USE OF WATER CATHOLYTES TO REDUCE ENVIRONMENTAL LOAD

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Summary. For washing use substances that give water “alkaline” properties and definitely increase the pH and reduce the surface tension, specifically they increase the extraction of pollutants from tissues. Surfactants in these solutions, which enter the environment after washing, promote the growth of blue-green algae. This leads to decrease in oxygen in water, which is necessary for aquatic organisms (fish, amphibians, etc.). We propose to find methods and devices that reduce the use of surfactants for washing by attracting catholytes instead of ordinary water.

Keywords: water catholytes, spectroscopy, herbal substances

Introduction

Electrolysis is the process of the water decomposition at electrodes when an electric field is applied. In this process oxidation takes place near anode generating hydrogen ions (H⁺) and oxygen (O₂), and reduction takes place near cathode generating and hydroxyl ions (OH⁻) and hydrogen (H₂).

The process of electrolysis causes changing in the soil pH near the electrodes. The region near anode develops a low pH of about 2 whereas near the cathode it increases up to 11 or 12. The hydrogen and hydroxyl ions move both due to electromigration and diffusion. The hydrogen ions being smaller than the hydroxyl ions tend to travel faster leading to rapid acid front migration than the base front migration. The acid dissolves the usual cations in the soil or precipitates and helps cation removal. If the contaminants are anionic, the acid front would increase adsorption and reduce the contaminant removal. Both the acid and base front will influence the zeta potential of the soil impacting the flow [1].

Electrolysis technologies can be divided in two basic branches: alkaline liquid electrolyte (using potassium hydroxide (KOH)) and acid electrolyte with solid...
polymer as a proton-exchange membrane (PEM). In both technologies, water is fed into the reaction electrolyte and is subjected to an electric current that causes dissociation, after which the resulting hydrogen and oxygen atoms are put through an ionic transfer mechanism that causes the hydrogen and oxygen to accumulate in separate physical streams. Electrolysis of water is a combination of two half reactions as shown below for acid and alkaline electrolytes.

For washing often use substances that give water "alkaline" properties and definitely increase the pH and reduce the surface tension, specifically they increase the extraction of pollutants from tissues. Surfactants in these solutions, which enter the environment after washing, promote the growth of blue-green algae. This leads to decrease in oxygen in water, which is necessary for aquatic organisms (fish, amphibians, etc).

**Experimental part**

We use spectrophotometric methods to evaluate the effectiveness of washing. We measure the transmittance of water and cooked catholytes using an RGB spectrometer.

There can be two types of Catholytes: "Ordinary" catholyte has a pH greater than 7. ORP - less than 0, mV (up to " 900 mV) "Neutral" catholyte has a pH of 7. ORP - less than 0, mV (up to " 900 mV) To evaluate the efficiency of washing using spectrophotometric methods. We measured the transmission coefficients of light for solutions prepared in ordinary water and its catholyte using an RGB spectrometer. To do this, applied the same dyes on the same type of textile fabric. We prepare catholyte of various types and with different pH and ORP values. Then immersed the pre-painted tissue in a cuvette with ordinary water or in cuvettes with different catholyte for a certain time (about 30 minutes). After that, we took the fabric from the cuvette and measured the light transmission coefficient for the colored solution in the cuvette. It is possible to measure the reflection coefficient of the light from the colored fabric before and after washing by an RGB reflectometer (Fig.1). In this way, it is possible to compare the efficiency of washing in two ways: measuring the transmission of light after extraction of the dye in the solution, or measuring the reflection of light from the tissue before and after washing.
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Preparation of solvents:
1. 550 ml distilled water with a +232 mV ORP.
2. Magnesium Strip Water: Immerse a magnesium strip with a mass of 0.17 g, length 105 mm, width 4 mm, thickness 0.2 mm in 500 ml of water. From time to time we measure ORP and when it becomes -170 mV we remove the magnesium strip from the water.
3. Water with baking soda: add 0.89 g of baking soda to the water (550 ml) and dissolve it in water. ORP of +280 mV solution. Then, within 3 hours, we perform electrolysis using a device manufactured by our Patent of Ukraine. When the ORP becomes "+24" mV we stop electrolysis.
4. Water with detergent powder: add 1 g of detergent powder to water (100 ml), dissolve. ORP of +113 mV solution.

Apply the same dyes (black tea and hibiscus tea) to the same fabric type. Immerse the tissues in vessels with different solvents (50 ml each) for a certain time (approximately 30 minutes). We remove the pre-painted fabrics from the vessels. Fill in a rectangular glass cuvette 50 mm in length with the obtained solutions. We measure the transmittance of solutions using an RGB spectrometer. We put a cuvette in it and measure the transmission at three wavelengths. To do this, turn on the LEDs and register the signal at the output.

Preparation of water-based solutions for extraction from dry plants
1. Water - poorly mineralized water (settling, boiling and chilled water), 400 cm³ capacity with +232 mV ORP
2. Magnesium strip water - Immerse magnesium metal tape in 400 cm³ of water (prepared according to claim 1). From time to time we measure ORP and when it becomes "-170 mV" we remove the magnesium strip from the water.
3. Water with baking soda - up to 400 cm$^3$ of water (prepared according to claim 1) add 1 g of baking soda, dissolve in this water. Then, within 30 minutes, we perform electrolysis using a device manufactured by our Patent of Ukraine. When the ORP becomes “-60” mV we stop electrolysis.

To each vessel with the prepared solvents add 1 gram of dried crushed plants and leave for 10 hours. After 10 hours we select the extract and fill it with a rectangular glass cuvette with a length of 50 mm, place it in the spectrometer and measure the transmission at three wavelengths. To do this, turn on the LEDs and register the signal at the output. The obtained transmission coefficients are represented in Table 1.

### Table 1

| SOLVENT                        | COLORING     | TRANSMISSION, mV |
|--------------------------------|--------------|-----------------|
|                                |              | R    | G    | B    |
| **Water**                      | *Black tea*  | 0.898| 0.913| 0.636|
|                                | *Hibiscus tea*| 0.721| 0.631| 0.477|
| **Catholytes**  
( *water with baking soda*) | *Black tea*  | 1.298| 1.357| 0.993|
|                                | *Hibiscus tea*| 1.139| 1.257| 0.977|
| **Water+detergent**            | *Black tea*  | 1.152| 1.332| 0.944|
|                                | *Hibiscus tea*| 1.325| 1.647| 1.007|

Reactions between magnesium and water

\[
\text{Mg} + \text{H}_2\text{O} \rightarrow \text{MgO} + \text{H}_2 + 75 \text{ kcal}
\]  

(1)

releases hydrogen, decreases water redox.

The reaction of magnesium with water is also possible

\[
\text{Mg} + 2\text{H}_2\text{O} \rightarrow \text{Mg(OH)}_2 + \text{H}_2 + 80.5 \text{ kcal}
\]  

(2)

**Discussion**

Catholytes can be of two types:"Ordinary" catholyte has a pH greater than 7. ORP - less than 0 mV (up to 900 mV)"Neutral" catholyte has a pH of about 7. ORP - less than 0 mV (up to 900 mV)Use of water catholytes to reduce environmental impact on the environment. We use spectrophotometric methods to evaluate the effectiveness of washing. We measure the transmittance of water and cooked catholyte using an RGB spectrometer. Apply the same dyes to the same type of fabric. We prepare catholytes of different types and with different pH and ORP values. Immerse the tissues in a cuvette with plain water and a cuvette with different catholyte for some time (approximately 30 minutes). We take away pre-painted fabrics from a ditch. We measure the transmittance of solutions using an RGB spectrometer. In the future, it is possible to measure the reflection coefficient with
an RGB reflectometer (I have a patent on the Skin-meter, a meter of the reflection coefficient). Then it will be possible to measure the quality of the laundry with different detergents in another way.

**Fig. 2** The appearance of extracts of herbal substances in various water-based solvents

**Conclusion**

1. For washing use substances that give water "alkaline" properties, i.e. increase the pH, reduce surface tension. In general, increase the extraction of contaminants from tissues.

2. After washing, the residues of the cleaning solution are discharged into the environment.

3. Surfactants in these solutions promote the growth of blue-green algae. This leads to a decrease in oxygen in the water, which destroys the organisms that live in the water (fish, amphibians, etc.).

4. So it is important to find ways and devices that reduce the use of surfactants for washing by attracting instead of the ordinary water of its catholyte.
5. It is best to extract substances in neutral catholyte prepared by electrolysis in a cell without diaphragm. The neutral catholyte has as the same pH value as ordinary water (pH = 7.0...7.5), but the ORP values go towards negative values and can vary from “+ 250 mV” to “- 400 mV”.

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