



## Zeolite and Removal of Ammonium in Sewage



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### Abstract

One of the problems that represent a nuisance for the citizens of the city of Portoviejo in Ecuador is related to the treatment to the waste water, since in their majority they are poured as effluents to the river Portoviejo. This situation causes at different times of the year that there is an unpleasant smell that affects the environment. In the work technical solutions are analyzed to avoid such annoyance; but the most important thing is to avoid contaminating the river waters with the dumping of pollutants that alter the quality of the water. A variant aimed at ammonium removal is proposed using zeolite filters.

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## 1. Introduction

Zeolite is a mineral with different properties. It is of volcanic origin, they have called it the magic material for the different applications and uses that is being given to it worldwide. In the human body is used as an activator of the immune system, cleans the blood, the lymphatic system, the glandular system; Cleans and activates the cellular system and is effective in the homeostasis of all functional systems of the organism [1].

Zeolite has been used in different processes, for example in the health of man for some specialists cure almost everything and this is because this product eliminates the causes of various modern diseases and cancer that often comes from metal poisoning Or minerals, carbon monoxide from the environment, pesticides that come in food and other chemical agents used in the daily life of the home or work.

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Since the last century zeolite has been used at the industrial level for water and air purification [2], as a purifier in the food industry, for agricultural fertilization and as a mineral supplement in animal nutrition [3]. It has a very versatile use ranging from industrial use, health, environment, among others.

In Ecuador also has different types of use, the great pharmacists are using this mineral of volcanic origin for the elaboration of products within the naturalistic line, for the cleaning of the human organism; Both for vegetables, and for the detoxification of blood.

## 2. Materials and Methods

Basically the research has been developed using the method of field work, being able to combine the scientific method to obtain new knowledge in the field of social reality, in order to study the situation of wastewater in the city of Portoviejo and possibilities Of using the zeolite for the removal of ammonia. This method made it possible to diagnose the existing needs and problems in order to handle data more safely and efficiently. The exploratory method was used to describe the situation of wastewater in the city of Portoviejo and described the common and known problems Be able to establish to what extent they may be influencing the pollution of the river, as well as the use of zeolite to reduce the ammonium content of these waters. Theoretical methods were used as the deductive, logical historical to interpret and examine the relationships between the residuals and to analyze their polluting potential in the city of Portoviejo and the possibilities of their reduction through the use of zeolite in the processes of ammonia removal from time Previous, in different places.

## 3. Results and Discussions

### 3.1 Properties of zeolite

Zeolite is a natural mineral that has negative charge, acts as a magnet to remove toxins from the body and trap them within the molecular structure that forms, to expel them as debris without any side effect. It is safe and extremely effective, also balances the pH of the body thus preventing the growth of foreign cells and boosting the entire immune system. Research carried out has shown that pH plays an important role in ion exchange experiments on zeolites [4].

It is a cleaning agent of heavy metals, giving support of the immune system 100% bioavailable, ecological and natural. It is a mineral (clinoptilolite), formed naturally from ashes and sea water, which is also present in the Andean folds [5]. Formerly used in Asia (China, Russia, India), as a natural supplement to promote health and organic welfare.

The five most common zeolites in sedimentary deposits are: analcime, clinoptilolite, heulandite, laumontite and phillipsite. Other existing deposits, of sufficient size and purity to be of commercial value, include chabazite, erionite, ferrierite, modernite natrolite and wairakite. The deposits are found in the United States, Japan, Italy, England, Cuba, Bulgaria, Yugoslavia, Korea, Mexico and Germany [6].

Zeolite for its cation exchange capacity is an excellent support of these. The mechanism of removal is by adsorption-oxidation of these metals on the surface of the oxide layer covering the zeolite grain [7].

The investigations with natural zeolites and their applications in the work related to the environment are increasing due to its properties and significant incidence [8].

In Ecuador, the volcanic rocks of Jama are found, which have a basaltic andesitic / trachiandestic composition and belong to the calcoalcaline series with high K. Their geochemical characteristics are typical of continental arc environments, with impoverishment in Nb, Ta and P and relations  $La / Ta > 30$  and  $Ba / Nb > 25$  [9].

Zeolite is considered to be the very powerful detoxification agent and the only known non-drift-like reactions [10]. It is a detoxifying mineral of soils, sewage and served.

Natural zeolite is the best natural filtration system available for water treatment. It offers a superior effect to the sand or the carbon filters, resulting in purer water with better productivity and requiring less maintenance. The highly porous structure of zeolites can capture contaminating particles up to 4 microns.

### 3.2 Contamination of aquifers

The current situation of uncontrolled pollution in rivers, canyons and estuaries by urban, industrial and mining effluents can be controlled with the use of natural zeolite filters that are designed as an effective and cheap alternative for the reduction of ammonium, by adsorbing in its Structures the most common elements of wastewater such as: ammonia, hydrogen sulfide, heavy metals, among others; In addition to the retention of certain colonies of microorganisms, harmful to health [11].

The hydrographic component of the Manabi territory is influenced by the crossing of the Cordillera de Chongón-Colonche and the Cordillera de Balzar, which hinders the existence of rivers flowing into the Pacific Ocean, except for the rivers Chone and Portoviejo, which are Important in winter and have a deep channel; This determines that certain areas of the province are predisposed to floods in the winter seasons of greater precipitation [12]. The river Portoviejo is born in the mountains of Paján and Puca, in the affluence of the rivers Mineral and Pata de Pájaro, in the Parish Honorato Vásquez and it ends in the bay of Charapoto, in a tourist site where there is a colony of frigates that nests in The La Boca mangrove, located at the mouth just a few steps from the spa of San Jacinto [13]. In figure 1, you can see its trajectory in the territory and how it crosses different municipalities the province.

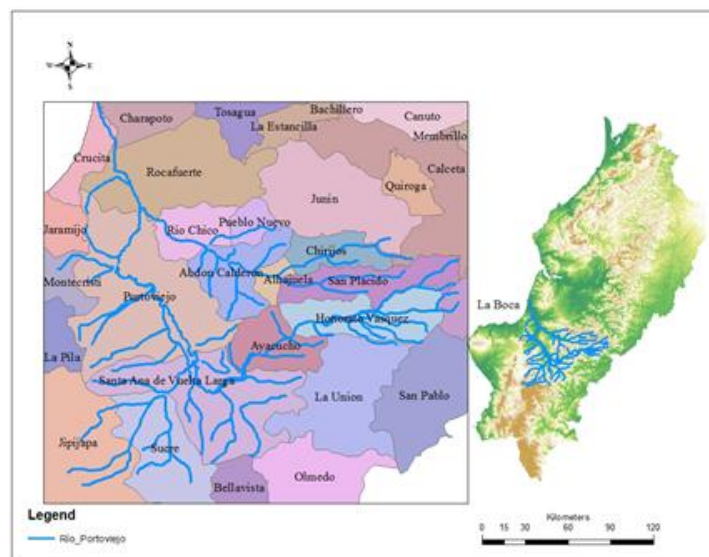


Figure 1. Portoviejo river

The river Portoviejo is the most important source of water supply in the central region of the Province of Manabí, which is crossed from East to West by the geographical accident. Formerly known as Rio Grande or also named as Rio Viejo by the settlers of the city [13].

It is currently the main source of water for more than 700,000 inhabitants of the cities of Portoviejo, Manta, Jipijapa, Rocafuerte, Montecristi, Santa Ana, Jaramijó, May 24 and part of Sucre. Some 300,000 people live on its shores, where there is an intense agricultural activity that has life in its valley, although its added value is very low. In rainy winters causes floods in the city and in the countryside [13]. Drains its waters in an area of 2108.29 Km<sup>2</sup>. The basin is constituted by 3 sub-basins and 23 micro-basins, in the range from 338 Km<sup>2</sup> to 3.5 Km<sup>2</sup>.

### 3.3 Contamination of the river Portoviejo

As an environmental object of provincial importance and all the benefits provided by the river Portoviejo, you can see that it is not isolated from the domestic waste that is discharged there. The damage falls on the populations close to rivers, streams, marshes and irrigation channels that discharge the waste directly into the river, which generates pockets of pollution limiting its own use for irrigation, domestic consumption and the tourist activity of the population. Figure 2 shows the territories that contribute effluents with contaminated water to the river.

As can be seen, the aggressions start from Santa Ana, where farmers wash coffee and other products on the banks. Then in Portoviejo the discharge of sewage from the oxidation lagoons in Picoazá takes place. Add to that the fact that dozens of families have connected their sewage pipes to stormwater collectors. This situation is observed in the sectors of the hospital Verdi Cevallos and San José Bridge, which contaminates much more because the waste receives no treatment [14].



Figure 2. Territories that contribute effluents with polluted waters to the river

In Portoviejo there are oxidation ponds that allow the treatment of municipal discharges, although at least 45 clandestine discharges to the river have been identified, which generates a significant contamination problem [15].

In the year 2012 another research affirmed that there are reliable quantitative results of laboratory analysis, which allow to conclude that from many years ago there is chemical contamination in chloride ions, nitrites and ammoniacal nitrogen, organic matter, hydrogen sulphide, carbon dioxide and carbonates, total solids. And what is more serious, highly positive results in the sediments of the river in organochlorine pesticides and organophosphates. And it is argued that although these results are from years ago, the problems persist and have probably been aggravated [16].

Other studies have shown that the water of the city of Portoviejo affects its quality due to runoff from farmland and drainage of sewage water with an important ammonium content that goes to the river.

In the work it is proposed the design of zeolite filters that can be used in areas where there are residual water spills, with the aim of reducing the ammonia of these waters before being discharged into the river of the city of Portoviejo.

### 3.4 Filters of Zeolite

The design of three types of tubular filters using different zeolite gravimetry through which the water passes, a graphic example of the proposed filters is shown in Figure 3. This system will allow decreasing or increasing the levels of zeolite, the capable or the gravimetric of the material.

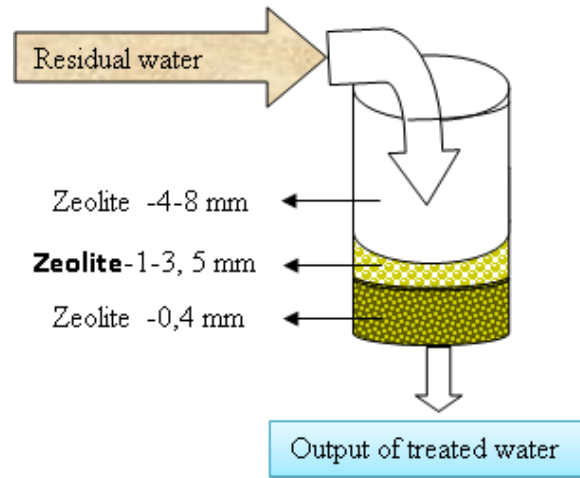


Figure 3. Zeolite filters

### 3.5 Benefits of Using Zeolite Filters

So far it is not known that in the city of Portoviejo a study was carried out using scientific methods to achieve ammonium reduction in wastewater using zeolite. The research developed can be a model that allows the removal of the ammonium content in wastewater that is discharged to the river Portoviejo, using its own materials and methods that can contribute to improve the water quality in the territory. With this proposal can reduce the environmental pollution, reducing the ammonium contents by applying a natural product friendly to the conditions of nature, which does not pollute and can be obtained in the national territory, and may represent a change in Environmental condition and water quality

## 4. Conclusion

Wastewater poses a risk to the health of people, as they have an important potential for contamination of drinking water sources, with a negative impact on the stability of society in the territory. The results of the project can contribute to a significant social impact, since it seeks to improve water quality by removing ammonia with zeolite filters of different granulometries, applying a model that is based on the use of indigenous materials that can be employed in the wastewater discharges in the Portoviejo river basin.

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### *Statement of authorship*

The author(s) have a responsibility for the conception and design of the study. The author(s) have approved the final article.

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