Contemporary Engineering Sciences, Vol. 10, 2017, no. 27, 1343 - 1350
HIKARI Ltd, www.m-hikari.com
https://doi.org/10.12988/ces.2017.710134

Environmental Impact Assessment at a Colombian Caribbean Wastewater Treatment Plant

C.A. Severiche-Sierra[1,2], M.K. Valest-Bustillo[1], J. Jaimes-Morales[1], E.A. Bedoya-Marrugo[2] and R. Mancera-De La Cruz[2]

[1] Universidad de Cartagena, Research Group on Environment, Food and Health – MAAS, Cartagena de indias-Colombia

[2] University Foundation Technological Comfenalco, Comfenalco Technological Process Research Center – CIPTEC, Cartagena de indias-Colombia

Abstract

In this paper it is identified and described the environmental aspects and impacts in a treatment plant wastewater. The inputs of raw materials, fuel, electricity and water are taken into account; similarly, the outputs as emissions, noise, discharges and waste, looking comply with environmental legislation and resource management. The most relevant results of the work leading to the qualification of environmental impacts studied for low and middle levels of significance area. The treatment plant wastewater meets its environmental management system, with appropriate controls on environmental impacts both normal and abnormal conditions. Higher level of significance was found in the areas of water pretreatment, but this has an environmental regulation and compliance under national law.

Keywords: Wastewater, Environmental pollution, Level of significance, Treatment plant

Introduction

Learning Water plays an important role in supporting and sustaining human health and sustainable development of ecosystems. Population growth, urbanization, industrialization and the consumption of patterns of change have generated demands for freshwater resources throughout the growing world [1, 2]. The scarcity of water poses a serious threat to the development of human societies.

Wastewater recovery and reuse is considered to be the best strategy to meet current and future water needs [3, 4].

Wastewater is treated in wastewater treatment plants (WWTPs), which has the important role within the urban water cycle to improve water quality before being returned to natural ecosystems. Traditional wastewater treatment is considered an industrial activity in which wastewater is transformed through different processes, which consume chemicals and energy, into the treated water (of higher quality), which generates by-products (mostly solid waste and emissions Soda) [5]. Thus, the impact of water emissions on natural ecosystems is reduced; However, there is an increase in costs and other environmental impacts [6].

The WWTPs are a complex combination of physical processes with the objective of minimizing the damages caused by the discharge of wastewater, chemical and biological. However, the WWTPs have traditionally been optimized taking into account only aspects of cost and quality performance [7]. The inclusion of sustainability criteria in the choice of plant operation has some difficult points, such as the inclusion of processes in the background by extending the life cycle limits of the system, evaluation of all economic spheres, Environmental and social indicators and the choice of appropriate indicators to quantify the achievement of the objectives set [8, 9].

Cleaner Production is a business strategy, focused on productive processes, products and services, in order to strengthen business competitiveness by encouraging innovations and reducing costs and risks relevant to humans and the environment [10, 11]. The essence of this strategy is the preventive nature of its alternatives that seek the efficient use of energy, water, and inputs and the use of waste, integrating economic, environmental and social benefits [12, 13]. The initial environmental review is a tool for collecting information, used to visualize the physical reality of the activities and the environmental impacts involved, to eco-mapping, is a simple and easy to use tool that allows a quick inventory of practices and Problems of multiple variables through the use of figures [14].

Based on the importance of the implementation of cleaner production systems in wastewater treatment processes in urban environments, in this work the main objective was to identify and qualify environmental aspects and impacts in a wastewater treatment plant ; For it was raised an eco-mapping of the site; A second specific objective was to identify the environmental aspects of entry and exit, as well as to qualify the environmental impacts, and finally, the results were analyzed in terms of compliance with the current environmental regulations.

Materials and Methods

It describes the initial diagnosis, then explains how the identification of the environmental aspects and the qualification of the environmental impacts were carried out.

Initial diagnosis

The environmental regulations in force regarding atmospheric emissions, solid waste, disposal of liquid spills and environmental noise were inspected. Next, we performed a reconnaissance of the areas of the WWTP using an eco-mapping [5]. The legal requirements under which a wastewater treatment plant is to be operated were unified.

Identification of environmental aspects

We proceed by means of an eco-mapping for the WWTP, using the data collection format for environmental aspects [12]; which takes into account the inputs and outputs, eight (8) specific areas of study are established.

Qualification of environmental impacts

In order to quantify the level of significance of the impact, reference is made to the environmental aspects of the different areas of the WWTP. According to Vale et al. [15], (1) to three (3), being one (1) mild, two (2) moderate and three (1) moderate, and three (3) severe; the scale of impact, which refers to the geographical dimension of this, i.e., punctual, municipal or regional; to environmental legislation, that is, their status of compliance with their existing relationships. The frequency, related to the number of times the event can occur in a given period of time [16].

Results and Discussion

To make the tour of the areas of PTAR and the identification of the environmental aspects of the eco-mapping of Figure 1.

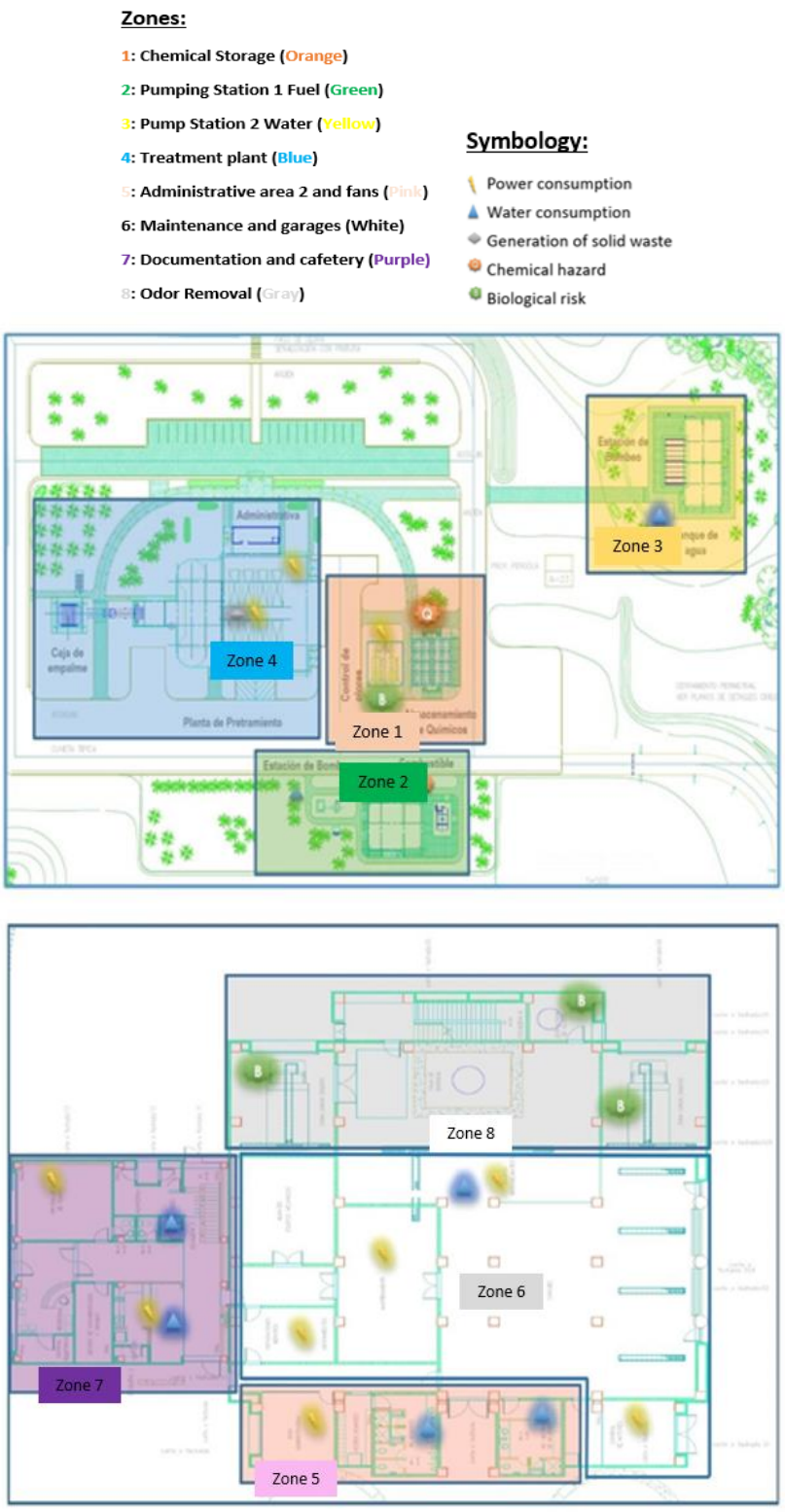

Figure 1 Eco-mapping WWTP

Assessment of input aspects

The consumption of raw material and inputs: as a consequence the exhaustion of natural resources which we qualify we find that the zone of greatest impact are zones 1 and 7, where there is a scale of impact at a specific level, with a moderate severity whose legislation Environmental, does not exist, with a high frequency and a low level of significance, to control this impact is bought from suppliers with sustainable and environmental commitment.

Water consumption: there is a depletion of the non-renewable water resource, with impact in all areas, its scale of impact is at a specific level, with moderate severity, its environmental legislation is met, has a high frequency and a level of Low significance, for the control of this impact an optimal dosage of the water is recommended, taking into account the quantities to be used that the operation requires. It is governed by Law 373 of 199718, and Law 1333 of 200919, which establishes the program for the efficient use and saving of water and by which establishes the environmental sanction procedure and others are dictated Provisions.

Energy consumption: it reflects depletion of non-renewable natural resources with impact in all areas, has a punctual effect, with a moderate severity whose environmental legislation is met with a high frequency and a mean level of significance, for its control Purchase of meters and study for change of engines and low-efficiency equipment governed by Law 697 of 200120, which encourages the rational and efficient use of alternative energy and other provisions.

Evaluation of output aspects

Environmental Noise: generated by the scrubbers operation that affects all workers but especially impact at zones 4 and 5, its scale of impact is at a specific level, with moderate severity, its national environmental legislation which is Meets, has a high frequency and a moderate level of significance, to control this impact, it is important to monitor the noise levels in the operation, governed by Decree 0627 of 200621, which establishes the maximum permitted levels Of emission noise and environmental noise.
Liquid spills: they produce soil contamination in the areas of 1,5,6 zones, and the discharge of wastewater to the zone of submarine outfall previously from the pretreatment plant in zone 4, also producing sludge as a sandy residue, presents a Scale of impact at municipal level, high severity, complies with national legislation, high frequency, level of moderate significance, to control this aspect is required to use the Recirculation of water with grit to the pretreatment plant, is governed by Decree 3930 of 201022, which establishes compliance with national regulations. In addition, monitoring is carried out to the waters discharged and / or served to the sea, governed by Resolution 0631 of 201523, which establishes the microbiological parameters of analysis and reporting in the point of discharge of residual waters to bodies of surface waters.

Atmospheric emissions: which produce atmospheric pollution by hydrogen sulphate gases (H2S), with greater impact at zones 4 and 8, producing alteration of scale of impact at municipal level, high severity, complies with national legislation, frequency High and moderate level of significance, for the control of this aspect is made the measurement of H2S concentration in parts per million (ppm), regulated according to Resolution 610 of 201024, which establishes the measurement of Air Quality , And defines the limits of exposure and its danger.

Solid waste: the greatest impact from solid waste occurs during the treatment of wastewater, specifically when floating solids are removed from water through rotating mills and sand sorters, these occur in zone 4 And are stored in containers with tank to capture leachate in zone 8, the scale of impact is punctual, with a high severity and complies with national legislation, in turn its frequency is high; For this case the company is governed by Decree 2811 of 197425, on the basis of which it has chosen to establish an instructive for the collection, transportation and final disposal of waste, these being classified as ordinary and placed in the cell Of disposal for this type of waste, are transported in an ampliroll system vehicle and taken to the site authorized by the district.

Abnormal operating conditions

Under abnormal conditions, there is a depletion of the non-renewable water resource, with greater impact in abnormal working conditions in zone 4, its scale of impact is punctual, with high severity, its environmental legislation is met, has a frequency High and a low level of significance, to control this impact is recommended an optimal dosage of water, taking into account the quantities to be used that requires the operation. It is governed by Law 373 of 199718 and Law 1333 of 200919 which establishes the program for the efficient use and saving of water and by which establishes the environmental sanction procedure and other provisions are dictated, and includes the plan for saving and efficient use of water.

In terms of discharges, they produce soil contamination by sludge, and wastewater dumping with greater impact in abnormal working conditions in zone 4, has an impact scale at municipal level, high severity, complies with national legislation, High frequency, level of moderate significance, to control this aspect is required to use the Recirculation of water with grit to the pre-treatment plant, is governed by Decree 3930 of 201022 which establishes compliance with national standards. In addition, monitoring is carried out to the waters discharged and / or served to the sea, governed by Resolution 0631 of 201523, which establishes the microbiological parameters of analysis and reporting in the point of discharge of residual waters to bodies of surface water.

Conclusion

The wastewater treatment plant PTAR, complies with the legal provisions required

for environmental management, in its management system program, in the identification of aspects and assessment of impacts under normal conditions the company has established controls, taking into account Its impact at a specific level and municipal level, without affecting the normal development of activities, counting on a program of environmental sanitation and preventive and corrective maintenance, which are fulfilled according to the system of integral management of the company, which compromises with the environment Minimizing impacts.

References

[1] Y. Sun, Z. Chen, G. Wu, Q. Wu, F. Zhang, Z. Niu and Y. Hu, Characteristics of water quality of municipal wastewater treatment plants in China: implications for resources utilization and management, *Journal of Cleaner Production*, **131** (2016), 1-9. https://doi.org/10.1016/j.jclepro.2016.05.068

[2] C. Severiche, E. Gómez and J. Jaimes, As the basis of environmental education and culture strategy for sustainable development, *Telos*, **18** (2016), 266–281.

[3] Q. Zhang, W. Yang, H. Ngo, W. Guo, P. Jin, M. Dzakpasu, S. Yang, Q. Wang, X. Wang and D. Ao, Current status of urban wastewater treatment plants in China, *Environment International*, **92–93** (2016). 11-22. https://doi.org/10.1016/j.envint.2016.03.024

[4] S. Morera, L. Corominas, M. Poch, M.M. Aldaya and J. Comas, Water footprint assessment in wastewater treatment plants, *Journal of Cleaner Production*, **112** (2016), 4741-4748. https://doi.org/10.1016/j.jclepro.2015.05.102

[5] R.L. Acevedo Barrios and C.A. Severiche Sierra, Evaluation of environmental impacts in a water quality laboratory, *Revista Producción Más Limpia*, **8** (2013), 32-38.

[6] M. Barbu, R. Vilanova, M. Meneses and I. Santin, On the evaluation of the global impact of control strategies applied to wastewater treatment plants, *Journal of Cleaner Production*, **149** (2017), 396-405. https://doi.org/10.1016/j.jclepro.2017.02.018

[7] F. Gutiérrez-Martin, A. Nieto-Márquez, E. Atanes and M. Ruiz-Pastrana, Evaluation of biotic environmental impacts in chemical industries using free software, *Form. Univ.*, **7** (2014), 3-12. https://doi.org/10.4067/s0718-50062014000100002

[8] E.A. Bedoya Marrugo, C.A. Severiche Sierra, D. D. Sierra Calderon, C. Sierra Ferreira, Integrated Management System Based on the OHSAS 18001: 2007

and ISO 28000: 2006 Standards for a Logistic Services Company, *International Journal of Engineering and Applied Sciences*, **4** (2017), 85–89.

[9] A.A. Marticorena, B.A. Mandagaran and E.A. Campanella, Environmental Impact Analysis of Methanol Recovery in Biodiesel Production using the Waste Reduction Algorithm WAR, *Inf. Tecnol*, **21** (2010), 23-30. https://doi.org/10.4067/s0718-07642010000100005

[10] J.D. Leal Navarro, A.D. Gonzalez-Delgado and Y.Y. Peralta-Ruiz, Environmental assessment of HF alkylation process using WAR algorithm, *Contemporary Engineering Sciences*, **10** (2017), 641-649. https://doi.org/10.12988/ces.2017.7764

[11] E.A. Bedoya Marrugo, C.A. Severiche Sierra, D. D. Sierra Calderon and M.J. Meza Alemán, Diagnosis of solid waste management in the petrochemical-plastic sector of Cartagena de indias, Northern Colombia, *International Journal of Engineering and Applied Sciences*, **4** (2017), 37 – 39.

[12] C. Afonso, Z. Sosa and J. Santana, Occurrence and environmental impact of pharmaceutical residues from conventional and natural wastewater treatment plants in Gran Canaria (Spain), *Science of The Total Environment*, **599–600** (2017), 934-943. https://doi.org/10.1016/j.scitotenv.2017.05.058

[13] C. Severiche, I. Baldiris, J. Acosta, E. Bedoya, I. Castro and H. Pacheco, Multivariate Analysis of Water Quality in Rosario Islands National Park (Colombia), *American Journal of Engineering Research*, **6** (2017), 136–144.

[14] M. Perevochtchikova, The environmental impact assessment and the importance of environmental indicators, *Management and Public Policy*, **22** (2013), 283-312.

[15] R. Vale, R. Pérez and M. Ramirez, Evaluation of the environmental impact in a producer of oils and lubricating greases, *Revista Cubana de Química*, **28** (2016), 736-750.

[16] M.A. Mustapha, Z.A. Manan and S.R.W. Alwi, A new quantitative overall environmental performance indicator for a wastewater treatment plant, *Journal of Cleaner Production*, **167** (2017), 815-823. https://doi.org/10.1016/j.jclepro.2017.08.169

Received: October 21, 2017; Published: December 7, 2017