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Implementation of the use of condensed water from air conditioners in the development of chemical laboratory practices at the Instituto Tecnologico de Cancún as an alternative in the consumption of distilled water

Implementación del uso de agua condensada de los aires acondicionados en el desarrollo de las prácticas de laboratorio de química del Instituto Tecnológico de Cancún como una alternativa en el consumo de agua destilada

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Abstract

Use and collection of condensed water from air conditioners in the ITCancún laboratories that generate a large amount of this water. The ITCancún chemistry laboratory generates more than 15 liters per day of its air conditioners and the same amount is produced by the Electromechanical Engineering workshop. These impressive amounts can be attributed to the climatic conditions of the state due to the high humidity index. The purpose of this Article is to use the water collected from the air conditioning systems of the ITCancún laboratories, in the cleaning of the chemistry laboratory material and in the preparation of solutions for the development of the chemistry practices of the careers of the institute's engineering. The collection of water represents a significant economic saving in the acquisition of distilled water. The results obtained from the physicochemical parameters of the water collected from the air conditioning are pH 8.3, Alkalinity of 2.8 mg / L, conductivity 16μS, and 22μS, these parameters being water quality. Said water by condensation can be reused in cleaning floors, bathrooms. Having a comprehensive and sustainable project friendly with water care

Sustainable, Integral, Reused, Condensed Water

Resumen

Aprovechamiento y recolección del agua condensada de los aires acondicionados en los laboratorios del ITCancún que generan una gran cantidad de dicha agua. El laboratorio de química del ITCancún genera más de 15 litros cada día de sus aires acondicionados y la misma cantidad produce el taller de Ingeniería Electromecánica. Estas cantidades impresionantes se pueden atribuir a las condiciones climáticas del estado por el alto índice de humedad. En este Artículo se tiene como objetivo darle uso al agua captada proveniente de los sistemas de aire acondicionado de los laboratorios del ITCancún, en la limpieza del material del laboratorio de química y de la preparación de soluciones para el desarrollo de las prácticas de química de las carreras de las ingenierías del instituto. La recolección del agua representa un ahorro económico significativo en la adquisición de agua destilada. Los resultados obtenidos a las pruebas físico químicas del agua recolectada del aire acondicionado, son pH 8.3, Alcalinidad de 2,8 mg/L, conductividad 16μS, y 22μS, siendo estos parámetros de calidad del agua. Dicha agua por condensación la podemos reutilizar en limpieza de pisos, baños. Teniendo un proyecto integral y sostenible amigable con el cuidado del agua.

Sostenible, Reusó, Agua Condensada

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Introduction

We know that a domestic air conditioner can produce up to 25 liters per day of condensed water, however, the water produced is often discarded. This amount of water collected can represent a great saving for institutions that use distilled water for commercial use in the performance of laboratory practices. The water collected is of sufficient quality to be used in all types of activities that require water: for example, cleaning, for the consumption of the building itself, being a sustainable building in the reuse of water for cleaning the bathrooms, floors of the halls and laboratories. In these places, the best thing about air conditioning condensate recovery is that water is produced as a natural product without cost being friendly to the environment in the care of drinking water. During periods of high heat and high humidity, when it is most necessary to justify having condensate capture systems. The relative humidity in Cancun remains at around 60% to 90% during the summer months.

The air conditioning system allows water to be produced by extracting moisture from the air through a condensation process, condensation is the change in matter from a substance to a denser phase, such as from gas to liquid. Condensation usually occurs when a vapor cools, but it can also occur if the water vapor in the air that condenses naturally on cold surfaces is called dew. Water vapor will only condense on another surface when it is colder than the temperature of water vapor, or when the balance of water vapor in the air, that is, the saturation humidity, has been exceeded is compressed.

The principle of distillation is very simple, but the realization of the process on a large scale presents many problems, for example, as water is distilled from a container with brackish water, the salts become more concentrated and end up precipitating or forming large calcic crusts and consumption of large amounts of energy. We are increasingly aware that we must create a sustainable society; that is, one whose processes are in equilibrium with the natural processes of the planet, not releasing toxic materials into the environment and satisfying their needs with renewable resources.

As man increases the production of environmental pollutants, we find that large amounts of money and resources are being invested to guarantee the supply of fresh water. This is one of the reasons why we choose to use the condensed water from the air conditioners being a sustainable chemistry laboratory.

The ecological environment has become a global concern, because pollution of the environment is becoming more serious. Rapid industrialization has caused many serious problems, such as depletion of natural resources, degradation of major ecosystems (Zheng-Xia He, 2016). Given the environmental conditions and problems and the depletion of water supplies, we resort to the process of using the distilled water generated by the air conditioners in a sustainable way in saving the consumption of 80 liters of distilled water, which is consumed in a semester in the development of chemistry laboratory practices.

Finally, all this must be achieved with a minimum possible expenditure in the consumption of distilled water, in the performance of laboratory experiments. The raw materials of the chemical processes must be renewable and economically viable resources, especially if a total of 180 students are attended per semester distributed in a total of twelve teams per group.

Distilled water and its importance

It is one that like all types of water is composed of two hydrogen atoms and one oxygen, whose molecule is represented chemically by the formula H2O and through the process of distillation have been removed impurities and ions.

Distillation is used to purify water for a long time, in this process dissolved pollutants such as dissolved salts remain in the tank where the water boils, while the impurities free water vapor rises out.

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The process to distill the water is based on the elimination of the various components that are in the water, for it is necessary to submit to water, to various processes that include condensation and vaporization, to be able to carry out said procedure, it is need to have a distiller at hand, this tool is not so easy to obtain, since it is not a very common article without mentioning the fact that its cost is quite high, however there are much simpler and cheaper alternatives to achieve debugging water, although these methods do not guarantee 100% purity.(Brown LeMay Burnsten. 2014)

Types of distilled water as Chemical reagent It is the water used in laboratories to prepare solutions, mixtures, patterns, etc.

- Deionized water-deionized
- Bidistilled water
- Water chemically pure reactive grade
- Tri-distilled water

The natural process of the water cycle creates by itself distilled water when it is condensed in the atmosphere the rainwater is much softer than others in its natural state. Currently there are several ways to obtain it through renewable energy following the culture of saving the consumption of electricity, as is the case of the use of solar energy for distillation of water these devices are known as solar distillers and use the sun as energy for water evaporation. (Ecured 2018)

Distilled water

Distilled water is free of minerals, metals, poisons, etc. As it carries absolutely nothing, it has a very large mineral absorption capacity.

Condensed water air conditioners

The air conditioners, when they are working, generate a large amount of water due to the condensation effect. Instead of discarding this water, one option is to reuse it for different uses and thus, make the most of this type of condensate.

Water has become a scarce resource in some parts of the country and the world, it is important that we are aware not to waste or throw large quantities of this vital liquid.

But, you have to suggest how you can collect this water, put a hose or pipe the valve by which the device throws the excess liquid put a container underneath where we will accumulate a large amount of water for use in the chemistry laboratory, another of our water suppliers is the electromechanical engineering workshop.

How an air conditioner works

An air conditioning system does not generate cold air, but extracts the heat from the air of the room that you want to air condition, how a refrigeration circuit works to extract heat from the air of a home or a classroom, laboratory, shopping center, etc.

Components that form an air conditioning system

Evaporator

The evaporator, where the process of extracting the hot air occurs, which gives its heat to the refrigerant gas, a fan distributes the flow of refrigerated air to the room. The Split system has temperature sensors connected to the thermostat.

Expansion valve

The expansion valve releases the refrigerant gas from the pressure, which passes through it from the liquid to the gaseous state when it passes through.

Condenser

The condenser and the compressor where the refrigerant gas passes from gas to liquid, in unit the hot air (from the heat it has absorbed) is expelled from the inside to the outside.

Compressor

It generates a force by compressing the gas that comes from the evaporator in a gaseous state. This pressure increases the temperature of the gas that returns to its liquid state and heats up. The compressor is one of the most important parts of the cycle and the one that consumes the most energy. The working speed of the compressor will depend on the signal sent by the temperature sensor.

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Refrigerant gas

Synthetics: halocarbonated fluids such as CFC, HCFC and HFC

Non-synthetic: hydrocarbons, carbon dioxide, ammonia, water, air (also called natural refrigerants).

The refrigeration cycle uses a refrigerant gas to which the excess temperature is transferred, when circulating it at a temperature lower than that of the refrigerated space. The refrigerant gases contain Hydrofluorocarbons HFC refrigerants consist of hydrogen, fluorine and carbon that can be contaminants to the atmosphere, although today there are refrigerant gases with a very low level of PCA or "polluting power". CFCs and HCFCs do not contain chlorine, and therefore do not harm the ozone layer. However, due to their long period of life, they are ecologically acceptable refrigerants but with a high GWP (Global Warming Potential) value.

While the refrigerant is circulating inside the evaporator, the hot air inside the house is passing through the evaporator because of the work done by the fans. The refrigerant absorbs at this point the heat of the air, which leaves the Split much colder.

Yunus Cengel, Michael Boles (...) in this process, the refrigerant, now already in gaseous state and warmer (it has absorbed the heat from the air), goes back to the compressor where the cycle will be fulfilled again.

While this process is working, the temperature inside the house, although the relative humidity increases until reaching the dew point in which the water vapor becomes liquid that is accumulated in the base of the evaporator. That is why the Split must have a drain to expel these condensed droplets or vapors.

In air conditioning systems they condense approximately seven liters of water every day; Potentially potable water that is wasted. (www.acrlatinoamerica.com). Approximately 10 to 20 liters of water are generated daily from condensed air in the chemistry laboratory, generated daily (see figure 1), which remain on all day and the reagents need a suitable climate so that humidity does not affect its quality.

Figure 1 Water collection system of the chemistry laboratory
Source: Own Elaboration

This type water that is not susceptible to human consumption, but can be used for domestic chores, the PH is very acidic 5. 8, the use has already been mentioned that it can be given to the water is for housework such as grooming, washing, water the plants, but it can not be ingested, because it contains bacteria, but it is not harmful since the relative unit of the air when hitting the coil causes the water vapor to lower its temperature and condense.

One of the first things that air conditioners do with the air they take is to extract moisture through evaporation coils, which attract water vapor to condense inside the device. The moisture is then evacuated by means of drainage pipes. If the condensation appears on the outside of the appliance, it is probably due to the large temperature difference between some of its components.

Water quality parameters

In the process of characterization of the quality of a water sample, the parameters such as acidity, alkalinity, and hardness are of utmost relevance, since they allow to know possible characteristics of the origin of that sample, as well as the possible contamination by diverse ions that are aggregates in excess to the bodies of water where the sample has been taken.

Hardness: It is called water hardness to the concentration of mineral compounds in a certain amount of water, in particular magnesium and calcium salts. Water commonly referred to as "hard" has a high concentration of these salts and "soft" water contains them in very small quantities.

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Water hardness is normally expressed as an equivalent amount of calcium carbonate (although this salt itself is not found in water) and is calculated, generically, from the sum of the existing calcium and magnesium concentrations (milligrams) per each liter of water; which can be expressed in $CaCO_3$ concentration.

Acidity: Acidity is the quality of an acid. Acid solutions may have characteristics such as sour taste, hydrogen release, or pH less than 7 (at 25ºC).

Alkalinity: The basicity or alkalinity is the neutralizing acid capacity of a chemical in aqueous solution. This alkalinity of a substance is expressed in base equivalents per liter or its equivalent of calcium carbonate.

pH: The electrometric method is based on the measurement of the electromotive force of an electrochemical cell, which consists of the sample, a glass electrode and a reference electrode. A standard deviation of ΔpH = 0.05 or less can be obtained by this method. If the sample is low in ionic strength, ie less than 5 mS / m electrolytic conductivity, special analysis equipment and procedures are necessary.

Conductivity: The electrolytic conductivity is a numerical expression of the capacity of a solution to transport an electric current. This capacity depends on the presence of ions, their total concentration, their mobility, valence and relative concentrations, as well as the temperature.

The determination of conductivity is of great importance because it gives an idea of the degree of mineralization of natural, potable, residual water, treated waste, process or water to be used in the laboratory in routine analysis or for research. The conductivity value is a parameter regulated by maximum permissible limits in discharges of wastewater to the sewage system or to receiving bodies, it is also a parameter of water quality for agricultural uses and activities, for primary contact and for human consumption.

Temperature: so it is necessary to measure the temperature as an indicator of the presence of compounds and contaminants, through the test method established in this Mexican regulation.

The temperature value is a criterion of water quality for the protection of aquatic life and for sources of drinking water supply, it is also a parameter established as the maximum limit allowed in wastewater discharges and a specification of importance in the calculations of energy and heat balance of industrial processes. For the application of this Mexican standard it is essential to have a measuring instrument with demonstrable traceability to the international system of units.

Nitrates: Nitrate is an essential nutrient for many photosynthetic autotrophs, and in some cases has been identified as the determinant of the growth of these.

A high concentration of nitrates is a sign of a greater stage of mineralization of nitrogen compounds. In the waters of some wells, appreciable amounts of nitrates are usually found, which is objectionable from the sanitary point of view.

For C. Zetina-Moguel (2018) the cost of distilled water from air conditioning equipment is an externality that derives from the comfort acquired by decreasing temperature and humidity in indoor environments. If we take advantage of the quantity of byproduct, it will not allow us to not have to buy large quantities of distilled water, which would only be acquired where more rigorous experimental tests are carried out and of a research nature. At the same time, the use of air conditioners inside the houses and enclosures increased; replacing the fans in some homes by excessive heat. Although the costs of this artificial comfort are high and are not accessible to the majority of the population, offices and public buildings as well as hospitals and schools, squares have been mostly equipped with artificial cooling equipment.

The classrooms of the educational establishments in the different levels have not been alien to this tendency and at present ventilators and air conditioning equipment are used in almost all the closed spaces of the Technological Institute. The air conditioning equipment are environmental cooling systems that mostly produce condensation of water from the environment. Virtually this by-product of waste disposal of the spaces is not used and is poured outside the rooms causing the walls to be stained by runoff, producing fungi and visual pollution, it can be used to keep the grass moist although it is a water lack of nutrients.

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Methodology

Description of the method

The sampling of the conditioned air of the air conditioning was carried out in the chemistry laboratory and the Electromechanical Engineering Workshop, water sampling of the keys of the tables, comparisons with the samples, drinking water that was taken from the chemical and water laboratory. Characterization of physical and some chemical parameters of the water that drain from the air conditioners of the laboratories, and of the distilled water that is acquired from the supplier of chemical substances. The analytical methodology used included the techniques of:

SAMPLING

The sampling is carried out in accordance with the NMX-AA-3 "Wastewater-Sampling" and NMX-AA-14 "Receptor Bodies. Sampling", as the case may be. Physical characterization of the water quality of the samples was made from the organoleptic parameters, temperature, electrical conductivity, salinity, total dissolved solids, pH. A sample was taken in the water outlet pipe of the air conditioning of the chemistry laboratory, Workshop of Electromechanics of the IT Cancún, it was classified as indicated below in table No. 1

Sample	Place	Milliliters	Observations
A	Water from the air conditioning condensate collected inside the chemistry laboratory	1000 ml	Taken from the existing drainage drum by simple transfer.
B	Water from the air conditioning condensate collected outside the chemistry laboratory	1000 ml	Water collected during a period of approximately one day
C	Water from the condensate of the electromechanical laboratory; collected from the key connected to a storage tank.	1000 ml	Water taken directly from the outlet valve of the tank or tank that collects the condensed water from the cooling system of the electromechanical laboratory
D	Water coming from the basin tap of the water chemistry laboratory	1000 ml	Water from the key of the chemistry lab tables. For water comparison with respect to condensate water

Table 1 Description of the samples
Source: Own Elaboration

In each semester the careers of Electromechanical Engineering, Computational Systems, Civil, Mechatronics, are made a total of 6 laboratory practices according to the chemistry program, serving a total of students per career of 57 students, each group is very peculiar form teams between 10 and 14. The assembly of each practice is the preparation of solutions at different concentrations and volumes, as indicated in table number 2.

Engineering Careers	No. of Students	No. Practices	No. of equipment	Milliliters of water used in washing laboratory equipment approximately per equipment	Shift	Milliliters used for each practice at different molar concentrations
Electromechanics	60	5	10	5000 ml.	morning	5000 ml
Electromechanics	50	5	10	5000 ml.	evening	5000 ml
Mechatronics	59	5	12	5000 ml.	morning	5000ml
Civil	60	5	14	5000 ml	morning	5000 ml
Computer systems	49	5	10	5000 ml	morning	5000ml

Table 2 Assembly of Experiments period August december 2017
Source: Own Elaboration

According to the previous table, an approximate of 65 to 100 liters of water per semester is consumed, including other subjects that will be carried out in the laboratory, as well as the practices of the students of the Master of Environmental Sciences.

The collection of condensate water from air conditioners per day is approximately 15 to 20 liters depending on the humidity conditions in the environment. (See figure 2 and 3)

Figure 2 condensate water collection systems air conditioning chemical laboratory
Source: Own Elaboration

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Figure 3 condensate water collection systems air conditioning electromechanical workshop
Source: Own Elaboration

It seems that we see it normal to have to have a gutter falling from our air conditioning to the ground and under it a bottle that we have to change every time it is filling.

Physical Parameters

The measurement and analysis of the physical parameters, the methodologies established in the standards and the equipment in existence in the laboratory were used.

A OAKTON Brand conductivity and pH meter, PC 700 (pH / mV / Conductivity / ºC / ºF) Bench Meter - Eutech Instruments was used. With the same equipment the reading of total dissolved solids and salinity was taken.

The meter, for the moment of the practice, had two electrodes, one for conductivity and another for pH with a temperature sensor. The methodology for each parameter was followed according to Mexican water standards.

NMX-AA-008-SCFI-2011 - Determination of pH - test method

NMX-AA-093-SCFI-2000- Determination of electrolytic conductivity - test method

NMX-AA-007-SCFI-2013 - Measurement of temperature in natural, residual and treated wastewater - test method.

Chemical Parameter

Determination of hardness, total alkalinity and total acidity in water samples according to the Procedure that marks these standards for water samples from air conditioner condensates.

Nitrate in water by UV Mexican Standard NMX-AA-82-1986. Water pollution_ Nitrate nitrogen determination_ Ultraviolet spectrophotometric method. DOF. 1992. A spectrophotometer of the Shimadzu brand was used, Model UV-1800.

Condensed water flows were estimated using field gauges (water measurement NMX-AA-072-SCFI-2001, which establishes the test method for the determination of total hardness in natural, treated residuals and residual waters, Mexican Standard NMX-AA -036-SCFI-2001. Water analysis Determination of acidity and alkalinity in Natural, Residual and Wastewater treated. Test method we follow the same by flask and stopwatch) in volume / time. The readings were made in the mornings before starting activities and at the end of the daily routine of work, during a continuous period of 4 months, it was also used in the rinsing of the laboratory material used to prepare analytical solutions, (see figure 4)

Figure 4 sample taking of condensed water from air conditioning
Source: Own Elaboration

Preparation of solutions for chemistry experiments

Table No. 3 indicates the solutions prepared per experiment, and the number of equipment per group and the distilled water that is used in addition to the preparation of solutions and solutions.

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Name of the practice	Solutions	Required milliliters	Average number of teams per group
Chemical reactions	NaCl (table salt) lead nitrate II, 0.05M Concentrated sulfuric acid, 2M HCl Vinegar, acetic acid: CH3COOH Magnesium tape: Mg 0.5M potassium iodide sodium bicarbonate: NaHCO3 **Distilled water**	**Approximately 5 liters per group** **5 liters**	
Electrochemistry	Granulated Zn 5% NaOH solution $ZnSO_4$ solution KCl solution $CuSO_4$ Copper Sulfate Solution $AgNO_3$ Silver Nitrate Solution **Distilled water**	Approximately 5 liters per group Approximately 5 liters per group	**10**
Periodic Properties	Distilled water Sodium hydroxide 6M Hydrochloric acid 1: 1 Universal indicator Li, Na, K, Ma, Ca, P, S Dry ice Oxides of chromium (III), zinc, copper (II), iron (III), silicon, nickel and aluminum **Distilled water**	**Approximately 5 liters per group** **5 liters**	**10**
Volumetry and gravimetry	**Hardness Alkalinity Acidity Nitrates**	**15 liters**	

Table 3 laboratory practices consumption of distilled water
Source: Own Elaboration

The air conditioners produce a continuous supply of water when they are in operation, the devices have the capacity to drain the water, which is used in the chemistry laboratory as an economical and sustainable saving in the experimental development proposed in the practices laboratory of the subject of chemistry for engineering careers taught by the Technological Institute of Cancun. (See figure 5)

Figure 5 standard preparations for determination of NO3 and Cobalt by the UV method
Source: Own Elaboration

Results

The results of the analysis of the physical parameters of the samples are presented.

Sample	Temperature °C	CE (µS)	pH (ua)
A (interior of the chemistry laboratory)	19.7	10.83	8.52
B (outside of the chemistry lab)	19.7	22.3	8.3
C (from the electromechanical laboratory)	19.7	16.32	8.07
D (lavabo del laboratorio de química del agua)	19.7	766	7.53

Table 4 Results of the measurement of physical parameters
Source: Own Elaboration

Determination of Acidity and Alkalinity

Initially the titration of the titrants was carried out, considering the real grams titrated in a 10 ml aliquot, in order to perform the calculations of the concentration in units of equivalents per liter, we considered the grams titrated in the 10 ml aliquot, correcting in this sense any error that may exist in terms of weighing and / or preparation of solutions. Thus, the equations described below were used:

For the acid: considering 53 grams per equivalent of sodium carbonate (Na_2CO_3):

$$N_{HCl} = \frac{gr Na_2CO_3 \; x \; 1000}{ml.\, HCl \; tilizado \; x \; 53}$$

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For the base: considering 204.2 grams per equivalent of potassium hydrogen biphthalate ($C_8H_5O_4K$):

$$N_{NaOH} = \frac{grC_8H_5O_4K\ x\ 1000}{ml.NaOH\ tilizado\ x\ 204.2}$$

The results obtained from solutions prepared with water from air conditioning.

Title Solution	Normality (N)	Titled	Titled mass (g±0.0001)	Vol titulante (ml±0.1)	Titled titling concentration (N)
Hydrochloric acid	0.020	Sodium carbonate	0.0006	4.1	0.003
Hydroxide Sodium	0.02	Potassium bicarbonate acid	0.0042	10.1	0.002

Table 5 Calculation of the normality of the titulants to be used in determining acidity and alkalinity
Source: Own Elaboration

Results of concentration of acidity and alkalinity obtained for the different sample of water a practice of volumetry and gravimetry.

SAMPLE VOL.	Sample (ml)	Total Alkalinity mg/L CaCO3	HCl (ml±0.1)
A	10	3.26	0.2
B	10	2.80	0.2
C	10	2.80	0.2
D	10	26.09	1.9

Table 6 sample preparation for alkalinity determination
Source: Own Elaboration

Results of acidity and alkalinity concentration obtained for the different samples (see figure 6)

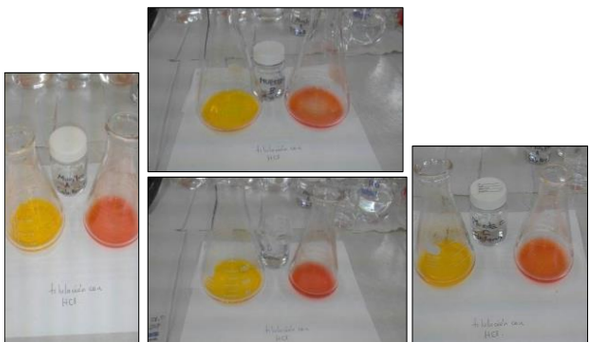

Figure 6 Methyl orange turn alkalinity determination
Source: Own Elaboration

From the results obtained, it is generally observed that the samples are more alkaline than acidic, mainly the sample D coming from the basin of the water chemistry laboratory, this result being consistent with the values of hardness obtained, where the sample D is definitely more hard, that is to say it contains more salts, and these salts are those that possibly contribute grade of alkalinity to the sample.

Acid base titration was tested for the determination of acidity, using different indicators, it is worth mentioning that the use of the indicator is important to locate the end point with greater or lesser precision, besides that the volumes in this case were small, resulting in more advisable the indicator of range of turn, ends that is to say, phenolphthalein that turns from acid to base and not inside ph acids like the orange of methyl. (See figure 7)

Figure 7 preparations of solutions with condensate water from air conditioners
Source: Own Elaboration

Determination of hardness

Calcium carbonate was evaluated, using the EDTA solution, to obtain the F factor from the following equation:

$$F = \frac{mg\ de\ solución\ de\ CaCO3}{2ml\ de\ EDTA\ utilzados}$$

We proceeded to titrate 25 milliliters of each sample, with the volume of EDTA used and the factor discussed in the previous point we proceeded to perform the calculation of total hardness with the equation shown below:

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$$Dureza\ Total \frac{mg}{L} CaCO3 = \frac{Vol.EDTA * F * 1000}{Vol.Muestra}$$

Where F is the factor that represents the equivalent in mg of CaCO3 per ml of EDTA. The results obtained are shown in figure 7 and table 7.

Sample Vol.	Sample (ml)	NaOH (ml±0.1)	total acidity mg/L CaCO3
A	10	0.3	3.4
B	10	0.1	1.0
C	10	0.1	1.3
D	15	0.0	0.0

Table 7 Preparation of the sample for the determination of the Acidity test With phenolphthalein (from colorless to red wine)
Source: Own Elaboration

Figure 7 hardness determinations
Source: Own Elaboration

As expected, the condensate samples from the air conditioners did not have high hardness values, the variations of the data fall within the margin of error since, when propagating these, the error occurs in the order of ± 0.01 mg / L in terms of CaCO3, so you could say that the water in these samples are not hard.

In the case of water from the basin of the water chemistry laboratory (sample D), a value of 0.90 ± 0.01 is obtained in terms of mg / L of CaCO3, thus noting that this water is harder than the others, due, possibly at the origin by virtue of the different salts contained in the well from which it is extracted or dragged through tanks and or pipes. A spectrophotometer of the brand Shimadzu, Mod elo UV-1800 was used (see figure 8).

Figure 8 Shimadu UV-183 spectrophotometer
Source: Own Elaboration

Determination of nitrate nitrate in water simples

Based on the provisions of standard NOM-AA-082-1986, solutions were prepared as shown in table 8, for the calibration curve, and measurement at 220 nm.

ID	Pattern	concentration concentration ppm	Concentration (M) 0 Mother Solution	Concentration µg N-NO3/cm3
Solution to fix HCl	4.15ml HCl concentrated in 50ml distilled water	-------	IN	-----
Mother KNO3 solution	192.1mg in 250m	768.4		1061
KNO 3 Standard Solution 0	50ml of mother in 500ml	76.8	0.01	0.6
		76.8	0.006	0.6
Pattern 1 of KNO3 Pattern 2 of KNO3	0.5ml mother in 25ml	1.5 0. 2	0	0.21 2
	1.5 ml mother in 25ml			
	3.5 ml mother in 25ml	14.6	0.00005	0.64
Patrón 3 de KNO_3	5ml mother in 25ml	10.76	0.0001	1.49
Patrón 4 de KNO_3	.5ml mother in 25ml	15.37	0.0002	2.13 5
Patrón 5 de KNO3 Patrón 6 de KNO_3	10ml mother in 25ml	723.05	0.0002	3.196
		30.74	0.0003	4.26

Table 8 preparation of standards for NO3 by the UV method
Source: Own Elaboration

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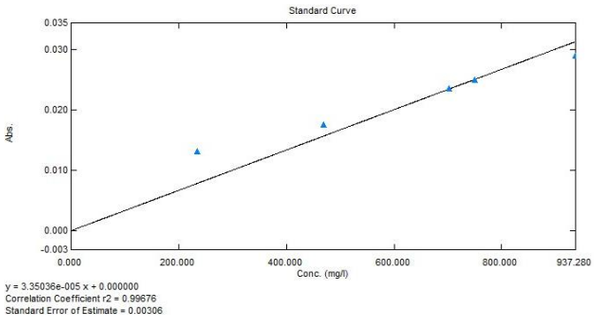
The absorbance reading of each of the standard solutions was performed, and with the software of the equipment a calibration curve was obtained with intercession adjusted to zero on the abscissa axis. In graph 1, the calibration curve obtained at 220 nm is shown



Graphic 1 *Calibration curve of NO_3 standards*
Source: Own Elaboration

Results of concentration of N-NO3 in µg / cm3 in samples at 220 nm

Sample Table

	Sample ID	Type	Ex	Conc	WL220.0
1	A	Unknown		0.051	0.016
2	B	Unknown		-0.014	-0.004
3	C	Unknown		0.318	0.099
4	D (tuberia lab procesos)	Unknown		1.047	0.327

Table 8 Results obtained from the N-NO_3 readings, at 220 nm the samples by the UV method
Source: Own Elaboration

It was expected that the condensate samples from the air conditioners do not present a nitrogen-nitrate concentration, however three of the three samples present nitrates, this is possible if the water drains salts and / or minerals present in the pipes through the which is downloaded. In the case of sample B, which is condensed water from the air conditioning taken outside the laboratory, at the outlet of the pipe where this sample was taken (see figure 9), presence of algae was observed, in this sense it is even possible that the nitrate of having been used as a nutrient by the plants present.

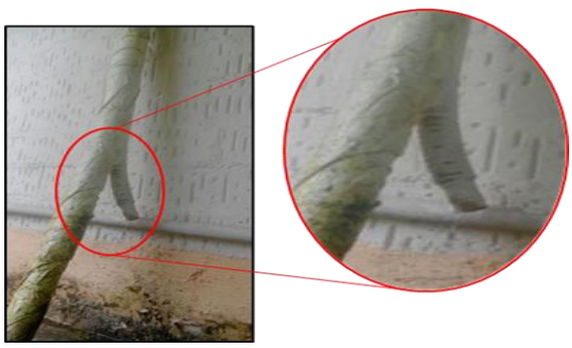


Figure 9 probable contamination of the sample
Source: Own Elaboration

In the case of sample D, a concentration was obtained that was much higher than the 0 value, which was expected considering that the sample was taken from a pipeline, from which it is presumed that the sample is usually stored for a time, as well as water possibly coming from well, which usually contains salts such as nitrates.

From the practices of chemical periodicity, chemical reactions, oxidation-reduction reactions, electrochemistry, silvery electroplating of an object, there was no interference that altered the process, (see figure 10).

Figure 10 Electro plated silver nitrate solution
Source: Own Elaboration

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Conclusions

The degree of alkalinity, acidity and / or hardness of a water sample can allow us to establish coherence with the origin of this, and even possibility of contamination by external elements that should not be present and that affect these characteristics in the samples.

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Therefore, knowing the standards - methods that govern the determination of these parameters is very useful in the environmental analysis of water samples, and with it the appropriate assessment of the substances used to eliminate possible systematic errors committed in the weighing or other, as well as the selection of indicators on which we can rely with confidence to locate the end point of the degrees involved.

Sampling is a determining phase in the process of environmental analysis of a sample, so special care must be taken in following the appropriate protocols for that purpose. All sample taming must be designed prior to the analysis in order to have clarity of the study objectives and the ways of conservation of the sample.

From the samples of water taken, it was expected to have pH towards the acidity and low conductivities for the samples of the air conditioners, this by virtue of being practically distilled water, nevertheless the obtained basic pH could be due to salts and / or ions dragged from the pipes of such equipment; In this regard, it is expected that as long as the equipment receives periodic maintenance services and replaces hoses and / or pipes, the water could have characteristics closer to that of the distilled water.

In the case of sample D, water from a sink, it is definitely observed through the electrical conductivity, which has a higher quantity of dissolved ions, either by treatments subsequent to the well extraction process or by the intrinsic characteristics of the well water.

UV-Visible spectroscopy is a very useful technique for the characterization of water, which is directly dependent on the objective of a research and the elements or chromophores that are to be detected.

The condensate water from air conditioners is possibly contaminated with nitrates during the passage through the pipes.

When the silver nitrate solution is prepared and the water does not have the required properties, the solution acquires a whitish hue indicating that the water contained minerals or the presence of chlorides. Turning black, interfering with the reactions.

The use of condensed water from air conditioners is a type of water suitable for use in academic laboratories that do not require a 99.999% purity quality, to perform the experiments, it is also free and does not generate an additional cost to perform the tests chemistry lab practices, the cost of a 20-liter jug has a cost of 210 pesos, the Tri-distilled water used in special analyzes 20-liter drum has a cost of $ 235. (see table No. 9)

Type of water	Water generated	Water costs	Amount of water in ml consumed Per semester	Savings in distilled water consumption.
Distilled	We do not have a distiller	215 x 20 liter jug	100 liters	100%
Condensate of the air	Water generated per day 20 liters	Free of charge	Water generated contributes the necessary amount for the supply of water	

Table 9 reduction of costs in the consumption of distilled water
Source: Own Elaboration

The uses that are given to the condensed water of the air conditioners are washing floors, bathrooms, water for the plates, the engineers of the electromechanical laboratory, use it in the radiator of their car. The environmental impact would be in saving the consumption of distilled water and energy when the institution has a distillation system, in addition to having an impact on the educational environment, which could be used in basic and basic education laboratories.

The characterization of the physical parameters was based on some chemical parameters according to the Mexican water standards, some of them are from 1986, 1991, they are still valid, for the analysis of water quality according to the official newspaper of the federation there have been modifications to those standards.

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