Volume 7, Issue 21 — July — December — 2021

ISSN 2414-4932

Journal of Urban and Sustainable Development

ECORFAN®

Journal of Urban and Sustainable Development, Volume 7, Issue 21, July – December 2021, is a journal edited sixmonthly by ECORFAN-Bolivia. Loa 1179, Cd. Sucre. Chuquisaca, Bolivia.WEB: www.ecorfan.org/bolivia, journal@ecorfan.org. Editor in Chief: VALDIVIA - ALTAMIRANO, William Fernando. PhD. ISSN On line: 2414-4932. Responsible for the latest update of this number ECORFAN Computer Unit. ESCAMILLA-BOUCHÁN, Imelda. PhD, LUNA-SOTO, Vladimir. PhD, last updated December 31, 2021.

Journal of Urban and Sustainable Development

Definition of Research Journal

Scientific Objectives

Support the international scientific community in its written production Science, Technology and Innovation in the Field of Humanities and Behavioral Sciences, in Subdisciplines Urban and sustainable development, Environmental sustainability, Social sustainability, Economic sustainability, Integrated transport systems, Urban mobility.

ECORFAN-Mexico SC is a Scientific and Technological Company in contribution to the Human Resource training focused on the continuity in the critical analysis of International Research and is attached to CONACYT-RENIECYT number 1702902, its commitment is to disseminate research and contributions of the International Scientific Community, academic institutions, agencies and entities of the public and private sectors and contribute to the linking of researchers who carry out scientific activities, technological developments and training of specialized human resources with governments, companies and social organizations.

Encourage the interlocution of the International Scientific Community with other Study Centers in Mexico and abroad and promote a wide incorporation of academics, specialists and researchers to the publication in Science Structures of Autonomous Universities - State Public Universities - Federal IES - Polytechnic Universities - Technological Universities - Federal Technological Institutes - Normal Schools - Decentralized Technological Institutes - Intercultural Universities - S & T Councils - CONACYT Research Centers.

Scope, Coverage and Audience

Journal of Urban and Sustainable Development a Research Journal edited by ECORFAN-Mexico S.C in its Holding with repository in Bolivia, is a scientific publication arbitrated and indexed with semester periods. It supports a wide range of contents that are evaluated by academic peers by the Double-Blind method, around subjects related to the theory and practice of Urban and sustainable development, Environmental sustainability, Social sustainability, Economic sustainability, Integrated transport systems, Urban mobility with diverse approaches and perspectives , That contribute to the diffusion of the development of Science Humanities and Behavioral Sciences that allow the arguments related to the decision making and influence in the formulation of international policies in the Field of Engineering and Technology. The editorial horizon of ECORFAN-Mexico® extends beyond the academy and integrates other segments of research and analysis outside the scope, as long as they meet the requirements of rigorous argumentative and scientific, as well as addressing issues of general and current interest of the International Scientific Society.

Editorial Board

Arbitration Committee

Assignment of Rights

The sending of an Article to Journal of Urban and Sustainable Development emanates the commitment of the author not to submit it simultaneously to the consideration of other series publications for it must complement the Originality Format for its Article.

The authors sign the Authorization Format for their Article to be disseminated by means that ECORFAN-Mexico, S.C. In its Holding Bolivia considers pertinent for disclosure and diffusion of its Article its Rights of Work.

Declaration of Authorship

Indicate the Name of Author and Coauthors at most in the participation of the Article and indicate in extensive the Institutional Affiliation indicating the Department.

Identify the Name of Author and Coauthors at most with the CVU Scholarship Number-PNPC or SNI-CONACYT- Indicating the Researcher Level and their Google Scholar Profile to verify their Citation Level and H index.

Identify the Name of Author and Coauthors at most in the Science and Technology Profiles widely accepted by the International Scientific Community ORC ID - Researcher ID Thomson - arXiv Author ID - PubMed Author ID - Open ID respectively.

Indicate the contact for correspondence to the Author (Mail and Telephone) and indicate the Researcher who contributes as the first Author of the Article.

Plagiarism Detection

All Articles will be tested by plagiarism software PLAGSCAN if a plagiarism level is detected Positive will not be sent to arbitration and will be rescinded of the reception of the Article notifying the Authors responsible, claiming that academic plagiarism is criminalized in the Penal Code.

Arbitration Process

All Articles will be evaluated by academic peers by the Double Blind method, the Arbitration Approval is a requirement for the Editorial Board to make a final decision that will be final in all cases. MARVID® is a derivative brand of ECORFAN® specialized in providing the expert evaluators all of them with Doctorate degree and distinction of International Researchers in the respective Councils of Science and Technology the counterpart of CONACYT for the chapters of America-Europe-Asia-Africa and Oceania. The identification of the authorship should only appear on a first removable page, in order to ensure that the Arbitration process is anonymous and covers the following stages: Identification of the Research Journal with its author occupation rate - Identification of Authors and Coauthors - Detection of plagiarism PLAGSCAN - Review of Formats of Authorization and Originality-Allocation to the Editorial Board- Allocation of the pair of Expert Arbitrators-Notification of Arbitration -Declaration of observations to the Author-Verification of Article Modified for Editing-Publication.

Instructions for Scientific, Technological and Innovation Publication

Knowledge Area

The works must be unpublished and refer to topics of Urban and sustainable development, Environmental sustainability, Social sustainability, Economic sustainability, Integrated transport systems, Urban mobility and other topics related to Humanities and Behavioral Sciences.

Presentation of Content

In the first article we present, *Obtaining particulate agglomerates from the recycling of multilayer containers and low density polyethylene*, by ENRÍQUEZ-PÉREZ, Ma. Angeles, ROSALES-DAVALOS, Jaime and CASTREJÓN-SÁNCHEZ, Víctor Hugo, with adscription in the Tecnológico de Estudios Superiores de Jocotitlán, as next article we present, *Energy sustainability alternatives for the Home for the elderly Maty, in the community of Villa Juárez, Aguascalientes*, by CASTILLO-ZÁRATE, Ma. Alicia, with adscription in the Universidad Tecnológica de Aguascalientes, as next article we present, *Vermicompost production monitoring and the internet of things*, by SILVERIO-GARRIDO, Elid, SAMPAYO-RODRIGUEZ, Carmen Jeannette, HERNANDEZ-LUNA, Aldo and CASTILLO-QUIROZ, Gregorio, with adscription in the Instituto Tecnológico Superior de Huauchinango, as next article we present, *Disposal of mouth covers, masks or respirators, after they are used, to minimize the environmental impact and contages by COVID 19*, by HERNÁNDEZ-RODRÍGUEZ, María Guadalupe, ORTEGA-CHÁVEZ, Laura Antonia, CARO ESCUDERO, Iveth Selene and BARRAZA-ÁLVAREZ, Alberto Guerrero, with adscription in the Instituto Tecnológico de Chihuahua II.

Content

Article	Page

Article **Journal of Urban and Sustainable Development**
December 2021 Vol.7 No.21 1-6

Obtaining particulate agglomerates from the recycling of multilayer containers and low density polyethylene

Obtención de aglomerados particulados a partir del reciclaje de envases multicapa y polietileno de baja densidad

ENRÍQUEZ-PÉREZ, Ma. Angeles†[1], ROSALES-DAVALOS, Jaime[2] and CASTREJÓN-SÁNCHEZ, Víctor Hugo[1]

[1]Tecnológico de Estudios Superiores de Jocotitlán, Departamento de Ingeniería en Materiales
[2]Tecnológico de Estudios Superiores de Jocotitlán, Departamento de Ingeniería Mecatrónica

ID 1st Author: *Ma. Angeles, Enríquez-Pérez* / **ORC ID**: 0000-0002-2280-0661, **Researcher ID Thomson**: H-9399-2018

ID 1st Co-author: *Jaime, Rosales-Davalos* / **ORC ID**: 0000-0002-9059-6093, **CVU CONACYT ID**: 812961

ID 2nd Co-author: *Víctor Hugo, Castrejón-Sánchez* / **ORC ID**: 0000-0002-0112-5388, **Researcher ID Thomson**: C-9077-2015, **CVU CONACYT ID**: 235470

DOI: 10.35429/JUSD.2021.21.7.1.6 Received: July 10, 2021; Accepted October 30, 2021

Resumen

Actualmente, ha crecido el interés y la necesidad de innovar nuevos materiales mediante el uso de materiales de desecho, que cumplan con características físicas, químicas y mecánicas similares o mejoradas de los materiales a los cuales sustituirán. Durante la presente investigación se recolectaron Envases Multicapa (EM) y de Polietileno de Baja Densidad (PEBD), se obtuvieron aglomerados particulados con diferentes proporciones, se determinó la densidad aparente, absorción de agua, masa, volumen, comportamiento al calor, ángulo de contacto, mecanizado y ensayos a la compresión. Con el objetivo de evaluar las proporciones p/p en las propiedades. La ventaja del material obtenido es que no generan residuos y son 100% reciclables. La proporción 90:10 es la que se podría usar en la industria de la construcción como muros falsos, con un módulo de ruptura de 52.7 N/mm^2 y un esfuerzo de compresión de 32.9 MP, debido a que puede ser mecanizado sin alterar sus características físicas; mientras que las proporciones 85:15 y 80:20 al no poderse mecanizar podrían usarse como soporte flotante con un catalizador fotocatalizador, debido a que estos aglomerados poseen estabilidad dimensional al estar en contacto con el agua.

Proporción p/p, Aglomerados, Ensayo de compresión

Abstract

Currently, the interest and the need to innovate new materials through the use of waste materials has grown, which meet similar or improved physical, chemical and mechanical characteristics of the materials they will replace. During the present investigation, Multilayer Containers (EM) and Low Density Polyethylene (LDPE) were collected, particulate agglomerates with different proportions were obtained, the apparent density, water absorption, mass, volume, heat behavior, angle were determined. contact, machining and compression tests. With the objective of evaluating the proportions p / p in the properties. The advantage of the material obtained is that they do not generate waste and are 100% recyclable. The 90:10 ratio is the one that could be used in the construction industry as false walls, with a modulus of rupture of 52.7 N / mm2 and a compressive stress of 32.9 MP, because it can be machined without altering its characteristics. -physical houses; While the 85:15 and 80:20 proportions, since they cannot be machined, could be used as a floating support with a photocatalyst catalyst, due to the fact that these agglomerates have dimensional stability when in contact with water.

w/w ratio, Agglomerates, Compresion test

Citation: ENRÍQUEZ-PÉREZ, Ma. Angeles, ROSALES-DAVALOS, Jaime and CASTREJÓN-SÁNCHEZ, Víctor Hugo. Obtaining particulate agglomerates from the recycling of multilayer containers and low density polyethylene. Journal of Urban and Sustainable Development. 2021. 7-21: 1-6

*Correspondence to the author (e-mail: angelenriper@gmail.com)
† Researcher contributing as first author

1. Introduction

The evolution of humanity is analyzed in social, cultural or technological aspects; such evolution has always been conditioned by the discovery of new materials with better properties than those that already exist, the development of technologies focused on production processes is needed, in order to reduce material losses and the creation of new materials (Tenorio, Moya, & Camacho, 2012).

For example, manufacturing lighter construction materials, smaller in size and with good mechanical and physical properties, low cost and easy to use, the important thing is the benefit they can bring to the environment with the purpose of finding sustainable solutions to the environmental problems that arise (Nemli, Ozturk, & Aydin, 2005).

By definition a chipboard is a composite type material that is generally made up of a resin (matrix), bonded with a fiber or wood (reinforcement) (Gaitán, Fonthal, & Ariza, 2016). In some cases, they are manufactured with mineral, glass, carbon and aramid fibers; however, synthetic fibers have been replacing synthetic fibers with natural fibers (Nguong, Lee, & Sujan, 2013). Although, branches and small-sized roundwood from primary forest harvesting and residues from forest industries, such as sawmills, carpentries, plywood factories, among others, are also used as raw material (Rangel, Moreno, Trejo, & Valero, 2017).

The world population consumes approximately 188 million tons of wood per year (Hernández T & Hernández F., 2020), if the rate of wood fiber consumption and population growth remains constant the demand for wood will increase which could increase deforestation, causing an environmental problem (Zambrano, et al., 2013) (González, Jaramillo, Pérez, & Sablón, 2018). For this reason, the substitution of the raw material for a more accessible one that does not affect the ecosystem is analyzed (Contreras, et al., 2010) (Akkus, Akbulut, & Candan, 2019).

Recycling being an alternative, it allows the recovery of various materials, not only of wood origin, multilayer containers could be used to obtain agglomerates.

Multilayer containers are formed by several layers of polyethylene, aluminum and cardboard, being the polyethylene the binding agent that allows by the action of heat to keep the materials together (Obando & Escobar, 2009). Therefore, this work evaluates the influence on the physical-mechanical properties, when the agglomerates are reinforced with low density polyethylene, in different proportions w/w, in order to analyze the possible applications, they can be used in the construction industry as false walls or as supports in photocatalysis.

2. Methodology

2.1 Obtaining agglomerates

To obtain the agglomerates, post-consumer multilayer (MS) and low density polyethylene (LDPE) containers were collected, washed and dried at room temperature. The raw material was ground with a grinder to obtain a particle size of 5 mm for the MS and 1 cm for the LDPE. Subsequently, the raw material is weighed; Table 1 shows the w/w ratios that were experimented to obtain the agglomerates. The raw material is placed inside a mold with dimensions of 23 x 12.5 x 5 cm, which functions as a heating plate for thermoforming, controlled by a control system designed in Labview software.

The shredder and the heating plate were designed and built at the Tecnológico de Estudios Superiores de Jocotitlán. In thermoforming, agglomerates are obtained under the following operating conditions: heating time 60 min, pressure 4 tons of axial compression at 180°C; then the agglomerate is cooled to room temperature and extracted. The procedure described above has been previously reported (Enríquez Pérez, Rosales Davalos, López Ramirez, & Castrejon Sanchez, 2017).

Agglomerate	% MS	% LDPE
1	70	30
2	75	25
3	80	20
4	85	15
5	90	10
6	95	5
7	100	0

Table 1 Variation w/w between multilayer packaging (MS) and low-density polyethylene (LDPE)
Source: Own Elaboration

The physical-mechanical properties evaluated were: physical appearance, density, moisture content, water absorption, swelling, fireproofing, contact angle and compression tests, according to NMX-C- 013-1978 "Gypsum panels for partition walls, ceilings and fire protection" and ASTM D 1037-12 Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials.

3. Results

3.1 Physical Appearance

Table 2 describes the physical characteristics of the agglomerates.

Code	Appearance
A_1-70:30	Heterogeneous matrix, hard to the touch, with cracks on the faces.
A_2-75:25	Heterogeneous matrix, hard to the touch, with cracks on the faces.
A_3-80:20	Homogeneous matrix, compact, hard to the touch
A_4-85:15	Homogeneous matrix, compact, hard to the touch
A_5-90:10	Homogeneous matrix, compact, hard to the touch
A_6-95:5	Heterogeneous matrix, hard to the touch
A_7-100:0	Homogeneous matrix, fragile to the touch, spongy

Table 2 Characteristics of the agglomerates
Source: Own Elaboration

The appearance of the agglomerates depends on the percentage by weight of ES and LDPE. The higher the proportion of plastic, the harder the matrix is, but the material does not interact with each other, presenting cracks on the faces, making it an unsuitable material for use as agglomerate. Therefore, we only worked with the materials that presented a homogeneous matrix, the agglomerates A3-80:20, A4-85:15 and A5-90:10 (see Figure 1).

Figure 1 Agglomerates obtained
Source: Own Elaboration

3.2 Properties of the agglomerates

The agglomerates obtained are lightweight materials; as the amount of plastic increases, the weight increases (see Table 3).

The agglomerates were left outdoors for one month to determine the moisture absorbed from the environment, as shown in Table 3, the moisture absorption is minimal, so they are suitable for outdoor use.

Agglomerate	Density Kg/m^3	Humidity %
A_3-80:20	947	3.3
A_4-85:15	752	2.9
A_5-90:10	651	2.9

Table 3 Density and relative humidity of the agglomerates
Source: Own Elaboration

The water absorption and dimensional stability of an agglomerate is determined when the material is immersed in water for a period of time. Figure 2 shows the evolution of water absorption as a function of time (hours).

A3 initially absorbs 15.2% after 2 hr and 16.7% after 24 hr. Meanwhile, A4 absorbs 24% of water, then at 10 hours it increases to 35%, this value being the maximum absorption of the material. Finally, A5, initially absorbs 8.7% and increases until it reaches a maximum of 14.2% after 10 hours. The agglomerates comply with ASTM D 1037, where the agglomerates can have an absorption between 25 and 60% between 2 and 24 hours.

There is no relationship between weight and absorption; some authors report that the greater the weight, the greater the absorption, but this behavior is not present in the materials obtained, since the material that absorbs less water is the one with the greater weight, although the most stable material is the one with the less weight.

ISSN 2414-4932

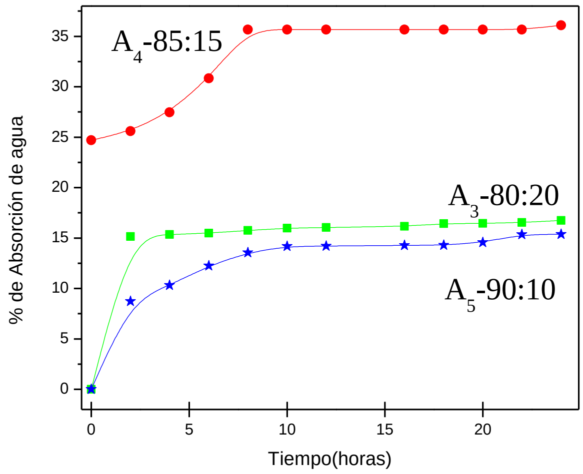


Figure 2 Percentage of water absorption.
Source: Own Elaboration

When the moisture content is below the saturation point of the fibers (from 30%), there is only an increase in weight and its volume remains practically constant (Volcuende, Parra, & Benlloch, 2005). The increase in volume of the agglomerates ranges from 4.2 to 6.1% (see Figure 3). Being A4 the one that presents the highest shrinkage, followed by A3 and then A5; although the agglomerates practically conserve their size, since the material remains stable in the presence of water. The change of volume in the materials is not visible to the naked eye.

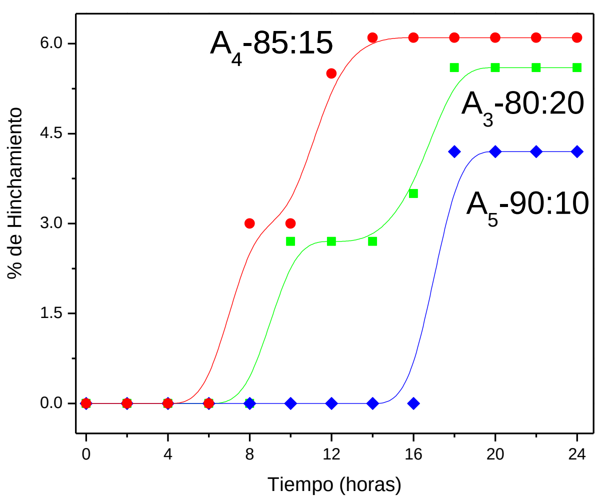


Figure 3 Percentage of swelling
Source: Own Elaboration

The agglomerates were left submerged in water for a period of two months, the material floats in the water, despite the time there is no change in its appearance, when they were taken out and left to dry at room temperature, they did not have any modification in their structure.

The contact angle was determined by placing a drop (water, salts or acid) on the surface of the material, taking the time and calculating the angle formed between the surface and the drop, as shown in Figure 4. Agglomerates are hydrophilic materials to water, it takes approximately 2hrs for a drop to deform. They show chemical resistance to attack with acids, lye and marine environment.

Figure 4 Contact angle of A4 with H_2O and HCl.
Source: Own Elaboration

The agglomerates are fireproof materials, they do not propagate heat, they only carbonize. They have a weight loss between 14 to 17% of the material in a time of approximately 25-35 min.

In addition, they can be cut and bound without altering their structure. Machining tests were carried out to determine if they can be drilled with a ¼" drill bit, if they can support anchors and screws (see figure 5), the 6 faces were analyzed to determine if they can be assembled with screws, obtaining the following results:

- A_3, presented cracks when inserting the dowels, fractures occurred near the perforated area. It was not able to keep the dowel fixed, preventing the insertion of a screw. It has a brittle fracture, a modulus of rupture of 65.2 N/mm^2 and a compressive strength of 41 MPa.
- A_4 could be drilled, but the screw was not fixed, since there were small fractures on the lateral faces; therefore, it has a brittle fracture, with a modulus of rupture of 56.4 N/mm^2 and a compressive stress of 34.1 MPa.
- Finally, the A_5 could be drilled, so that the dowels and therefore the bolt could be drilled out. It can be nailed, it behaves as a ductile material, its modulus of rupture is 52.7 N/mm^2 and a compressive stress of 32.9 MPa.

December 2021 Vol.7 No.21 1-6

Figure 5 Screw test
Source: Own Elaboration

As the proportion of polymer in the agglomerates increases, both the modulus of rupture and compressive stress are higher; although this trend is not reflected in the machining tests, the opposite is true, the lower the proportion of LDPE, the more easily it can be machined.

Conclusions

Agglomerates were obtained, varying the proportion (w/w), between multilayer and LDPE containers.

However, only the proportions: 80:20, 85:15 and 90:10 are able to obtain agglomerates where the materials are integrated and homogeneous matrices are obtained.

Being, the A5 (90:10) a feasible alternative as an ecological agglomerate for closed and/or open places, to make divisions in interiors or as false walls, it can be mechanized without difficulty, it is light and absorbs 14.2% when it is immersed in water; due to its own characteristics they are electrical, thermal and acoustic insulating materials.

However, A4 and A3 (85:15 and 80:20, respectively) are not discarded, since they can be sawn and do not release material and are stable in water, they can be used as a floating support with a photocatalytic catalyst (composite) for the photocatalytic degradation of organic pollutants (e.g., dyes) present in wastewater.

References

Akkus, M., Akbulut, T., & Candan, Z. (2019). Application of electrostatic powder coating and wood composite panels using a cooling method. Part 1: investigation of water intake, abrasion, scratch resistance, adhesion strength . *Bioresources*, 9557-9574.

Contreras, M. W., Will, V. S., Owen, C. M., Cloquell, B. C., Rondón, S. M., Barrios, P. E., Contreras, A. (2010). El Diseño Ambientalmente Integrado y el Ecodiseño en la elaboración de tableros aglomerados de partículas de bambú con adhesivo Fenol Formaldehido Integrated environme. *Ecodiseño y sostenibilidad*, 117-144.

Enríquez Pérez, M., Rosales Davalos, J., López Ramirez, R., & Castrejon Sanchez, V. (2017). Aprovechamiento de residuos de envases multicapas para la elaboración de aglomerados. *Ciencias Ambientales y Recursos Naturales*, 27-31.

Gaitán, A., Fonthal, G., & Ariza, C. (2016). Fabricación y propiedades físicas de aglomerados de Pennisetum purpureum schum, Philodendron longirrhizum y Musa acuminata. *Revista Ciencias Técnicas Agropecuarias*, 5-11.

González, R., Jaramillo, J., Pérez, Q., & Sablón, C. (2018). Evaluación físico-mecánicas de tableros a base del Aserrín de Pigüe (Piptocoma discolor) y bagazo de caña de azúcar en Pastaza. *Revista Amazónica y Ciencia y Tecnología*, 95-104.

Hernández T, M., & Hernández F., P. (25 de Octubre de 2020). Madera importada domina el mercado de México, pionero en el manejo forestal comunitario. *Animal Politico*, págs. 1-2.

Nemli, G., Ozturk, I., & Aydin, I. (2005). Some of the parameters influencing surface roughness of particleboard. *Building and Environment*, 1337–1340.

Nguong, C., Lee, S., & Sujan, D. (2013). A Review on Natural Fibre Reinforced Polymer composites. *International Journal of Chemical*, 33-44.

Obando, J., & Escobar, M. (2009). Modelación del proceso de recuperación parcial de envases de tretra pak. *Revista EIA*, 157-167.

Rangel, L., Moreno, P., Trejo, S., & Valero, S. (2017). Propiedades de tableros aglomerados de partículas fabricados con madera de Eucalyptus urophylla . *Maderas. Ciencia y tecnología*, 373 - 386.

ISSN 2414-4932

Tenorio, C., Moya, R., & Camacho, D. (2012). Propiedades físico-mecánicas de tableros terciados construidos con especies tropicales de plantaciones para uso estructur. *Cerne, Lavras*, 317-325.

Volcuende, M. O., Parra, C., & Benlloch, J. (2005). Permeabilidad,porosidad y resistencia a la compresión de hormigones autocompactables. *Materiales de construcción*, 17-26.

Zambrano, L., Moreno, P., Muñoz, F., Durán, J., Garay, D., & Valero, S. (2013). Tableros de partículas fabricados con residuos industriales de madera de Pinus patula. *Madera y Bosques*, 65-80.

Article **Journal of Urban and Sustainable Development**
December 2021 Vol.7 No.21 7-16

Energy sustainability alternatives for the Home for the elderly Maty, in the community of Villa Juárez, Aguascalientes

Alternativas de sustentabilidad energética para el asilo Hogar del Abuelo Maty, en la comunidad de Villa Juárez, Aguascalientes

CASTILLO-ZÁRATE, Ma. Alicia †*

Universidad Tecnológica de Aguascalientes, México

ID 1st Author: *Ma. Alicia, Castillo-Zarate* / **ORC ID**: 0000-0003-0812-1125

DOI: 10.35429/JUSD.2021.21.7.7.16 Received: July 10, 2021; Accepted October 30, 2021

Abstract

Base on the objectives of the 2030 Schedule, for sustainable development for the benefit of people and the planet and, with the visionary commitment of the Universidad Tecnológica de Aguascalientes to contribute to the sustainable development of the various sectors, this article presents five alternatives of energy sustainability for the benefit of the Hogar del Abuelo Maty nursing home, located in the community of Villa Juárez, municipality of Asientos in the state of Aguascalientes. The document describes the context of this Institution, its energy consumption situation, the dynamics and operating status of equipment that requires electricity for basic healthcare services. Under a sustainability approach, the objective of this work is to provide resilient energy alternatives, aimed at generating, saving or efficient use of energy and caring for the environment. Following the applied research methodology, knowledge of photovoltaic systems allows the development of alternatives to meet a need for social impact. The main contributions derived from any of these are the positive impact generated in reducing the cost of energy consumption, caring for the environment and adult care services provided with clean energy.

Sustainability, Energy, Nursing Homes

Resumen

Con base a los objetivos de la Agenda 2030, para el desarrollo sostenible en beneficio de las personas y el planeta y, con el compromiso visionario de la Universidad Tecnológica de Aguascalientes para contribuir al desarrollo sostenible de los diversos sectores, se presenta en este artículo cinco alternativas de sustentabilidad energética en beneficio del asilo Hogar del Abuelo Maty, ubicado en la comunidad de Villa Juárez, municipio de Asientos del estado de Aguascalientes. El documento describe el contexto de esta Institución, su situación del consumo energético, la dinámica y estatus de operación de equipos que requieren electricidad para los servicios básicos asistenciales. Bajo un enfoque de sustentabilidad, el objetivo de este trabajo es proveer alternativas de energía resiliente, orientadas a la generación, ahorro o uso eficiente de energía y, el cuidado al medio ambiente. Siguiendo la metodología de investigación aplicada, el conocimiento de sistemas fotovoltaicos permite desarrollar alternativas para atender una necesidad de impacto social. Las contribuciones principales derivadas de cualesquiera de éstas, son el impacto positivo generado en la disminución del costo del consumo de energía, el cuidado del medio ambiente y los servicios de atención de adultos otorgados con energía limpia.

Sustentabilidad, Energía, Asilos

Citation: CASTILLO-ZÁRATE, Ma. Alicia. Energy sustainability alternatives for the Home for the elderly Maty, in the community of Villa Juárez, Aguascalientes. Journal of Urban and Sustainable Development. 2021. 7-21: 7-16

*Correspondence to the author (e-mail: acastillo@utags.edu.mx)
† Researcher contributing as first author

Introduction

Statistical data on population and demographic growth in Aguascalientes project in 2021, 9.8% corresponding to the older adult population ONAPO, 2018), by 2030 it is expected to represent 9.1% of the total; however, according to the projection of mortality decrease, by 2050 an increase of this population to 15.8% is expected, therefore, public and private institutions should consider this growth and provide for the attention to the demands and needs for this sector. In general terms, an increase in the percentage of the 65 and over age group with respect to the total population is projected, since while in 1970 it was 3.9%, in 2015 it represented 5.5% and, the projection indicates 15.8% of the total population by 2050. Under this scenario, the quality and quantity of assistance and health services provided to the elderly are decisive for the improvement of conditions that contribute to the extension of the projected life expectancy.

In this regard, it should be noted that the current operation and activities carried out by State organizations dedicated to the attention and care of the elderly depend to a large extent on the income received from the fees paid by family members and various donations. In order to provide basic care services, those that operate with their own resources or exclusively with donations, have the priority of covering food, water, electricity and thermal services, and frequently their economic solvency (which is why some of them are at risk of closing) limits the provision of complementary care services such as physical therapies, This has an impact on the quality of life of the adult, which is why it is of utmost importance to ensure and expand the availability of resources to provide primary care services and offer complementary services.

To address this situation, specifically in the largest nursing home in the state of Aguascalientes, where monthly energy consumption costs exceed an average of $10,000 and, with the primary objective of this institution focused on reducing electricity costs, this document presents five energy sustainability alternatives for the benefit of elderly residents of the Hogar del Abuelo nursing home, oriented to the generation, saving or efficient use of energy and care for the environment.

The different alternatives are developed in a first stage of intervention to this problem, and each one shows its respective amount and return on investment, leaving open a second stage for the search of resources that allow the implementation of any of these.

In this way, the document includes the following sections: Background of Hogar del Abuelo, the detected problem, the proposal of attention to the problem, the objective of this intervention, the detailed description of the work methodology used and, as results, the different proposals of solution as alternatives of energetic sustainability, likewise in the conclusions section it is emphasized on the fulfillment of the sustainability approach and the impact that all the proposals generate in the economic, environmental and social fields.

The added value that any of the alternatives will provide with their implementation will be the decrease in the cost of energy consumption, as well as the generation of energy from alternative sources to continue offering basic and complementary services in a socially and environmentally sustainable space.

Background

The "Casa de Descanso para Ancianos" also known as "Hogar del Abuelo Maty", was founded in 1979 and inaugurated on February 14, 1981; it was founded by Mrs. Carolina Villanueva de García and her son Mr. Carlos García Villanueva, with the purpose of offering the elderly the opportunity to live a dignified and healthy old age. Currently, Mr. Carlos García presides this institution.

The Daughters of Charity of St. Vincent de Paul have collaborated with this organization and at the same time, a board of trustees is formed with representative people in the State of Aguascalientes; it also has the support of public and private institutions that have collaborated to provide assistance to the elderly.

The Hogar del Abuelo is characterized for being the institution in the state that has benefited more people since its inauguration, since it has assisted more than a thousand elderly adults in vulnerable and marginalized situations in Aguascalientes.

December 2021 Vol.7 No.21 7-16

This organization is located in the town of Villa Juarez, which belongs to the municipality of Asientos and currently serves 60 to 80 elderly people per year, to whom it offers a permanent home, with food services, medical and spiritual care, physical therapies, laundry, hairdressing, personal grooming, as well as personalized care necessary for their physical and emotional well-being; the support also includes funeral services.

Figure 1 Geographical location of Hogar del Abuelo
Source: www.googlemaps.com.mx

In addition to caring for the elderly, the "Maty" rest home serves as the Basic Rehabilitation Unit of the Integral Family Development System (DIF) for the municipality of Asientos, offering physical and rehabilitation therapies free of charge. It has also worked with collegiate bodies such as the State Committee for Health and Attention to Aging, the Technical Council for Private Charity and the National Network of CSOs in Health.

Problem

For many years, the Hogar del Abuelo Maty received support from the company "Bordados Maty", however, with the decline of the textile industry in the state, the institution has sought other ways to obtain resources, currently subsisting through public and private donations. On the other hand, even though the pandemic situation has temporarily restricted the services of physical therapies and rehabilitation of older adults, as well as collective care events, for the residents of this Institution, there are food services, medical attention, laundry, hairdressing, personal grooming and personalized care, which evidently cannot be suspended.

Being these essential services those that require the constant consumption of thermal and electric energy, however in the last years, the average monthly cost of this service has averaged $12,000. 00, reaching in some months up to $18,000.00, hence the supply and consumption of energy represents an area of opportunity to diversify its generation sources, optimize its use and reduce its cost.

Description of the proposal for the development of sustainable alternatives

To ensure the minimum availability of energy required for care services, it is important to analyze the dynamics of energy consumption and, if necessary, adapt the Hogar del Abuelo's facilities under an energy sustainability approach, which will allow, on the one hand, to reduce the cost of thermal and electrical energy consumption and, on the other hand, to provide alternative sources of energy generation for the Hogar del Abuelo's facilities and, if necessary, to reduce the cost of thermal and electrical energy consumption, provide alternative sources of energy to continue offering basic services in a socially and environmentally sustainable space, in which priority is given to the comprehensive care of adults, strengthening social coexistence through the diversification of interactive activities, promoting the care of environmental resources with the appropriate use of solar technology, and at the same time reducing the cost of energy consumption for such actions.

Considering the situation and dynamics of energy consumption in the Hogar del Abuelo, as well as the alignment towards the objectives of the 2030 Agenda for sustainable development for the benefit of people and the planet, this project develops proposals for energy sustainability with the use of solar technology, as alternatives to meet the energy demand and reduce the cost of energy consumption.

Objective

To provide resilient energy alternatives, through the proposals of solar energy systems developed as sustainable alternatives, that provide electric energy for the basic care services required by the older adults of the Hogar del Abuelo Maty.

ISSN 2414-4932

December 2021 Vol.7 No.21 7-16

Methodology

Under the Applied Research approach, the knowledge of photovoltaic systems allows the development of alternatives to meet and improve a need of social impact, specifically the reduction of the cost of electricity consumption in the Hogar del Abuelo, therefore, this intervention is developed in the following stages:

Search for support and backing from governmental institutions.

The support of the State Integral Family Development (DIF) was sought for the development of the proposal. The response was positive, committed, and collaborative, mainly with the information required for the development of the proposals and access to the facilities of the Hogar del Abuelo.

Identification of the dynamics of energy consumption in the Hogar del Abuelo Maty's facilities.

a) The facilities have a well with a dynamic load depth of 120 m, in which a submersible pump with unknown power but calculated at 6 HP, extracts the water that supplies a tank with a capacity of 84 m3.

Figure 2 Well, submersible pump and reservoir
Source: Own Elaboration

b) The pumping equipment (supply pump) for the restrooms sends water to sinks, toilets and three 600-liter tanks used only for showers. This pump is activated every 5 minutes throughout the day and, although its nominal power is 3 HP, during operation it operates at 6.4 HP, this being the equipment with the highest energy consumption.

Figure 3 Well, submersible pump and supply pump
Source: Own Elaboration

c) The kitchen has a cold room and a freezer.

Figure 4 Cold storage and freezer
Source: Own Elaboration

d) In the laundry room has five washing machines and two dryers.

Figure 5 Washers and dryers
Source: Own Elaboration

e) The dormitories and corridors are equipped with energy-saving lighting.

f) In the asylum's load center, the power supply to the facilities is supplied to the following sections:

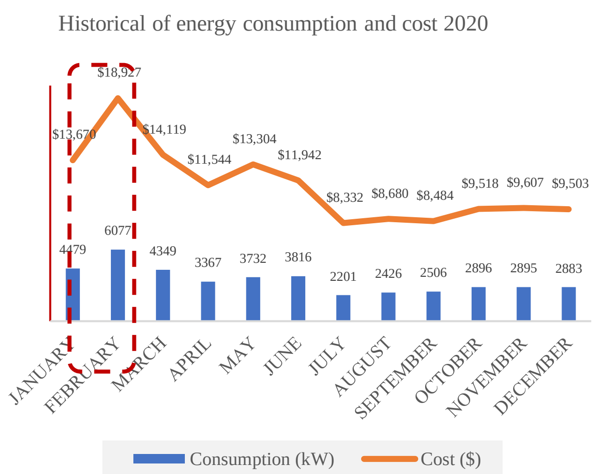
– Men's dormitory and kitchen
– Laundry and boiler
– Women's dormitory and south corridor
– Well pump

ISSN 2414-4932

– Water supply pump for services
– Clinic, chapel and auditorium

Figure 6 Load Center
Source: Own Elaboration

g) The history of electricity consumption during 2020, shows in Graph 1, a variability of consumption in a range of 2201 to 6077 KWh per month, which places this Institution with a tariff as a consumer of High Demand Medium Voltage (GDMT), generating a consumption cost in a range ranging from $8,832.00 to $18,927.00.



Graph 1 Historical energy consumption and cost – 2020
Source: Own elaboration with information from www.cfe.mx

h) Status of energy consumption in the "Hogar del Abuelo Maty" nursing home.

Month	Consumption (kW)	Cost ($)
January 20	4479	$ 13,670
February 20	6077	$ 18,927
March 20	4349	$ 14,119
April 20	3367	$ 11,544
May 20	3732	$ 13,304
June 20	3816	$ 11,942
July 20	2201	$ 8,332
August 20	2426	$ 8,680
September 20	2506	$ 8,484
October	2896	$ 9,518
November	2895	$ 9,607
December	2883	$ 9,503
Total annual	41627 kW	$ 137,630
Monthly average	3468.91 kW	$ 11,469

Table 1 Historical Energy Consumption and Cost 2020
Source: www.cfe.mx

Energy tariff:	GDMTO (Great Demand Medium Voltage Ordinary)
Division:	Bajio
Service number:	106820100011
Meter number:	307CGD
KWh/month:	3,468.91
Amount/month:	$11,469

Table 2 Average monthly energy consumption and cost
Source: Own Elaboration

This tariff will be applied to services that use energy for any purpose, supplied at medium voltage, with a demand of less than 100 kW.

i) CFE fees applicable per month

Fees apply per month according to the geographic region (CFE, 2021). For Aguascalientes (Bajío region), the rate is:

Tariff	Description	Cargo	Units	FEB-21
GDMTO	High demand in ordinary medium voltage	Fixed	$ / mes	478.51
		Variable (Energy)	$ / kWh	1.295
		Distribution	$ / kW	100.61
		Capacity	$ / kW	278.15

Table 3 Energy supply tariff charges in the GDMTO tariff
Source: www.cfe.mx

The final tariff charges for basic supply described in this section correspond to the integration of charges for Transmission, Distribution, CENACE Operation, Basic Supplier Operation, Non-MEM Ancillary Services, Energy and Capacity.

ISSN 2414-4932

Development of alternatives for electricity supply

Taking into account the dynamics of energy consumption, specifically the operation of the supply pump described in paragraph c) and, considering that the amounts of investment in photovoltaic modules can have a great impact for this Institution, five alternatives are developed, with different scope in reducing the cost of energy consumption and use, all of them under the approach of sustainability.

Results

Alternative 1

Generation of energy from Interconnected Photovoltaic Systems (SFV-I), with different dimensions to partially cover the energy consumption of Hogar del Abuelo.

Different dimensions of SFV-I are presented to cover part of the energy demand indicated in the CFE bill.

Number of modules in SFV 435 W	Estimated payment consumption	Savings	Return on investment years(a) months (m)	Investment cost
58	$ 1,785.92	$ 10,252.98	5 a 2 m	$ 796,752.92
42	$ 3,495.26	$ 8,543.65	4 a 2 m	$ 619,446.96
34	$ 4,770.78	$ 7,268.15	3 a 7 m	$ 540,684.12
22	$ 7,342.51	$ 4,696.39	2 a 8 m	$ 405,851.52
10	$ 9,914.22	$ 2,124.68	2 a 2 m	$ 330,349.44

Table 1 Amount and return on investment of Alternative 1: Different size of SFV-I to cover the partial consumption indicated in the CFE bill
Source: Own elaboration with YRN-Solar company

Characteristics of Alternative 1:

- The energy generated by the SFV-I covers only part of the asylum's energy demand; the rest is consumed from the CFE grid.
- There is no significant return of power generated to the CFE grid. Most of the energy generated by the SFV-I is consumed by the supply pump.
- The water supply pump from the cistern to the utilities is kept on every 5 minutes throughout the day (at least 12 hours) all year round. This is the equipment with the highest energy consumption.
- The hydraulic installations of the nursing home remain unchanged.
- Due to the high consumption, the electricity tariff assigned by CFE is GDMTO (high demand medium voltage ordinary), so there is a high demand cost WITHOUT energy consumption subsidy.
- The investment costs include the services of the Verification and Inspection Unit, as well as the bi-directional meter, since the tariff is for the Ordinary Medium Voltage High Demand (GDMTO).

Alternative 2

Autonomous Photovoltaic System (SFV-A) to cover only the demand of the hydraulic system.

Concept	Unit	Quantity	Technical characteristics	Amount of investment
Monocrystalline PV modules	parts	33	410 W - CONNERA	$ 113,224.14
Submersible pumps for wells and reservoirs	parts	2	5 y 10 HP, 3F, 2", 230 VCA	$ 57,167.24
Pump handling service	service	1	---	$ 13,151.72
Solar pumping system accessories	kit	2	Accessories for 2 pumps	$ 76,488.62
Anodized structure for installation	kit	1	Anodized aluminum	$ 28,163.79
Photovoltaic installation material	Kit	1	PV installation accessories	$ 34,991.38
SFV labor, installation and commissioning service	service	1	Installation of the SFV	$ 32,658. 62
tanks	parts	6	5 de 5000 lt 1 de 10000 lt	$ 108,350.00
Support structure for tanks	Lot	1	Bases and reinforcement for tank supports	$ 40,655.17
Hydraulic installation material	Lot	1	Piping, valves, elbows	$ 41,762.00
Hydraulic installation service	Lot	1	Installation service	$ 8,448.28
		Subtotal		**$ 555,050.97**
		IVA		**$ 88,808.15**
		Total		**$ 643,859.12**
		Return on investment		**4 years 6 months**

Table 2 Amount and return on investment of Alternative 2: SFV-A to cover the demand of the hydraulic system (pumps)
Source: Own elaboration with information from YRN-Solar company

Characteristics of Alternative 2:

- The SFV-A generates energy that is consumed by the pumping system.
- Although the asylum rate is GDMTO, the installation of this SFV-A does **NOT require** consideration of the services of the Verification Unit, the inspection unit and the bidirectional meter.

ISSN 2414-4932

– With this SFV-A, five hours of solar energy is efficiently used for the operation of both pumps, during which time the amount of water required for the services is supplied and the constant consumption of energy from the CFE network is eliminated, especially for the supply pump.
– It is recommended that the well pumps (submersible) be replaced with new technology equipment that supplies the amount of water required for the showers and other services directly from the well.
– The adaptation and expansion of the asylum's hydraulic system is considered in order to efficiently take advantage of the 5 hours of sunlight by placing water tanks on the roof of the dormitories and the community area (religious people).
– A 10,000 liter central water tank will be filled by the solar pumping system, and from there the remaining 5 tanks with a capacity of 5,000 liters will be filled by gravity, as well as the existing tanks for the showers.
– It is also recommended to replace the supply pump (surface pump) for alternative water supply required from the storage tank to the toilets (sinks, toilets and showers), with another submersible pump that will have the option of connection to the autonomous solar pumping system and connection to the CFE network only to be used in case of cloudy days.
– With the elimination of energy consumption by the pumping system, the possibility of changing the electricity tariff can be considered, which would have a greater impact on the monthly energy cost.

Alternative 3:

Interconnected Photovoltaic System to supply energy to pumps.

Concept	Unit	Quantity	Technical characteristics	Amount of investment
Polycrystalline modules	parts	26	450 W TRINA	$ 121,394.00
Central Inverter	parts	1	6 kW	$ 34,200.00
Photovoltaic and electrical equipment and interconnection protections	kW	11.7	Connection material	$ 35,100.00
Engineering, design and installation	kW	11.7	Tailor-made service	$ 32,760.00
Anodized structure for installation / adjustable pole base	pieza	1	Anodized aluminum	$ 22,189.00
Unit for Verification of Electrical Installations (UVIE)	service	1	Verification unit to guarantee compliance with NOM-001- SEDE-2012 (DOF, 2019)	$ 55,000.00
Electrical Interconnection Inspection Unit (UIIE)	service	1	Verification unit for interconnection certification, endorsed by the Energy Regulatory Commission (CRE).	
Bidirectional meter	piece	1	Meter for reading the supply and injection of energy to the CFE network.	$ 40,000.00
	Subtotal			**$ 340,643.00**
	Iva			**$ 54,502.88**
	Total			**$ 395,145.88**
	Return on investment			2 years 9 months

Tabla 3 Amount and return on investment of Alternative 3: SFV-I to cover energy demand in pumps only
Source: Own elaboration with information from YRN-Solar.

Characteristics of Alternative 3:

– Well and supply pumps consume 50% of the total energy required by the nursing home.
– The SFV-I generates power to supply well and supply pumps throughout the day.
– The SFV-I generates 1,723 kW of the total 3,488 kW consumed by the nursing home (50%).
– There is no significant return of power generated to the CFE grid. Most of the energy generated by the SFV-I is consumed by the supply pump.
– Since the nursing home's tariff is GDMTO, it is necessary to consider the services of the Verification Unit, the inspection unit and the bidirectional meter.
– Since the consumption does not change, the tariff remains at GDMTO, which does not make it possible to change the tariff, even if the system is in place.

– The asylum's hydraulic system remains in the same conditions, especially with the energy overload on the supply pump, the equipment with the highest energy consumption.

Alternative 4

Autonomous Photovoltaic System (SFV-A) for supply pump replaced by submersible pump.

Concept	Unit	Quantity	Technical characteristics	Amount of investment
Monocrystalline modules	parts	10	435 W CONNERA DUO TIER 1	$ 40,301.72
Submersible pump	parts	1	3 HP	$ 10,918.00
Starter for supply pump	parts	3	Solar pumping voltage starter	$ 23,972.00
Harmonic protection	piece	1	20 A for well, 3 F 230 v	$ 7,450.00
Submersible cable	m	20	3x8F flat submersible cable. It is proposed to reuse the existing one	$ 640.00
Pipe	piece	1	Pipe for 2" column for deep well. Stretch of 3 m.	$ 445.00
Column adapters	kit	1	Column adapters, safety clamp and protection jacket. Connection accessories.	$ 886.00
Anodized aluminum structure	piece	1	Anodized aluminum for panel base, the proposal is for installation close to solar pumping control.	$ 9,850.00
Accessories and safety devices for connections	kW	4.35	PV wiring, connectors, power protections, insulators, screws and ducts.	$ 11,250.00
Engineerin, design and installation	kW	4.35	Engineering, labor, installation and start-up services.	$ 10,500.00
Tanks	parts	2	1 tank of 5000 lt and 1 tank of 10,000 lt, for water storage taking advantage of solar hours.	$ 39,267.24
PTR Bases	lote	1	PTR bases, with enamel paint seal in place, reinforcement between building castle for tank support.	$ 15,275.86
Hydraulic piping	m	133	Hydraulic piping for water conduction and distribution between new and existing water tanks, faucets and elbows registered in the technical visit as reinforcement of the distribution network for the current services.	$ 17,955.00
Technical Service	service	1	Technical service, specialized labor in the distribution of hydraulic network, by service section in the two tanks.	$ 8,448.28
			Subtotal	**$ 197,159.10**
			IVA	**$ 31,545.46**
			Total	**$ 228,704.56**
			Return on investment	1 year 7 months

Table 7 Amount and return on investment for Alternative 4: SFV-A to cover demand for supply pump replaced by submersible pump
Source: YRN-Solar Company

Characteristics of Proposal 4:

– This proposal suggests the replacement of the supply pump with a submersible one and of lower operating capacity (3HP) with the intention that it will only be activated three or four times during the day (approximately one hour running for each operating occasion) to cover the demand of the nursing home.

– To this end, it is recommended to reinforce the hydraulic system with the installation of a 10,000 liter central tank, which will be supplied by the SFV-A, as well as a 5,000 liter tank to cover the kitchen and laundry area, the latter being supplied by gravity with the central tank. The three existing tanks of 600 liters each will also be supplied by gravity.

– Considering that the daily consumption of the nursing home is 38,000 liters, the supply pump must supply 16,600 liters each time it is activated (3 or 4 times). These 16,600 liters will be distributed in the central tank (10,000 liters), the laundry and kitchen tank (5,000 liters) and the 3 shower tanks (1,800 liters).

– With this operation scheme, the supply pump will be operating an average of 4 hours per day.

– Likewise, the well pump will only work approximately 3 hours per day to supply the cistern with the 38,000 liters required by the nursing home.

– The SFV-A generates power to cover only the supply pump load for approximately 4 hours net. This pump will have an alternate connection to the CFE network, in case it is needed at night.

– Although the asylum tariff is GDMTO, the installation of this SFV-A does NOT require consideration of the services of the Verification Unit, the inspection unit and the bidirectional meter.

– The reduction of the operation time of the pumps and therefore the energy consumption, makes it possible to change the electricity tariff after 2 or 3 months.

Alternative 5

Efficient use of energy from the CFE grid with replacement of the supply pump with a new technology at 3 HP.

Concept	Uni	Canti	Technical characteristics	Amount of investment
Surface pump	piece	1	3 HP, 2 " pressurized PRISMA	$ 10,700.42
tank	piece	1	10,000 lt capacity	$ 25,000.00
Support structure for water tank	piece	1	PTR structure	$ 10,275.86
Water tank installation	service	1	Laying of structure and installation of water tank	$ 12,250.00
Hydraulic installation material	kit	1	Elbows, wrenches	$ 1,800.00
Hydraulic equipment installation service	service	1	Service for installation of hydraulic equipment	$ 8,448.28
		Subtotal		**$ 68,474.56**
		IVA		**$ 10,955.93**
		Total		**$ 79,430.49**
		Return on investment		7 months

Table 8 Amount and return on investment for Alternative 5: Replacement of supply pump with a new technology pump with 3HP
Source: Own elaboration with information from YRN-Solar

Characteristics of Alternative 5:

- This proposal suggests replacing the supply pump with one of recent technology and lower operating capacity (3HP) with the intention that it will only be activated three times during the day (approximately one hour running for each operating occasion) to cover the demand of the nursing home.
- For this purpose, it is recommended to reinforce the hydraulic system with the installation of a 10,000 liter central tank to supply by gravity the kitchen and laundry area, as well as the three existing tanks of 600 liters each.
- Considering that the daily consumption of the nursing home is 38,000 liters, the supply pump must meet this requirement when activated three or four times.
- With this operation scheme, the supply pump will be operating an average of 4 hours per day.
- The well pump will only work approximately 3 hours per day to supply the cistern with the 38,000 liters required by the nursing home.
- There is no SFV-I installation, so the energy required to operate the pumps is taken from the CFE grid.
- By reducing the operation time of the pumps, a reduction in the energy consumption of the network is expected, making it possible to change the electricity tariff after 2 or 3 months, according to the drop in consumption.

Acknowledgements

Special thanks to the company YRN-Solar for their support, advice, design support and investment quotation during the development of the proposals.

Conclusions

- Under the sustainability approach, all the alternatives are viable because they comply with at least one of the following purposes: generation, saving or efficient use of energy and, consequently, care for the environment.
- The sustainability approach in Alternative 1: SFV-I energy generation with different dimensions, fulfills the purpose of the system oriented to the generation and use of clean energy.
- For the case of Alternative 2: SFV-A to cover the demand of hydraulic pumps, the sustainability approach is fulfilled with the purpose of generation and efficient use of electric energy in the hydraulic system.
- Alternative 3: SFV-I for supplying energy to pumps, aimed at the generation of energy by the SFV-I exclusively for the demand required by the pumps, decreases the consumption of the CFE network, and at the same time decreases the cost of consumption.
- The purpose of "Alternative 4: SFV-A for supply pump replaced by submersible pump" is oriented to the generation and consumption of energy only for the submersible supply pump; thus, it meets the sustainability criteria by saving energy consumption supplied by the grid.

ISSN 2414-4932

- The sustainability approach in "Alternative 5: Replacement of supply pump by a new technology with 3HP", meets the purpose of the system oriented to the efficient use of energy from the CFE grid for supply pump operation.
- These purposes also represent a positive impact mainly in the following aspects:

a. Economic. There is a decrease in the cost of energy consumption.

b. Environmental. The clean generation of energy through photovoltaic modules avoids pollution caused by the emission of greenhouse gases from conventional sources.

c. Social: The basic services to the elderly are not limited, since the supply of energy by clean sources and the saving of its cost, opens the possibility for Hogar del Abuelo to consider offering other complementary services.

- Finally, the proposals indicated here represent an area of opportunity for the search of resources in different governmental institutions, research, development or applied technology, that will allow the implementation of some of the alternatives, for the benefit of this sector of the population and the environment.

References

CFE. (19 de Febrero de 2021). *CFE*. Obtenido de https://app.cfe.mx/Aplicaciones/CCFE/Tarifas/TarifasCRENegocio/Tarifas/GranDemandaMTO.aspx

CONAPO. (2018). *Colección Proyecciones de la población de México y las entidades federativas 2016-2050. Aguascalientes.* México.

DOF. (19 de 11 de 2019). *Diario Oficial de la Federación.* Recuperado el 14 de 04 de 2021, de https://www.gob.mx/cms/uploads/attachment/file/512096/NOM-001-SEDE-2012.pdf

IMPLAN, c. d. (2019). *Panorama demográfico de Aguascalientes 2015-2016.*

IMPLAN, I. M. (2019). *En 2019, Proyecciones de la Población de México y de las Entidades.* AGUASCALIENTES.

PDM. (2019). *Plan de Desarrollo Municipal 2019-2020.* Aguascalientes.

Serrano Rangel, R. A. (2019). *Datos Aguascalientes.* Coordinación Genreal de Planeación y Proyectos (CLAP), Aguascalientes.

Vargas Cordero, Z. R. (2009). LA INVESTIGACIÓN APLICADA: UNA FORMA DE CONOCER LAS REALIDADES CON EVIDENCIA. (REDALyC, Ed.) *Revista Educación, 33*(1), 155-165. Recuperado el 16 de 03 de 2021, de https://www.redalyc.org/pdf/440/44015082010.pdf

Article **Journal of Urban and Sustainable Development**
December 2021 Vol.7 No.21 17-23

Vermicompost production monitoring and the internet of things

Monitoreo de la producción de lombricomposta y el internet de las cosas

SILVERIO-GARRIDO, Elid†*, SAMPAYO-RODRIGUEZ, Carmen Jeannette, HERNANDEZ-LUNA, Aldo and CASTILLO-QUIROZ, Gregorio

Tecnológico Nacional de México / Instituto Tecnológico Superior de Huauchinango/ Maestría en Tecnologías de la Información

ID 1st Author: *Elid, Silverio-Garrido* / **ORC ID**: 0000-0001-6386-2423 y CVU 1er Autor: 1116101

ID 1st Co-author: *Carmen Jeannette, Sampayo-Rodriguez* / **ORC ID**: 0000-0001-8844-6055 Y CVU 1er Coautor: 951529

ID 2nd Co-author: *Aldo, Hernández-Luna* / **ORC ID**: 0000-0002-7717-5314, CVU CONACYT ID: 441305.

ID 3er Coautor: *Gregorio, Castillo-Quiroz* / **ORC ID:** 0000-0002-1904-4172, **Researcher ID Thomson:** H-9402-2018, **CVU CONACYT ID:** 162009

DOI: 10.35429/JUSD.2021.21.7.17.23 Received: July 10, 2021; Accepted October 30, 2021

Abstract

This article presents the results obtained by implementing an application with an architecture based on the Internet of Things, applied to the production of red California earthworm, using an interface with which it is possible to monitor and collect data on temperature, humidity and PH with sensors that allow recording the necessary data. For the implementation, an experimental module was built in which the temperature and humidity variables were monitored, with the data obtained from the sensor measurements, the constant changes in temperature (between 20 to 29 ºC) and humidity (from 35% to 50%) were observed, This information made it possible to keep a weekly plan in which irrigation, aeration and compost mixing were attended to in a timely manner, reducing time, cost and human labor in the production of the red California earthworm and maintaining the reproduction of the red California earthworm in optimal conditions

Vermiculture, Eisenia foétida, Humus, Internet of things

Resumen

En el presente artículo se da a conocer los resultados obtenidos al implementar una aplicación con una arquitectura basada en el Internet de las cosas, aplicada para la producción de lombriz roja californiana, utilizando una interfaz con la cual se puede monitorear y recolectar datos de temperatura, humedad y PH con sensores que permiten registrar los datos necesarios. Para la implementación se construyó un módulo experimental en el que se realizó el monitoreo de las variables de temperatura y humedad, con los datos obtenidos por las mediciones de los sensores, se observaron los cambios constantes de temperatura (entre los 20 a 29 ºC) y humedad (desde un 35% a 50%), esta información permitió al usuario llevar un plan semanal en el cual se atendió de manera oportuna el riego, la aireación, la mezcla de la composta, reducir el tiempo, costo, trabajo humano en la producción de lombricomposta y mantener en óptimas condiciones la reproducción de la lombriz roja californiana.

Lombricultura, Eisenia foétida, Humus, Internet de las cosas

Citation: SILVERIO-GARRIDO, Elid, SAMPAYO-RODRIGUEZ, Carmen Jeannette, HERNANDEZ-LUNA, Aldo and CASTILLO-QUIROZ, Gregorio. Vermicompost production monitoring and the internet of things. Journal of Urban and Sustainable Development. 2021. 7-21: 17-23

*Correspondence to the author (e-mail: elidsilveriog@gmail.com)
† Researcher contributing as first author

December 2021 Vol.7 No.21 17-23

Introduction

Vermicomposting can be defined as the breeding and management of earthworms in captive conditions, with the basic purpose of obtaining two products of great importance for humans: vermicompost, which is a material similar to soil, produced from organic waste, high in nutrients and commonly used as a soil improver or fertilizer substitute for agricultural use, and protein (fresh meat or flour), as a supplement for animal rations. (Instituto de Nutrición de Centroamérica y Panamá (INCAP)).

Vermicompost or also known as vermicompost is located in the vermiculture section, and this is nothing more than the management of organic waste through the cultivation of worms.

The type of earthworm used is not the one found in most soils, it is a special earthworm scientifically named Eisenia foetida also known as Californian red worm, it is a species of greater use in the elaboration of vermicompost, due to its ability to decompose organic waste in captivity and produce humus. The Californian red worm can consume between 50% and 100% of its daily weight and double its population in 90 days.

The main factors for good vermicompost production are mainly temperature and humidity, as well as pH level. (Ruiz Morales, Mariana, 2011)

An ideal temperature should be between 20ºC and 29ºC, a humid environment is necessary to avoid dehydration of the worm, as well as to allow its free movement on the substrate. If, on the other hand, excess humidity is present, rotting odors may be released.

For the production of vermicompost, different organic wastes can be used, such as: manure, preferably from cows, horses, sheep, poultry or rabbits; wastes from vegetable crops, stubble, coffee pulp, even the same food wastes generated at home, avoiding citrus fruits at all costs. These wastes are mixed with soil and by maintaining a good humidity, an organic fertilizer in good conditions is obtained.

The Internet of Things

The internet of things (IoT) is a term that refers to the interconnection of devices and objects through a network (it can be private or internet), almost any type of objects or devices can be connected, they can be sensors and mechanical devices, or any object of daily use such as a bathroom, a bathroom or an alarm. Any object that one can imagine can be connected to the internet and also interact without the need for human intervention. The internet of things allows communication between different devices implementing embedded systems, mobile applications and cloud computing, with this users can use mobile devices to interact and obtain information from the embedded system through the cloud for monitoring and control of variables. (González - Rodríguez, 2018).

The implementation of the Internet of Things IoT uses different connectivity models, these models include: device-to-device, device-to-cloud, device-to-gateway and back-end data exchange; each of these models has the flexibility for devices using IoT technology to connect as well as being easier to operate.

This project will change the way in which the parameters of humidity, temperature and pH of the soil are monitored, although it is normally done in person using techniques such as pressing a fist of vermicompost to determine the percentage of humidity; with this project sensors will be implemented to obtain readings in real time that will allow some action to be taken for the best production of vermicompost and thus only be in the vermicompost area when it is necessary to make any adjustment in the aforementioned parameters.

Description of communication models

Different connectivity models are used for the implementation of the Internet of Things, each with different characteristics. (Karen Rose, 2015)

A. Device-to-device

Device-to-device communication represents two or more devices that are directly connected and communicate with each other. They can communicate over many types of networks, including IP networks or the Internet, but most often use protocols such as Bluetooth, Z-Wave and ZigBee.

B. Device-to-cloud

Device-to-cloud communication involves an IoT device connecting directly to an Internet cloud service such as an application service provider to exchange data and control message traffic. It often uses traditional wired Ethernet or Wi-Fi connections, but can also use cellular technology such as the 4.5G network.

Device to gateway

In the device-to-gateway model, devices essentially connect to an intermediary device to access a cloud service. This model often involves software or applications operating on a local gateway device (such as a smartphone or a "hub") which acts as an intermediary between a device and a cloud service.

Data exchange through the back-end

Back-End Data-Sharing essentially extends the device-to-cloud communication model to allow authorized third parties to access devices and sensor data. Under this model, users can export and analyze smart object data from a cloud service in combination with data from other sources and send it to other services for aggregation and analysis.Cloud Computing. Cloud computing, often referred to simply as "the cloud," means storing and accessing data and programs over the Internet rather than directly on your computer's hard drive. (Barnard, Delgado, & Juan, 2016)

Closely related to cloud computing is the term Internet of Things (IoT), and this term refers to the connection of devices other than the usual ones to the Internet. For example vehicles, kitchen appliances, devices to monitor health issues such as heart rate among others.

Those who understand cloud computing know that one of its functions is to increase agility, efficiency and reach in our business processes and daily tasks. And that is precisely where IoT comes in, as the ideal complement that helps processing deliver more complete results. IoT generates massive amounts of data. These data are very characteristic and can be be defined by qualities such as the following following:

– They come from anywhere and on any device.

– They arrive at all times, as a continuous flow of information.

Each of the data coming from the IoT, in itself, does not generate value as it is extracted from the analysis of a collection of them, which is the one that has the ability to provide context to the study of the information.

Methodology

For this research project, a quantitative method was applied to collect statistical data on temperature, humidity and pH by means of sensors. With the data obtained, the user can identify the situation of the vermicompost module, and if any parameter is out of the allowed range, decisions can be made to correct the problem. The phases of this project were as follows:

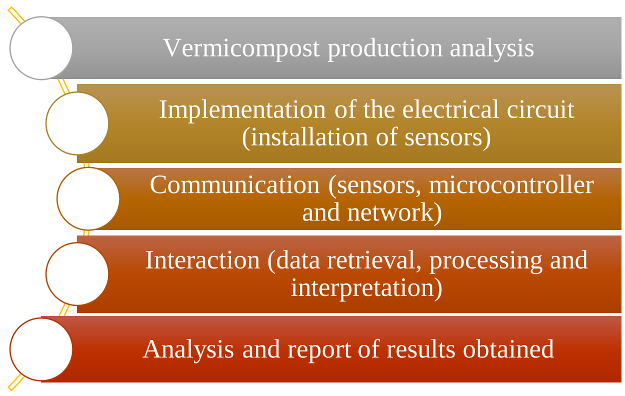


Figure 1 Project phases
Source: Own Elaboration

1. Analysis of vermicompost production: This phase allowed to analyze the best indicators in the production of vermicompost, which are the benefits, as well as the materials or organic residues that allowed a good production of worms, to analyze the amount of production according to the different intervals of humidity, temperature, pH, the organic material with which the worms were fed and the periodicity with which they were fed.

2. Implementation of the electrical circuit (installation of sensors). In this phase, the best sensors were selected to allow the readings of the variables, as well as the platform to be implemented and the construction of the program that would take the readings for the monitoring of the vermicompost production.

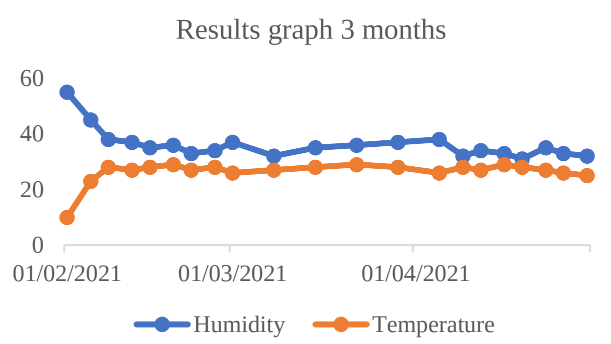
3. Communication (sensors, microcontroller and network): This phase allowed to find the best way of communication between the different actors of the system, as such it is sought to incorporate the sensors along with the microcontroller to a means of communication that allowed to send and receive data in real time, through the wireless network.

4. Interaction (data retrieval, processing and interpretation): For data retrieval, we interacted with the data that were registered, these data were processed and interpreted by the program algorithm that issues an alert to the user to take the necessary measures if necessary or just to continuously observe the variables for the production of vermicompost in the appropriate intervals.

5. Analysis and report of results obtained: With the recovery of the data and the processing, the different readings taken were analyzed and a report was issued that allowed the identification of the most suitable variables in the production of vermicompost. These data obtained will help in the future to make improvements or will allow the user to determine if his production is the most suitable in a given time.

Results

In the expected results in the architecture that was implemented, based on the IoT for the production of vermicompost, where an interface is implemented with which you can monitor and collect temperature and humidity data, the ranges for temperature are 20-29 ºC, for what corresponds to the humidity the range is 35-50%, and finally the PH should be monitored where the estimated range is 6. 5 to 7.5 %, these values should be taken using sensors, with cloud computing services an alert or alarm can be issued when any of the readings are outside the ideal ranges.



Graphic 1 Results Graph
Source: Own Elaboration

A. Vermicompost production analysis

The red Californian earthworm is useful in the decomposition of organic waste, with this decomposition allows transforming this waste into organic fertilizer that can be applied in different areas of production, such as in planting, in vegetables or in pots on the patio. Because composting is a biological process that is carried out by microorganisms, it is necessary to take into account certain parameters that can affect the growth and reproduction of the same within the main parameters is the temperature (20 º C and 29 º C), humidity (35-50%) and pH (6.5 to 7.5%).

Figure 2 Comparison of initial production and after three months
Source: Own Elaboration

B. Detection layer

This section corresponds to the devices needed for the communication between the sensors and the internet, the device used for the direct connection is: ESP8266MOD. The sensors used to collect the data were: for temperature and humidity detection the DHT11 sensor was used, to obtain the pH readings the electrode sensor was used, these sensors connected to the ESP8266 board, which is a module for Arduino and allows the Wi-Fi connection of the board with the network.

A collection for the storage of environmental conditions readings was built with fields for temperature and humidity readings. A MySQL database was created to store the temperature, humidity and pH data. The database is connected to be able to store the data obtained, perform data processing and send to the cloud. In this way the time to obtain the values or parameters that are out of range according to those established in the production of vermicompost.

C. Information exchange layer

This section corresponds to support the connection of the devices to the network, for this the necessary protocols for communication were considered, this communication can be between the devices or the network itself.

In this section the necessary tools are implemented to be able to have communication and therefore transmit data between the different devices, as well as to be able to manage the information collected with the sensors. When implementing the wireless connectivity system, the network and web server configuration parameters (TCP/IP protocol, IP address) were taken into account, in addition to which the wifi connection was also defined by means of the SSID and password.

Figure 3 Wifi module, sensor, Program running
Source: Own Elaboration

A. Information integration layer

This section is one of the main ones, since this is where the user can consult the information processed by the application, which in turn is connected to the database. With the processing of the information the users can know optimal and valuable data, in this way they will be able to take the necessary measures that will allow them to avoid the death of the Californian red worm and obtain a greater production of vermicompost.

B. Application service layer

The information collected by the physical devices (sensors) will be transmitted to the network and processed in the Compost Control application, shown in Figure 4, through which the user monitors the data and can make appropriate use of the information for harvesting.

Figure 4 Application Control Compost. Login.
Source: Own Elaboration

Control Compost is an application that shows the temperature, humidity and pH indicators in the vermicomposting process where the main active ingredient is the red Californian earthworm and from it the humus and leachate that belong to the organic fertilizers are generated. Compost Control is an application that provides security to the user, no person outside this may have access without the authorization of the same, for this the user must provide their user credentials and password to enter the application. This application is designed specifically for the use of this project, so there is no record of it.

Figure 5 Control Compost application. Information section interface
Source: Own Elaboration

Once the user has entered his credentials Control Compost shows a brief introduction to the optimal parameters.

ISSN 2414-4932

Figure 5, and thus have a good production of Californian red worm and vermicompost (humus and leachate).

Figure 6 Application Control Compost. pH indicator interface
Source: Own Elaboration

Compost Control shows you the pH indicator in real time, displays the optimum parameters and tells you if the pH is correct, as shown in Figure 6.

Figure 7 Control Compost application. interface to display non-optimal values of pH parameters
Source: Own Elaboration

Figure 7 shows the interface to indicate when the pH parameter is not optimal, it shows it in red and gives you a suggestion to maintain the pH at an appropriate level.

Figure 8 Control Compost application. real-time moisture indicator interface
Source: Own Elaboration

Figure 8 shows the moisture indicator interface that shows the percentage in real time of the vermicompost, if the indicator is adequate, it will tell us that it is in an optimal situation.

Figure 9 Application Control Compost. Real-time moisture indicator of suboptimal values
Source: Own Elaboration

If the humidity is below optimum levels, the application will display the current value in red and give a recommendation to return to the appropriate parameters.

Figure 10 Control Compost application. Real-time temperature display interface
Source: Own Elaboration

The temperature indicator, Figure 10, shows in what percentage in real time is the temperature of the worm compost, if the indicator is adequate, it will tell us that it is in an optimal situation.

Acknowledgment

We are grateful to the Tecnológico Nacional de México/Instituto Tecnológico Superior de Huauchinango/Maestría en Tecnologías de la Información for the economic resources granted for the publication of this article.

December 2021 Vol.7 No.21 17-23

Conclusions

The Internet of Things has a great impact in different areas and sectors of the industry, with the implementation of different devices (sensors) that allow to collect and process information with appropriate communication technologies, you can have a communication with users or workgroups, this gives us an advantage, since it will not be necessary to have human interaction to perform an action, and above all that with the internet of things can be monitored in real time and remotely and thus make the most accurate decisions.

The prototype of the vermicompost module and the design and development of the mobile application, meet its objective which is to collect data on temperature, humidity and pH, considering these parameters can lead to good production of vermicompost. But not only fulfilled this objective, but also allowed to explore and learn about areas of knowledge such as cloud computing, mobile applications and especially the Internet of Things.

References

Barnard, A., Delgado, A., & Juan, V. (2016). Introducción al cómputo en la nube. México: ICA/InterPARES.

Gómez, J. D.-C.-M. (2010). Influencia del vermicompost en el crecimiento de las plantas. Aportes para la elaboración de un concepto objetivo. Acta Zoológica Mexicana (n.s).

González-Rodríguez, A. G.-B.-H. (2018). Automatización de una caldera pirotubular. Revista de Ingeniería Mecánica, 12-17

Irigoyen Gallego, Rodrigo. Internet de las Cosas. Sistema electrónico de control basado en Arduino

Instituto de Nutrición de Centroamérica y Panamá (INCAP). Lombricultura. Obtenido de http://www.incap.int/index.php/es/lombricultura

Karen Rose, S. E. (Octubre de 2015). La Internet de las cosas-Una breve reseña. Obtenido de https://www.internetsociety.org/wpcontent/uploads/2017/09/reportInternetOfThings-20160817-es-1.pdf

Ovidiu Vermesan, P. F. (2014). Internet of Things – From Research and Innovation to Market Deployment. River Publishers.

Pizarro Peláez, Jesús(1ª edición 2019). Internet de las Cosas (IoT) con Arduino. Manual Practico. Paraninfo.

Rajkumar Buyya, A. V. (2016). Internet of Things Principles and Paradigms. Rajkumar Buyya, Amir Vahid Dastjerdi Elsevier .

Ray, P. (2018). A survey on Internet of Things architectures. Computer and Information Sciences.

Ruiz Morales, Mariana (2011)Taller de elaboración de lombricomposta: porque tener lombrices nos beneficia a todos. Obtenido de https://ibero.mx/web/filesd/publicaciones/taller-de-lombricomposta.pdf

Schuldt M. 2006. Lombricultura Teoría y Práctica. Ediciones MUNDI-PRENSA. Madrid, España.
Tutorial sobre NodeMCU: https://programarfacil.com/podcast/nodemcututorial-paso-a-paso/
Tutoriales sobre Arduino, ESP8266, NodeMCU y componentes electrónicos: https://www.prometec.net/indice-tutoriales

Article **Journal of Urban and Sustainable Development**
December 2021 Vol.7 No.21 24-33

Disposal of mouth covers, masks or respirators, after they are used, to minimize the environmental impact and contages by COVID 19

Disposición de cubre bocas, mascarillas o respiradores, depués de ser utilizados, para minimizar el impacto ambiental y contagios por COVID 19

HERNÁNDEZ-RODRÍGUEZ, María Guadalupe*†, ORTEGA-CHÁVEZ, Laura Antonia, CARO ESCUDERO, Iveth Selene and BARRAZA-ÁLVAREZ, Alberto Guerrero

Tecnológico Nacional de México/ Instituto Tecnológico de Chihuahua II.

ID 1st Author: *Maria Guadalupe, Hernández-Rodríguez* / **ORC ID**: 0000-0001-7278-7699, **Researcher ID Thomson**: I-6541-2018

ID 1st Co-author: *Laura Antonia, Ortega-Chávez* / **ORC ID**: 0000-0001-7860-1277

ID 2nd Co-author: *Iveth Selene, Caro-Escudero* / **ORC ID**: 0000-0002-3611-2309

ID 3rd Co-author: *Alberto Guerrero, Barraza-Alvárez* / **ORC ID**: 0000-0002-0197-1859

DOI: 10.35429/JUSD.2021.21.7.24.33 Received: July 10, 2021; Accepted October 30, 2021

Abstract

This article addresses the problem that is being generated by the use of mouth covers, gloves and masks used as protection against covid 19. After more than a year in a pandemic, the demand and waste of these protective implements has increased exponentially, which is why it is necessary to dispose of these sanitary wastes safely, to guarantee community health and the integrity of the environment. On the contrary, improper handling of such a volume of these wastes can have a rebound effect, both on people's health and on the environment. The objective of the research is to properly dispose of these wastes, through the use of special containers for this type of waste, as well as the proposal with the government and companies that use ovens for the production of their products, so that with the necessary measures They could dispose of this type of waste as raw material for their furnaces, since these companies have standards that they comply with to regulate the Co2 emissions that they emit into the environment, and thus minimize the impact that these wastes bring to the environment.

Waste, Environment, Disposal

Resumen

Este artículo aborda la problemática que se está generando por el uso y disposición de cubrebocas, guantes y mascarillas utilizados como protección contra el covid-19. Tras más de un año en pandemia, la demanda y desechos de estos implementos de protección se ha incrementado en forma exponencial, por lo que es necesario disponer de manera segura de estos desechos sanitarios, para garantizar la salud comunitaria y la integridad del medio ambiente. Por el contrario, el manejo incorrecto de tal volumen de estos desechos, puede ocasionar un efecto de rebote, tanto en la salud de las personas como en el medio ambiente. El objetivo de la investigación es encontrar alternativas para la disposición adecuada de estos desechos, mediante el uso de contenedores especiales para su recolección, así como la propuesta con gobierno y empresas que utilizan hornos en sus procesos de producción, para que con las medidas de seguridad necesarias pudieran disponer de este tipo de materiales, y utilizarlos como combustible para sus hornos, siempre que estas empresas cuenten con controles para el cumplimiento de las normas que regulan las emisiones de CO2 y otras partículas a la atmósfera, y así minimizar el impacto que estos desechos traen al medio ambiente.

Desechos, Ambiente, Disposición

Citation: HERNÁNDEZ-RODRÍGUEZ, María Guadalupe, ORTEGA-CHÁVEZ, Laura Antonia, CARO ESCUDERO, Iveth Selene and BARRAZA-ÁLVAREZ, Alberto Guerrero. Disposal of mouth covers, masks or respirators, after they are used, to minimize the environmental impact and contages by COVID 19. Journal of Urban and Sustainable Development. 2021. 7-21: 24-33

*Correspondence to the author (e-mail: maria.hr@chihuahua2.tecnm.mx)
† Researcher contributing as first author

Introduction

In December 2019, there was an epidemic outbreak of pneumonia of unknown cause in Wuhan, China, the rapid spread of the disease prompted the WHO on January 30, 2020, to declare it a health emergency of international concern, based on the impact the virus could have on underdeveloped countries with less health infrastructure. By that date, the disease had been detected in all provinces of mainland China, and cases were diagnosed in 15 other countries. By March 11, the disease was already present in more than 100 countries worldwide, and was recognized as a pandemic by the WHO.

According to available information, the two main routes of transmission of the COVID-19 virus are contact and respiratory droplets. These are generated when an infected person coughs or sneezes. Anyone in close proximity (less than one meter) to another person with respiratory symptoms, such as coughing or sneezing, is exposed to these potentially infectious respiratory droplets. In addition, these droplets could be deposited on surfaces where the virus can remain viable, which means that the immediate environment of an infected person can be a source of transmission (contact transmission).

WHO has summarized reports of COVID-19 virus transmission and provided a brief overview of the available evidence of transmission from infected persons, whether symptomatic, presymptomatic or asymptomatic, and has made a series of recommendations on the use of facemasks and other preventive measures to avoid COVID-19 transmission.

The most recommended masks are KN95 masks, which filter 95% of particles from the environment using static electricity, as well as three-layer surgical masks, which are resistant to fluids and can protect against droplets.

In addition to masks and mouthguards, there has also been a great demand for other protective items such as masks, disinfectant wipes, antibacterial gel, to mention a few, and this has generated an exponential increase of this type of waste, thus generating a great environmental impact, so it is important and necessary to seek strategies that help minimize the impact on the environment.

The UN Environment Program warns that 75% of the plastics generated in the pandemic will end up in the ocean and estimates that the indirect negative effects of plastic waste for fishing, tourism and maritime transport, add up to $40 billion dollars in losses each year.

Given this problem, the research focuses on the importance of disposing of this waste in the most environmentally friendly way, since finding a place for it in the landfill does not contribute to environmental safety and integrity.

Therefore, it is proposed to have special containers for the collection of masks and other protective items, located in various areas of the city, to take them to companies that can use them as fuel for their furnaces, provided that these companies have controls for compliance with the standards that regulate emissions of CO_2 and other particles into the atmosphere, and thus minimize the impact that these wastes bring to the environment.

Therefore, the problem to be solved is to reduce the pollution resulting from the use of mouth covers and other articles to protect against COVID-19, and to use these wastes as fuel for the production furnaces of companies that require it.

Theoretical Framework

It was from 1890 onwards that the use of face masks began to become common among those engaged in operations. Dr. Guillermo Murillo Godínez, in his brief article Flügge's droplets, explains the following:

1. The droplets reach a distance of one meter, even if spoken in a low voice.

2. They remain in the air for half an hour and then settle on surfaces.

3. They measure up to ten microns. That is, ten millionths of a meter, (Brian Ley demonstrated in 1999 with his study Diameter of a Human Hair that a human hair, however thin it may be, is not less than 17 microns).

4. They are carriers of bacteria and viruses.

ISSN 2414-4932

December 2021 Vol.7 No.21 24-33

It was because of this last point that in 1897 the use of surgical masks was advocated in order to protect people from dying from infections after surgery.

The use of mouth covers also helped doctors to face crises such as the 'Chinese plague', an epidemic that emerged in Hong Kong and reached the region of Manchuria in 1910.

During the Spanish flu pandemic in 1918, the surgical mask became a great ally of doctors and nurses to combat the disease.

At first, the masks had only one or two layers and were sterilized after being used for a certain period of time, until in 1930 Herbert Mellinger, an American doctor, placed a piece of rubber between two layers of gauze to reinforce the safety of the masks and thus prevent the passage of germs.

Although over time the arrival of antibiotics and other medications reduced the use of mouth masks, in 1961 the disposable mask was implemented, which had a more comfortable design that adapted perfectly to the shape of the face.

Today, this garment, which has transcended over the years, has become one of our main allies in the fight against COVID-19.

Mouthpiece or Mask

It is a resource that serves to ensure the safety of health personnel and patients. Depending on their application, masks are called as follows:

– Surgical or Hygiene Mask.
– Protective Mask or Respirator

Surgical or Hygiene Masks

When a surgical or hygiene mask is used, the objective is to avoid the transmission of infectious agents to the patient from the health personnel who use it. They are also intended to prevent contact with splashes of potentially pathogenic fluids and blood.

They are designed to prevent the spread of microorganisms that lodge in the mouth, nose and throat, thus avoiding contamination of the patient's wounds, they work from the inside out, the reason why they fulfill their function is because, during exhalation, the air from the nose and mouth comes out with a certain speed and is directed frontally. The particles are relatively coarse, between 3 and 8 microns, (1 micron = 0.001 mm), and impact directly on the inside of the mask.

Who should use them:

– People who have any flu symptoms.
– People who live with or take care of a sick person with flu symptoms or other ailment.
– People who need to be in crowded places such as: public transportation, shopping malls, markets, stadiums, churches, elevators, among others.
– In clinical and surgical procedures that require asepsis technique.
– People with flu-like symptoms.

Instructions for use:

– Remove the mouth cover from the bag by taking it from the straps.
– Put it on carefully, covering the mouth and nose; adjust it well to reduce the minimum space between the face and the mouthpiece.
– While wearing it, avoid touching it. If you do touch it, wash your hands or clean them with an alcohol-based gel cleanser.
– Every time the mouthpiece gets wet, change it.
– Do not share it, it is for personal use.
– Do not reuse it.
– Change it when it is broken or worn out.
– Throw it away after visiting a sick person in the hospital.

How to dispose of it:

– Once used, destroy and throw the mouth cover immediately into the garbage can or plastic bag, tie it and throw it into the garbage can.
– Wash hands immediately with soap and water, applying the correct technique.

- In a hospital, dispose of it in the designated containers.
- Do not leave the mouth cover on the table, bureau, desk or any other surface to avoid contamination.

Protective Mask or Respirator

This mask is used when what is required is to protect health personnel from the inhalation of environmental contaminants, such as biological hazards, drugs, cytostatics, among others. They are designed to work from the outside in, since, when inhaling, the air velocity is lower and is distributed uniformly across the entire surface of the mask, the filtration is produced thanks to several mechanisms such as; diffusion, interception, inertia and electrostatic charge. The risk of penetration depends on the size of the particle, these masks trap up to 0.6 microns.

In these masks the facial adjustment is fundamental for the effectiveness of protection, the possible leaks by the edges of the mask have an important effect, since the air can pass towards the interior of the mask and the smaller the particles are, such as those of laser smoke that measure 1 micron, the greater the risk.

Experimental data indicate that, if a surgical mask is used for the purpose of protecting the user from inhaling particles, the air inside the mask is between 1.5 and 3 times cleaner than the air outside. Measurements carried out in the same way, but with a protective mask, show that the air inside is between 4 and 50 times cleaner than the air outside, so it is clear that when it comes to protecting the user, the effective alternative is the respirator.

Before being marketed, respirators must be tested in a notified laboratory to ensure that they meet basic safety requirements, using a test procedure of the European Harmonized Standard for Respiratory Protection Equipment; EN149, which establishes different categories FFP1, FFP2 and FFP3, the latter being the maximum protection level, the test evaluates the effectiveness of the filter and the facial adjustment.

The selection of the mask depends on the toxicity or hazardousness of the material, the environmental concentration and the exposure time. In the case of microorganisms, the epidemiology and the ease of treatment or cure of the disease must be taken into account. For example, in the case of tuberculosis, and due to the appearance of resistant strains, the recommended protection is FFP3.

Use and Positioning

- Place the respirator over your hand so that it covers your fingertips with the nose clip, allowing the elastic bands to hang freely under your hand.
- Place the respirator under your chin with the nose clip facing up.
- Pull the lower elastic band over your head and place it around your neck, under your ears Take the upper elastic band and pull it over your head to place it at the back, on top of your head.
- If the respirator becomes damaged, soiled or difficult to breathe through, immediately leave the contaminated area and replace the respirator. This is a symptom that the respirator is saturated, and can be a cause of illness or death.
- This respirator can help reduce inhalation exposure to certain types of biological particles, e.g., molds, Bacillus anthracis, Mycobacterium tuberculosis, among others, but it cannot eliminate the risk of disease or infection.
- Using the fingers of both hands, mold the clip to fit the shape of your nose by pushing inward while moving your fingertips down both sides of the nose clip. Squeezing (pinching) the nose clip with one hand may cause improper fit and reduced respirator effectiveness.
- To check the fit of the respirator, place both hands on the respirator and exhale sharply. If air comes out around the nose, readjust the respirator.

Most commonly used types of respirators

The Centers for Disease Control and Prevention (CDC) now recommends that all citizens wear a facemask as a protective measure, but with so many options available it can be confusing to know which is best for everyday use.

The facemasks needed by doctors and first responders are different from the ones someone should wear when going to the grocery store, and it's important to understand the difference. So what is an N95 mask and how is it different from a surgical mask? Is a cloth mask safe?

N95 Respirators

N95 respirators, technically considered respirators, are named for their ability to filter out 95% of ambient particles using static electricity. To ensure their safety and effectiveness, all N95s must be tested and approved by the National Institute for Occupational Safety and Health (NIOSH).

Unlike other forms of respirators, N95s are fitted and must be tested for each individual. Once properly fitted, the mask should fit snugly and create a seal against the skin with minimal leakage, which makes it very safe but can also be uncomfortable.

Static electricity coupled with the custom fit and minimal leaks make the N95 mask an extremely effective option. "N95s are critical supplies that are primarily recommended for healthcare workers and other first responders."

N95s are vital to protecting healthcare workers who provide direct patient care. Not only are they in very close contact with patients, but they often perform procedures-such as intubating ventilators-that increase the risk of infection by generating large amounts of aerosol particles.

Prior to COVID-19, N95s were typically used for patients with highly infectious respiratory diseases, such as tuberculosis, and these masks were discarded after each patient visit. Now, N95s are so scarce that clinicians must wear their respirator during their shift and decontaminate it for reuse.

At Mass General and throughout Mass General Brigham HealthCare systems, the N95s are being decontaminated using a machine that generates vaporized hydrogen peroxide.

Figure 1 Mask N95 Unimat innovation on surfaces

Surgical masks

Surgical masks are the most commonly used surgical masks in Mass General. "The benefit of the surgical mask is that it is fluid-resistant and can protect you against large drops or splashes of body fluids. Also, it does not require fit testing."

Unlike N95s, surgical masks do not protect against aerosols and are not sufficient protection when in direct contact with COVID patients during aerosol-generating procedures.

Surgical masks are an extremely valuable piece of PPE (personal protective equipment) within the current COVID-19 pandemic. At Massachusetts General Hospital, each person is required to wear a surgical mask upon entering the hospital because it can help trap droplets and prevent the spread of disease when the mask wearer coughs or sneezes. It can also protect personnel from exposure to asymptomatic personnel or patients who may not have been identified as COVID-19 carriers. The mask must be discarded upon exit, which means that maintaining a sufficient supply is crucial for these facilities.

Figure 2 Surgical mask Elements of protection.com

Cloth Facemasks

CDC continues to recommend that the general public wear cloth facemasks in public places to slow the spread of COVID-19.

Article **Journal of Urban and Sustainable Development**
December 2021 Vol.7 No.21 24-33

While they may not protect against aerosols, if the CDC's recommendations for mitigating the spread of the disease - staying home, reducing unnecessary travel and keeping six feet of physical distance - are practiced, the level of protection provided by a cloth mask is sufficient.

"The chance of becoming infected through aerosols in public is so low [due to the amount of open space] that a cloth mask is sufficient to prevent it."

Figure 3 Fabric mask arfacemask.com

Proper Disposal of Masks and Respirators

During the pandemic, the use of face masks has been a key health measure to prevent the transmission of COVID-19, however, these types of masks take more than 450 years to disintegrate and in many cases end up in landfills, rivers and oceans.

According to the World Health Organization (WHO), masks should be disposed of in a closed garbage container immediately after use and should not be reused, as factors such as humidity and secretions shorten their useful life. In health centers, these surgical materials should be treated as medical waste and disposed of in red bags.

Currently, many people leave the masks on the streets instead of putting them in industrial waste containers, which causes pollution in rivers and seas. Laurent Lombard, co-founder of the NGO Operation Clean Sea, mentions that it is best to put the masks in a plastic bag before throwing them in closed cans to prevent animals from opening them and the wind from carrying them to other places.

Thanks to their manufacturing components such as polypropylene, mouth covers are difficult to degrade. As biohazardous materials, placing them in the recycling section puts the health of garbage collectors and other recycling workers at risk.

In this sense, garbage collectors are an essential link because they have direct contact with contaminated materials. They are the first line of defense so that personal protective equipment does not end up in rivers and seas. Improving our practices in the disposal process would translate into healthier ecosystems.

Figure 4 Disposal of face masks Ean University

Best practices for disposing of face masks

To preserve everyone's health, it is recommended to dispose of the face mask as follows:

1. Destroy the mouth cover with scissors and place the pieces in a knotted plastic bag.
2. Spray the bag with chlorine solution.
3. Wash hands and disinfect scissors after inserting the mask into the bag.
4. Do not dispose of masks on public roads.
5. In case you have a cloth mask, wash and disinfect it after each use.

As citizens we have the responsibility to take care of our health and that of our loved ones, thus avoiding the spread of the coronavirus.

ISSN 2414-4932

December 2021 Vol.7 No.21 24-33

Containers for the exclusive use of mouth covers

Once the practices for disposing of masks or mouth masks are recognized, it is necessary to place them in a special container, in order to dispose of them properly, and thus reduce contamination by this type of material, as well as COVID-19 infections.

Figure 5 Container for used mouthpieces. Sablon

Large industries that use kilns in their production

In order to carry out this project, it is necessary to establish agreements with companies that use kilns in their production and that are well regulated in terms of environmental emissions.

Among the companies known to use industrial kilns for their production are cement companies, as well as producers of flooring and ceramics, which are looking for alternative fuels for their kilns.

The high temperatures used by cement kilns in the clinkerization process (1200 - 1450°C) make them an excellent option for burning industrial waste (plastics, paper, textiles, etc.) and biomass (wood, sawdust, nut shells, etc.), which helps prevent these wastes from reaching sanitary landfills and at the same time takes advantage of the calorific value they generate.

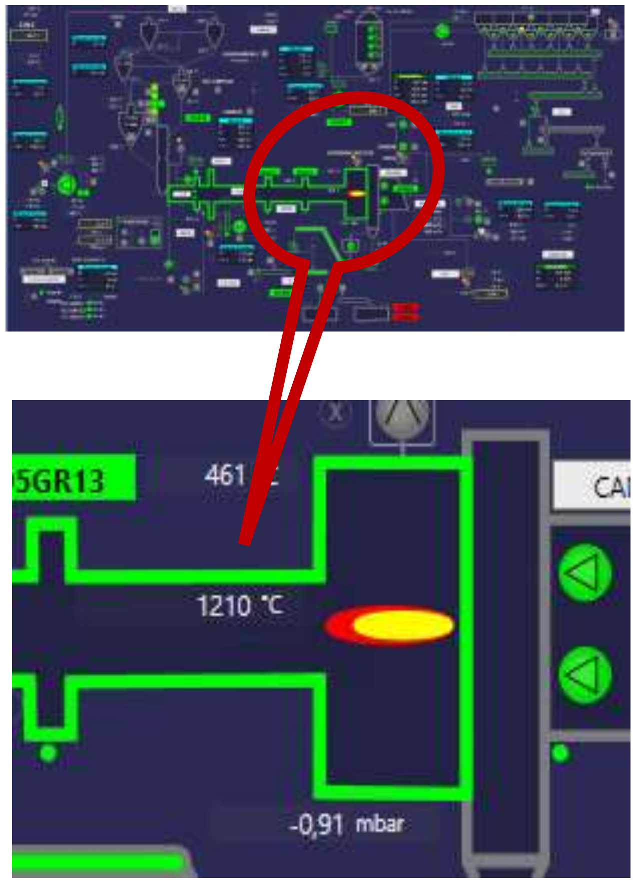


Figure 6 Operating screen mimic, furnace temperature analyzer. Taken from own image

In order to carry out this process of replacing coal (primary or main fuel) with alternative fuels (those mentioned above), it is necessary to characterize the materials that will be introduced into the combustion process, which consider the content of chlorine and sulfur among the main components, since these can generate instability in the furnace process.

Since the material from which the ventilators are made does not contain these compounds, it is possible to use them as an alternative fuel.

One of the control variables in the combustion processes is the emission of gases into the atmosphere, being CO (carbon monoxide) the most representative, which is continuously monitored by means of a gas analyzer, which continuously measures the content of CO, NOx (nitrogen oxides), Sox (sulfur oxides) and oxygen present in the combustion gases. Keeping the oxygen content in the gases above 2% ensures a good combustion process.

ISSN 2414-4932

Figure 7 Operating screen mimic, gas analyzer. Own image taken

To analyze the expected benefits of disposing of the used respirators to be used as alternative fuel, a measurement of the unit weight was made using a precision scale, obtaining a weight of 4.83 grams per piece.

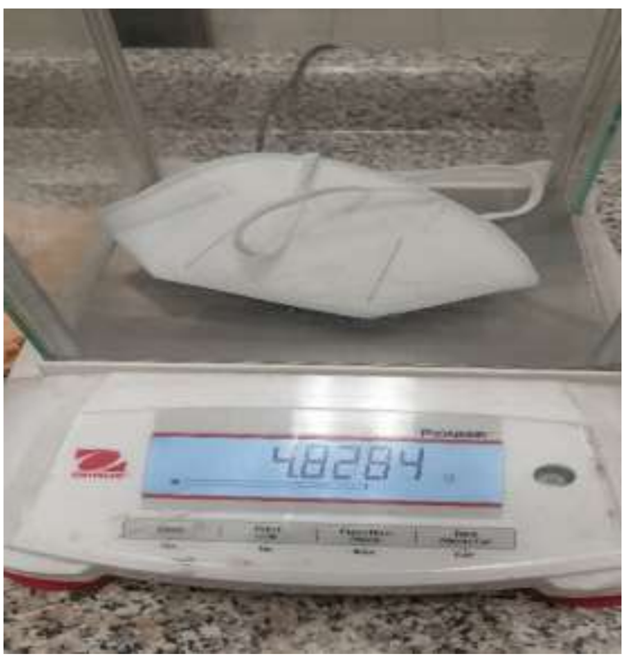


Figure 8 Weighing of N95 respirator. Taken from own image

Subsequently, the calorific value of the material from which a ventilator is made is determined. This is done using a Leco model AC500 calorimeter, which yielded a result of 13,596.5 BTU/lb (7,559.68 Kcal/Kg), which is slightly higher than that of the bituminous coal used as primary fuel (12,150 BTU/lb or 6,756 Kcl/Kg). This result shows that 1 ton of rebreathers is equivalent to 1.12 tons of coal.

Figure 9 Leco Calorimeter model AC500, taken from own image

The current approximate cost of coal is mxp$2,160.00, so replacing it with one ton of respirators would result in a partial savings of mxp$2,419.20 (due to the factor of 1.12).

It is estimated a cost for handling and shredding the respirator (it must be reduced to a size that optimizes its combustion in the burner) of mxp$625.00/ton, this for collection, electric energy, shredding, transportation and labor) so the benefit per ton of respirator co-processed as an alternative fuel is mxp$1,794.20. To obtain 1 ton of respirators, it is necessary to collect 207,040 pieces. The population in the main cities of the state of Chihuahua is:

Cd. Juárez	1,500,000
Chihuahua	926,000
Cuauhtémoc	180,000
Delicias	152,000
Total	2,758,000

If it is estimated that on average each inhabitant generates 4 used respirators per month, and only 50% of them are recovered to be co-processed to generate energy, we obtain 5,516,000 pieces, which means 26.64 tons, which would provide a savings of mxp$47,801.43 per month, and mxp$573,617.11 per year.

Main regulations regarding waste management and emissions

The following are the main laws and regulations governing waste management and emissions produced by the burning of materials:

Ley General del Equilibrio Ecológico y Protección al Ambiente (LGEEPA) Establishes general provisions regarding waste.

ISSN 2414-4932

December 2021 Vol.7 No.21 24-33

Ley del Equilibrio Ecológico y Protección al Ambiente del Estado de Chihuahua (LGEEPA CH) Establishes general provisions regarding waste of state application.

General Law for the Prevention and Integral Management of Waste (LGPGIR) General regulation, includes 3 categories of hazardous waste, urban solid waste and special handling waste.

Regulation of the General Law for the Prevention and Integral Management of Waste (RLGPGIR).

Law for the Prevention and Integral Management of Waste of the State of Chihuahua (LGPGIR CH) Regulates urban solid waste and special handling waste.

Regulation of the Law for the Prevention and Integral Management of Waste of the State of Chihuahua (RLGPGIR CH).

NOM-052-SEMARNAT-93. Establishes characteristics of Hazardous Waste.

NOM-052-SEMARNAT-93 Establishes methods for the determination of hazardous waste.

NOM-054-SEMARNAT-93. Procedure to establish incompatibility between two or more hazardous wastes.

NOM-087-SEMARNAT- SSA1-2002 Biological Infectious Waste, classification and handling specifications.

NOM-161-SEMARNAT-2011 Special Management Waste, classification and management plans.

Regarding emissions:

Ley General del Equilibrio Ecológico y Protección al Ambiente (LGEEPA) Establishes general provisions regarding emissions.

Law of Ecological Balance and Environmental Protection of the State of Chihuahua (LGEEPA CH) Establishes general provisions regarding emissions of state application.

Regulation of the General Law of Ecological Balance and Environmental Protection regarding the prevention and control of air pollution (RLGEEPA PCCA) Establishes more specific requirements regarding fixed sources under federal jurisdiction.

NOM-085-SEMARNAT-2011, Air Pollution-Maximum permissible emission levels of indirect heating combustion equipment and their measurement.

Capacity thermal Nominal of the equipment GJ/h	Type of Fuel	Smoke # of spotting	Particulates mg/m³			Sulfur dioxide, ppmv			Oxides of nitrogen, ppmv			Carbon monoxide carbon monoxide, ppmv		
			ZVM	ZC	RP	ZVM	ZC	RP	ZVM	(2) ZC	RP	ZVM	ZC	RP
Greater than 0.53 to 5.3 (Greater than 15 to 150 CC)	Liquid	3	NA	NA	NA	550	1100	2200	NA	NA	NA	400	450	500
	Gaseous	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	400	450	500
Greater than 5.3 to 42.4 (Greater than 150 to 1200 CC)	Liquid	NA	75	350	450	550	1100	2200	190	190	375	400	450	500
	Gaseous	NA	NA	NA	NA	NA	NA	NA	190	190	375	400	450	500
Greater than 42.4 to 106 (Greater than 1200 to 3000 CC)	Liquid	NA	60	300	400	550	1100	2200	110	110	375	400	450	500
	Gaseous	NA	NA	NA	NA	NA	NA	NA	110	110	375	400	450	500
Greater than 106 to 530 (Greater than 3000 to 15000 CC)	Solid and Liquid	NA	60	250	350	550	1100	2200	110	110	375	400	400	500
	Gaseous	NA	NA	NA	NA	NA	NA	NA	110	110	375	400	450	500
Greater than 530 (Over 15000 CC)	Solid and Liquid	NA	60	250	350	550	600	2200	110	110	375	400	400	500
	Gaseous	NA	NA	NA	NA	NA	NA	NA	110	110	375	400	450	500

Table 1 Maximum permissible emission levels for existing equipment at the time the NOM came into force. (Boilers, steam generators, thermal oil heaters or other types of fluids, and indirect heating ovens and dryers. NOM-085-SEMARNAT-2011
ZMCM= CDMX metropolitan zone.
ZC= Critical zones (borders and large metropolitan zones such as GDL, MTY, among others).
RP= Rest of the country

NOM-040-SEMARNAT-2002. Maximum permissible levels of atmospheric emissions for the manufacture of cement and establishes several compliance tables:

Operation	Maximum Level	Frequency of Measurement	Method of Mediation
Shredding (1)	80mg/m³	ANUAL	NMX-AA-010-SCFI-2001
Raw material milling (1)	80mg/m³		
Cement grinding hydraulic (1)	80mg/m³		
Clinker Cooling (1)	100g/m3		
Clinker Calcification (1)	0.15*Ckg of particles /ton of raw material fed		

Table 2 Maximum permissible levels of particulate emissions. NOM-040-SEMARNAT-2002

Parameter	White cement Mg/m³			Gray cement Mg/m³			Frequency of measurement	Method or principle of measurement
	ZMCM	ZC	RP	ZCMC	ZC	RP		
Sulfur dioxide sulfur	400	2200	2500	400	800	1200		NMX-AA-055-1979
Nitrogen oxide nitrogen oxide (2)	800	1400	1600	800	1000	1200		Infrared no
Carbon monoxide arbon monoxide	3000	3500	4000	3000	3500	4000		dispersive or

Table 3 Maximum permissible levels of gas emissions. NOM-040-SEMARNAT-2002
Subject to validation * Maximum total substitution at any time based on the calorific value of the conventional fuel.

Fuel Replacement Fuel Replacement Conventional * (%)	Tires	Fuel From Recovery	Fuel Formulated
0 a 5	Level 0	Level 0	Level 1
5 a 15	Level 1	Level 1	Level 2
15 a 30	Level 1	Level 2	Level 3
>30	Level 2	Subject to validation	

Table 4 Level of Compliance, Type and Volume of Substitution Fuel. NOM-040-SEMARNAT-2002

ISSN 2414-4932

December 2021 Vol.7 No.21 24-33

Parameter	Emission Mg/m^3	Frequency of Measurement		Method or principle of measurement
		Nivel 2	Nivel 3	
CO(2)	Table 2	Annual		Infrarrojo no dispersivo NMX-AA-035-1976
HCI	70	Semiannual	Continuo	Infrarrojo no dispersivo NMX-AA-070-1980
Nox(2)	Table 2	Annual	Continuo	Quimiluminisencia
SO_2(2)	Table 2	Annual	Continuo	Infrarrojo no dispersivo NMX-AA-070-1980
HCt (as CH_4)	70	Semiannual	Continuo	Ionización de flama
Particles	Table 1	Annual	Annual	Isocinético NMX-AA-10-2001
Sb, As, Se, Ni, Mn	0.7(3)	Annual	Semiannual	Atomic absorption spectrometry or equivalent
Cd	0.07	Annual	Semiannual	
Hg	0.07	Annual	Semiannual	
Pb, Cr, Zn	0.7(3)	Annual	Semiannual	
Dioxins and furans	0.2 (ng EQT/m^3)	Biennial	Annual	High resolution gas chromatography coupled to coupled to high resolution high resolution gas chromatography coupled to mass spectrometry

Table 5 Maximum Permissible Levels of Emissions to the Atmosphere. NOM-040-SEMARNAT-2002

(1) All values refer to normal dry conditions, corrected to 7% oxygen (O2) by volume.
(2) According to the location of the facility.
(3) Total sum of heavy metals.

SEMARNAT has several procedures for the authorization of atmospheric emissions:

SEMARNAT-07-033-C - Recycling or co-processing of hazardous waste.

SEMARNAT-07-033-F - Hazardous waste incineration.

Conclusions

According to the analysis carried out, it can be seen that by carrying out the project we expect a reduction in pollution due to the disposal of masks and respirators, thus contributing to help the environment, since at least 5,516,000 pieces would be collected per year to be co-processed to generate energy, which would mean a savings of MXP$573,617.11 per year in fuel for the furnace of the company that decides to implement this project.

Referencias

AXA México. (2020). *COVID-19 sin contaminación: desecha tu cubrebocas de forma correcta*. axa.mx. https://axa.mx/blogs/blog-axa/covid-19-sin-contaminacion-desecha-tu-cubrebocas-de-forma-correcta

Leyva, R. G. (2009). *El cubre bocas ó mascarilla, un recurso para garantizar la seguridad del personal de salud y del paciente*. Enfermería Universitaria. https://www.medigraphic.com/cgi-bin/new/resumen.cgi?IDARTICULO=37501

Massachusetts General Hospital. (2020). *La diferencia entre las mascarillas N95, las mascarillas quirúrgicas y las mascarillas de tela*. https://www.massgeneral.org/es/coronavirus/la-diferencia-entre-las-mascarillas-N95-las-mascarillas-quirurgicas-y-las-mascarillas-de-tela

Organización Mundial de la Salud (OMS). (2020). *Cronología de la respuesta de la OMS a la COVID-19*. who.int. https://www.who.int/es/news/item/29-06-2020-covidtimeline

SEMARNAT. (2011). *NORMA Oficial Mexicana NOM-085-SEMARNAT-2011, Contaminación atmosférica-Niveles máximos permisibles de emisión de los equipos de combustión de calentamiento indirecto y su medición*. Diario Oficial de la Federación. http://www.dof.gob.mx/normasOficiales/4632/semarnat/semarnat.htm

SEMARNAT. (2002). *NORMA Oficial Mexicana NOM-040-SEMARNAT-2002, Protección ambiental-Fabricación de cemento hidráulico-Niveles máximos permisibles*. Diario Oficial de la Federación. http://siga.jalisco.gob.mx/assets/documentos/normatividad/nom040semarnat2002.htm

Tiempo, M. E. E. (2020). *Así nació el cubrebocas*. El Universal. https://www.eluniversal.com.mx/opinion/mochilazo-en-el-tiempo/asi-nacio-el-cubrebocas

Torreón.-, S. E. G. E. D. E. (2020). *Este es el origen del cubrebocas*. El Siglo. https://www.elsiglodetorreon.com.mx/noticia/1724109.este-es-el-origen-del-cubrebocas.html
T. (2020b). *Que es un cubrebocas y para qué sirve*. Tecnomedicina. https://www.tecnomedicina.mx/que-es-un-cubrebocas-y-para-que-sirve/

ISSN 2414-4932

[Title in Times New Roman and Bold No. 14 in English and Spanish]

Surname (IN UPPERCASE), Name 1st Author†*, Surname (IN UPPERCASE), Name 1st Coauthor, Surname (IN UPPERCASE), Name 2nd Coauthor and Surname (IN UPPERCASE), Name 3rd Coauthor

Institutional Affiliation of Author including Dependency (No.10 Times New Roman and Italic)

<u>*International Identification of Science - Technology and Innovation*</u>

ID 1st Author: (ORC ID - Researcher ID Thomson, arXiv Author ID - PubMed Author ID - Open ID) and CVU 1st author: (Scholar-PNPC or SNI-CONACYT) (No.10 Times New Roman)

ID 1st Coauthor: (ORC ID - Researcher ID Thomson, arXiv Author ID - PubMed Author ID - Open ID) and CVU 1st coauthor: (Scholar or SNI) (No.10 Times New Roman)

ID 2nd Coauthor: (ORC ID - Researcher ID Thomson, arXiv Author ID - PubMed Author ID - Open ID) and CVU 2nd coauthor: (Scholar or SNI) (No.10 Times New Roman)

ID 3rd Coauthor: (ORC ID - Researcher ID Thomson, arXiv Author ID - PubMed Author ID - Open ID) and CVU 3rd coauthor: (Scholar or SNI) (No.10 Times New Roman)

(Report Submission Date: Month, Day, and Year); Accepted (Insert date of Acceptance: Use Only ECORFAN)

Abstract (In English, 150-200 words)

Objectives
Methodology
Contribution

Keywords (In English)

Indicate 3 keywords in Times New Roman and Bold No. 10

Abstract (In Spanish, 150-200 words)

Objectives
Methodology
Contribution

Keywords (In Spanish)

Indicate 3 keywords in Times New Roman and Bold No. 10

Citation: Surname (IN UPPERCASE), Name 1st Author, Surname (IN UPPERCASE), Name 1st Coauthor, Surname (IN UPPERCASE), Name 2nd Coauthor and Surname (IN UPPERCASE), Name 3rd Coauthor. Paper Title. Journal of Urban and Sustainable Development. Year 1-1: 1-11 [Times New Roman No.10]

* Correspondence to Author (example@example.org)
† Researcher contributing as first author.

Introduction

Text in Times New Roman No.12, single space.

General explanation of the subject and explain why it is important.

What is your added value with respect to other techniques?

Clearly focus each of its features

Clearly explain the problem to be solved and the central hypothesis.

Explanation of sections Article.

Development of headings and subheadings of the article with subsequent numbers

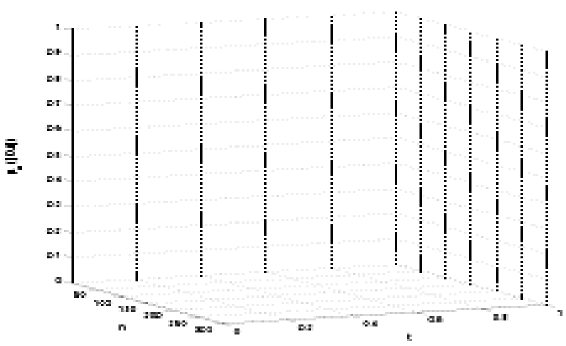
[Title No.12 in Times New Roman, single spaced and bold]

Products in development No.12 Times New Roman, single spaced.

Including graphs, figures and tables-Editable

In the article content any graphic, table and figure should be editable formats that can change size, type and number of letter, for the purposes of edition, these must be high quality, not pixelated and should be noticeable even reducing image scale.

[Indicating the title at the bottom with No.10 and Times New Roman Bold]



Graphic 1 Title and *Source (in italics)*

Should not be images-everything must be editable.

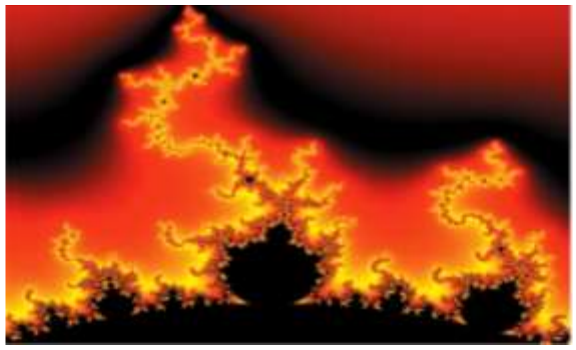


Figure 1 Title and *Source (in italics)*

Should not be images-everything must be editable.

Table 1 Title and *Source (in italics)*

Should not be images-everything must be editable.

Each article shall present separately in **3 folders**: a) Figures, b) Charts and c) Tables in .JPG format, indicating the number and sequential Bold Title.

For the use of equations, noted as follows:

$$Y_{ij} = \alpha + \sum_{h=1}^{r} \beta_h X_{hij} + u_j + e_{ij} \quad (1)$$

Must be editable and number aligned on the right side.

Methodology

Develop give the meaning of the variables in linear writing and important is the comparison of the used criteria.

Results

The results shall be by section of the article.

Annexes

Tables and adequate sources

Thanks

Indicate if they were financed by any institution, University or company.

Conclusions

Explain clearly the results and possibilities of improvement.

References

Use APA system. Should not be numbered, nor with bullets, however if necessary numbering will be because reference or mention is made somewhere in the Article.

Use Roman Alphabet, all references you have used must be in the Roman Alphabet, even if you have quoted an Article, book in any of the official languages of the United Nations (English, French, German, Chinese, Russian, Portuguese, Italian, Spanish, Arabic), you must write the reference in Roman script and not in any of the official languages.

Technical Specifications

Each article must submit your dates into a Word document (.docx):

Journal Name
Article title
Abstract
Keywords
Article sections, for example:

1. Introduction
2. Description of the method
3. Analysis from the regression demand curve
4. Results
5. Thanks
6. Conclusions
7. References

Author Name (s)
Email Correspondence to Author
References

Intellectual Property Requirements for editing:

-Authentic Signature in Color of Originality Format Author and Coauthors

-Authentic Signature in Color of the Acceptance Format of Author and Coauthors

Reservation to Editorial Policy

Journal of Urban and Sustainable Development reserves the right to make editorial changes required to adapt the Articles to the Editorial Policy of the Research Journal. Once the Article is accepted in its final version, the Research Journal will send the author the proofs for review. ECORFAN® will only accept the correction of errata and errors or omissions arising from the editing process of the Research Journal, reserving in full the copyrights and content dissemination. No deletions, substitutions or additions that alter the formation of the Article will be accepted.

Code of Ethics - Good Practices and Declaration of Solution to Editorial Conflicts

Declaration of Originality and unpublished character of the Article, of Authors, on the obtaining of data and interpretation of results, Acknowledgments, Conflict of interests, Assignment of rights and Distribution

The ECORFAN-Mexico, S.C Management claims to Authors of Articles that its content must be original, unpublished and of Scientific, Technological and Innovation content to be submitted for evaluation.

The Authors signing the Article must be the same that have contributed to its conception, realization and development, as well as obtaining the data, interpreting the results, drafting and reviewing it. The Corresponding Author of the proposed Article will request the form that follows.

Article title:

– The sending of an Article to Journal of Urban and Sustainable Development emanates the commitment of the author not to submit it simultaneously to the consideration of other series publications for it must complement the Format of Originality for its Article, unless it is rejected by the Arbitration Committee, it may be withdrawn.

– None of the data presented in this article has been plagiarized or invented. The original data are clearly distinguished from those already published. And it is known of the test in PLAGSCAN if a level of plagiarism is detected Positive will not proceed to arbitrate.

– References are cited on which the information contained in the Article is based, as well as theories and data from other previously published Articles.

– The authors sign the Format of Authorization for their Article to be disseminated by means that ECORFAN-Mexico, S.C. In its Holding Bolivia considers pertinent for disclosure and diffusion of its Article its Rights of Work.

– Consent has been obtained from those who have contributed unpublished data obtained through verbal or written communication, and such communication and Authorship are adequately identified.

– The Author and Co-Authors who sign this work have participated in its planning, design and execution, as well as in the interpretation of the results. They also critically reviewed the paper, approved its final version and agreed with its publication.

– No signature responsible for the work has been omitted and the criteria of Scientific Authorization are satisfied.

– The results of this Article have been interpreted objectively. Any results contrary to the point of view of those who sign are exposed and discussed in the Article.

Copyright and Access

The publication of this Article supposes the transfer of the copyright to ECORFAN-Mexico, SC in its Holding Bolivia for it Journal of Urban and Sustainable Development, which reserves the right to distribute on the Web the published version of the Article and the making available of the Article in This format supposes for its Authors the fulfilment of what is established in the Law of Science and Technology of the United Mexican States, regarding the obligation to allow access to the results of Scientific Research.

Article Title:

Name and Surnames of the Contact Author and the Coauthors	Signature
1.	
2.	
3.	
4.	

Principles of Ethics and Declaration of Solution to Editorial Conflicts

Editor Responsibilities

The Publisher undertakes to guarantee the confidentiality of the evaluation process, it may not disclose to the Arbitrators the identity of the Authors, nor may it reveal the identity of the Arbitrators at any time.

The Editor assumes the responsibility to properly inform the Author of the stage of the editorial process in which the text is sent, as well as the resolutions of Double-Blind Review.

The Editor should evaluate manuscripts and their intellectual content without distinction of race, gender, sexual orientation, religious beliefs, ethnicity, nationality, or the political philosophy of the Authors.

The Editor and his editing team of ECORFAN® Holdings will not disclose any information about Articles submitted to anyone other than the corresponding Author.

The Editor should make fair and impartial decisions and ensure a fair Double-Blind Review.

Responsibilities of the Editorial Board

The description of the peer review processes is made known by the Editorial Board in order that the Authors know what the evaluation criteria are and will always be willing to justify any controversy in the evaluation process. In case of Plagiarism Detection to the Article the Committee notifies the Authors for Violation to the Right of Scientific, Technological and Innovation Authorization.

Responsibilities of the Arbitration Committee

The Arbitrators undertake to notify about any unethical conduct by the Authors and to indicate all the information that may be reason to reject the publication of the Articles. In addition, they must undertake to keep confidential information related to the Articles they evaluate.

Any manuscript received for your arbitration must be treated as confidential, should not be displayed or discussed with other experts, except with the permission of the Editor.

The Arbitrators must be conducted objectively, any personal criticism of the Author is inappropriate.

The Arbitrators must express their points of view with clarity and with valid arguments that contribute to the Scientific, Technological and Innovation of the Author.

The Arbitrators should not evaluate manuscripts in which they have conflicts of interest and have been notified to the Editor before submitting the Article for Double-Blind Review.

Responsibilities of the Authors

Authors must guarantee that their articles are the product of their original work and that the data has been obtained ethically.

Authors must ensure that they have not been previously published or that they are not considered in another serial publication.

Authors must strictly follow the rules for the publication of Defined Articles by the Editorial Board.

The authors have requested that the text in all its forms be an unethical editorial behavior and is unacceptable, consequently, any manuscript that incurs in plagiarism is eliminated and not considered for publication.

Authors should cite publications that have been influential in the nature of the Article submitted to arbitration.

Information services

Indexation - Bases and Repositories

RESEARCH GATE (Germany)
GOOGLE SCHOLAR (Citation indices-Google)
REDIB (Ibero-American Network of Innovation and Scientific Knowledge- CSIC)
MENDELEY (Bibliographic References Manager)
DULCINEA (Spanish scientific journals)
UNIVERSIA (University Library-Madrid)
SHERPA (University of Nottingham - England)

Publishing Services

Citation and Index Identification H
Management of Originality Format and Authorization
Testing Article with PLAGSCAN
Article Evaluation
Certificate of Double-Blind Review
Article Edition
Web layout
Indexing and Repository
ArticleTranslation
Article Publication
Certificate of Article
Service Billing

Editorial Policy and Management

21 Santa Lucía, CP-5220. Libertadores -Sucre – Bolivia. Phones: +52 1 55 6159 2296, +52 1 55 1260 0355, +52 1 55 6034 9181; Email: contact@ecorfan.org www.ecorfan.org

Site Licences

03-2010-032610094200-01-For printed material ,03-2010-031613323600-01-For Electronic material,03-2010-032610105200-01-For Photographic material,03-2010-032610115700-14-For the facts Compilation,04-2010-031613323600-01-For its Web page,19502-For the Iberoamerican and Caribbean Indexation,20-281 HB9-For its indexation in Latin-American in Social Sciences and Humanities,671-For its indexing in Electronic Scientific Journals Spanish and Latin-America,7045008-For its divulgation and edition in the Ministry of Education and Culture-Spain,25409-For its repository in the Biblioteca Universitaria-Madrid,16258-For its indexing in the Dialnet,20589-For its indexing in the edited Journals in the countries of Iberian-America and the Caribbean, 15048-For the international registration of Congress and Colloquiums. financingprograms@ecorfan.org

Management Offices

21 Santa Lucía, CP-5220. Libertadores -Sucre–Bolivia.

Journal of Urban and Sustainable Development

"Obtaining particulate agglomerates from the recycling of multilayer containers and low density polyethylene"
ENRÍQUEZ-PÉREZ, Ma. Angeles, ROSALES-DAVALOS, Jaime and CASTREJÓN-SÁNCHEZ, Víctor Hugo
Tecnológico de Estudios Superiores de Jocotitlán

"Energy sustainability alternatives for the Home for the elderly Maty, in the community of Villa Juárez, Aguascalientes"
CASTILLO-ZÁRATE, Ma. Alicia
Universidad Tecnológica de Aguascalientes

"Vermicompost production monitoring and the internet of things"
SILVERIO-GARRIDO, Elid, SAMPAYO-RODRIGUEZ, Carmen Jeannette, HERNANDEZ-LUNA, Aldo and CASTILLO-QUIROZ, Gregorio
Instituto Tecnológico Superior de Huauchinango

"Disposal of mouth covers, masks or respirators, after they are used, to minimize the environmental impact and contages by COVID 19"
HERNÁNDEZ-RODRÍGUEZ, María Guadalupe, ORTEGA-CHÁVEZ, Laura Antonia, CARO ESCUDERO, Iveth Selene and BARRAZA-ÁLVAREZ, Alberto Guerrero
Instituto Tecnológico de Chihuahua II

2414 4932
ISSN 2414 - 4932
www.ecorfan.org