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Aspects to consider in managing the detection and quantification of pollutants in a water body through a Web platform

Aspectos a considerar en la gestión de la detección y cuantificación de contaminantes en un Cuerpo de Agua mediante una plataforma Web

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Abstract

Currently, the problem of pollution of water bodies is of public relevance. Unfortunately, in most cases, the types of pollutants or even natural elements that in excess can become highly dangerous for people are unknown. the biotic and abiotic factors that inhabit it, as well as damaging the human health of surrounding inhabitants. In this work, the data management proposal is presented through a web page with the purpose of being a reliable source of free access to information about the contaminants found in the samples taken from Laguna Nuevo Amanecer with their respective concentrations; These data were obtained by applying the laboratory procedures established in the Official Mexican Standards.

Pollutants, Data management, Official Mexican Standards

Resumen

En la actualidad la problemática sobre la contaminación de los cuerpos de agua es de relevancia pública, desafortunadamente en la mayoría de los casos se desconocen hasta los tipos de contaminantes o incluso elementos naturales que en exceso pueden llegar a tener un de alto grado de peligrosidad para los factores bióticos y abióticos que en ella habitan, así como dañar la salud humana de habitantes aledaños. En este trabajo se presenta la propuesta de gestión de datos mediante una página web con el propósito de ser una fuente confiable de libre acceso a la información acerca de los contaminantes encontrados en las muestras tomadas de la Laguna Nuevo Amanecer con sus respectivas concentraciones; estos datos fueron obtenidos mediante la aplicación de los procedimientos de laboratorio establecidos en las Normas Oficiales Mexicanas.

Contaminantes, Gestión de datos, Normas Oficiales Mexicanas

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Introduction

Water is an essential natural resource for the development of the biological processes that make life possible for any living being in our ecosystem. Water is the most abundant component in organic media; living beings contain an average of 70% water. Not all of them have the same amount, for example, plants have more water than animals.

In spite of being aware of the great importance of water in life on earth, it is a natural resource with a latent contamination problem despite the excessive and irresponsible use of it, thus manifesting a wide variety of types of pollutants present in water such as faeces, colloids, chloride metals, among others. The present work is carried out with the purpose of accessing the real contamination indexes of a water body. In this particular case of study, the sample submitted for analysis will be taken from the Nuevo Amanecer water located in Ciudad Madero, Tamaulipas. A website was developed as an informative tool for the population.

Detection and quantification of pollutants according to official Mexican standards

Sampling

Mexican Standard NMX-AA-003 Wastewater - Sampling, published in the Official Journal of the Federation on 25 March 1980.

When taking a sample, precautions must be taken to ensure that it is possible to identify the samples at any time.

1. Attached or hanging labels should be used, or the bottles should be numbered and the information noted on a record sheet. These labels should contain at least the following information. Identification of the discharge. Sample number. Date and time of sampling. Sampling point. Sample temperature. Sampling depth Name and signature of the person carrying out the sampling.

2. Record sheet

   a. A record sheet must be kept with the information allowing the identification of the origin of the sample and all the data that at a given moment will allow the sampling to be repeated.

   b. It is recommended that the record sheet contains the following information: The data referred to in point

Figure 1 Sampling report

3. Results of field tests carried out on the sampled discharge. Where applicable, the discharge or flow rate of the wastewater discharge being sampled.

Detailed description of the sampling point so that anyone can take other samples at the same location.

4. Qualitative description of the odour and colour of the sampled wastewater.

ACTA DE TOMA DE MUESTRA

NOMBRE DEL INSPECTOR:
ENTIDAD INSPECCIONADA:
NOMBRE DEL INTERLOCUTOR:
FECHA DE TOMA DE MUESTRAS:

Codigo de la Muestra	Remolque / Lugar toma muestra	Tamaño muestra	Destino de la muestra

Figura 2 Acta de toma de muestras

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Sedimentable Solids

Mexican Standard NMX-AA-004 Water - Determination of settleable solids in wastewater - Imhoff cone method, published in the Official Journal of the Federation on September 13, 1977.

Settleable matter

Settleable matter is defined as the amount of solids that in a given time settle to the bottom of a vessel under static conditions. A sample of this is shown in figure 3.

Figure 3 Sedimentable matter

Sample collection, preservation and storage

1. The sample may be a point sample (single) or a composite sample.

2. Collect a homogeneous and representative sample volume greater than 1 L in a polyethylene or glass bottle with a wide-mouth lid, always taking into account that the suspended material must not adhere to the walls of the container.

3. Transport the sample and keep it at 2 °C to 8 °C until analysis.

4. The maximum storage time prior to analysis is 7 days. However, it is recommended to perform the analysis within 24 h after collection.

Fats and oils

Mexican Standard NMX-AA-005 Waters - Determination of fats and oils - Soxhlet extraction method, published in the Official Journal of the Federation on 8 August 1980.

This method is based on the adsorption of fats and oils on diatomaceous earth, which are extracted in a recirculation extraction equipment using hexane as solvent. Once the extraction is finished, the hexane is evaporated and the residue left in the container is weighed; this value being the content of fats and oils.

Fats and oils are organic compounds consisting mainly of fatty acids of animal and vegetable origin as shown in Figure 2.4, as well as petroleum hydrocarbons which are extracted from the sample using hexane as solvent.

Figure 4 Fats and oils

Sample collection, preservation and storage nmx-aa-005-scfi-2013

Collect a volume of approximately 1 L of sample from the surface of the water body in a wide-mouthed glass bottle with a plastic or metal lid.

1. Collection of a composite sample is not permitted. Since the whole sample is used in this test, aliquots of the sample cannot be taken for other types of analysis.

2. In case of the presence of emulsified oils in the water to be sampled, the sample is taken from a depth of 20 cm to 30 cm, at the site with the least turbulence to ensure greater representativeness.

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3. The sample must be preserved by acidification with hydrochloric acid 1:1 or sulphuric acid 1:1 at a pH value of two or lower and refrigerated at 4 °C ± 2 °C. For samples with a pH less than 8, it is generally sufficient to add 5 mL. For samples with a pH above 8 add concentrated acid to avoid dilution of the sample.

4. Avoid filling the bottle completely to avoid loss of fats and oils.

5. The maximum storage time prior to analysis is 30 days.

Figure 5 shows the biodegradability criteria.

CUADRO II. CRITERIOS DE BIODEGRADABILIDAD SEGÚN LA RELACIÓN DBO_5*/DQO** (Ardila *et al.* 2012)

DBO_5/DQO	Carácter
> 0.8	Muy biodegradable
0.7 – 0.8	Biodegradable
0.3 – 0.7	Poco biodegradable
< 0.3	No biodegradable

* Demanda bioquímica de oxígeno transcurridos cinco días de reacción; ** Demanda química de oxígeno

Figure 5 Criterios de biodegradabilidad

Floating matter

Norma Mexicana NMX-AA-006 Aguas - Determinación de materia flotante - Método visual con malla específica, published in the Diario Oficial de la Federación on 5 December 1973.

For the purposes of this standard, the following definitions are established:

1. Natural waters Raw water, groundwater, rainwater, stormwater, residual stormwater and surface water. NMX-AA-006-SCFI-2000 2/6 DGN

2. Wastewater The waters of varied composition coming from the discharges of municipal, industrial, commercial, agricultural, livestock, domestic and similar uses, as well as the mixture of them.

3. Logbook Laboratory logbook duly numbered and identified, in which analysts write down all the data of the procedures they follow in the analysis of a sample, as well as all the pertinent and relevant information to their work in the laboratory. It is from these logs that inspectors can reconstruct the process of analysis of a sample some time after it was carried out.

4. Discharge The action of discharging, infiltrating, depositing or injecting wastewater into a receiving body in a continuous, intermittent or incidental manner, when this is a property of the public domain of the Nation.

5. Floating matter All material that is retained in a mesh between 2.8 mm and 3.3 mm. opening.

6. Simple Sample That which is taken at the point of discharge, continuously, on a normal day of operation that reflects quantitatively and qualitatively the most representative process or processes of the activities that generate the discharge, for the time necessary to complete at least a sufficient volume to carry out the necessary analysis to know its composition, gauging the flow discharged at the site and at the time of sampling.

7. Parameter Variable used as a reference to determine water quality.

8. Traceability Property of the result of a measurement or of the value of a standard by which it can be related to certain references, generally national or international standards, by means of an uninterrupted chain of comparisons having all the uncertainties determined.

Determination of biochemical oxygen demand

Mexican Standard NMX-AA-028 Waters - Determination of biochemical oxygen demand - Incubation method by dilutions, published in the Official Journal of the Federation on 6 July 1981.

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The method is based on measuring the amount of oxygen required by microorganisms to carry out the oxidation of organic matter present in natural and waste waters and is determined by the difference between the initial dissolved oxygen and the dissolved oxygen after five days of incubation at 20°C.

For the purposes of this standard the following definitions are established:

1. Natural waters Raw water, groundwater and rainwater.

2. Wastewater The waters of varied composition coming from the discharges of municipal, industrial, commercial, service, agricultural, livestock, domestic uses and in general from any other use.

Determination of solids in wáter

Mexican Standard NMX-AA-034 Waters - Determination of solids in water - Gravimetric method, published in the Official Journal of the Federation on 3 July 1981.

All waters contain dissolved substances in varying amounts depending on their origin. Water may contain various types of solids, including dissolved solids and suspended solids. Dissolved solids and salts can adversely affect the quality of a water body, effluent or process in a number of ways, in water treatment plants for example dissolved solids analysis is important as an indicator of the effectiveness of water treatment processes.

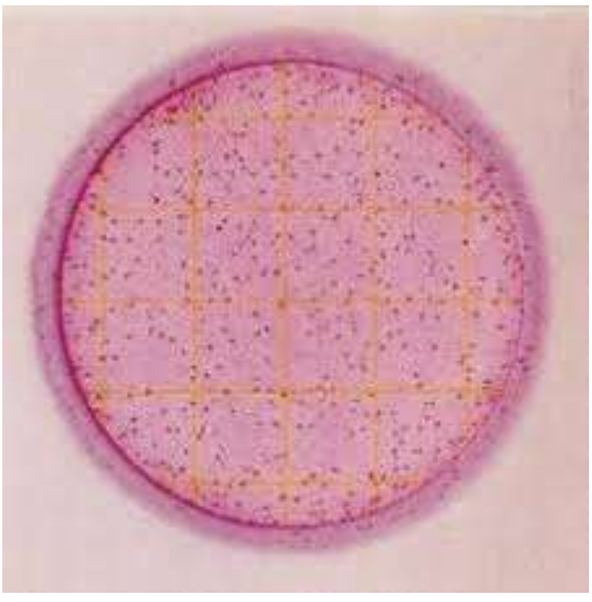

Figure 6 Coliforms

The principle of this method is based on the quantitative measurement of solids and dissolved solids, as well as the amount of organic matter contained in natural, waste and treated waste water, by evaporation and calcination of the filtered or unfiltered sample, where appropriate, at specific temperatures, where the residues are weighed and serve as a basis for the calculation of the content of these.

1. Constant mass: This is the mass that is recorded when the material has been heated, cooled and weighed, and that in two consecutive complete cycles presents a difference ≤ 0.000 5 g.

2. Total Dissolved Solids (TDS): The soluble material consisting of inorganic and organic matter which remains as a residue after evaporation and drying of a sample previously filtered through a glass fibre filter with a pore size of 1,5 µm at a temperature of 105 °C ± 2 °C.

3. Total Suspended Solids (TSS): The material consisting of settleable solids, suspended and colloidal solids which are retained by a 1,5 µm pore glass fibre filter dried and brought to constant mass at a temperature of 105 °C ± 2 °C.

4. Volatile Suspended Solids (VSS): Suspended solids that volatilise during calcination at 550 °C ± 50 °C.

5. Total Solids (TS): The residue remaining in a capsule after evaporation and drying of a sample at a temperature of 105 °C ± 2 °C.

6. Total Volatile Solids (TVS): Amount of organic and inorganic matter that is volatilised by the effect of calcination at 550 °C ± 50 °C.

Total and faecal coliforms

Mexican Standard NMX-AA-042 Waters - Determination of the most probable number of total and faecal coliforms - Multiple fermentation tube method, published in the Official Journal of the Federation on 22 June 1987.

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The presence and degree of faecal contamination is an important factor in assessing the quality of a water body. Examining water samples for the presence of organisms of the coliform bacteria group1 (which normally inhabit the gut of humans and other warm-blooded animals, as shown in Figure 2.6), provides an indicator of contamination.

Since the ability of some members of the coliform bacteria group to survive in water is limited, their numbers can also be used to estimate the degree of contamination.

For the purposes of this Mexican Standard, the terms and definitions contained in: NMX-AA-089/1-SCFI and NMX-AA-089/2-SCFI apply; and the following definitions are established:

1. Total coliform organisms Aerobic or facultative anaerobic organisms capable of growing at 35 ºC in a liquid lactose medium, with production of acid and gas in a period of 48 h.

2. Faecal coliform organisms (thermotolerant) Coliform organisms as described in A) which have the same fermentative properties over a period of 24 h at 44,5 °C ± 0,2 °C. 3.3 Escherichia coli (E. coli) Faecal coliform (thermotolerant) organisms as described in B) which in addition produce indole from tryptophan within 24 h at 44,5 °C ± 0,2 °C.

Sample collection, storage and preservation

1. Collect at least 100 mL of sample in sterile bottles or bags. Sampling is in sterile containers with solid sodium thiosulphate (10 mg/100 mL container) or with 0,1 mL of sterile 10 % solution.

2. For transport the samples should be kept at a temperature of 4 °C ± 2 °C. III.- Store refrigerated at 4 °C ± 2 °C in the laboratory. Temper the sample before analysis not to exceed 24 h after collection of the last sample. The sample can be analysed up to 48 h after collection and stored at 2 °C ± 1 °C.

Website design

A Web page is an electronic document that is part of the WWW (World Wide Web) usually constructed in HTML (Hyper Text Markup Language) or XHTML (eXtensible Hyper Text Markup Language). This document may contain links (hypertext characteristic) that direct us to another Web page when clicked on. To visualise a Web Page it is necessary to use a Browser.

A Web Page can be hosted on a local computer or on a remote computer. The server where the Web Page is hosted is called a Web Server. The Web Server handles Web Page requests using the HTTP (HyperText Transfer Protocol) protocol; on the client side it is the Browser that receives and displays the Web Pages using the same protocol. Another important characteristic is that a Web Page can be static (its content is always the same) or dynamic (its content is built from the information entered by the user).

A Web is a set of interrelated Web pages that make up what is known as a Website. The WWW or the Web is the whole set of interrelated information available on the Internet, which is made up of a series of worldwide servers organised by domains (logical names associated with institutions or companies, granted by official registration companies).

Elements of a website

A Web Page can contain any of the following elements: Text, Images, Audio, Animated Objects (generally built with the Adobe Flash tool), hyperlinks (feature that allows navigation from one web page to another), Meta tags (are instructions in HTML language that tell search engines which are the words or terms by which a page must be indexed to be found), cascading style sheets or CSS (Cascading Style Sheets) that allow separating the presentation of the page from its structure. The aforementioned elements are shown graphically in figure 7.

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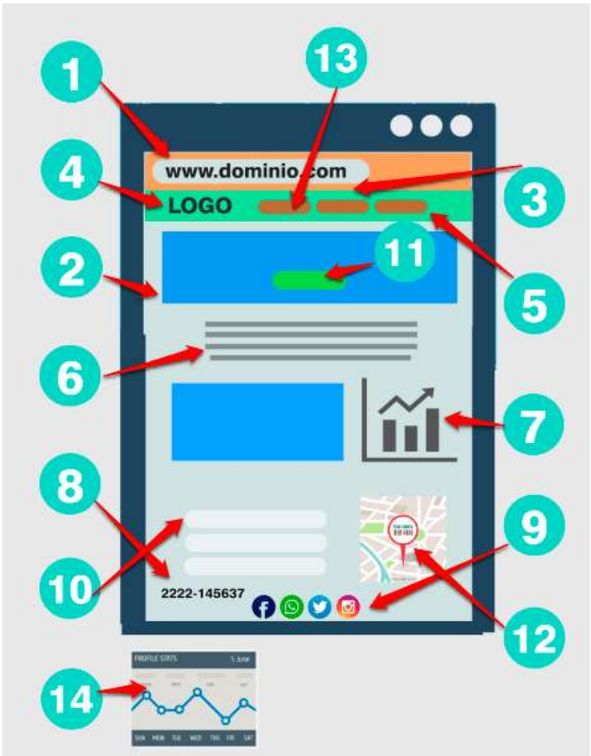

Figure 7 Elements of a web page

1. Domain Name
2. Navigation Design
3. Internal Pages
4. Logo
5. Menus
6. Texts
7. Images
8. Contact details
9. Social Media Buttons
10. Contact Form
11. Calls to Action
12. Location map
13. Supplementary pages
14. Tools for statistics

Figure 8 Screenshot of the created website

Conclusions

Various data were collected and analysed in order to feed the database with the results obtained from the freely accessible web page developed. A future goal of this project is to raise awareness among the population living in the municipality of Ciudad Madero of the damage caused to water bodies due to the amount of waste and discharges that are dumped. For the analysis of the samples it became evident that the application and compliance with the official Mexican standards in charge of regulating the appropriate procedures for sample taking, transport and storage of samples, the description of the specifications required according to the parameter to be verified, as well as establishing the maximum permissible limits endorsed for the preservation of species and human health.

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