtures (12). Few investigations were conducted on the possibility of EAF steel slag used in concrete (13, 14).

EAF steel slag produced in UAE possesses good properties to be used as aggregate in construction and it could be used in the production of concrete mixtures with high workability applicable in pumps and it also increases the strength of concrete in comparison to similar conventional concrete mixtures. High density of the produced concrete using EAF steel slag opens the venue for several construction applications such as aggregates for road construction (e.g. surface layer, road base and sub-base), earthworks, breakwater blocks, foundations, shoring walls, and radiation insulators among others (15).

The possibility of EAF slag being used satisfactorily in concrete has been demonstrated in several studies (14). The results show that the performance of EAF slag concretes is similar to that of a more traditional concrete in terms of its strength and slightly less in terms of its durability. The high porosity of EAF slag is an obstacle to making a concrete resistant to freezing. Eventual improvements in this field could be further analyzed by adding specific admixtures.

Table 1: Chemical composition of cement and other materials

Element	Cement	Sand	Water	Steel chips	Scale	Granulated slag
H	-	-	0.11	-	-	-
O	52.25	49.48	0.89	-	30.19	59.09
Al	2.55	6.04	-	-	-	6.19
Si	11.75	34.23	-	-	-	8.19
Mg	2.43	0.81	-	-	-	3.48
Fe	0.77	2.53	-	60.04	67.19	11.22
Na	-	4.03	-	-	-	-
C	-	0.46	-	-	-	-
S	1.34	-	-	-	-	1.58
Ca	23.66	2.42	-	-	-	8.9
Pb	-	-	-	-	-	0.56
Cu	-	-	-	6.78	0.51	-
Cr	-	-	-	25.05	1.41	-
Ni	-	-	-	7.91	0.55	-
Others	5.25	-	-	-	-	-

The possibility of partially substituting natural aggregates with Black/Oxidizing Electric Arc Furnace (EAF) slag in concrete production showed that high substitution ratios of coarse natural aggregates are possible without decreasing mechanical properties of concrete. Conversely, replacement of fine natural aggregates with recycled ones seems feasible at lower substitution ratios only. The presence of calcium and magnesium oxides in the slag does not seem to represent a limit for durability of concrete, due to their stabilization in a crystalline lattice (16).

3.2.2. EAFD

Electric arc furnace dust (EAFD) is one of the by-products of steelmaking industry which has been classified as hazardous due to containing some heavy metals such as zinc, cobalt, copper, lead or cadmium. Through mixing it with asphalt cement observed that while the penetration and ductility were decreasing with the increase of EAFD concentration in the binder, specific gravity, softening point, flash point, fire point and rotational viscosity were increasing. From the environmental point of view, the stabilization -solidification of EAFD by mixing it with asphalt would be an excellent option to get rid of this hazardous material to be used in road construction. It has been concluded that the results are promising to use the EAFD for road construction (17). it is possible to use additives to improve the performance of asphalt cement mixtures. The EAFD–asphalt binder would be more suitable for cold weathers as the penetration was increasing with the increase of % EAFD by volume of binder. According to the obtained results of penetration at 15% and 20%, the mixtures would be suitable for crack filling of flexible and rigid pavement as well as for roofing (17).

3.2.3. Lead–Zinc Slag

Granulated lead–zinc slag is taken into consideration specifically because of its suitable particle sizes for use as the sand replacement in concrete. Additionally, examined granulated lead–zinc slag has a high density (about 3.86 g/cm3) allows them to be used as heavy aggregates. Results indicate that the concrete mixed with granulated lead–zinc slag (GLZS) as a sand replacement have better strength. By data from concrete specimens with and without lead, it was observed that, if the powder of lead with 90% ratio of lead-to-cement by weight is added to concrete mixture, the compressive strength of concrete reaches a maximum value and concrete can be a suitable shield against gamma-ray (18).

3.2.4. Granulated Blast-Furnace Slag

The tests results of concrete with steel chips and scale waste as a partial replacement for sand obtained that the concrete mixed with steel chips have better strength than conventional concrete, while in the case of concrete mixed with scale in excess of 25%, the strength becomes deteriorated (19). Test results by (20) explored the possibility of using metallurgic slags (granulated and air-cooled) in making blended slag cement with conventional Portland cement showed that the compressive strength of blast furnace slag aggregate (BFSA) concrete was approximately 60–80% higher than that of traditional concretes (21).

3.2.5. Fly Ash and Ground Granulated Blast-Furnace Slag

They study on the influence of the combination of fly ash and ground granulated blast-furnace slag on the properties of high-strength concrete. The results indicated that their application can improve both short- and long-term properties of concrete. Explored the possibility of using metallurgic slags (granulated and air-cooled) in making blended slag cement with ordinary Portland cement. The results indicated that slag could be used with slight modifications as non-structural concrete (20). Chemical composition of cement and ındustrial waste and by-products materials mentioned in table 2.

The experimental work by (3) on the use of low CaO unprocessed steel slag in concrete as fine aggregate indicated that when optimum values are used, the 28-day tensile strength of concrete is improved by 1.4–2.4 times and the compressive strength is improved by 1.1–1.3 times depending on the replacement ratio and the grade of concrete.

The best results are obtained for replacement ratios of 30–50% for tensile strength and 15–30% for compressive strength. concrete containing copper slag as fine aggregate exhibited similar mechanical properties as that containing conventional sand and coarse aggregates. (21) Studied the use of blast furnace slag aggregate (BFSA) to produce high-strength concretes. Their results showed that the compressive strength of BFSA concretes was approximately 60–80% higher than that of traditional concretes. (22) carried out a study into the strength properties of concrete incorporating coal bottom ash (CBA) and granulated blast furnace slag (GBFS), and concluded that replacement of (GBFS) and (CBA) as fine aggregate in concrete generally decreases the compressive strength. (6) presented an extensive data on effects of replacements of sand with waste iron on the properties of concrete. The compressive strengths and flexural strengths were higher than the plain concrete mixes. (23) Stated that, slag fines may be used as a substitute for sand without any deleterious effect. Utilized an industrial solid waste produced from the iron and steel industry (24). The results confirmed that concrete mixes made with the waste material gave a higher modulus of rigidity, higher rebound number and higher chemical resistance towards the exposure to acids/salts solutions as compared with conventional concrete mixes. (25) examined durability properties of concrete containing 50% and 65% slag. They found that initial water curing of about 7 days prior to exposure to a drying environment is essential to minimize the damage to microstructure that influences the durability of the slag concretes. The data also show that even when exposed to an aggressive environment, slag concretes have a refined pore structure compared to normal concrete and a better resistance to deterioration.

Table 2: Chemical composition of cement and other materials

Content (%)	Alwaeli	Alsheyab & Khedayw	Etkisi., et al., 2011	Etkisi., et al., 20112	Guney et al., 2010	Maslehuddin, et al., 2011	Maslehuddin, et al., 2011	Manso, et al., 2006
Element	**cement**	**EAFD**	**YFC**	**Cem I 42.5R**	**WFS**	**Silica fume**	**fly ash**	**EAF slag**
Fe_2O_3	5.83	32	0.96	3.78	0.25	0.4	4.6	-
ZnO	-	29			-	-	-	-
Al_2O_3	4.48	1.28	13.6	4.33	0.8	0.4	25.2	7.4
Cu_2O	-	0.7			-	-	-	-
SiO_2	22.9	4	42.9	20.52	98	92.5	52.3	15.3
$CaSO_4$	-	3.43	-	-	-	-	-	-
$CaCl_2$	-	1.91	-	-	-	-	-	-
CaO	59.4	1.4	34.7	64.77	0.035	0.5	10	23.9 (0.45 free)
NaCl	-	5.79	-	-	-	-	-	-
K_2O	-	2.7	0.84	0.54	0.04	0.4	0.1	-
MgO	5	4.66	5.83	1.26	0.023	0.9	2.2	5.1(~1 free)
SO_3	2.41	-	0.2	2.3	0.01	0.5	0.6	0.1
CL^-	-	-	0.02	0.0078	-	-	-	-
Na_2O	-	-	0.66	0.23	0.04	0.1	0.1	4.5

3.2.6. Copper Slag

Investigated that the concrete mixes made with waste iron had higher compressive strengths and flexural strengths than the conventional concrete mixes (6). the effect of using copper slag as a replacement of sand on the properties of high performance concrete (HPC) (26) showed that there is a slight increase in the HPC density of nearly 5% with the increase of copper slag content, whereas the workability increased rapidly with increase in copper slag percentage. The addition of up to 50% of copper slag as sand replacement yielded comparable strength with that of the control mix. However, further additions of copper slag caused the reduction in the strength due to an increase of the free water content in the mix.

3.2.7. Steel Slag and Fly Ash

The results of steel slag and fly ash in concrete showed that the use of fine construction and demolition waste aggregate increases porosity in concrete and also reduces strength and durability, while its combination with steel slag aggregate partly recovers strength and durability loss. Concrete with mixed construction and demolition waste as fine aggregate and steel slag as coarse aggregate reached 30 Mpa 28-day compressive strength and showed adequate durability for low-grade applications. Also, 50% cement replacement with high calcium fly ash and use only of steel slag and recycled aggregates resulted in concrete of adequate strength and considerable environmental gains.

The effect of limestone dust on the properties of asphalt cement and shown that limestone dust caused a decrease in the penetration and the ductility values with the increase in dust concentration in the binder (26).

EAF slag aggregate increases and fine CDW decreases concrete strength (27). The softening point and the specific gravity were increasing with the increase of limestone dust concentration in the binder.

3.3. Other Wastes

3.3.1. GRF and GRF and Olive Husk

The use of giant reed ash (GRA) and air-dried giant reed fibers (GRF) to partially replace sand in concrete mixes results revealed that at 28 days curing, the compressive strength increased up to 7.96% and 2.47% using GRA and GRF, respectively to replace sand by 7.5% by weight. compressive strength values of giant reed modified-concrete vary depending on the grain size distribution of the GRF and GRA aggregate (28). The use of giant reed ash and air-dried giant reed fibers to partially replace sand in concrete mixes showed the compressive and flexural strengths decreases with increasing the giant reed ratio at all curing aging (28).

The effect of olive husk on properties of bituminous concrete showed that the olive husk material improved workability and stability and reduced the optimum binder content of bituminous mixes.

3.3.2. Sulfonated Naphthalene Formaldehyde Condensates

Sludge water with a total solids content of less than 6% is suitable for use in the production of concrete with acceptable strength and durability.

3.3.3. Wood Ash

Wood ash is the inorganic and organic residue remaining after the combustion of wood and wood products such as chips, sawdust, bark, etc. Approximately 70% of the wood ash is being landfilled, around 20% is being used as the soil supplement, and the remaining 10% is being used in miscellaneous applications. wood ash influences the workability of concrete in replacement to cement and showed that mixtures with greater wood ash content require a greater water content to achieve a reasonable workability. They reported that wood ash exhibited pozzolanic properties and that mixture containing 20% wood ash had higher strength than 10% wood ash content due to the presence of silica in wood ash responsible for the establishment of adequate hydration products in concrete. Wood ash partial replacement of cement adversely affects the slump of the concrete, Water absorption capacity of the concrete increases with increase in wood ash content, Strength properties of concrete mixtures decreases marginally with the increase in wood ash contents but increases with age due to pozzolanic actions (29).

3.3.4. PWC (modified zeolite)

Use of zeolite in improving concrete properties can be enhanced if modified so that the cation exchange of the modified product is greatly increased. PWC is a modified zeolite, can have the advantage of enhancing concrete strength better and also reduce the dosage of zeolite additive that will be needed. Concrete workability results showed no noteworthy difference between control samples and samples containing PWC additive. The use of PWC in concrete generally increases both early and late compressive strengths when compared to strength results of the command. The PWC additive on concrete strength.

Improves significantly when it is utilized in conjugation with the FA. The oxygen permeability of concrete improved only when PWC additive was used in conjugation with the FA. PWC additive improves concrete porosity and sorptivity but further effective reductions in the properties are respected when the PWC is used together with the FA. Outcomes show that PWC additive is most efficient when applied in the presence of FA (30). The writer looks at the effects of minimizing the economic consumption of cement replacing it with waste additives, on the concrete durability. The depth of carbonation is adopted as the possible measure of durability (31).

3.3.5. Recycled fine ceramic & coarse mixed aggregates

High performance concretes were produced using fine ceramic aggregates that have been obtained from building demolition and also from the ceramic industry, The results showed that concrete produced with up to 30% of high performance concretes achieved similar or improved mechanical and durability properties to those of conventional concrete. Concrete made with up to 20% of coarse mixed aggregates achieved similar compressive strength to the high-performance conventional concrete of 100 Mpa. At 180 days of curing the concretes produced with up to 50% coarse mixed aggregates obtained low corrosion risk. the disparity in water absorption between ceramic and natural aggregate points towards the main trouble with the role of ceramic aggregates in the production of concrete that does not lose in strength, workability or durability.

The usage of ceramic waste material as fine admixtures has positive values as an additional binder that could be really useful in HPC. If ceramic minerals are blended with calcium hydroxide and water, pozzolanic reactions can create new compounds, therefore increasing the strength and strength properties of the concrete. In most cases the ceramic materials were used as aggregates, researchers extended the statement of long-term compressive strength, recommending the use of 50% of FCA in the substitution of natural sand for concrete production, but others showed that the replacing 20% of cement for ceramic powder did not have a significantly negative effect on the compressive strength of concrete. They Also showed that 20% of ceramic powder substitution for cement was satisfactory for achieving adequate mechanical properties and 40% were adequate for chemical resistance (32). The suitability of ceramic recycled aggregates for use in different applications proved by many writers.

3.3.6. WFS (waste foundry sand)

The effect of waste foundry sand and bottom ash in equal quantities as partial replacement of fine aggregates in various percentages (0–60%) on concrete properties, the results showed the compressive strength was observed to be in the range of 29–32 Mpa, splitting tensile strength in the range of 1.8–2.46 Mpa, and flexural strength in the range of 3.95–4.10 Mpa on the replacement of fine aggregates from 10% to 50% at the interval of 10%. Furthermore, it was observed that the greatest increase in compressive, splitting tensile strength, and flexural strength compared to that of the conventional concrete was achieved by substituting 30% of the natural fine aggregates with industrial by-product aggregates.

The inclusion of waste foundry sand and bottom ash as fine aggregate does not affect the strength properties negatively as the strength remains within limits except for 60% replacement (33). The use of industrial by-products and waste materials as fine and coarse aggregates in concrete and its effects on the different properties of mortar and concrete, confirmed that the mean values of the uniaxial compressive strength of concrete cubes after 28 days of curing was found to be of the order of 21.93 and 19.91 Mpa with mine aggregate and granite aggregate, respectively.

Evaluated the mechanical properties of conventional concrete and concrete mixes made with the pieces of concrete from demolition waste in the place of natural coarse aggregate material (34) showed that recycled concrete best matches the mechanical behavior of conventional concrete when the recycled concrete is enriched in the gravel at the expense of mortar.

The recycled aggregate concrete has a compressive strength of at least 76% and modulus of elasticity from 60% to 100% of the control mix. The effect of fine aggregate replacement with class F fly ash on the mechanical properties of concrete showed that significant improvement in the strength properties of plain concrete by the inclusion of fly ash as partial replacement of sand, and can be effectively used in structural concrete (35).

Used demolished concrete, glass, and plastic in concrete production showed that the main findings of this investigation revealed that the three types of waste materials could be reused successfully as partial substitutes for sand or coarse aggregates in concrete mixtures (36).

Investigated the properties of concretes containing waste glass as fine aggregate indicated that the flexural strength and compressive strength of specimens with 20% waste glass content were 10.99% and 4.23%, respectively higher than those of the control specimen at 28 days.

3.3.7. Coal bottom ash

Coal bottom ash is the non-flammable agglomerated ash particles formed in coal furnaces of coal-fired thermal power plants; researchers showed the feasibility of using bottom ash as a partial replacement of coarse as well as fine aggregates. Workability of concrete mainly depends on the number of fines and properties of fine aggregate in it. The particle size of bottom ash is generally smaller (75 μm) than natural river sand. The role of bottom ash as a successor of natural sand in concrete enhance the water requirement and reduce the workability. With an addition CBA in concrete, the water demand increased. the replacement of 30% sand with CBA increased the initial and final setting time. Researchers found a higher chloride permeability in bottom ash concrete than control concrete. They demonstrated that with increasing percentages CBA replacement of river sand at fixed water-cement ratio, the resistance to chloride-ion penetration of the concrete mixes decreased. Bottom ash is the potentially viable material to be used as fine aggregate to produce durable concrete; Decrease in strength of concrete is primarily due to higher porosity and higher water requirement for economic consumption of bottom ash in concrete (35,29).

3.3.8. Waste materials, such as waste vehicle tıres, fly ash, silica fume

The usage of waste materials, such as waste vehicle tires, fly ash silica fume blast furnace slag waste marble dust in concrete shown the use of fly ash is safe, because the shape of fly ash is spheral and very fine, so help to have a concrete with efficiency and workability. Fly ash can be utilized in whole segments of concrete such as raw materials, fine and coarse aggregate, binder material geotechnical, block dam, mortar, etc. Silica fume is often used as cement in concrete and increase early strength of the concrete and decrease permeability (37).

The volume of polymeric wastes such as tire rubber and polyethylene terephthalate bottles is increasing at a fast rate. The low unit weight of the rubber waste, good heat insulation, good drainage due to features such as the ability to use as aggregate in concrete. Researchers have shown improved the performance of concrete containing tire rubber and polymeric wastes and have shown improved the properties of concrete and this wastes can be used as fine aggregate in concrete (38).

3.3.9. Rubber

The study of the applicability of asphalt rubber for reducing reflecting cracking (39) and have studied the effect of oil shale ash, rubber ash, husk ash, and polyethylene on properties of asphalt cement. They concluded that penetration and ductility of the binder are inversely proportional to the increased amount of these additives in the binders. Also, the softening point of these binders is directly proportional to the added amount of additives in the binder. The specific gravity of the binder is directly proportional to the added amount of ashes and inversely proportional to the added amount of polyethylene in the binder (26).

The effect of rubber on properties of asphalt concrete mixtures showed that asphalt–rubber concrete mixtures have lower stability and higher flow than do asphalt concrete mixtures without rubber (40). Study on the effect of phosphate slimes on properties and performance of asphalt–cement and asphalt concrete mixtures showed that the increase of phosphate slime showed an increase then a decrease in Marshall Stability, air voids increased, and no improvements in the moisture susceptibility of asphalt concrete mixtures (41). Concluded that 1.0% lime slurry additive was the best additive to use with asphalt–crushed limestone concrete mix and 2.0% lime slurry additive was the best additive to use with asphalt–valley gravel concrete mixture. The results showed that the fresh rubberized concrete mixtures with increasing rubber concentrations present lower unit weights compared to plain concrete (42). Workability of rubberized concrete with coarse rubber particles is reduced with increasing rubber concentration. However, rubberized concrete with fine rubber particles exhibits an acceptable workability with respect to plain concrete.

4. Conclusions

An electric arc furnace (EAF) slag generated in a steel plant are suitable partial substitutes for both limestone (up to 38%) and clay (up to 72%) in the kiln feed (43). Results have indicated that wood waste ash can be effectively used as a cement replacement material for the production of structural grade concrete of acceptable strength and durability performances (44).

The obtained results showed that electric arc furnace (EAF) steel slag as by-products from the steel production industry is considered as an aggregate could improve fire performance of concrete in the temperature range up to 400 °c (45). Concrete made with EAF oxidizing slag as an aggregate shows good physical and mechanical properties and further study of its durability will ensure greater reliability in its usage. The use of ground granulated blast furnace slag in the manufacture of cement as a partial substitute for Portland cement clinker is a well-known practice by EN 197-1 standard (46). The studies show the feasibility and safety in utilizing waste foundry sand in cement additives (47). The possibility of EAF slag being used satisfactorily in concrete has been demonstrated (14). Published literature has shown that waste foundry sand could be very conveniently used in making good quality concrete and construction materials (35). Electric arc furnace oxidizing slag obtained from the manufacture of plain and low-alloy carbon steels can be used as aggregate in concrete following appropriate conditioning. just Special attention must be paid to the crushing process to produce a suitable grading to obtain the best results. for example, the use of steel slag as a fine aggregate has a negative impact on the workability of concrete especially for replacement ratios above 50%. I think like the other researchers that this problem can easily be taken care of by the use of admixtures (3).

The great amount of industrial waste produced all over the world implies that their recycling is presently necessary not only due to the rising cost of their landfill disposal which, in turn, is reflected in the cost of the products, but also as a consequence of the "zero-waste" objective which must be the final goal of all future human activities. Due to the suitability of using these additive materials and industrial waste with construction especially concrete and the fact that it is safe from the environmental point of view, it is recommended to conduct a study on the real application of these wastes in construction (17).

The possibility of substituting natural aggregate and cement with industrial by-product materials offers technical, economic and environmental advantages which are of great importance in the present context of sustainability in the construction sector (33). Utilization of industrial waste in applications such as aggregates substitution has threefold advantages of eliminating the costs of dumping, reducing the cost of concrete, and minimizing air pollution problems. This would also lead additional benefits in terms of energy savings, promote ecological balance and conservation of natural resources, etc. So with these explanations, we can to show that these waste and by-products materials can be used in concrete as a partial replacement of fine and coarse aggregate and as a cement also. So these materials suitably used in making structural grade concrete (35,18).

Finally, we saw natural wastes and industrial wastes and agriculture wastes can be used replacement as fine and coarse aggregate, as cement, even cement clinker. Great quantities of solid waste, agriculture wastes, natural waste and other wastes can be employed as sources of new materials in the concrete industry not only as constituents of the final products but also as components of the kiln feed, cement. Therefore, making a significant donation to a sustainable evolution. Improving hydraulic activities by adding composition adjusting material at high temperature, improving surface cementitious properties of fly ashes by dehydration and rehydration treatment, and arranging cement clinker and industrial wastes in the particle size distribution of blended cement according to their hydraulic activities, can be done.

It is also recommended adding chemical additives to concrete and cement, in that result give to have a better concrete with high properties, also, clean air and a healthy environment. For example, when using EAF slag concrete, it is important to produce appropriate mixtures to guarantee the correct level of durability. High compressive strength and low water Penetration should be the main characteristics. The results show that the performance of EAF slag concretes Is similar to that of a more traditional concrete in terms of its strength and slightly less so in terms of its durability. The high porosity of EAF slag is an obstacle to making a concrete resistant to freezing. Additive fly ash and silica fume to EAF concrete improve the durability performance of the EAF steel slag concrete. This concrete has high workability and high ductility, also high density in spit of EAF concrete use for several construction application. Eventual improvements in this field could be further analyzed by adding specific admixtures. So we need to analyzed other chemical additive for used in concrete.

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