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Dr. Haitham Shaheen
Prof, Higher Institute of Environmental Research, Tishreen University, Latakia Syria

Dr. Imad Fadel
Prof, Faculty of Civil Engineering / Tishreen University, Latakia, Syria

Naji Dayoub
PhD Student, Faculty of Civil Engineering, Tishreen University, Syria

Correspondence
Dr. Haitham Shaheen
Prof, Higher institute of environmental research, Tishreen University, Latakia Syria

A comparison of selected parameters of leachate in natural and recycled aggregates used in the design of sanitary landfills

Dr. Haitham Shaheen, Dr. Imad Fadel and Naji Dayoub

Abstract
The aim of this study is to determine the possibility of using recycled aggregates resulting from demolition and construction debris in the design of different layers of sanitary landfills instead of natural aggregates. This enables this research to be designed to avoid or minimize negative environmental impacts due to the emissions that are potentials threats that may adversely affect human beings, flora and fauna in coastal environment and estuaries.
This has been achieved by analysing the leachate resulting from recycled aggregates and comparing it with the leachate resulting from natural aggregates. Here we have implemented a number of columns made up of pvc (length of 1 meter and diameter of 8 inches). These columns have been divided into two groups, the first group consists of layers of waste and natural aggregates and the other consists of waste and recycled aggregates. After that we have compared the chemical parameters of leachate such as PH, BOD, COD, TSS and TOC between the columns groups described above and verified that the resulted values are among the permissible values. Finally, an evaluation has been carried out in terms of economic feasibility of using the recycled aggregates in the layers of landfills instead of natural aggregates

Keywords: Sanitary landfills, recycled aggregates, natural aggregates, parameters of leachate, los anglos, CBR & aggregates gradient tests

1. Introduction
The term "demolition and construction waste" is used to express a wide range of activities related to industry, construction, restoration and demolition, known as demolition and construction waste according to USEPA: As construction materials resulting from the construction or renovation of existing buildings or the demolition of old buildings or the maintenance of roads and sidewalks. (40 CFR 243.101). The rapid increase in population and urban projects is causing a frightening drain on natural resources on the planet and we are constantly generating millions of tons of demolition and construction debris. Therefore, the need for many techniques through which the use, reuse or recycling of these resources has been reduced to other usable materials, whether in the same field as in the same field or elsewhere.
The rapid growth of population and urban projects is causing a frightening depletion of natural resources and millions of tons of demolition and construction waste are being generated. The war in Syria has created large quantities of demolition waste estimated at 30 million tons according to the General Company for Roads and Bridges in Syria. Disposal of these wastes or recycling of the largest quantity. The amount of demolition and building waste is increasing significantly due to the increasing population, for example: In 2010, the amount of waste generated in the EU is estimated to be about 2.51 billion tons, of which about (859 million tons) of demolition and construction waste (34%) of total waste generated [3]. In Poland, it produces three and a half million tons annually and is in excess, but only 5% is reused, while the rest is dumped in landfills [1].
These debris require large areas of land for landfill and lead to the consumption of large quantities of fuel for transport to landfills, which contributes to increased emissions and air pollution, in addition to the economic cost of transport. Waste recycling is one of the most important components of sustainable development, which aims to convert waste from an economic environment problem to a source of raw materials.
Silva *et al*. 2014 found a small number of references to the installation and treatment of building and field debris, and that these wastes contained high levels of contaminants

(eg glass, plastic, wood). Therefore, the structure and behavior of the demolition and construction debris varies significantly according to construction projects. On the other hand, the US Environmental Protection Agency (EPA) estimated the percentage of materials in construction and demolition waste at the rates [5].

The study of Butera *et al*. 2015 analysed 29 C & D samples collected from different regions of Denmark. They analysed different elements (DOC, Al, As, Ba, Cu, Sb, Si, Mg, Se, Mn, Pb, P, and Zn). Samples were tested on distilled water in special test columns showing the value of some parameters.

The study found that there is a diversity and difference in the concentration levels of salinity compounds, depending on the age of the sample in addition to its composition of building materials. The concentration of elements (chlorine, sulphate and chromium) in salinity was found to be critical in accordance with European requirements

The study recommended a detailed sorting of the demolition and construction debris with a focus on the use of the clean, broken concrete which gives less amount of filtration and therefore its negative impact on the environment less [2].

In the study of Fransico *et al.* 2016 they designed a program to compare recycled and natural aggregates. They found based on a set of data, an economical saving of recycled materials of about 50% [4].

In Syria, the treatment of solid waste in general, and demolition, construction and rubble remains particularly primitive, and no methodology or mechanism has yet been put in place to deal with the huge debris from the rubble created by the war. In this context, we will study the possibility of using demolition and construction wastes instead of natural grafts in sanitary landfill on the chemical and economical levels.

1.1 Difficulities of the Research

1. The accumulation of rubble on the outskirts of the communities and around the cities.
2. Landfills are full and reach their maximum capacity quickly.
3. Scary depletion of natural resources as a result of the use of expensive raw grains instead of recycled grains.
4. Air pollution and increasing the proportion of sand and dust in it.
5. Groundwater pollution.
6. Exiting large areas of land from service due to the accumulation of demolition and construction waste.
7. The main problem in the research is the absence of scientifically and academically documented studies on the effectiveness of using the recycled aggregates in landfills.

1.2 Research importance

1. Finding an alternative of recycled aggregates instead of the natural aggregates for using in the landfill layers.
2. Reducing the costs paid for natural aggregates quarries by taking advantage of proven savings using recycled materials.
3. Disposal of random landfilling of demolition and construction.
4. Contribution in preparation of the database and properties of a guide and design of the waste binder using recycled aggregates.
5. The main importance of this research is that, this study is one of the few studies on the effectiveness of the use of recycled aggregates in landfills.

1.3 Research goals

1. Comparison of concentrations of leachate components resulting from using demolition and construction wastes with leachate resulting from using natural aggregates in sanitary landfills layers.
2. An economic comparison between recycled and nature aggregates in terms of their use in landfills.

2. Materials and Methods

1. Sampling of the demolition sites (samples of the block - concrete - a mixture of beton and block) and natural quarries (natural stone).
2. The implementation of laboratory columns simulating the layers of the sanitary landfill and can be controlled by the amount of spit resulting from the faucet and made of PVC length of 1 m and 8 inch diameter of real filtration and natural and other real fragility and recycled recycled residues of demolition and construction.
3. Perform the following experiments on the filtration of laboratory columns: PH- BOD5- COD-TOC- TSS- - SO4.
4. Study of changing the concentrations of different compounds of the salinity in natural and recycled stones.
5. An economic comparison between recycled quarries and nature reserves in terms of their use in landfills.
6. Samples were collected from the columns containing a spray from the demolition and construction debris and a sample of the salinity produced by the natural gravel. They were periodically analyzed in the labs of the Higher Institute of Environmental Research at Tishreen University.

3. Results and discussion

This study has proved according to the chemical results that the recycled aggregates of demolition and construction wastes can be used in sanitary landfill layers instead of natural aggregates. Economically, the use of recycled aggregates resulting from demolition and construction wastes in sanitary landfill layers is more economical than natural aggregates.clearly notified in the following tables. i.e. in table 1 it's been found that pH values in the case of using natural or recycled have been within the permissible range. BOD_5 values in the case of using natural or recycled have been within the permissible range as shown in table 2. COD values in the case of using natural or recycled have been within the permissible range as shown in table 3 TSS values in case of using of natural or recycled have been within the permissible range table 4 TOC values in the case of using natural or recycled have been within the permissible range table 5. In economic viewpoint, a comparison between natural and recycled aggregates for the design of solid landfill layers as shown in Table6 has revealed that transporting one ton costs approximately $ 1.2. Recently, the permeability tests of los anglos test, CBR the aggregates gradient have been adopted to improve the use of the recycled aggregates in sanitary landfill.

Table 1: shows PH values of natural and recycled aggregates over time

pH	Natural aggregates	Recycled aggregates	Range
At the beginning	7	6	7.5-4.5
After 4 months	6.6	5.7	
After 8 months	6.3	5.2	
After 12 months	6.2	5	

Table 2: BOD_5 values of natural and recycled aggregates over time.

BOD_5(mg/l)	Natural aggregates	Recycled aggregates	Range
At the beginning	2500	3000	30000-2000
After 4 months	2600	3300	
After 8 months	3000	3600	
After 12 months	3100	3700	

Table 3: COD values of natural and recycled aggregates over time.

COD (mg/l)	Natural aggregates	Recycled aggregates	Range
At the beginning	4700	4600	-3000 60000
After 4 months	5100	4800	
After 8 months	5150	5000	
After 12 months	5500	5600	

Table 4: TSS values of natural and recycled aggregates over time.

TSS (mg/l)	Natural aggregates	Recycled aggregates	Range
At the beginning	400	410	-200 2000
After 4 months	400	400	
After 8 months	375	380	
After 12 months	370	380	

Table 5: TOC values of natural and recycled aggregates over time

TOC (mg/l)	Natural aggregates	Recycled aggregates	Range
At the beginning	2000	2500	1500-20000
After 4 months	1900	2500	
After 8 months	1900	2400	
After 12 months	1850	2200	

Table 6: transportation cost per one ton of natural and recycled aggregates

Type of aggregates	Sand ($/ton) mm12-0	Diameter of aggregants ($/ton) mm40-0	Diameter of aggregants ($/ton) mm40-20
Recycled	4	4.5	4
Natural	8	4	7

4. Conclusion

It's been highly recommended the determination of physical properties of recycled aggregates in order to be used not only in sanitary landfill but also in paving roads

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6. References

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