CONSTRUCTION OF A DRINKING WATER TREATMENT PLANT FOR THE ZENÚ INDIGENOUS COMMUNITY IN PURÍSIMA, COLOMBIA.

SUMMARY

This article presents the initial living conditions of the members of the Zenú indigenous community, among these conditions are the water supply for consumption, health, welfare and environmental conditions. This community is located in lands adjacent to the Purísima village, in which they do not have the supply of basic sanitary services (drinking water, electricity, gas, among others) for the development of life and other activities related to it. According to the above, the Zenú indigenous community lacks the necessary conditions for the development of a good quality of life, emphasizing the precarious water supply system they have, as this has brought with it different environmental, social, economic and health problems, since the liquid is not received with the quality parameters established by the Colombian technical standards. Due to this problem identified in the indigenous community, a sanitary solution was proposed, which consisted in the construction and start-up of a raw water treatment plant, in order to improve the quality of life of the inhabitants, reduce diseases, improve the development of economic activities, prevent internal conflicts, etc.

Key words: Drinking water, Indigenous community, Health, Environment, wellbeing.

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INTRODUCTION

The Zenú indigenous community is a settlement of people of indigenous descent, located in the township of Purísima, Córdoba. These lands where the indigenous community is located do not belong to them, because over time they have been affected by the Colombian armed conflict and have had to move from one place to another to avoid being victims of this conflict.

In addition to the above, the Zenú indigenous community is a vulnerable population from several points of view, including environmental, social, economic, health and welfare. This is due to the fact that the community not only has the problem of the lack of its own land, but also has sanitary problems, such as the absence of basic public services for the development of a good quality of life, which becomes a trigger for other problems, such as health conditions and integral wellbeing.

The lack of drinking water supply for the inhabitants, which is consolidated as a sanitary problem, brings with it different additional problems that affect the quality of life of the people in the community. These problems are: health problems due to ingestion of water unfit for human consumption and domestic use, investment of time in the search for the precious liquid, decrease in the economic activities of the population, social problems among the inhabitants and sanitary and/or environmental problems.

Because of this, the Faculty of Engineering of Universidad del Caribe decided to plan and develop a project to solve this problem. The project consisted in the construction and operation of a water purification plant, whose function is to supply the community of the Zenú indigenous cabildo, which currently takes non-drinking water for consumption of the entire population, this supply does not meet the quality standards and environmental standards in force in Colombia.

Zenú indigenous community of Purísima

Culture: The Zenú indigenous community in Purísima has a culture rooted in traditional customs, such as the creation of arrow cane for the vueltiao hat, creation of bracelets, among other activities. In terms of music, dances and traditional festivities. In addition to this, among the rules of coexistence are the punishments for abuse or mistreatment of women and / or children, misbehavior of the villagers, among others.

The Zenú community, through focus groups, expressed their desire to maintain their customs and to be recognized for their cultural richness, which is composed of their food, the way they paint and dress, and above all, their handicrafts mentioned above. They also expressed that life in the indigenous cabildo is very healthy and that when any of the members go astray, they are all united to guide them.

Community economy: There are several economic activities, such as laying hens and broiler chickens, chili, beans, eggplant, tomatoes, corn, cassava, among others. These activities are initially used by the community for family sustenance and after meeting the need, they are marketed. It is worth mentioning that the women work hard with the planting and must also watch over their children's education.

Figure 1: Photograph of crops in the Zenú indigenous community.

Population: The Zenú indigenous community has a population of approximately 466 inhabitants, who live in social conditions appropriate to the activities carried out by the community, such as: productive patios, raising broiler chickens and laying hens, handicraft projects, planting traditional plants for community use, planting vegetables, etc.

During the community study phase, a census was carried out to characterize the community.

During the community study phase, a census was carried out in order to characterize the population of the Zenú indigenous community. According to this census, the vast majority of the population is composed of children under 12 years of age.

is made up of children under 12 years of age, which makes the community much more vulnerable to disease due to the lack of drinking water and other environmental and sanitary conditions.

Current conditions of the environment, public services, health and wellbeing

Environmental conditions: because the Zenú indigenous community is located in Purísima, in the department of Córdoba, Colombia, a condition was created that brings with it different difficulties, one of them is the absence of basic public services such as drinking water supply, electricity, natural gas, among others.

As for the environment of the population, it can be said that it is composed of vegetation of the bush type area, fruit trees (mango, plum, orange, papaya, guanabana, guama, banana, sugar cane, pumpkin, sesame, arrow cane) among others, which give rise to the habitat of different species of fauna (Iguana, Guacharaca, Pigeon, Turkey, Reptiles, Insects) typical of the area.

This tropical forest ecosystem is of vital importance because it could be affected by the construction of the treatment plant, which must be considered from the beginning to the end of construction and implementation.

Public services: As mentioned above, the land where the Zenú indigenous community is located does not have any of the basic sanitation services, including electric power, natural gas, sewage, and potable water.

Currently, the indigenous community has a raw water pipeline belonging to Aguas de Córdoba S.A., a company that provides drinking water services. This pipeline supplies water to the community, but it is raw and therefore does not meet the quality standards required by Colombian regulations for human consumption. This raw water is used by the population for drinking, domestic, agricultural, and artisanal use, which has led to a large number of public health problems.

Health and well-being: Due to the lack of potable water in the indigenous community under study, the villagers have had to look for simple artisanal methods to remove the solids in the raw water piped in, but the water is not suitable for human consumption because the methods used by the population do not eliminate the infectious agents that the raw water may contain.

The method used by the population initially consists of adding alum to the water in order to remove dissolved and suspended solids in the liquid, then allowing time for these solids to settle so that they can be separated from the water, and finally boiling the water to improve its quality and try to eliminate possible pathogens.

Because these methods used by the community are not 100% adequate or efficient for treating raw water, there have been gastrointestinal illnesses from drinking the water and skin problems from using it for personal hygiene and domestic activities.

Diseases related to water use include those caused by microorganisms (viruses and bacteria) and chemical substances present in the water; diseases such as intestinal parasitism, dengue fever, whose vectors are related to water storage; diarrhea caused by viruses and bacteria; and others.

Land issues: It is worth mentioning that currently the population of the Zenú indigenous community is going through difficult times due to the problems they have with the use of the land where they are located, since it does not belong to the community and there is a claim by the owner of the land. This has led the community to express their concern to the city leaders in search of a solution to the problem, as they need a permanent place to live in order to be able to carry out all their economic, social, cultural, etc. activities.

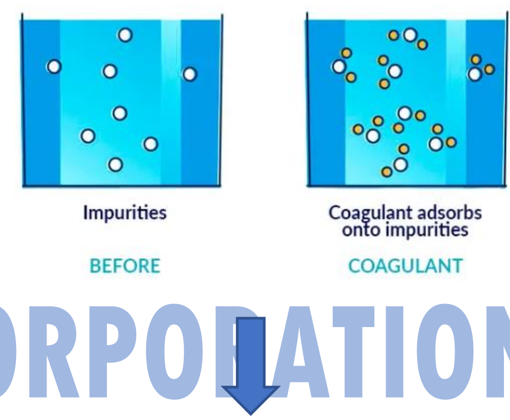
METHODOLOGY

The solution to the problem of water supply to the Zenú indigenous community was the construction and operation of a water purification plant. This treatment plant would consist of each of the processes necessary to carry out the treatment of drinking water to the raw water currently available to the inhabitants of the community.

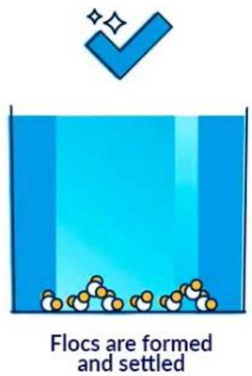
These processes are: coagulation, flocculation, sedimentation, filtration and disinfection. Each of these processes will be carried out in assemblies with tanks, pipes, hydraulic accessories, among others, which will allow obtaining potable water suitable for human consumption at the end of the process.

The following is a description of the water potabilization process:

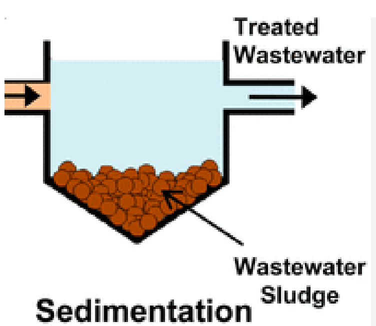
Coagulation process: Coagulation is achieved by rapid diffusion of the coagulating substances in the water under treatment, using means of rapid agitation. After neutralization of the colloidal particles, i.e. once colloidal destabilization has been achieved, the particles formed are ready to agglomerate. This agglomeration of the discharged particles, now aided by slow agitation, is the objective of flocculation. Flocculation is related to the transport phenomena of the particles within the liquid, which are the ones that cause the contact of the coagulated particles.



Flocculation process: In flocculators, which can be mechanical or hydraulic, the mixing between the chemical and the colloid that produces turbidity occurs, forming flocs. Due to the effect of the aluminum sulfate, the suspended particles still in the water agglomerate to form larger clots or blocs that settle more easily.



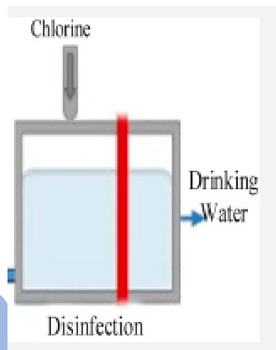
Sedimentation process: Sedimentation is carried out in decanters or basins of variable capacity, depending on the Drinking Water Treatment Plant. There the flocs are decanted, which precipitate to the bottom of the settling tank forming sludge. The decanters or settling basins in their final section have weirs where the upper layer of water, which contains less turbidity, is captured. Through these weirs the water passes to the filtration zone.



Filtration process: A filter is composed of a support mantle: sand, gravel and stone. Filtration is carried out by entering the settled or decanted water above the filter. By gravity the water passes through the sand which retains the impurities or residual turbidity that remains in the settling stage.

Disinfection process: Once the water has been filtered, it goes to the reservoir, where it is disinfected according to different methods. The most commonly used is the addition of chlorine (sodium hypochlorite). Chlorine has the chemical characteristic of being an oxidant, it releases oxygen, killing pathogens, usually anaerobic bacteria.

Among the disinfection methods commonly used are: disinfection with sodium hypochlorite, disinfection with calcium hypochlorite (tablets), disinfection with ozone and disinfectionwith ultraviolet light.



Analytical quality controls are carried out during the entire purification process. The sum of the stages to make the water drinkable takes approximately 4 hours.

The above mentioned about the water potabilization process is based on the quality parameters indicated in the Colombian technical standard;

TECHNICAL REGULATION OF THE DRINKING WATER AND BASIC SANITATION SECTOR NTC-RAS 2000, title C Potabilization Systems, Chapter C.2, which deals with "Aspects of water quality and its treatability", in which quality parameters that the water catchment body must meet and quality parameters of the treated water are indicated.

For the development of the project in question in the community of Purísima, a large amount of materials, equipment and tools were required, which are mentioned below.

The materials necessary for the construction of the plant were: water storage tanks with a capacity of 1000 Lt, drinking water pipes of 1", 2", 3" and 4" diameters, hydraulic accessories such as: stopcocks, 90° elbows, 45° elbows, tees, adapters, reductions, unions, among others. On the other hand, chemicals were used to carry out the raw water treatment processes, such as activated carbon, silica sand, liquid aluminum sulfate and liquid sodium hypochlorite.

In addition to this, an experimental design of the pilot treatment plant was carried out in order to analyze each of the processes that would be carried out in the drinking water treatment plant.

Figure 2: Photograph of water treatment plant construction site.

Figure 3: Construction of the water treatment plant.

Figures 2 and 3 show evidence of the results obtained in the construction of the water purification plant in the Zenú indigenous community.

According to the initial conditions of the raw water in the Zenú indigenous community, it was necessary to carry out jar tests to determine the optimum doses of aluminum sulfate for the removal of solids and the dose of sodium hypochlorite for water disinfection. The results obtained are shown in Table 1.

Table 1: Results of jug tests on water samples.

Parameters of pitcher	1	2	3	4	5	6
Stirring speed rapid mixing	120	120	120	120	120	120
Stirring time rapid mixing (min)	1	1	1	1	1	1
Stirring speed slow mixing (min)	60	60	60	60	60	60
Sedimentation time	20	20	20	20	20	20
pH	8.2	8.5	7.9	7.6	7.5	7.2
Temperature (°C)	16	16	16	16	16	16
Turbidity (NTU)	11	8.1	4.6	6.7	8.7	5.5
Color(UC)	2.2	1.9	1.5	2	1.6	1.5
Sedimentation rate	6	5	4	3	1	2
Floc size	6	5	4	3	1	2

It is worth mentioning that the process of operation of the treatment plant is in progress and final tests of the water quality obtained from the mini-treatment plant have not yet been conducted.

final water quality tests have not yet been performed on the water obtained from the mini-treatment plant. Once the plant is

Once it is ready to meet the needs of the population, the pertinent tests will be carried out.

The expected results are as follows:

1. Implementation and start-up of the drinking water treatment plant in the Zenú indigenous community of Purísima.

2. Improvement in the quality of life of the community's inhabitants, as they will have better quality water for their consumption.

3. Consumption of water with better quality according to Colombian standards.

4. Decrease in water-related diseases.

5. Improvements in the economy of the community, since less time is spent in the search for drinking water.

DISCUSSION

According to the results obtained, the drinking water supply problem in the Zenú indigenous community will be minimized by a large percentage, since the community will have the implementation of the drinking water treatment plant with which they will be able to meet the basic need of water for human consumption and personal hygiene. The data obtained in the jug tests indicate that the conditions in which the inhabitants of the indigenous community were consuming the water were precarious, since the water contains a large amount of dissolved and suspended solids, which led to high turbidity units in the water samples between 6.5 and 11.2 NTU, where the standard indicates that it should be less than or equal to 5 NTU. In addition to this, the samples presented pH values above the permitted range, as can be seen in Table 1 in sample No. 2, which presents a pH of 8.5, values quite high in the accepted range for water.

According to the quality tests after treatment, it is necessary to wait until the project is fully constructed and commissioned to carry them out, and thus identify the improvements in water quality obtained with the implementation of the project for the construction of a mini drinking water plant.

Finally, it was necessary to treat the water before its consumption by the people living in the indigenous community, in order to prevent diseases in the population, improve their quality of life and well-being. In addition to this, it should be noted that there were several limitations in the development of the activities, due to the living conditions in the cabildo, the access to the place and the lack of many services necessary for the development of the project.

CONCLUSIONS

It can be concluded that the implementation of the mini raw water treatment plant in the Zenú indigenous community of Purísima offers many environmental, sanitary and quality benefits. These benefits are:

1. Obtaining their own water treatment plant for the community of Purísima that allows the improvement of the quality of the water that was consumed before implementing the water treatment plant.

2. Improved quality of life for the population of Purísima, as food consumption improves, illnesses are reduced, and water is used appropriately for personal hygiene and domestic consumption, thus improving sanitary and environmental aspects.

3. Because the treatment and transportation times of drinking water in the community are optimized, economic activities are benefited and in the same way different activities have been added that contribute to the economic sector.

Finally, it can be said that in Colombia, the indigenous communities have suffered due to the forced displacements caused by the internal conflict in the country, which has generated other types of environmental, social, cultural, economic and sanitary problems, such as those of the Zenú indigenous community; lack of land for the development of the community's activities, absence of basic sanitary services (drinking water, electricity, natural gas, etc.), gastrointestinal diseases, gastrointestinal diseases, etc., as well as the lack of basic sanitary services.), gastrointestinal and skin diseases due to consumption and use of water that is not suitable for human consumption, hygiene problems in the community, proliferation of disease-generating vectors, decrease in economic activities, etc.

In addition, it is recommended to maintain the installed raw water treatment plant in order to guarantee its use and benefits over time and to ensure that the processes are carried out with quality.

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