Enhancing the physical and chemical characteristics of landfill leachate through a filtration system incorporating granite, iron filings, and recycled rubber waste

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Abstract:

Introduction/purpose: The use of composite filters made from waste such as granite powder, iron filings, and rubber granules for treating landfill leachate is an innovative approach that can help mitigate the environmental impact of landfill sites.

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Methods: The experiment involved assessing the performance of single-layer and three-layer filters before and after treatment. To gauge the effectiveness of each filter configuration, the permeability coefficient is calculated for every cell. Calculating the permeability coefficient for single-layer and three-layer filters is an important aspect of assessing the efficiency of the treatment process for landfill leachate. It is also essential to consider other physical and chemical parameters (e.g. color, pH, oxidation coefficient, conductivity, BOD, COD, SS, NO_4-, NO_3^-, NH_4^+, PO_4^-, and P) to assess the overall treatment efficiency and the removal of specific contaminants.

Results: The results demonstrated a decrease in both physical and chemical factors with the formation of each cell. Notably, cell 5, consisting of a three-layer filter, exhibited favorable outcomes across physical and chemical parameters as well as permeability. Conversely, cell 2, containing granite powder, exhibited the best physical and chemical parameters but performed poorly in terms of the transmittance factor.

Conclusion: These findings suggest that granite powder, iron filings, and rubber granules can serve as cost-effective filter layers for leachate treatment, helping alleviate its adverse environmental and groundwater impact.

Key words: leachate, granite powder, iron filings, rubber waste, permeability, physico-chemical parameters.

Introduction

Landfills are used worldwide for domestic and industrial solid waste disposal. They are greatly advantageous in terms of environmental protection and respect of sanitary and economic norms. Since landfills generally cover large areas, they are liable to rainfall. Thus, this leads to the generation of large amounts of leachate which is created at the bottom of landfills (Izumoto et al, 2019; Liu et al, 2022; Ishaq et al, 2023). This is due to the deterioration of waste resulting from a range of physical, chemical and biological processes (Azougarh et al, 2019; Gan et al, 2023). The inappropriate disposal of leachate substances induces the pollution of water bodies, groundwaters, (Chidichimo et al, 2020; Negi et al, 2020), and green spaces (Alizadeh et al, 2018; Brahmi et al, 2021).

The leachate treatment has seen a lot of interest recently due to leachate varied characteristics which include higher rates of organic and non-organic substances such as salts, ammonia, and minerals (Ahmadzadeh & Dolatabadi, 2018; Dolatabadi et al, 2021). The type of waste, the age of the storage zone, the location, and the climate in the burial zone are only a few of the factors that affect the content and composition of leachate (Wang et al, 2021; Suknark et al, 2023; Yu et al, 2022). Generally, recently-constructed burials are characterized by higher amounts of organic compounds and non-toxic organisms, thus minimizing leachate over time. Throughout time, organic chemicals dissolve; hence, levels of their concentrations are reduced.

There are many approaches to the leachate processing. The conventional approach relies on reducing the leachate concentration through channeling it towards sanitation stations. Alternatively, the biological treatment is carried out using water pumps for oxygen stabilization, often known as aerobic and anaerobic processes. Moreover, physical and chemical treatments of leachate are supported in landfills and mines by methods such as deposition, chemical oxidation, sintering, vibration, air removal, and coagulation (Trabelsi et al, 2023; Faheem et al, 2022; Da Silva et al, 2022; Zhao et al, 2023). Some approaches, however, proved less effective in diminishing detrimental substances. From a financial perspective, some treating approaches are known to be costly; therefore, local authorities cannot manage such higher budgets. For this reason, it is highly important to introduce an economical and an environmentally-friendly plan to handle this problem.

Bougdour et al. (2022) installed a multi-layered filter of different materials, modeled in a brick-like shape; it was formed by mixing sand with sawdust, iron filings, and a fertilizer including a limited amount of coal. The current approach was promising in reducing all contaminants. The averages for BOD, COD, nitrogen, phosphorus, and ammonia were 92.8%, 88.7%, 81.6%, 72.4%, and 97%, respectively. Reddy et al. (2020) relied on the integration of four different filtration substances - calcite, zeolite, sand, and iron filings. Consequently, they were effective in removing individual contaminants such as cadmium, copper, nickel, chromium, zinc, nitrate, and phosphate in a 24-hour trial. The first-class motor model was applicable only to remove nitrates by iron filings. Sellaf et al. (2017) among others have designed a filter composed of dam deposits and rubber granules which was promising in removing organic and inorganic materials. Balegh & Sellaf (2022) installed a filter of three different layers: rubber, ceramic powder, and geotextile. This model has also demonstrated thriving potential when physical and chemical properties are reduced.

The main objective of this work is to introduce a new approach to leachate filtration by exploiting the results of previous studies. A new filter made up of monolayers (granite powder, iron filings, rubber granules) and multilayers (the same materials but repositioned) is designed to eliminate contaminants and improve the permeability and the physical and chemical parameters of sap drainage, using composite cell filtration systems based on different residual materials. Seven filter cells were filled with layers of leftover rubber granules, iron filings and granite powder of the same thickness, changing the position of the layer each time and ensuring that the permeability of the geotextiles in the lower part of the cells was improved. They were then filled with landfill leachate. This study was designed to determine the effect of the three-layer filter element in the cells, as well as the effect of thickness stratification on various physicochemical parameters of the leachate, including permeability, color, pH, conductivity, redox potential, and carbon pollution by nitrogen and phosphorus. The economic objective is to assess the performance and suitability of the leachate treatment method at landfill sites. The study also aims to eliminate residues of rubber, iron filings, and granite and reuse them as filters for leachate treatment, thereby protecting groundwaters from pollution and preserving the environment.

Materials

Leachate

In our preliminary experiment, leachate samples were collected from the landfill site located in the city El-Keurt in the western region of Mascara in Algeria (see Figure 1): coordinates 35 ° 2 3 ′ 40 ″ North and 0 ° 08 ′ 23 East. It is located at 5 km from the province of Mascara along national road N° 06 in western Algeria. The area is characterized by low hills, sparse woodlands and medium regression. The average annual rainfall is estimated at 240 and 300 mm. As for the average temperature, it is about 28 °C and humidity ranges up to 60%.

Leachate is noticeably dark as a result of its complex chemical composition. Furthermore, it is stinky and liquid. In addition, its liquidity allows it to fuse into groundwaters. The samples were gathered daily at 8 a.m. for seven days. Once stabilized, they were placed in glass containers and stored in laboratories at a regular temperature and humidity. The final sample for the experiment was the resulting seven-day mixture of an equal size.

Granite waste is largely abundant in the region. It is also solid and possesses various forms. Granite powder was extracted from granite waste in construction workshops and then placed in a micro-Deval test device to be fragmented and crushed as shown in Figure 2. After that, it was sifted through a 2 mm sieve.

Figure 1 – Location map of the study area and granite waste powder

Figure 2 – Granite powder, scrap rubber, and iron filings

Granite powder underwent several laboratory identification tests based on standard procedures in accordance with international AFNOR standards. (NF P 94-051, NF P 94-054, NF 94-056, NF P 94-057, and NF P 94-068). The particle size distribution of this powder showed liquid limit 32 .00%, sand 2%, silt 38%, clay 60% (see Figure 3), blue color size VB = 0.22 cm^3, and specific surface SST = 4.62 m^2/g. The chemical analysis of the granite powder was conducted in accordance with NF EN 1744, and the results are presented in Table 1. The results presented in Figure 4 show that the granite powder mostly contained quartz (SiO_2), some traces of orthoclase ($NaKAlSi_3O$), and alpite ($NaAlSi_3O_8$).

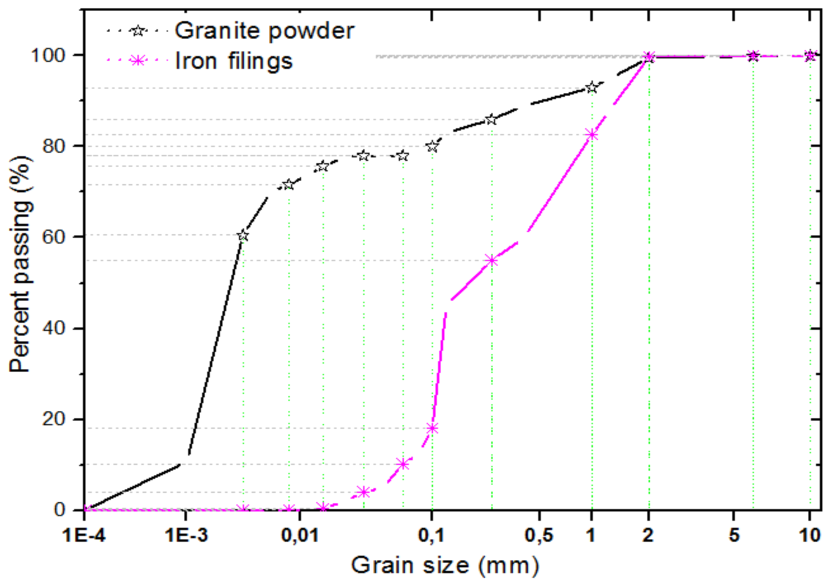

Figure 3 – Particle size distribution of granite powder and iron filings

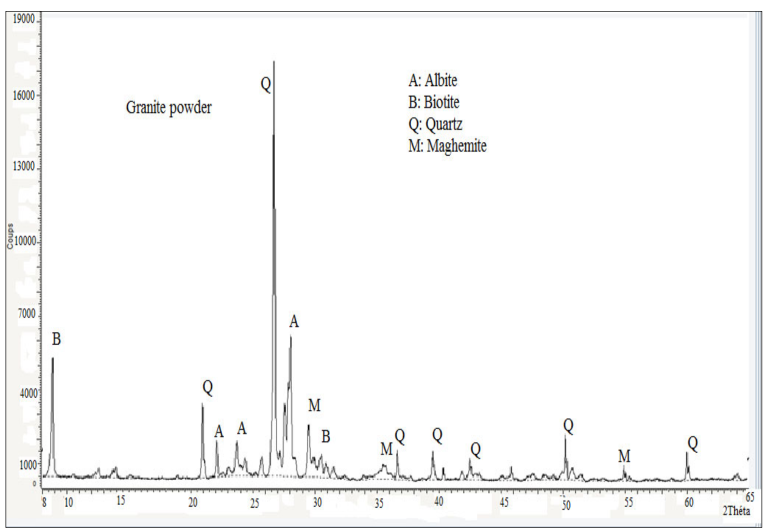

Figure 4 – XRD patterns and the identified phases of the granite powder

Table 1 – Chemical compositions of the granite powder

Property	SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	CaO (%)	MgO (%)	NaOH (%)	Cl (%)	SiO_3 (%)	$P.F_2$ (%)
Granit powder	70.23	16.55	2.63	1.33	0.44	4.74	0.05	0.02	4.01

Iron waste filings

Iron filings represent a fine powder (see Figure 2) obtained from iron cutting and molding workshops, abundantly available in all construction workshops. The iron filings extracted from the construction workshop were sifted through 2 mm sieves, then washed and then dried under 50 °C. The chemical components of the iron filings were: 93.40% iron, 2.67% silicone, 0.03% phosphorus, 0.05% magnesium, 0.01% sulfur, 0.31% manganese, and 3.53% carbon (Olutoge et al, 2016; Kim et al, 2018).

Rubber waste granulate

Rubber granulate can be obtained by mechanical processing through a crush or friction machine. We exhausted the rubber and collected the scattered fragments and then sifted the output through 02 mm sieves (see Figure 2). Rubber granulate consisted of a complex mixture of elastic plastics, polyisoprene, polyptadine, and styrene butadiene. Numerator oil (1.9%), zinc oxide (1.9%), carbon black (31.0%) and fatty acid (1.2%) are also important components in rubber scrap (Sellaf et al, 2014).

The geotextile used in the current study is non-woven. It is made of polypropylene with the estimated tensile strength of 15 kN m^{-1}, the resistance to static punching of 2700 N, the mass per unit area of 2000 gm^{-2}, and the permeability of 40 mms^{-1} (Sellaf et al, 2017).

Methods

Filtration experiences

The experiment consists of seven cells of 1000 mm PVC columns, 50 mm in diameter. Figure 5 shows the scheme of the experiment. The first cell is left empty from any layer for the purpose of observing the ratio of filtration of the geotextile layer. Cells 02, 03 and 04 were filled each with one layer to a height of 600 mm (granite powder layer, iron filings layer and rubber granule layer), respectively. The remaining cells - 05, 06 and 07 - are equally filled in three layers at 200 mm height.

The position of the layers for each cell was taken into account. The positioning is depicted in Figure 5.

The cells are positioned vertically so that they flow naturally and then all cells are fed with leachate through a separate tank placed above the cells with a capacity of 4,000 ml.

The leachate flows for 30 minutes on all cells until they are saturated and then the filtration results are collected for each cell.

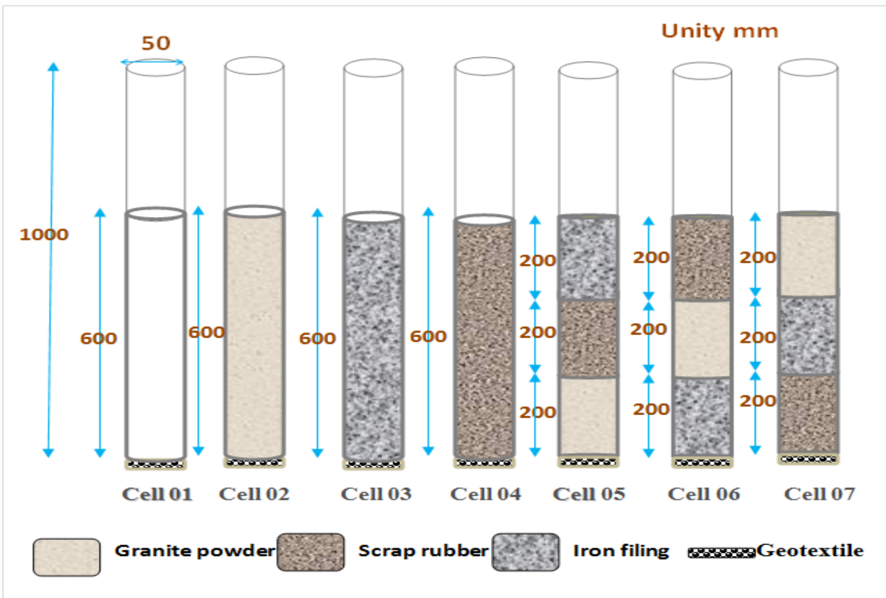

Figure 5 – Schematic representation of the apparatus for the loaded soil-geotextile filtration test

The examination and study of the cell samples are carried out for different aspects: "Color, pH, electrical conductivity (EC) and total suspended solids (SS), dissolved oxygen (DO), chemical oxygen demand (COD), biological oxygen demand (BOD), ammonia (NH_4^+) nitrate (NO_3^-), phosphate (PO_4^-), and phosphorus (P) ", based on the international standards for the analysis of water and liquid waste as shown in Table 2.

Table 2 – Parameters and methods

Parameters	Reference	Standards
pH	pH	NF T 90-008
Conductivity	EC (µs/cm)	NF EN 27888
Dissolved oxygen	DO(mg/l)	NF T 90-106
Biochemical Oxygen Demand	DBO(mg/l)	NFT 90-103-10
Suspended solids	SS(mg/l)	NFT 90-105
Phosphorus	P(mg/l)	NFT 90-042-01
Nitrite	NO_2^-(mg/l)	NF EN ISO 13395
Nitrates	NO_3^-(mg/l)	NF EN 26777
Ammonia	NH_4^+(mg/l)	NF T 90-015

Results and the discussion

The major elements found in granite powder are Si, Al, Ca, Fe, and Mg in their oxidizing forms such as SiO_2, Al_2O_3, CaO, Fe_2O_3 and MgO, in addition to the metal composition of iron filing: 3.53% carbon, 2.67% silicone, 0.05% magnesium, 0.01% sulfur, 0.03% phosphorus, 0.31% manganese, and 93.40% iron as well as a complex installation of the rubber granules of elastomer (1.9%), zinc oxide (1.9%), carbon black (31.0%), and fatty acid (1.2%). All these diverse and inclusive elements result in the interconnectedness between granules, thus rendering them more effective in the leachate filtration process.

Table 3 shows the physical and chemical factors of the leachate resulting from cell number one. This cell does not contain any layer (geotextiles) and no changes in the physical and chemical factors of the leachate have been observed when compared to the leachate before filtration. This is proved by Balegh & Sellaf (2022) and Koerner & Koerner (2013).

Permeability

Water flows based on Darcy's law (Darcy, 1856) in a vertically placed porous medium: the test cell can be considered as a cylindrical tube with a size of an S. In addition, this cylindrical tube is filled with porous substances: granite powder, rubber granules and iron filings in a size of an L length. Subsequently, they are rotated with distilled water at a total height of ΔH (fixed). When the medium is saturated with water, consequently, Q is the flow (m^3/s). Furthermore, k is the permeability or the hydraulic connectivity (m/s). Moreover, A is the vertical surface of the flow (m), L is the layer length (600mm), and h marks the difference between the upstream and the downstream.

Table 3 – Filtration test results for cell 01

Property	Leachate Pre filter	Cell 01(Geotextile)
pH	7.5	7.5
EC (µs/cm at 22C°)	3200	3200
Dissolved oxygen	4.11	4.11
COD(mg/l)	27000	27000
BOD(mg/l)	5600	5600
SS (mg/l)	820	820
P (mg/l)	1.08	1.08
PO_4^-(mg/l)	3.50	3.50
NO_2^-(mg/l)	1.45	1.45
NO_3^-(mg/l)	7.86	7.86
NH_4^+(mg/l)	48	48

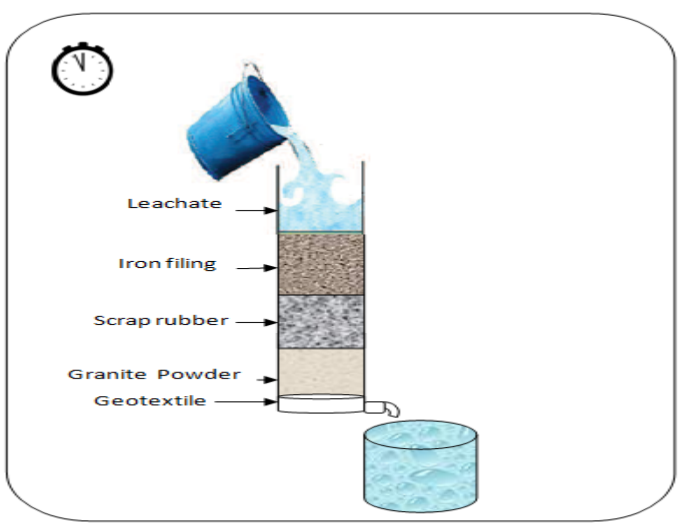

Figure 6 – Permeability test

The filter encompassing layers made up of granite powder, rubber granules, and iron filings is considered as a porous multi-layered middle barrier designed according to the Darcy permeability model (see Figure 6). The permeability coefficients were compared for all cells taking into account their composition.

As shown in Figure 7, the cell containing a single layer has the weakest permeability such as cell 02 (granite powder layer) - 1.50 mm/s, followed by cell 03 (iron filings layer) - 4.87 mm/s, contrary to cell 04 (layer of rubber granules) - 11.02 mm/s. On the other hand, the results related to the cells with three layers were correlated to the positioning of the granite powder and iron filings layers. The results were as follows: cell 05= 3.55 mm/s, cell 06= 3.07 mm/s, and cell 07= 2.89 mm/s.

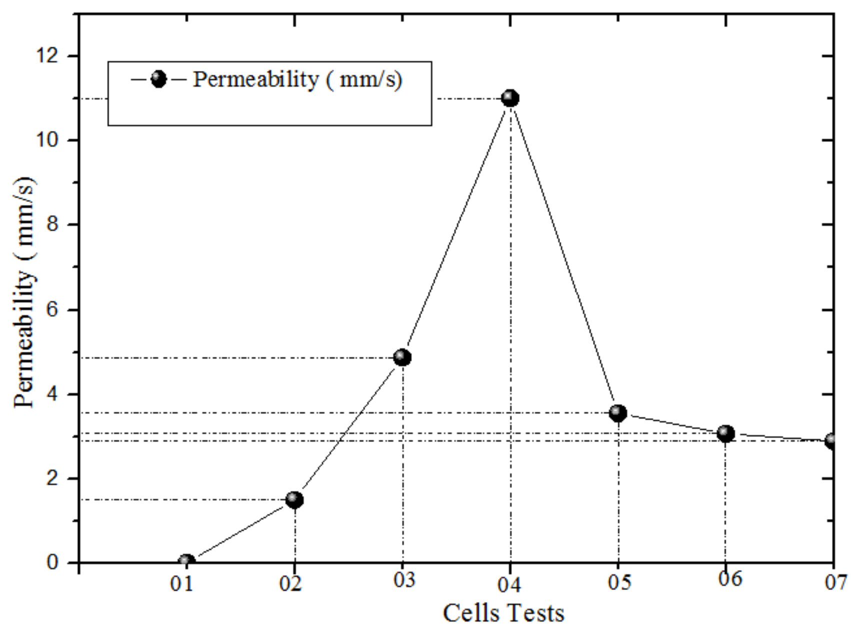

Figure 7 – Values of the permeability test (mm/s)

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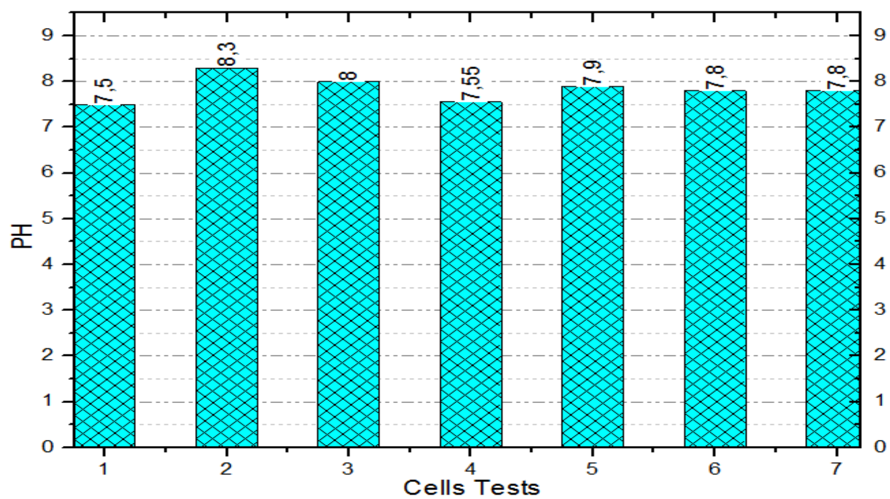

Figure 8 – Values of pH

Color

Before conducting the filtration process, the color of the leachate was dark. After flowing the leachate into the multilayer cells (granite powder layer, iron filings layer, and rubber granules layer), the color of the resulting leachate was light, though the layers were dissimilar (see cells 05, 06, and 07). Likewise, when the leachate was flown through the single layer filtration cells, there was a noticeable change in its color; it was transparent in cell 02 (granite powder layer). Yet, the color is slightly cloudy in cell 03 (iron filings layer). Similarly, it was dark brown in cell 04 (rubber granules layer).

The relevant references have demonstrated that the change in color has three main indications: the value of the hydrogen exponent, the reduction rate of COD, and ammonia. In a similar fashion, Veli et al. (2021) have proved the relationship between the pH value and the COD value besides its effect on color removal. (42% of the COD removal showed the color removal of 97% whereas removing 93% of COD demonstrated the color removal of 98%). Beyazıt & Atmaca (2021) have also argued that a maximum of 83.84% COD removal resulted in removing color from the filter material of about 84.46%. Similarly, Onn et al. (2020) succeeded in removing 45.70% of the COD and in lightening the color of the filtered water to 97.30%.

pH

When pH was tested for the filtration results in all cells from 02 to 07, it was observed that the pH values were stable between 7.5 to 7.8 in the filtration of the three-layer cells containing granite powder (see Figure 8), iron filings and rubber granules despite their different position. Unlike single layer cells, different pH values were depicted. Cell 02 showed pH=8.50 while, cell 03 demonstrated pH=8.10 whereas cell 04 has demonstrated pH=7.55.

Xie et al. (2015) have confirmed the correlation between pH and concentrations in dissolved heavy metals (Zn, Cu, Ni, Pb, and Cd). The pH of leachate increases when fewer inorganic ingredients dissolve; thus the concentration of heavy metals will be reduced, Øygard et al. (2004) and Chen et al. (2020).

Potential conductivity and oxidation

According to Figures 9 and 10, variables in the conductivity potential in addition to the oxidation factor were evident in all cells, especially in single-layer cells in which values varied from 70%, 67%, and 7% (1.24, 1.34, and 3.81 mg/l, respectively) for the oxidation factor. For the conductivity factor, the results dropped to a third or a half (1250, 1850, and 3050 µs/cm).

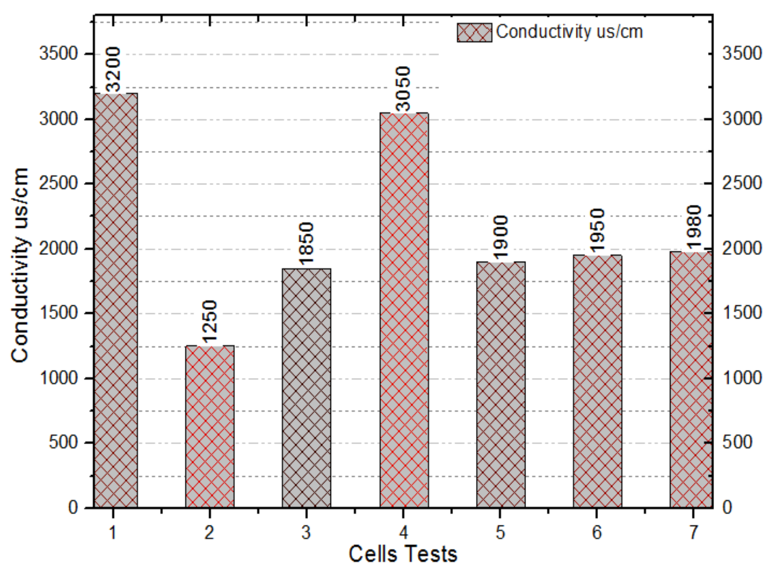

Figure 9 – Values of conductivity (mg/l)

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For the three-layered cells, regardless of the positions and the arrangements of layers, the results were approximate in terms of the oxidation conductivity factor. The results of the conductivity factor were 1900, 1950, and 1980 µs/cm in cells 05, 06 and 07, respectively. For the oxidation factor, the results were 1.42, 1.45, and 1.47 mg/l in cells 05, 06, and 07, respectively.

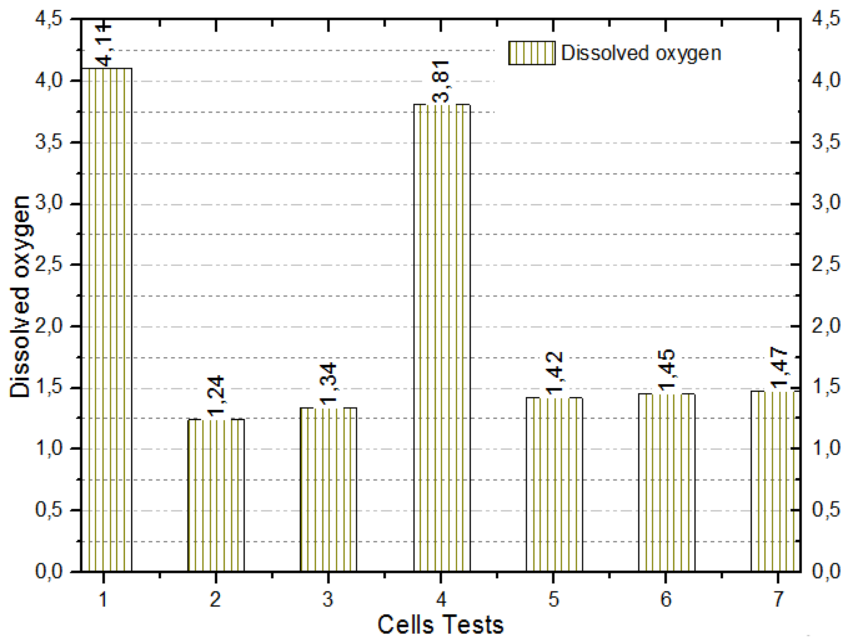

Figure 10 – Values of dissolved oxygen (mg/l)

Carbon pollution

The results presented in Figure 11 show the BOD and COD values, and the difference appears in the results depending on the cell composition, as they were close in the multilayer cells regardless of their arrangement, and were far apart in the monolayer cell results. The average BOD leachate concentrations were 1220, 2400, 5200, 2600, 2700, 2750 mg/L for cells 02, 03, 04, 05, 06 and 07, respectively.

Although the results obtained were uneven, as it was obtained that the granite powder layer achieved a 78% decrease, in contrast to the iron filings layer which achieved a 21% decrease, the decrease was estimated at 7%. For the cells containing three layers, regardless of their order, the percentage on bioxygen demand decreased from 50% to 44%.

The chemical oxygen demand values before the filtration were estimated at 27,000 mg/L. After the intracellular filtration, the change was evident as a function of cell compositions from a monolayer to tertiary layers, and the removal curve was similar to the BOD removal curve (elimination curve), where the elimination rate amplitudes in the monolayer cells were 55%, 51%, and 48 % (cells 02, 03 and 04, respectively), while in the trilayer cells the elimination rate ranged from 55% to 49%.

The values of suspended materials ranged from 350 to 720 mg/l based on the composition of each cell. The reduction ratio in the single-layer cells was 57.4% to 10.9 % while for the three-layer cells, the reduction ratio was between 45% and 43%. These findings are in line with those found by Aziz et al. (2020).

Deng et al. (2020) have built an iron filings-filled electrochemical system (IFES) to improve the removal efficiency of total nitrogen (TN) and the chemical oxygen demand (COD). The current TN removal efficiency is significant.

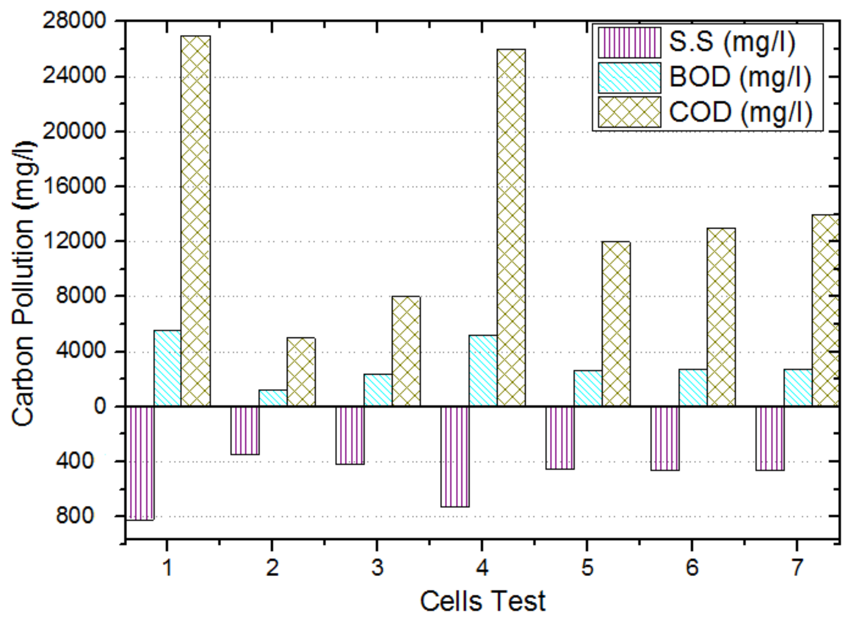

Figure 11 – Values of carbon pollution (mg/l)

Nitrogen pollution

Prior to filtration, the ammonia factor was 33 times higher (48 mg/l, and 1.45 mg/l) (see Figure 12) than the nitrate factor. The nitrite factor is normal and moderate (8.12 mg/l). After the filtration process, the reduction of the three factors in all single-layer and three-layer cells is observed. The three coefficients of the values were analogous in the three-layer cells. The ammonia values were estimated at NH_4^+ 31.51, 32.22, and 33.14 mg/l for cells 05, 06, and 07, and the nitrate values were estimated at NO_3^- 4.65, 4.71 and 4.77 for cells 05, 06, and 7. The nitrite values NO_3^- were between 0.87, 0.92, and 0.95 for cells 05, 06, and 0**7.**

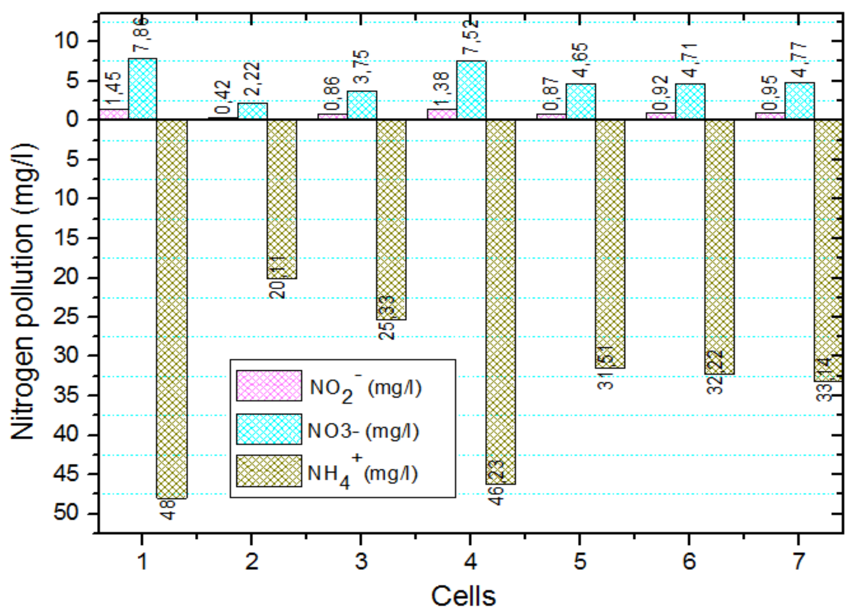

Figure 12 – Values of nitrogen pollution (mg/l)

The single-layer cells containing granite powder were promising in the removing rate for the three coefficients in which the ratio is estimated at 58% and 71 %, unlike the cell containing iron filings layer where the removal ratio was estimated between 40% and 52%. Nonetheless, the cell containing the rubber granules layer had a very low removal ratio, estimated at 41% to 48 %.

Sun et al. (2020) successfully removed some parameters using EC (electrocoagulation) added to iron powder to lose electrons and produce coagulants in situ, and the removal efficiency was 72.5% for total organic carbon (TOC), 98.5% for ammonia, and 98.6% for carbon and phosphorus. Some heavy metals and hardness were also removed.

Phosphorus pollution

Prior to the filtration process, the value of the phosphorus factor (P) was significantly lower than the value of the phosphate factor (PO_4^-), where the ratio made up a quarter (25%) (see Figure 13). From cell 06, the difference between the results of the single-layer cells and the three-layer cells is evident.

In the three-layer cells, the results were remarkably similar, and the variation did not surpass 0.04 for phosphate and 0.01 for phosphorus. Unlike the single layer cells, cell 02 containing granite powder layer depicted a higher removal value of 64% to 75 % for the phosphorus agent and the phosphate. Instead, cell 03 containing the iron filings layer demonstrated a weak removal value of 9% to 15 % for the phosphate and phosphorus coefficients.

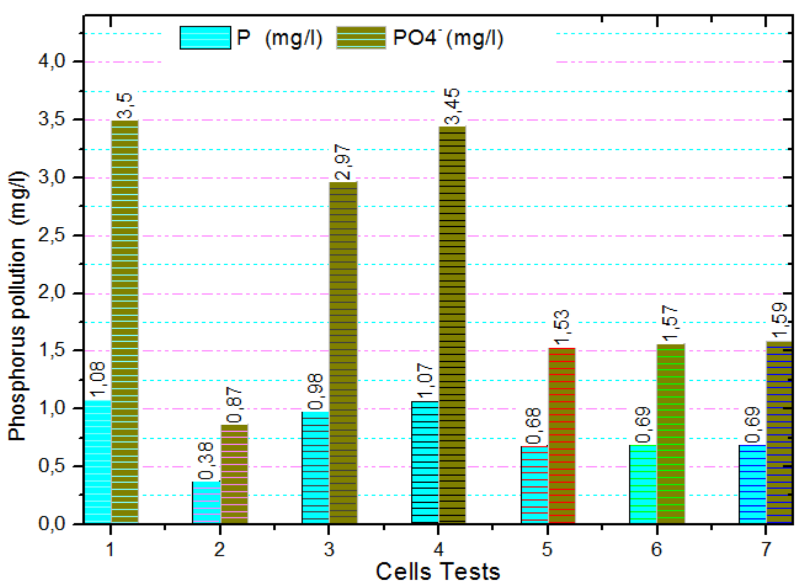

Figure 13 – Values of phosphorus pollution (mg/l)

The removal efficiency of PO_4^-, total nitrogen (TN), and total phosphorus (TP) in this study is better than the results obtained by Liang et al. (2023), where PO_4^-, TN, and TP are reduced between 89.25%, 80.64%, and 92.2%, respectively.

Conclusion

In this study, a leachate filtration system consisting of seven cells was tested and divided into two types: single-layer cells and multi-layer cells. The conclusions drawn from this experiment are limited to three branches in accordance with the permeability coefficient, the composition of the single cell, and the arrangement of layers for the permeability coefficient which is affected by the material constituting the cell in this context. Cell 04, which consists of a layer of rubber granules, has the highest permeability coefficient, while cell 02, with a layer of granite powder, has the lowest permeability coefficient. This indicates that the choice of material significantly impacts the permeability of the cell with rubber granules allowing for higher permeability compared to granite powder.

It appears that altering the arrangement or the sequence of layers within the cell had no discernible impact on the permeability coefficient. This implies that the configuration of layers in the multi-layered cell does not exert any influence on its permeability, and the permeability remains consistent irrespective of how the layers are arranged.

When using geotextile alone in the filtration of leachate, there is no change in the physicochemical parameters of the resulting water. This suggests that geotextile alone is not effective in treating leachate.

The cells with granite powder alone show better results in reducing the physicochemical parameters of leachate compared to the cells with the three layers of granite powder, iron filings, and rubber granulate. Significant improvements in various physicochemical parameters of leachate are observed in cells 02, 03, 05, and 06. For cell 04, there is almost no improvement in the physicochemical parameters of leachate.

The current study highlights the use of a three-layer filtration combination comprising granite powder, iron filings, and rubber granulate as a promising alternative to the conventional use of gravel or sand in the drainage layer of leachate collection and treatment systems. Incorporating scrap tires, iron filings, and granite waste in this manner not only offers a sustainable solution but also mitigates the challenges associated with solid waste disposal. This approach transforms waste materials into valuable resources, contributing to environmental conservation and pollution reduction.

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Mejora de las características físicas y químicas del lixiviado de vertederos mediante un sistema de filtración que incorpora granito, limaduras de hierro y residuos de caucho reciclado

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CAMPO: tecnología química
TIPO DE ARTÍCULO: artículo científico original

Resumen:

Introducción/objetivo: El uso de filtros compuestos hechos a partir de desechos como polvo de granito, limaduras de hierro y gránulos de caucho para tratar el lixiviado de los vertederos es un enfoque innovador que puede ayudar a mitigar el impacto ambiental de los vertederos.

Métodos: El experimento implicó evaluar el rendimiento de los filtros de una y tres capas antes y después del tratamiento. Para medir la eficacia de cada configuración de filtro, se calcula el coeficiente de permeabilidad para cada celda. Calcular el coeficiente de permeabilidad para los filtros de una y tres capas es un aspecto importante para evaluar la eficiencia del proceso de tratamiento del lixiviado de los vertederos. También es esencial considerar los demás parámetros físicos y químicos (por ejemplo, color, pH, coeficiente de oxidación, conductividad, DBO, DQO, SS, NO4-, NO3-, NH4+, PO4- y P) para evaluar la eficiencia general del tratamiento y la eliminación de contaminantes específicos.

Resultados: Los resultados demostraron una disminución de los factores físicos y químicos con la formación de cada celda. Cabe destacar que la celda 5, que consta de un filtro de tres capas, exhibió resultados favorables en los parámetros físicos y químicos, así como en la permeabilidad. Por el contrario, la celda 2, que contiene polvo de granito, exhibió los mejores parámetros físicos y químicos, pero tuvo un desempeño deficiente en términos del factor de transmitancia

Conclusión: Estos hallazgos sugieren que el polvo de granito, las limaduras de hierro y los gránulos de caucho pueden servir como capas de filtro rentables para el tratamiento de lixiviados, ayudando a aliviar impactos ambientales y de aguas subterráneas adversos.

Palabras claves: lixiviado, polvo de granito, limaduras de hierro, desechos de caucho, permeabilidad, parámetros fisicoquímicos.

Улучшение физических и химических свойств фильтрата, образующегося на свалках, благодаря системе фильтрации, включающей гранитную пыль, металлическую стружку и переработанные резиновые отходы

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РУБРИКА ГРНТИ: 61.13.21 Химические процессы,
61.01.94 Охрана окружающей среды
ВИД СТАТЬИ: оригинальная научная статья

Резюме:

Введение/цель: Использование композитных фильтров, изготовленных из таких отходов, как гранитная пыль, металлическая стружка и резиновая крошка для очистки фильтрата, образующегося на свалках, является инновационным подходом, который может помочь снизить воздействие свалок на окружающую среду.

Методы: В ходе эксперимента оценивались характеристики однослойных и трехслойных фильтров до и после обработки. В целях оценки эффективности каждой конфигурации фильтра для каждой ячейки был рассчитан коэффициент проницаемости. Расчет коэффициента проницаемости для однослойных и трехслойных фильтров является важным аспектом оценки эффективности процесса очистки сточных вод на свалках. Также для оценки общей эффективности очистки и удаления конкретных загрязнений важно учитывать другие физические и химические параметры: цвет, pH, коэффициент окисления, электропроводность, BOD, COD, SS, NO4-, NO3-, NH4+, PO4-,а также P.

Результаты: Результаты показали снижение как физических, так и химических факторов при формировании каждой ячейки.

Примечательно, что ячейка №5, состоящая из трехслойного фильтра, показала благоприятные результаты по физическим и химическим параметрам, а также по проницаемости. И наоборот, ячейка №2, содержащая гранитную пыль, обладала наилучшими физическими и химическими параметрами, но имела плохие показатели с точки зрения коэффициента пропускания.

Выводы: Результаты исследования свидетельствуют о том, что гранитная пыль, металлическая стружка и резиновая крошка могут использоваться как экономичные фильтрующие слои для очистки фильтрата, помогая снизить его негативное воздействие на окружающую среду и грунтовые воды.

Ключевые слова: фильтрат, гранитная пыль, металлическая стружка, резиновая крошка, проницаемость, физико-химические свойства.

Побољшавање физичких и хемијских карактеристика оцедних вода депонија путем филтрационог система који садржи отпад од гранита, опиљака гвожђа и рециклиране гуме

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КАТЕГОРИЈА (ТИП) ЧЛАНКА: оригинални научни рад

Сажетак:

Увод/циљ: Коришћење композитних филтера израђених од отпада, као што су гранитни прах, опиљци гвожђа и грануле од гуме, који служе за третирање оцедних вода депонија, представља нов приступ који може да помогне у смањивању утицаја депонија на животну средину.

Методе: Експериментом су се процењивале карактеристике једнослојних и трослојних филтера пре и после третирања. За *мерење ефикасности сваке конфигурације филтера понаособ израчунат је коефицијент пермеабилности за сваку ћелију. Израчунавање коефицијента пермеабилности за једнослојне и трослојне филтере важан је аспект приликом одређивања ефикасности процеса третирања оцедних вода депонија. Такође, важно је узети у обзир остале физичке и хемијске параметре попут боје, pH фактора, коефицијента оксидације, проводљивости, BOD, COD, SS, NO_4-, NO_3^-, NH_4^+, PO_4^-, као и P како би се одредила ефикасност процеса у целини, као и успешност уклањања специфичних загађивача.*

Резултати: Резултати су показали редуковање и физичких и хемијских фактора са формирањем сваке појединачне ћелије. Нарочито је ћелија број 5, са трослојним филтером, показала пожељне резултате у погледу физичких и хемијских параметара, као и пермеабилности. Насупрот томе, ћелија број 2 са гранитним прахом имала је најбоље физичке и хемијске параметре, али се показало да је слаба у погледу фактора пропусности.

Закључак: Наведени резултати наводе на закључак да гранитни прах, опиљци гвожђа и гумени гранулат могу да буду исплативи филтрирајући слојеви при излуживању оцедних вода и да помажу да се смањи њихов утицај на животну средину и подземне воде.

Кључне речи: оцедне воде, гранитни прах, опиљци гвожђа, гумени отпад, пермеабилност, физичко-хемијски параметри.

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