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REINVESTIGATING USAGE OF NATURAL AGGREGATES IN DECREASING OR REMOVING ORGANIC LOAD FROM WASTEWATER

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ABSTRACT

It is necessary that industrial wastewater be treated through appropriate approaches prior to release. So far, various methods, including coagulation and sequestration, membranous processes, ionic exchange, oxidation, electrochemical, filtration, and absorption, have been employed in order to remove organic load from industrial wastewater. In recent years, it has been suggested that absorption process and usage of natural absorbents is an effective method for removing contaminants from wastewater. This study undertakes presenting a comprehensive report on such application. The results show that Absorption by natural aggregates is a more reasonable, economical method than others. Also, availability is another advantage,

Absorption by natural aggregates is an effective method to remove dissolved metal ions form aqueous solutions, Utilizing absorbent pretreatment or aggregate modifiers increases absorption capacity on the side of natural aggregates, Using natural aggregates makes removal of organic contaminants, including polycyclic hydrocarbons, phosphates, nitrates, heavy metals, etc., more efficient, Absorption factors such as pH, contact time, absorbent mass, and absorption isotherm greatly affect absorption by natural aggregates.

Keywords: Wastewater, Natural aggregates, nitrate, phosphate

INTRODUCTION

Nowadays, treating industrial wastewater appeals to many governments and environmental experts. Such wastewater is essentially contaminated by heavy metals, dyes, halogenated hydrocarbons, nitrate, phosphate, and phenol compounds. If these are released into the environment without treatment, irreversible environmental damage can be inflicted. Hence, it is necessary that industrial wastewater be treated through appropriate approaches prior to release. So far, various methods, including coagulation and sequestration, membranous processes, ionic exchange, oxidation, electrochemical, filtration, and absorption, have been employed in order to remove organic load from industrial wastewater. Most of these have disadvantages such as needing costly equipment and operation, generating sludge or other toxic substances, and requiring vast amounts of energy and space. Consequently, effective contaminant removal is highly in need of developing a new economical method. In recent years, it has been suggested that absorption process and usage of natural absorbents is an effective method for removing contaminants from wastewater [1]. Its privileges include inexpensiveness, availability, and lack of need for reconstruction and revitalization. Cost is one of the most crucial factors in comparing absorbents. Aggregates stand among cheap available natural absorbents. They fall into either synthetic or natural categories. The latter are generated thanks to volcanic activities (namely pumice), while the former (known as leca) through processing clay in aggregate industries. aggregates are characterized by lightness, heat and sound insulation, and resistance against fire; the facts that lead to their widespread application in construction material as heat and sound insulators, as absorbents in treatment plants for potable water, in biofilms, and heavy metal removal [2].

Using natural aggregated dates back to 1969 when Roman engineers utilized them as construction material [3 &4]. However, their application in wastewater industry has interested researchers since several years ago. A review of the literature pertaining to aggregates is presented in Table 1.

Table 1: A summary of the literature on employing natural aggregates for separating and removing contaminants

Researcher(s)	Year	Comments
Elikebrokk *et. al*	**2001**	**Chitosan and natural aggregates were used to remove NOM from and to filtrate potable water. Chitosan proved to be an efficient coagulant, and natural aggregate to be a good filter, both removing a high percentage of NOM (5).**
Haque *et. al*	**2008**	**Modified leca together with iron were used to remove As V present in underground water; a high percentage of As was eliminated this way (6).**

Zarabi *et. al*	**2011**	**Efficiency of pumice modified by hydrochloric acid in treating textile industries wastewater was investigated. The result suggested feasibility of modified pumice as an inexpensive absorbent in treating Azu –a major contaminant in textile wastewater (7).**
Cusido *et. al*	**2011**	**Natural aggregates were used to examine urban wastewater plant; numerous heavy metals were eliminated. Formerly, in order to reduce organic load in sludge, drying or tablet were employed, causing damage such as advent of more toxic substances in the sludge; however, using natural aggregates was considered an initiative in removing heavy metals and toxins form household wastewater (8).**
Moradian *et. al*	**2012**	**the results showed 95% and 85% efficiency regarding removal of surfactant and organic load respectively (9&10)**
Nkanseah *et. al*	**2012**	**Leca was utilized to eliminate PAHs from water; outcome was 94-percent efficiency (10).**
Dorido *et. al*	**2013**	**Investigated treating agricultural wastewater by leca; the result revealed a 97-percent elimination of pesticide (10).**
Naseri *et. al*	**2013**	**Investigated pumice efficiency in removing nitrate from aqueous solutions; the nitrate absorbed amounted to 0.65 mg/g by each mass unit of modified pumice employed (10).**
Kalhori *et. al*	**2013**	**Modified leca, magnesium chloride, and hydrogen peroxide were used to eliminate water soluble toxic chrome; favorable results were achieved thorough modifying leca surface (2).**

Many researches and experiments have been conducted on the application of natural aggregates in water and wastewater treatment industry. This study undertakes presenting a comprehensive report on such application.

DISCUSSION

As mentioned in *Table 1*, natural aggregates are used to remove organic load from wastewater containing heavy metals, polycyclic aromatic hydrocarbons, surfactants, nitrates, colors, etc. through absorption. To fully perceive their mechanism and function, the following parameters are notable.

Effective Parameters regarding absorption

1. *Modification of absorbent or using pretreatment in absorption process*
2. Surface modification of the absorbent, through various techniques, results in further pores, change in surface charge, increased ionic exchange, and eventually higher efficiency.
3. *pH of the absorbent (pH $_{pzc}$)*
   PH $_{pzc}$, which is a significant factor, indicates the point where charge across an absorbent's surface tends to zero. Above this point this surface holds negative charge, while below it the charge is positive.
4. *Initial concentration of modifier*
   Initial concentrating of the modifier needs to be at a level inducing charge, either cationic or ionic, on the absorbent's surface.
5. *Mass of absorbent*
6. *Contact time*
7. *Kinetics equations*

In environmental engineering, chemical processes are usually designed based on best contaminant removal model. Hence, when chemical processes are designed, contaminant removal kinetics should be closely examined.

8. *absorption Isotherm*
   Isotherms are normally used to anticipate and evaluate absorption capacity. Freundlich and Langumuir isotherms are among most frequent models to quantify absorption of dilute organic chemicals from aqueous solutions.
9. *Initial organic load*
   These are considered effective factors in absorption; however, in experiments and studies some of them are employed based on their significance (2, 3, 8, and 11).

CONCLUSIONS

1. Absorption by natural aggregates is a more reasonable, economical method than others. Also, availability is another advantage.
2. Absorption by natural aggregates is an effective method to remove dissolved metal ions form aqueous solutions.
3. Utilizing absorbent pretreatment or aggregate modifiers increases absorption capacity on the side of natural aggregates.
4. Using natural aggregates makes removal of organic contaminants, including polycyclic hydrocarbons, phosphates, nitrates, heavy metals, etc., more efficient.
5. Absorption factors such as pH, contact time, absorbent mass, and absorption isotherm greatly affect absorption by natural aggregates.

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