International Interdisciplinary Congress on Renewable Energies, Industrial Maintenance, Mechatronics and Informatics

Booklets

RENIECYT 1702902 CONACYT

RENIECYT - LATINDEX - Research Gate - DULCINEA - CLASE - Sudoc - HISPANA - SHERPA UNIVERSIA - Google Scholar DOI - REDIB - Mendeley - DIALNET - ROAD - ORCID

Title: Technological Implementation for rainwater harvesting

Authors: BONES-MARTINEZ, Rosalía, SOTO-LEYVA, Yasmin and SANTOS-OSORIO, Arturo

Editorial label ECORFAN: 607-8695
BCIERMMI Control Number: 2022-01
BCIERMMI Classification (2022): 261022-0001

Pages: 12
RNA: 03-2010-032610115700-14

ECORFAN-México, S.C.
143 – 50 Itzopan Street
La Florida, Ecatepec Municipality
Mexico State, 55120 Zipcode
Phone: +52 1 55 6159 2296
Skype: ecorfan-mexico.s.c.
E-mail: contacto@ecorfan.org
Facebook: ECORFAN-México S. C.
Twitter: @EcorfanC

www.ecorfan.org

Holdings
Mexico Colombia Guatemala
Bolivia Cameroon Democratic
Spain El Salvador Republic
Ecuador Taiwan of Congo
Peru Paraguay Nicaragua

Introduction

It is made an investigation and distribution of rainwater, based on the fact that it can be used as an alternative to supply the water demand in some of the daily activities carried out at the Higher Technological Institute of Huauchinango. Particularly the presentation of a physical model of rainwater collection and filtering will provide the necessary data to determine the appropriate use in such facilities.

Based on the above, some problems that have arisen over time are presented. The main one is due to the growth of the urban population, and therefore to the increase in the demand for water consumption. These problems of water scarcity are rethinking the role of rainwater from being considered as a waste to being considered as a resource, capable of supplying several of the daily activities. This water resource can be depleted quickly, that said, it is intended to generate the implementation of a rainwater harvesting system to supply the required demand, making use of the water that we took as waste.

This research work and for its development, different tests were elaborated to determine some physical and chemical characteristics of the collected water, and with these results to determine a good use of implementation for the utilization and optimization of captured water, following a series of phases within a methodology, a physical model is built which captures and filters the water improving its conditions for its use.

Methodology

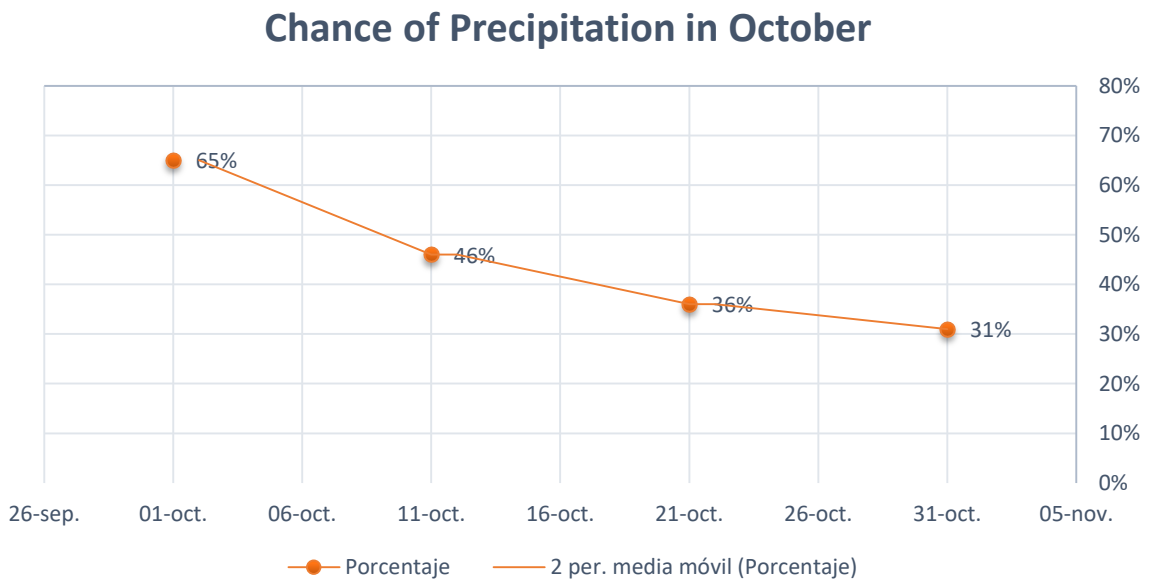
Current situation

The infrastructure of the Higher Institute of Huauchinango is in optimal conditions and its current water supply is not so critical, it is only a matter of focus since presenting our position with nature, it is convenient to work for it, take care of it, and reuse it.Working with rainwater harvesting is the solution to minimize the use of water supplied by the municipality, giving a plus to our ecology, making these benefits known and taking care of our environment by taking advantage of a vital liquid that is wasted to reuse it for purposes ecological.

Precipitation

A wet day is a day with less than 1 millimeter of liquid or liquid-equivalent precipitation. The chance of wet days in Huauchinango, Puebla varies very significantly throughout the year.
The wetter season lasts 4.5 months, from May 28 to October 13, with a greater than 43% chance of a given day being a wet day. The maximum chance of a wet day is 77% on July 3.
The drier season lasts 7.5 months, from October 13 to May 28. The smallest chance of a wet day is 9% on January 13.
Among the wet days, we distinguish between those with only rain, only snow, or a combination of the two. Based on this categorization, the most common form of precipitation throughout the year is rain alone, with a maximum probability of 77% on July 3 (Ovacen, 2018).

Graph 4.1 Chance of Precipitation in October



Reference:
(own elaboration, 2021)

Correct placement of the model for rainwater harvesting

Materials

Anthracite

For the main and first layer, this material is an excellent filtration medium, mainly for the elimination of chlorine and organic compounds present in the water that is captured.

Sand

As a second layer of the filter we find sand, with a lower density than gravel. Thanks to its round-shaped grain symmetry, it ensures porosity, letting the water flow easily, but retaining some suspended particles that continue to appear in the rainwater.

Gravel

As a third segment, this one below is used in the filters due to its density, the heaviest of these materials already installed previously, it has great characteristics which make it a very good material for filtration, which does not impart any characteristic to the water collected, passage of the water through the gravel will stop at these contaminants.

Geotextile NT1600

Finally, we have this material which, due to its fine conformation structure, its main quality is found in its faces, one of these is waterproof and the other is permeable, therefore, it is an excellent retainer of contaminants that water can bring. and fine particles, mentioning its properties above as a filter material, it is chosen to use between layers, this being one more layer of filter material in the rainwater harvesting model.

false bottom

It is like a type of storage tank where some suspended solids that may occur can settle, since the outlet of the collected water is located at a height of 0.10 m from the bottom, so the last contaminants end up here and let the water come out fully filtered for use.

Results

Implementation prototype

Finally, we find the physical prototype to verify the operation since this is how the collected water samples were taken to see the difference and verify its usefulness of the collected rainwater. This physical prototype is made with glass walls to appreciate its operation almost in its entirety.

Figure 5.1 Physical Prototype

Reference source:
(own elaboration, 2021)

Comparative physical and chemical properties

By taking into account the type of water to be collected, a comparison between rainwater is generated, measurements of these physical and chemical characteristics are made through an analysis of samples taken, before entering the model and at the exit of the model., the characteristics measured are the following: Determination of pH, Turbidity, Apparent Color, Suspended Solids, Odor and Taste, Oxygen and Conductivity.

In accordance with resolution 2115 of 2007, a comparison of its physical properties is made with a sample captured before and after the filter, obtaining the following results.

Figure 6.1 water Sample before passing through the Prototype (Filter)

Reference source:
(own elaboration, 2021)

Figure 6.2 water Sample after passing through the Prototype (Filter)

Reference source:(own elaboration, 2021)

catchment area

The collection of rainwater is carried out through the roofs, taking advantage of its large collection area. In this case, the drop that the tin roofs have with the slope and gutters that it contains are good for capturing this liquid.

In this regard, the material of these sheets is selected due to its conditions of easy handling, cost and good handling when building this cover, another great feature that this polyethylene provides is that it maintains the characteristics of water without altering its conditions. initials, it offers us a great impermeability which provides a collection without losses at the time of precipitation that occurs in the area.

Figure 6.3 Comparative physical and chemical properties

SAMPLE COLLECTION

SAMPLE PRESERVATION

PHYSICAL PARAMETERS	CHEMICAL PARAMETERS
DISSOLVED OR SUSPENDED SOLIDS AND TRUE COLOR	PH, CONDUCTIVITY, ANIONS, CATIONS, METAL IONS.

Reference source:
(own elaboration, 2021)

The rainwater captured according to its characteristics will be used for the discharge of toilets and general services such as cleaning in the facilities, it is assumed that, of the total design volume, only a percentage of 65% of this will be used for the aforementioned uses.

Daily demand used for flushing toilets and general services.

D= 0.45 m3/day * 0.65 = 0.2925 m3/day

Monthly demand used for flushing toilets and general services.

D= 0.2925 m3/day * 30 = 8.775 m3/day

The month of 30 days is determined, according to this it is calculated that the monthly water demand for this type of use is 8,775 m3.

Conclusions

According to the situation presented, it can be shown that the use and exploitation of rainwater is becoming a great alternative that is not common, which allows reducing the impact caused by conventional supply sources.

So with this we can say that the rainwater collection and filtering model created provides a sustainable solution, it is also providing water of an acceptable quality according to resolution 2115 of 2007 to be used in daily activities such as the discharge of toilets and general services such as the cleanliness of the facilities, except for use for human consumption that could affect health.

The benefits that will be reflected when implementing it:

- Sustainability
- Environmental benefit
- Economic savings

Based on atmospheric data from the region, it is a project that fits perfectly since the area is humid-rainy, this puts our plan into operation most of the year, but in terms of collection, the total volume demanded for the determined use, this is due to the fact that the collection area is small in consideration to supply the required need, however, a significant saving potential is obtained of a percentage of 65% of the 8,775 m3 consumed in a month in these activities such as it is in W.C. and cleanliness of the facilities.

References

Adler Ilán, Carmona Gabriela, Bojalil José Antonio; rainwater harvesting Manual for urban centers, 2001. URLhttps://www.academia.edu/6712743/MANUAL_DE_CAPTACIÓN_DE_AGUAS_DE_LLUVIA_PARA_CENTROS_URBANOS_MANUAL_DE_CAPTACIÓN_DE_AGUAS_DE_LLUVIA_PARA_CENTROS_URBANOS

Alder I, water and Mexico City: an Ecological proposal; Citizen Alternative Magazine Edition July 21-September 2005. URLhttp://www.ptolomeo.unam.mx:8080/jspui/bitstream/132.248.52.100/6137/1/Tesis.pdf

Bravo, H.A., R.J. Torres, J. Harris, R.M. Saavedra, P.A. Sánchez, R.C. Camacho, R.E. Sosa y M.R. Gamboa. Case Studies on Chemical, Atmospheric and Acid Rain. Autonomus University of Campeche. 1996. URLhttp://epomex.uacam.mx/?modulo_micrositio=paginas&acciones_micrositio=descargar&archivo=modulos/paginas/archivos/14/adjuntos/GM3TomoII.pdf&vistafull_micrositio=yes

FAO, Regional Office for Latin America, “Manual for Rainwater Harvesting and Use Experiences in Latin America, Series: Arid and Semi-arid Zones Nº 13”. Chile, 2000.

URLhttps://www.academia.edu/14181705/Estrategias_de_adaptación_al_cambio_climático_desde_la_pol%C3%ADtica_y_legislación_de_aguas_en_Argentina

Official Gazette of the Federal District; Sustainable certification program, 2008

URL https://paot.org.mx/centro/leyes/df/pdf/GODF/GODF_25_11_2008.pdf

Joao Pessoa Ibero-American Seminar on urban water supply systems, Brazil, 2006

URLhttps://www.academia.edu/33576289/VI_SEREA_Seminário_Iberoamericano_sobre_Sistemas_de_Abastecimento_Urbano_de_Água_João_Pessoa_Brasil_5_a_7_de_junho_de_2006

References

Nebel, Bernard J. and Wright, Richard, T. Environmental sciences ecology and sustainable development. Prentice Hall, 6th edition. Mexico,1999.

URLhttps://indaga.ual.es/discovery/fulldisplay?vid=34CBUA_UAL:VU1&search_scope=MyInstitution&tab=LibraryCatalog&docid=alma991001002539704991&lang=es&context=L&adaptor=Local%20Search%20Engine&query=sub,exact,Ecolog%C3%ADa,AND&mode=advanced&offset=0

ONU-FAO; Manual on catchment systems and use of rainwater for domestic use and human consumption experiences in Latin America, 2000.

URL https://www.fao.org/3/i3247s/i3247s.pdf

Phillips Victor D., GEM, et.al. Rainwater harvesting as an alternative to face the scarcity of the resource 2009.

URL https://nanopdf.com/download/captacion-de-agua-de-lluvia-pdf_pdf

CIDECALLI International Center for Demonstration and Training in the Use of Rainwater. Postgraduate College. Mexico (2008)

URL https://ecotec.unam.mx/organizaciones/centro-internacional-de-demostracion-y-capacitacion-en-aprovechamiento-del-agua-de-lluvia-cidecalli-cp

ECORFAN®