

Diagnosis of Dangerous Waste Management in Norte de Santander Using Sandbox-UFPS: Overview for sustainability Challenges

Environment and Technology

Víctor Emmanuel Urbina Alarcón
System Engineering Program
Francisco de Paula Santander University
Cúcuta, N de S, Colombia
victoremmanueluaura@ufps.edu.co

Andrea Carreño Rodríguez
Environment Engineering Program
Francisco de Paula Santander University
Cúcuta, N de S, Colombia
andreacr@ufps.edu.co

Abstract— The environment is one of the most important items in the world, therefore policies should be defined for the proper use of environmental resources and disposal of waste. In Colombia in 2005, the environmental policy for the management of dangerous wastes and wastes, and decree 4741, which together with other regulations are compiled in the single regulatory decree of the environmental sector 1076 of 2015, framed within the policies Public services for the management of solid waste and the integral management of RESPEL (dangerous waste). This research aims to diagnose in a general way the current state of the management of dangerous waste in the areas of jurisdiction of CORPONOR as environmental authority of the department of Norte de Santander, taking as sample CORPONOR territorial Cúcuta, defining the methodology of study in stages: planning, Documentary research, field research, elaboration and validation of the diagnostic report and of the information stored by the solid waste coordinator of the corporation, sent by generators and managers using formats [9] RH1, RUA, RESPEL Records, waste management and IDEAM applications [8], as well as management of agrochemicals and hydrocarbons, through the use of office tools and the academic platform for the deployment of web applications called Sandbox-UFPS, which allows to collect, store and process data, generating figures and statistics Of the total waste managed Two and their annual behavior.

Index Terms—Waste Management, Dangerous Waste, CORPONOR, Sandbox-UFPS.

I. INTRODUCTION

The increase in the different production processes and health care as well as the modernization of administrative processes has caused a gradual increase in the production of solid waste in recent years, taking into account that not all the product of original raw material Is used in one hundred percent [7], therefore the wastes from different activities have increased their magnitude and increased volume with this the need of the development of plans of integral management of solid waste within which it is important to emphasize the integral management of the residues Dangerous or RESPEL.

A dangerous waste is a dangerous waste which, because of its corrosive, reactive, explosive, toxic, flammable, infectious

or radioactive characteristics, may cause risk or damage to human health and the environment, or packaging and packaging that have been in contact with them [5]. For the last twenty years, at the international level, the management of dangerous waste (RESPEL) has been recognized as a priority problem. The different events and environmental disasters related to dangerous waste have led to the establishment of control systems as mentioned above.

In the 1980s, the increasing process of regulation and control in the industrialized countries led to a large increase in the costs of disposing of dangerous waste. In order to avoid disposal costs, toxic traders began shipping dangerous waste to developing countries. When this reality was made public, the Basel Convention was adopted [2], which in its first decade (1989-1999) focused on building a framework for the control of transboundary movements of dangerous wastes.

Colombia and the Norte de Santander Department has not been averse to the problem of dangerous waste, which is exacerbated by the fact that it is a region with a growing economy, an active frontier zone, a manufacturing sector, a tradition of agricultural vocation, Existence of a high index of informality in the commercial area, and oil areas with some technical capacities and human resources for the management of this waste, which has been growing. The knowledge of this problem is under construction, therefore, it is considered of great importance the carrying out of studies and proposal proposals that reduce the amount of waste through clean production strategies, generators and managers.

II. MATERIALS AND METHODS

For Support in the structuring of the plan for the promotion of the integral management of respel in Norte Santander as a function of the autonomous regional corporation of the Norte-eastern border corponor [6], a methodological process was proposed by means of the staged structure of the set of activities to be developed, reflected in the following diagram using environmental strategies and policies in addition to

Sandbox-UFPS.

of web applications using technologies such as PHP, Python, JSP, .Net and relational and non-relational database services. [12]



Figure 3 Sandbox-UFPS. coauthors 2016.

Was used for the collection, processing and visualization of the results and statistics making use of the tools offered and its test environment [13].



Figure 4. Tools offered by Sandbox-UFPS

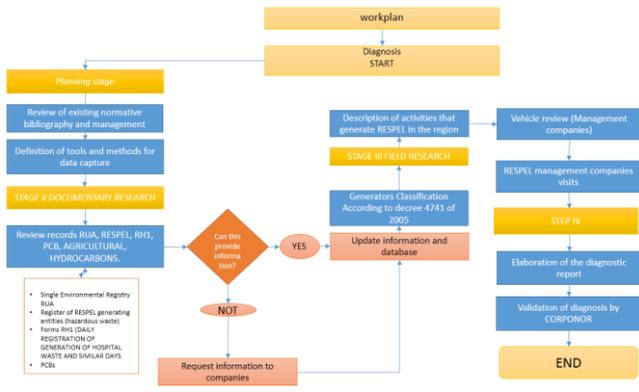


Figure 1 General methodology. Authors 2016.

A. Population and sample

The collection, analysis and analysis of the information was taken from each of the territories of CORPONOR present in the Department since both the generators and managers immersed in the whole department, the information resides in each one of its territories and these in turn to the main headquarters in the municipality of San José de Cúcuta, as web via IDEAM's national applications.

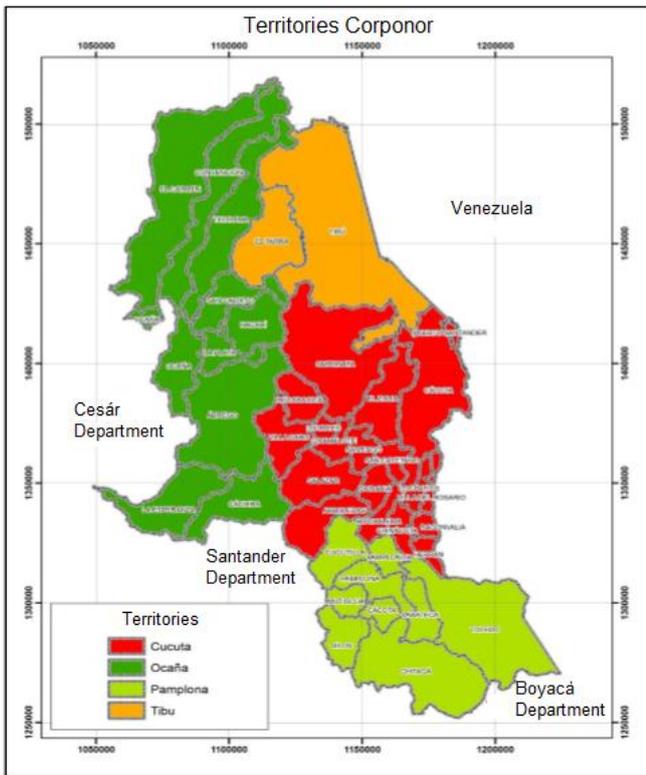


Figure 2 Location of study areas in Norte de Santander. IGAC, SIA. PAI-CORPONOR 2016

B. Sandbox-UFPS

It is a cloud development and server management platform, which allows administration, configuration and development

C. Diagnosis of dangerous waste Management in Norte de Santander

In this diagnosis, carried out by CORPONOR and the Universidad Francisco de Paula Santander, weaknesses and opportunities are identified in the management and management of RESPEL generated in Norte de Santander, with the purpose of planning measures within the framework of environmental policy for the Integrated management of dangerous wastes or wastes; Oriented to the strengthening of the existing scenario, the implementation of preventive and corrective actions, the inclusion of public, private and community actors and, above all, the protection of the city's environmental conditions.

Generally, in the Norte department of Santander the RESPEL management of dangerous waste is in the hands of the 4 authorized companies with disposal sites according to Colombian regulations inside and outside the department [1]. These are ASEO URBANO, EDEPSA, SANDESOL AND DESCONT, who treat around Of 1090t of hospital-type waste and similar to the year, so the waste stream with the highest incidence corresponds to Y1 (hospital waste), also shows in the region a large presence of equipment contained with PCBs and some agrochemicals and non-hydrocarbons Greater significance.

The transport of this waste is verified by reviewing vehicles belonging to each company where it is required to comply with dangerous goods transport regulations, safety for operators and conditions of the vehicle as specialized, established in Decree 1609 of 2002 of the Ministry Of Transport [3] although this one does not manage to cover the necessary restrictions for an efficient control of the handling

and the movement of the RESPEL and there are many companies doing this task that manage to fulfill the established in article 16 of the Decree 4741 of 2005 [4]. CORPONOR has been able to establish a mechanism for the control of the mobilization with which maintains an update of the record of the amount of this waste that are transported in the city and the companies that run it.

In accordance with the above, the results of the monitoring and control actions carried out on RESPEL generators show that the service sector is the one with the greatest performance, mainly due to the actions of the health services subsector, and in the case of Establishments belonging to the commercial sector that general bio sanitary waste the report indicates that the obligation of greater non-compliance is to "Register to the competent Environmental Authority for a single time and to keep updated the information of its registration annually, in accordance with the established in the article 27 of this decree "(literal f of article 10 of Decree 4741 of 2005).

III. RESULTS

By analyzing figures for the second half of 2015 and the first half of 2016, it was found that on a scale of greater to lesser production of dangerous waste in Norte de Santander, there are clinical waste resulting from medical care provided in hospitals and health centers Health, up to a total of 1090t annually of them, records with PCB contained equipment, and hydrocarbons located in specific areas of petroleum production in the region. Likewise, it was identified that 1.7% of RESPEL generators classified as large Produce 77.2% of residues represented in residues of biological risk ie hospital and similar (RHyS), while 77.8% of generators classified as minors, produce only 2.4% of total waste.

Table 1. RESPEL streams produced in Norte de Santander. coauthora 2016.

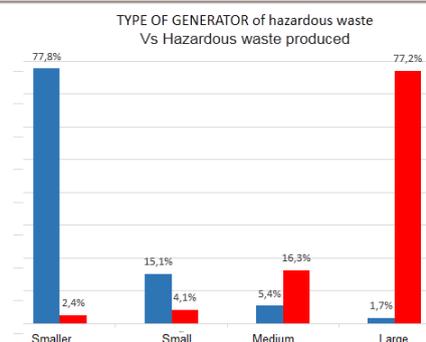


The major waste streams in Norte de Santander according to IDEAM records are Y1 Hospitals and clinicians resulting from medical care provided at Hospitals, Medical Centers and Clinics, Y10 Substances and waste articles containing or contaminated by biphenyls Polychlorinated terphenyls (PCBs), polychlorinated terphenyls (PCTs) or polybrominated biphenyls (PBBs), Y9 Mixtures and emulsions of wastes from oil and water or hydrocarbons and water, Y8 Wastes from mineral oils not suitable for their intended use.

Table 2. Waste numbers and users of managed RHyS in Norte de Santander (II sem. 2015 - I sem.2016). coauthora 2016

2015 Users served by management companies						
Type of generator of hazardous waste	ASEO URBANO	DESCONT	EDEPSA	SANDESOL	TOTAL	Percent
Smaller producers	867	129	138	63	1196	77,8%
Small producers	86	122	11	14	232	15,1%
Médium producers	33	36	5	9	82,5	5,4%
Large producers	9	13	0	4	25,5	1,7%
TOTAL	995	299	154	89	1537	100%
Percent	64,7%	19,5%	10,0%	5,8%		

WASTES - Received (2015-2016)						
Type of generator	ASEO URBANO	DESCONT	EDEPSA	SANDESOL	TOTAL	PERCENT
Smaller	19.691	1.136	2.756	2.293	25.876	2,4%
small	29.062	7.204	4.512	3.980	44.758	4,1%
medium	123.343	21.358	16.711	16.195	177.607	16,3%
large	589.093	222.161	0	31.018	842.272	77,2%
TOTAL	761.190	251.859	23.978	53.486	1.090.513	
Percent	69,8%	23,1%	2,2%	4,9%		
Tn	761,19	251,86	23,98	53,49	1090,51	



From the above, it is evident that there is an inversely proportional relationship between the amount of waste and the type of users, since there is a large number of generating companies classified as minors but in production they do not exceed 2.5% of total RHyS, While a smaller number of companies classified as large generators are responsible for the largest amount of RHyS, ie more than 77% of the total waste taken care of.

In the case of equipment with dangerous PCB waste contents, in the analysis of IDEAM's National Inventory of PCBs (Resolution 222 of 2011 and 1741 of 2016), the following information is obtained for Norte de Santander with a total of Equipment per year not classified as:

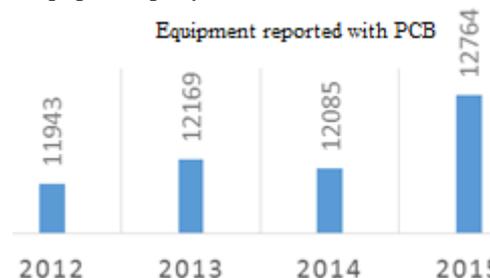


Figure 5. Equipment reported with PCB contents for jurisdiction of CORPONOR. coauthora 2016.

Subsequently and given the significant amounts of equipment registered for Norte de Santander, an annual review of each of the registered companies is carried out in order to corroborate the values in the total of equipment registered and classify them according to their group (GROUP 1 manufactured equipment With PCB fluids and wastes contaminated with PCBs) (GROUP 2 equipment and wastes containing or may contain suspected PCBs) (GROUP 3 equipment and wastes contaminated with PCBs) (GROUP 4 equipment and wastes not PCBs) [10][11], likewise for the year 2014 and 2015 not only classify the equipment by company according to its group but also according to its operational state obtaining:

ANNUAL REPORT 2014-2015

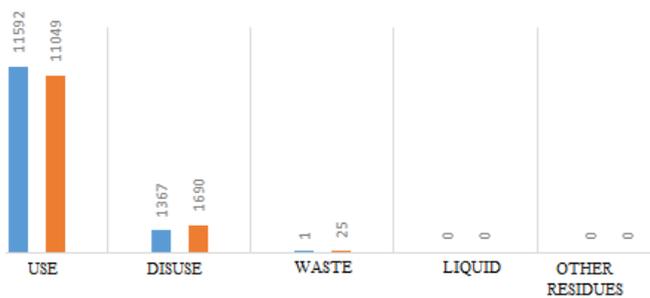


Figure 6. Equipment registered with PCB content in the jurisdiction of CORPONOR for 2014-2015. coauthora 2016

Although for the last two years analyzed in the inventory the total number of registered equipment increased, the total of used equipment decreased and in disuse increase which could indicate that the companies have begun to withdraw within their operational uses equipment with registered with PCB.

In terms of hydrocarbon figures, Norte de Santander is located in Northeeastern Colombia. It is a department that by its geographical location, is rich in natural resources: coal and oil. From 2012 to date, a little more than four million barrels of oil have been extracted from this territorial entity, which refers to the production of hydrocarbons by department; Ranking it in the 12th place of departments with greater production of hydrocarbons and place where much of the oil industry of the country is concentrated.

According to figures from the Colombian Petroleum Association (ACP), in 2014, Norte de Santander produced an average of 3700 barrels of oil per day; Contributing slightly more than 1% of the total production of the country (Petroleum Statistical Report 2014).

The majority of the oil extracted from the Norte Santandereano department is transported by the Caño Limón - Coveñas pipeline, whose route in this region passes through the municipalities of Samoré, Toledo, El Zulia and Tibú. As Colombia's flagship pipeline, since it has transported more than 1 billion barrels since the beginning of operations in 1983

(the Caño Limón brand), the treatment of this type of dangerous waste from hydrocarbons has reduced its work And management figures, as evidenced in the diagnostic process (I semestre of 2016).

With this in addition, it was possible to identify the amounts of users and waste that deal with dangerous waste in the Norte of Santander region from which they were obtained and it was observed that the management of RESPEL is done in sites with relevant environmental licenses and vehicles in the right conditions.

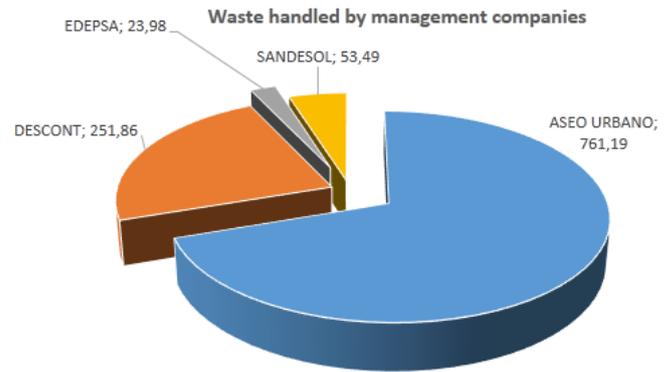


Figure 7. Waste cared for by companies in Norte de Santander. coauthora 2016.

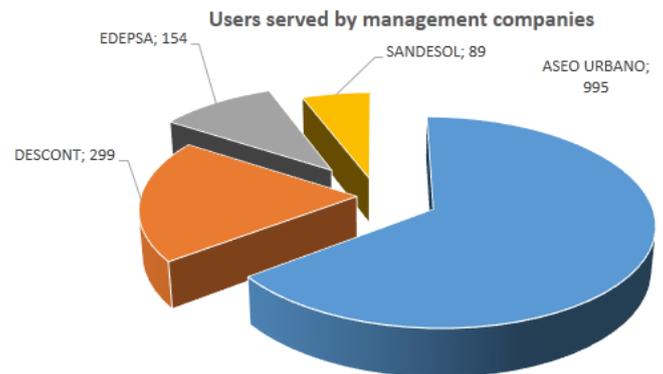


Figure 8. Users attended by companies in Norte de Santander. coauthora 2016

It was verified that in Norte de Santander the management of dangerous waste is being achieved as the type progresses and is correctly accommodated to current Colombian regulations.

The biggest challenge for planning and environmental authorities in the department is not only the implementation of the plan to promote the management of RESPEL, but also the development of schemes that, at the same time, solve the problems that generate the generation And inadequate management of dangerous wastes, address the Department's need for sustainable, inclusive and equitable development, reduce levels of pollution as it has been done, encourage the creation of sources of income and employment, which Increase the competitiveness of sectors with clean production

programs and improve the environmental performance of all actors and social sectors that generate and manage dangerous waste.

A. *Elements for the management of dangerous waste in a sustainable way*

This section is located in the results since it was created based on the analyzes made and based its development on the review of theoretical and methodological works, as well as good practices implemented in several countries for the integral and / or sustainable management of dangerous waste , The proposals are generally based on the circular approach to solid waste that integrates forms of production and consumption governed by environmental regulations in Colombia; Applying foreign management methodologies in Norte de Santander entails major challenges in education and training of personnel as well as economic investments in improvements to cleaner production equipment or sustainable treatments for RESPEL.

Figure 9 shows the elements that are an essential part of the planning and design of methodological strategies that respond to the planning needs for RESPEL management based on sustainability.



Figure 9. Elements that form the framework for the planning of dangerous Solid Waste from the sustainability approach. coauthora 2016.

The previous elements raised together with the environmental objectives that arise both the environmental authorities and the service sectors are of particular importance. In addition to implementing its own legislation, the public sector must create an investment climate that encourages and supports private investment

and growth in an environmentally sustainable way. This is particularly important in the case of energy, water resources, wastewater, waste management and recycling, sectors with significant impacts on the environment and public health.

Also, the incorporation of environmental considerations should go further. Since most of the environmental problems are external and affect more than one sector, the best way to address them is intersectorally and locally, proposing methodologies for a sustainable Norte de Santander where it is a challenge to act in a more coordinated way between the Public and private sector stakeholders, as well as between the different investment sectors.

IV. DISCUSSION

A The production of dangerous waste in Norte de Santander is framed by the production of hospital waste and the like, as well as the report of equipment with PCBs and the management of hydrocarbons and their derivatives as salinized waters.

However, attention is focused on the levels of generators and managers of hospital waste and similar, which is significant to indicate that 77.2% of hospital waste is produced by 1.7% of users and the other 2, 4% of waste is contributed by 77.8% smaller type.

It should be noted that Norte de Santander is a department that bases its production on trade, agriculture and livestock production but reports large amounts of PCB-containing equipment, which is a reason for discussion because decreasing their rates deserves a challenge for authorities both Environmental and administrative aspects of the company; So the management of dangerous wastes of hydrocarbons develops with less proportion when the production of the oil zones in the region increase their production, then the management of the same is not constant.

It is possible that in Norte of Santander a sustainable management of dangerous waste will be achieved if the plans and challenges that sustainability demand as production of materials, consumer goods, buildings and infrastructure in the form of a closed cycle are implemented. Recycling of degradable materials and biomaterials in the ecosystem without environmental toxicants, implementation of rigid monitoring and control policies, and above all participation and education of the joint actors of the chain of management.

V. CONCLUSIONS

In the Northern Department of Santander in general, although there are no large industries in its territory, there are currently 4 RESPEL management companies who have certified vehicles and environmental licenses in place for the development of operations with dangerous wastes, mainly tons of Hospital waste and similar that are reported in production

annually (1090t), thus fulfilling an efficient management of dangerous waste.

Based on the diagnosis of the management of dangerous waste RESPEL, which has been advanced with the information available in the Regional Autonomous Corporation of the Northeastern border CORPONOR, it is possible to identify the current conditions of the management and management of dangerous waste in Norte de Santander For waste streams that show higher production levels which correspond to hospital and similar Y1 and PCBs in existing figures. Reporting the largest number of PCB equipment in the country according to the national inventory of PCBs by the power company of Norte de Santander. It is intended to include in subsequent analyzes the numbers of agrochemicals and hydrocarbons that can be potentially dangerous to the environment if they are not given an environmentally safe internal and external management.

It is noteworthy that the information collected and organized in this document is used for the design of the Plan to promote the Comprehensive Management of RESPEL in Norte de Santander, which, when applied, shows an improvement in the registration of information and reduction of tons of waste Treated in the region.

ACKNOWLEDGMENT

Thanks to all the people and companies involved in the review and contributions of the information consolidated in this document by the authors, the University Francisco de Paula Santander: teachers, officials and engineers representing the environmental engineering curriculum (Nestor Urbina and Alexander Sánchez) and systems (Administrator Sandbox-UFPS), to the Regional Autonomous Corporation of the Northeastern border CORPONOR (coordinator of solid waste projects Mr. Álvaro Lenis Villafañe), who from their knowledge and dedication guided the process to The collection, organization and analysis of existing and established information on dangerous waste.

REFERENCES

[1] Angarita Lank Rafael Navi Gregorio. 2016. Plan de acción, Hacia un Norte Ambientalmente Sostenible ¡todos por el agua! Cúcuta. Colombia.

[2] Cancillería. Convenio de Basilea 2011. Colombia. Recuperado en <http://www.cancilleria.gov.co/convenio-basilea>.

[3] Decreto 1609 DE 2002 "Por el cual se reglamenta el manejo y transporte terrestre automotor de mercancías peligrosas por carretera". Expedido por el Ministerio de Transporte. 31 Julio de

2002.

[4] Decreto 4741 "Por el cual se reglamenta parcialmente la prevención y manejo de los residuos o desechos peligrosos generados en el marco de la gestión integral" expedido por el Ministerio de Ambiente, Vivienda y Desarrollo Territorial. 30 de diciembre de 2005.

[5] Decreto 1076 de 2015 "Por medio del cual se expide el Decreto Único Reglamentario del Sector Ambiente y Desarrollo Sostenible." Expedido por el Ministerio de ambiente y desarrollo sostenible 26 de mayo de 2015.

[6] Subsecretaría de Prevención y Participación Ciudadana Dirección General de Prevención del Delito y Participación Ciudadana (2008). Planes Locales de Prevención "Marco Metodológico para la Elaboración de Diagnósticos". Gobierno federal Estas unidos Mexicanos 37, 6.

[7] Ministerio de vivienda y desarrollo territorial 2005. Política Ambiental para la Gestión Integral de residuos o desechos peligrosos. Bogotá. Colombia. Panamericana.

[8] Resolución 1023 "Por la cual se adopta el protocolo para el monitoreo y seguimiento del Subsistema de Información sobre Uso de Recursos Naturales Renovables SIUR para el sector manufacturero y se dictan otras disposiciones" Expedida por el Ministro de ambiente, vivienda y desarrollo territorial 28 de mayo de 2010.

[9] Resolución 1362 "por la cual se establecen los requisitos y el procedimiento para el Registro de Generadores de Residuos o Desechos Peligrosos, a que hacen referencia los artículos 27 y 28 del Decreto 4741 del 30 de diciembre de 2005, expedida por el ministro de ambiente, vivienda y desarrollo territorial. 2 agosto de 2007.

[10] Resolución 222 "Por la cual se establecen requisitos para la gestión ambiental integral de equipos y desechos que consisten, contienen o están contaminados con Bifenilos Policlorados (PCB)" Expedida por el Ministerio de Ambiente y Desarrollo sostenible, 15 de diciembre de 2011.

[11] Resolución 1741 "Por el cual se modifica la Resolución 222 de 2011 y se dictan otras disposiciones" Expedida por el Ministerio de Ambiente y Desarrollo Sostenible, 24 de octubre de 2016.M. Young, The Technical Writer's Handbook. Mill Valley, CA: University Science, 1989.

[12] Vera-Rivera, F. H., Perez-Gutierrez, B. R., & Torres Bermudez, F. J. (2015). Sandbox UFPS - cloud development platform for server management, creation and deployment of web applications of academic use. Research in Computing Science, 101, 65–75.

[13] Vera-Rivera, F. H., Perez-Gutierrez, B. R., & Urbina Alarcón, V. E. (2016). Modelo de nube híbrida (hybrid cloud) de Infraestructura como servicio para mejorar el rendimiento de la plataforma Sandbox - UFPS. Research in CIACA PORTUGAL 2016, 237–244.