ECTS

Group 18211

Electric Circuit treating system

Grade 11 Semester one 2020/2021 STEM KFS

Rahma Elsayed - Manar Elsaiedy – Rana Samir – Shaza Hany

Electroplating –deionization Process – Chemical Oxidation –Waste water - Electric circuits

Key words

Abstract

"Be the part of the solution, not part of pollution .We live in the time of deforestation and destruction to the soil, and water, the root of life, everywhere is overflowing with dirty stuff. And this is a huge problem facing Egypt at the moment. "
Indeed, water contamination is very harmful and has come for many reasons such as water sacristy and water overuse and waste which in future will result in water shortages.
The project focuses on one of the most curious, newest and sensitive sectors in Egypt, which is high in water use (the rate is about 100 L/day) but, water can't be treated because after finishing procedure it produces several toxins including Cynite (Factory of Military production for electronics in Banha)
The approach focuses primarily on the reuse of polluted water in the electronics industry for the unique processing of double side circuits in a wash with different electrical plating solutions
Function with water after passing the circuit with KMnO4 solution is a critical step in the elimination of this substance from the electroplating.
Water is initially processed in H2so4 as it functions as an appropriate medium for reaction after the feso4 solution is added, it reacts with KMnO4 and color disappears after a time but the percentage of TDS increases.
Then mix the calcium hydroxide with water (to minimize TDS) Boost the deionization phase of the PH to decrease rest TDS amount ,deionize the water through electro dialysis to be used in the same process, thus decrease water consumption and solving this problem.

Introduction

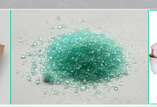
Egypt is facing many challenges that threaten the lives of its people, we can say the water crisis is the biggest one. Egypt's share of the Nile is 55, 5 billion cubic meters per annum, under a contract reached in 1959. Egypt's share has not improved, despite the growing number of Egyptians exceedingly almost 62 million, which means that the per capita water from the river has declined dramatically. Besides, as a result of chemical and agricultural activities, wastewater plants, and drainage, the water quality of the River Nile degraded. Because water is the main source of life, it's a real challenge to find a freshwater resource or we can simply reduce the amount of water used by factories to increase the amount of water for each person. projects have been applied to solve such problems, like Membrane Bioreactors (MBR) which are treatment processes, which integrate a perm-selective or semi-permeable membrane with a biological process. What makes MBR a good solution is its component, which is the eco-friendly membrane. Despite this advantage, the project is said to be disadvantageous for Egypt because of its high cost and the complexity of the membranes.
The textile dyeing industry is also one of the solutions, there's a factory in Belgium that uses a large amount of water and it exits saturated with colorants and citrus fruits and this water becomes unacceptable but this factory could use processes that helped him to reuse the water. They used Fe+2 to oxidize the solution to remove specific colors as we did.
All the prior solutions demonstrated above are good but they didn't apply the design requirements which are: first: the water quality, we have to improve the TDS amount allowing water to be reused, also the pH of the water has to be handled to be reusable. The second design requirement is either efficiency, environmental impact, or cost.
The solution is to clarify water from the electronics industry using a treatment system, which depends on removing the color of the water using FeSO4 and H2SO4 then improving the TDS amount in the water, as it is required to be deionized or with a little number of ions and the pH as well, we used Calcium hydroxide (Ca (OH)2) and electrodes to deionize the water thus lowering the TDS and ph. Our prototype is thought to be efficient because we got the best results as possible with the least amount of money, chemicals, and materials, also the way the prototype is working conserves energy as it doesn't require any electrical or mechanical appliances, but it depends more on the human factor allowing more people to work.

Materials

During working on the prototype, we needed some materials to construct it like:

Figure (2)
Acylric

Figure(3)
Wood



Figure(4)
Iron sulphate ($FeSO_4$)

Figure(5)
Taps

Figure(6)
Calcium hydroxide

Figure(F7)
Pump

Figure(8)
Sulfuric acid(H_2SO_4)

Figure(9)
Power supply

Figure(10)
Hose

Figure(11)
Guaze

Methods

Constructing prototype:
First of all , the body of prototype: it made from the wood & plywood, which carry all the prototype parts with thickness 4 mm and totally Height 55 cm and area of base (19*55) cm.
The boxes which simulate the treatment containers, are from Acrylic. Acrylic is used to avoid any chemical reaction with the material. They are about three boxes, first one carries the polluted water, second one is the place of chemical treatment and the third one is the place of the filtration and the deionization. Between the boxes, there are two taps to transfer the water from stage to another without wasting the water.
After the last step (the deionization), the water become acceptable to reuse again in the same process so pump and hose are used to transfer the clean water from the last step to t he first step which the same process occur again after the water is reused in the industry.

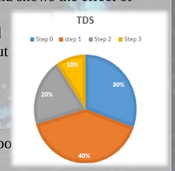
Methodology
Testing prototype occurs by using 1000mL of wasted water, 40ml is added firstly to make the solution acidic (because the waste water contains potassium permanganate and it is dissociate in acidic solution.
Then, 250ml of FeSO4 is added to oxidize the waste water then the color could be changed.
After changing the color, 25gram from the Lime (Ca (OH) 2) is added to deposit the dissolved solids and balance the PH.

Then this solution is poured with its precipitation by opening the tap to the cone that have gauze and sand for the filtration.
From the cone to the third box in the last stage deionization process has been done.
And using the water pump to raise the clean water to the industrial process to reuse it again.
Finally, the cleaner water becomes 6.5 PH and 1000 TDS after the treatment with law cost and creative process.

Test plane:
We choice two design requirements to walk on it to conduct
Our prototype and test plan:
The first one was water quality; we tested this condition by making water colorless after chemical reaction between the polluted water and sulfuric iron and sulfuric acid. And balance PH (6.5) and TDS (appox.1000ppm) by adding calcium hydroxide.
The second was prototype efficiency, we tested it by calculate the ratio between the efficiency of water before and after entering our prototype. And we find it has high efficiency according to color, PH and TDS of the final water.

Results

The prototype is about 3 steps and we cared about testing the sample of water after each step. From table (1), it shows the proportions of the PH and TDS after each step and shows the effect of water color after each step.
We use beaker to test the sample in it to know the volume and get accurate number and it helps us to test many times without waste the sample.
✓ At first we take 10 mL from waste water and its PH was (10.2) - its TDS was 7600 ppm - its color was violet.
✓ Then we put 0.4 from H2SO4 and 2.5 from FeSO4, the PH become too acidic, (1.33) and the TDS 10,000 ppm and it is too bad number but we could return the color to colorless water
✓ After that we put 0.3 g from the lime (Ca (OH) 2) and stirred the solution., The PH becomes 6.5 and TDS become 5000 and the color doesn't change
✓ Finally we use a simulation of deionization process to increase the efficiency of the project.



Trial Number	PH	TDS
First trail	6.3	2300
Second trial	6.7	2500
Third trial	6.4	2310
Average	6.5	2370

Test plan Trials

✓ In the final test of the prototype, we care about putting the same amount of chemicals and lime which we tested on it before to get the probability proportions of TDS and PH to know how much it will differ from trial to another. The PH wasn't changed much and it is close to the average PH so it is High precise and high accuracy. The TDS isn't precise enough as shown in the table (2) but because the value is bigger.

Analysis

- The current population of Egypt to date October 26, 2020, is102, 939,046. This phenomenon considered as one of the biggest problems facing Egypt as it cause many problems concerning water consumption as well as its pollution

As Technology is our future, Electronic industry depends on deionized water in washing the electric circuits and releasing it with some toxin so it can't be reused in the same industry.

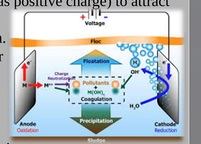
- The mission mainly is clarifying this water before being released and reusing it in the same process thus, reducing the amount of water used by the factory per year.

Before applying the solution and treatment processes, the factory used to consume 100 liter of water per day, but with project's results showed that the water enters the factory everyday can be reused for a week using the treatment plant, thus reducing the amount of water to be 100 liters per week instead of 700L per week.

- However the solution is efficient and could reduce the amount of used water but there is an issue with too much of using chemicals "it's not a very bad effect as it has low cost "but using natural materials is better
- Besides it help in water saving but it's a limiting step because it's used only "Electroplating" so innovate a way to work on the whole process and produce 100% clean water is encouraged
- The prototype is considered to be an efficient one because it show the best results as possible with the least amount of money, chemicals and materials, also the way the prototype is working conserves energy as it does not require many electrical or mechanical appliances, but it depends more on the human factor.
- Also it's testable as it was tested for its ability to work effectively and do its purpose which is clarifying the water and manipulating the amount of TDS and PH.

The prototype we did is safe to use with no risk emissions, it does not emit heat or electricity, so it has no negative effect in the using or the machines.

Scientific laws and theories
The idea of **deionization process** relies on the theory of the attraction between the positive and negative charges and the repulsion between the same charges (positive charge with positive charge) or (negative charge with negative charge) we studied the attraction and the repulsion between the charges in physics(2.02). Upon that we use cationic resins (has negative charge) and anion resins (has positive charge) to attract the charged dissolved metals and reduce the TDS.
Oxidation changes the color: upon this theory in chem. (2.01), we've used Fe+2 to oxidize the waste water color And make it color less and the easiest and efficient chemical to achieve this mission is the iron sulfate



PH equivalence point:
Reach the equivalence point is the main mission so we used "titration law "to determine which chemical destination we will use, base or acid to reach the equivalence point, $\frac{Molarity \times Volume(1)}{No.of\ moles} = \frac{Molarity \times Volume\ of\ titrant}{No.of\ moles}$
Ex, when the waste water becomes acidic, lime (chemical base) have been used to reduce the TDS instead of using chlorine (weak base).

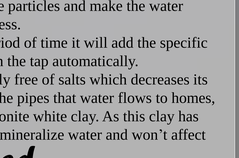
Number of step	Process	PH	TDS	Color
Step Zero	Before the treatment	10±0,2	7600±5 ppm	Violet
step 1	Adding chemicals	1.33±0.2	10.000±5 ppm	Colorless
Step 2	Adding the lime ($Ca(OH)_2$)	6.5±0.2	5000±5ppm	Colorless
Step 3	The Deionization	6.5±0.2	1000±5ppm	colorless

Wrong trials

Results :

- The 3 steps and we cared about testing the sample of water after each step. From table (1). it shows the proportions of the PH and TDS after each step and shows the effect of water color after each step.
- In the final test of the prototype, we care about putting the same amount of chemicals and lime which we tested on it before to get the probability proportions of TDS and PH to know how much it will differ from trial to another. The PH doesn't change much and it is close to the average PH so it is high precision and high accuracy.

❖ TDS isn't precise enough as shown in the table (2) but because the value is bigger.



wrong trials

- We used geological solution to reduce to treat the waste water. It was about layers. Layers of morenga, zeolite, sand, gravels. We used the morenga a pure plant which absorb the TDS and adapt the PH and it was really efficient but it changes the color to dark yellow and it had to being colorless.
- We tries to balance the PH buy using NaOH but it wasn't efficient because it raises the TDS.
- We use the chlorine to reduce the TDS but we deduce that it treats the biological pollutions and we was needed it for the TDS.

Conclusion

There is a difference between knowing something and hearing about it, just because you "heard" doesn't mean you "knew", so you must know our conclusion by estimating every single result so after collecting data and after trying many different solutions, we found that After we made the test plan and analyzed the results, we conclude that our project is effective and successful because it achieved the design requirements. It has a high permeability, low cost, suitable strength and it is saving a high amount of water. It is easy to apply in reality. Compared to other existing solutions our prototype is capable of save great amount of water for using it again in the electronic industry up to 600 Liter daily and this will help to solve the water shortage and pollution problem in Egypt.
Product of our prototype is a very large amounts of high purification water, and we could exploit there large amounts to in many things in short time. But the perfect usages for it is in the cycle again because it's important as the future depend on the newly updated technology and for reason it's consumption of water is high so we should focus on solving it

Recommendation

To improve our project and keep it more effective in the future, we recommend people who will complete our work, designers who will design it in the real life and any one will work in this project after us to:-
What we recommend for the future work in the Water pollution field: .
They should learn about the water treatment bases and the different water resources and contaminants.
They should learn about the whole cycle to produce electric cells
They should be co-operative with one another to make a good project.
If you need to start from the point that we stopped at:
Use batteries with higher power to get higher efficiency.
Use cationic and ionic resins to get the positive and negative particles and make the water deionized so it will be safer for the product and for the process.
Apply the idea of Sensors, to make a seclude and after a period of time it will add the specific chemicals for the process of treatment and to close and open the tap automatically.
As shown in the results that the produced water is completely free of salts which decreases its nutritious benefits, so in the future we will add a barrier in the pipes that water flows to homes, this barrier contains Pascaline clay which is: a calcium bentonite white clay. As this clay has many benefits one of its most important benefits is that can mineralize water and won't affect the flavor of your water.

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