ANTI-LIME CLEANING LIQUID AND OUR SKIN

Marta lives in a town where fresh water is hard[1]..One of the problems of having hard water at home is that some calcium carbonate incrustations appear in places in contact with water. For example Marta's shower has incrustations of calcium carbonate and it has to be cleaned periodically to prevent that it becomes useless. In previous occasions Marta has tried to clean incrustations with three different substances: "Salfuhant" (a commercial cleaning product that contains hydrochloric acid 3.7 g/L), home vinegar and fresh lemon juice. All three substances could remove the incrustations in her shower, but all three deteriorated Marta's skin. Anti-lime cleaning liquids are acidic solutions, but many of them can damage our skin, accustomed to the acidity of human sweat (pH = 5,5) due to the fact that their pH is different. Marta would like to know if is it possible to change the pH of these anti-lime products so that they don't damage her skin.

In this activity you will help Marta. Your task is to investigate if it is possible to change the pH of the cleaners that she has used into pH 5.5, the one of human sweat.

[1] Hard water contains lime, that is calcium oxide that in water forms calcium hydroxide; but when calcium hydroxide contacts carbon dioxide from the air, the solid calcium carbonate is formed Incrustations are mainly formed by calcium carbonate

To help Marta you will:

- Measure the pH of several substances using both universal indicator and pH sensors and MBL equipment. (optional)
- Propose research questions and decide which data do you need obtaining to answer them.
- Design and perform experiments.
- Evaluate your results.
- Draw conclusions from your results
- Share your results with other students' conclusions, discuss them with all group to find the best conclusions.

Write Marta a short letter informing her on if she can change the pH of the cleaner liquids and how to proceed, and explaining your opinion on which liquid-cleaner would you choose to do so.

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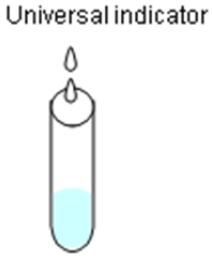
Measuring acidity in the laboratory (optional)

The pH is a magnitude that measures the degree of acidity or of basicity. In aqueous solutions, pH = -log $[H_3O^+]$. The pH varies slightly with temperature: at 25 ºC a solution of pH = 7 is neutral, an acid solution has a pH < 7 and a basic solution has a pH > 7. pH can be measured qualitatively using pH indicators (eg: phenolphthalein, methyl orange, universal indicator) that change its color depending on the pH value, and quantitatively using devices as a pH meter of a pH sensor connected to a microcomputer based laboratory equipment. This last methodology allows studying temporal variations of pH. You have distilled water and several solutions. Measure the pH of each liquid using both universal indicator and pH sensor.

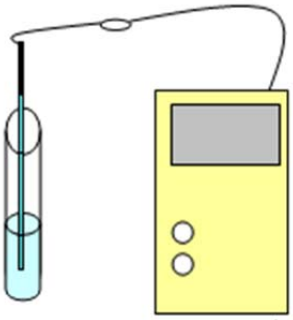


Methodology: using universal indicator

- Pour a few mL of each liquid in separates test tubes
- Add one or two drops of universal indicator to each tube
- Observe the change of color, compare it with the scale of color of the indicator, and deduce its pH.

Methodology: using pH sensor and MBL equipment

- Pour a few mL of each liquid in separate test tubes
- If necessary calibrate pH sensors
- Configure adequately your MBL equipment to measure pH
- Introduce pH electrode in each test tube, and measure until pH sensor is stabilized (in can take more than half a minute). Write the result obtained.
- Rinse adequately the electrode before being introduced in a new liquid.



Results

	Universal indicator		pH sensor	Conclusion: Acid/base/neutral
	Colour	pH		

Evaluating results

a) Compare the measures obtained with the universal indicator and with pH sensor, in what are they similar?

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b) In what do they differ? .....

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.....

c) Observe the results you have obtained for acids: what can you say about their concentrations.....what can you say about their pH.....

d) Do acids with the same concentration have the same pH? .....

e) How can you explain it?.....
.....
.....

f) Marta has used the commercial cleaner "Salfuhant", explain if any of the measured solutions can be used as it for our purposes?.....
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g) The main acid in vinegar is acetic acid. Taking into account your results, explain if the concentration of acetic acid in vinegar is higher, lower or similar to the solution measured
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Helping Marta: Modeling the situation in the laboratory

Your task in this activity is to investigate if it is possible to change the pH of the cleaners that she has used into pH 5.5, the one of human sweat.

Fill in the table; it will help you to model the problem

CLEANER	Chemical composition	You will use
"Salfuhant"		
Vinegar		
Fresh lemon juice		

Formulating suitable research questions

- Choose one cleaner .....
- Write a suitable research question that can help Marta to solve her problem

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Which data do we need to measure?

a) Do you have to increase or to decrease the pH of the cleaner you have chosen? .....

b) What can you do to increase/decrease (underline the correct option) the pH?
.....
.....

Compare your proposals with other students, divide your tasks:

c) Choose one of the actions in b) .....

d) Which experiments will you perform according to b) and c) to know if you can change the pH of the liquid? (draw a picture and write a short description of it)

e) What data will you measure and how? .....
.....
.....

f) Which are the variables in your experiment? .....

g) How will you measure them? .....
.....

h) Are there other variables that can affect the result of your experiment? .....
.....

i) What will you do to avoid its effects in the results obtained? .....
.....

Preparing the experiment

Prepare all glassware and products, configure the MBL equipment

Prediction: write your predictions about the results you will obtain, draw a graph if necessary:

.....
.....

Performing the experiment

Before you perform the experiment, prepare a table (or the axes for the graph) to write the results obtained.

Evaluating results

a) Which way of measuring pH is more precise?

b) Evaluate the data that you have obtained and compare them with your predictions
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.....
.....

c) Conclusions of your experiment: .....
.....
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Explain in a plenary session your results and conclusions. Find collaborative conclusions with the results of all groups.

General conclusions .....

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Helping Marta: Communicating results (homework exercise)

Write Marta a short letter informing her on if she can change the pH of the cleaner liquids and how to proceed, and explaining your opinion on which liquid-cleaner would you choose to do so.