

STUDY OF WATER PURIFIER THROUGH SOLAR ENERGY

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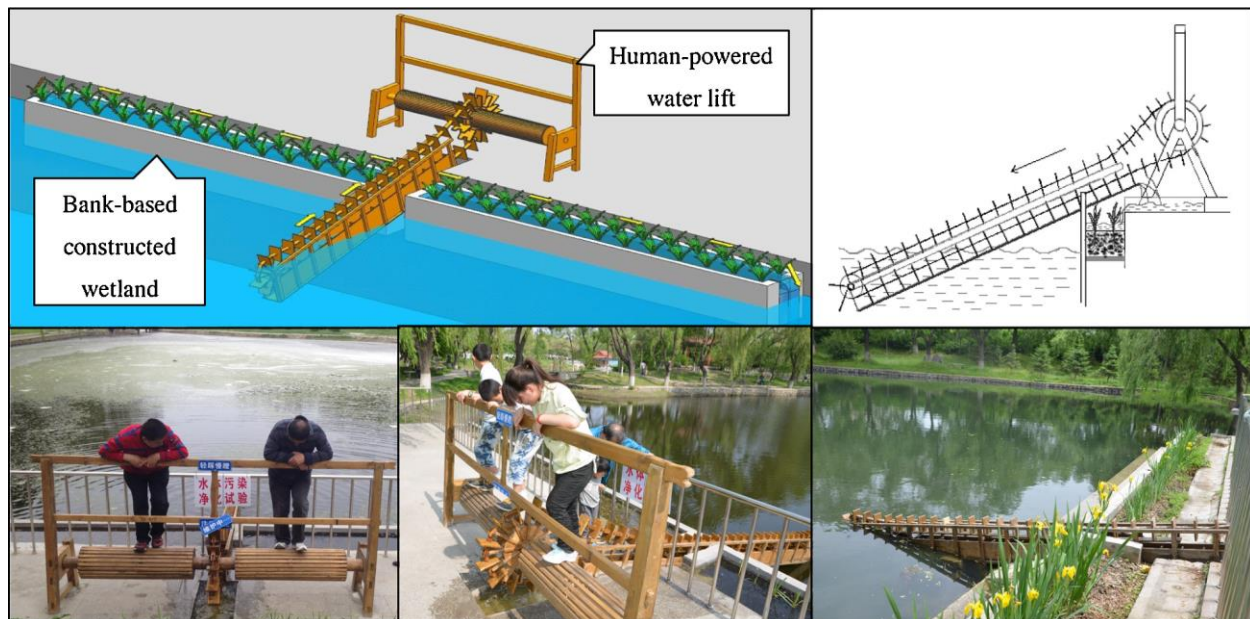
ABSTRACT

In order to maintain the quality and removes the unwanted harmful bacteria and other matters and made the water drinkable we can use our solar powered water purifier. We know that in our day to day life what plays an important role and a dirty water is the mother of all the diseases, so it is very much important to pure the water but we observe that a lot of energy also required for the purification of water so we are suggesting an experimental setup in which solar power is used for the purification of water, this setup is very much useful for the remote areas and villages of India where electricity is absent or not even available and also we can use it the urban areas to save electricity instead of conventional purifier.

Keyword : -Solar Panel ,Purification system, Emerging Pollutant etc....

1. Introduction

The rapidly rising demand for clean water, purified from hazardous chemicals (especially persistent organic pollutants and compounds of emerging concern) with adverse health effects even at extremely low concentrations, pose one of the most severe challenges worldwide. Water treatment is currently a field of research, with tremendous application potential answering the big needs and high expectations of modern human societies for drinking water. Many techniques have been developed for water purification, and two of the most commonly used are filtration and photocatalysis. It is strongly believed that an innovative combination of these two approaches will open new and promising horizons in providing a low-cost purification solution for alternative water resources treatment. As a matter of fact, alternative, photocatalytic membranes exhibiting the dual action of pollutant retention/rejection/repulsion and photocatalytic degradation, have recently received much attention due to the simplicity of the overall process and the manifold benefits arising from the presence of the photocatalyst on the membrane surface and pores (anti-bio fouling, less concentrated retentate effluent, cleaner permeate, higher flux) and vice versa, (increased pollutant concentration in the vicinity of the photocatalyst, turbulent flow and efficient mixing due to the asymmetric pore structure of the membrane).



2. Material and method

2.1. Samples collection

The raw water was obtained from the Shatt alArab River at Basrah city in Iraq. The shrimp (*Penaeus semisulcatus*) shells were purchased from local markets and used for the isolation of Chitosan.

2.2. Preparation of Chitosan solution

At the preconditioning stage, shrimp shells were washed thoroughly with water and dried to remove excess water. Then dried shells were demineralized using 1N HCL (1:15 w/v) at ambient temperature (approximately 30 °C) for 6 h. The residue was washed with distilled water until pH reached to 6.5–7 then the residue was dried. After that the demineralized shrimp shells were deproteinized using 3.5% NaOH solution (1:10 w/v) at 65 °C for 2 h and Decoloration was done with NaOCl (0.315%). Then residue was washed thoroughly with water, followed by distilled water until the pH reached in the range of 6.5–7.5. The chitin was dried and ground and screened. The chitin obtained from the above process was deacetylated in 50% NaOH (1:10 w/v) for 5 h at 100 °C. After deacetylation, the chitosan was washed thoroughly with water, followed by distilled water even the pH reached between at 6.5 and 7.5 (Ocloo et al., 2011). Chitosan powder (0–1 g) was accurately weighed into a glass beaker, mixed with 5 ml of 1% acetic acid solution (in the same of water sample), and kept aside for about 30 min to dissolve. It was then diluted to 100 ml with distilled water and stirred for 1 h at 25 °C. Six samples of 100 ml raw water were placed into six beakers (250 ml), and different concentrations of chitosan (0, 0.2, 0.4, 0.6, 0.8 and 1 g 100 ml⁻¹ water) were added under stirring (100 rpm).

3. Experimental

3.1. Materials

A commercial organoclay, named Cloisite®30B supplied by Southern Clay Products (Rockwood Company, Texas) was selected for synthesizing the Ce-doped TiO₂/clay materials. This organoclay is a natural layered clay (montmorillonite) modified with quaternary alkyl ammonium cations between its clay layers. The properties of this organoclay have been previously reported [13,18]. The Ce-doped TiO₂/clay heterostructures were prepared using titanium(IV) isopropoxide (TiIPO) and cerium nitrate (CeNit), respectively, as titania and cerium source (both from Sigma–Aldrich). Iso-propanol (Fluka) has been used as solvent. The photocatalytic activity experiments were performed using rhodamine B (RhB, Sigma–Aldrich, 95%) and phenol (Sigma–Aldrich, 99%) as target compounds.

3.2. Preparation of Ce-doped TiO₂/clay heterostructures

Several Ce-doped TiO₂/clay heterostructures were prepared by a colloidal route based on a modified sol-gel methodology described for synthesizing other oxide-clay heterostructures [13,19,20]. From Cloisite 30B was prepared a 10% (w/w) colloidal suspension in isopropanol stirring for 24 h at room temperature. The first set of heterostructures was prepared by addition of a TiIPO/isopropanol (70%, v/v) solution to the Cloisite 30B suspension, just fixing the TiIPO amount to get a final clay/TiO₂ ratio equal to 1/1 (w/w). This step was made under continuous stirring at 50°C. After 15 min, a calculated amount of CeNit water solution was dripped over the suspension, occurring a spontaneous gelification in a short time (less than 10 min). The gel was firstly dried at 50°C for one day and further calcinated at 500°C in air during 4 h, thus removing the precursors' remainders. Several heterostructures were prepared varying the CeNit concentration. The volume of water was always fixed to the necessary stoichiometric amount for hydrolyzing the TiIPO, while the CeNit amount was varied to cover Ce/Ti ratios from 0 up to 20%. The CeNit amount thus calculated was dissolved in the volume of water previously fixed for its further addition to the colloidal suspension. These heterostructures are named 1C/1Ti-Cex being \times the cerium percentage added in each case (from 0 up to 20). Two other sets of heterostructures were subsequently prepared just changing the TiIPO amount, adjusting the final clay/TiO₂ ratio to 1/2 and 1/4. From each series, the Ce/Ti ratio was also varied, from 0 up to 3%. Thus, the resulting solids were designated according to both the clay/TiO₂ ratio and the percentage of cerium incorporated, 1C/1Ti-Cex, 1C/2Ti-Cex and 1C/4Ti-Cex. Table 1 collects the nomenclature of each heterostructure synthesized.

3.3. Characterization

The structure and crystallinity of the solids were studied by powder X-ray diffraction (XRD) on a Bruker D8 diffractometer with a Sol-X energy dispersive detector, using Cu K α radiation and recording 2θ values from 2 to 70° with a scanning rate equal to 1.5° min⁻¹. The JCPDS cards [21] were used to identify the structures formed and the Scherrer's equation [22] was used to calculate the average crystal size (D). Variable temperature XRD (VT-XRD) diffractograms were acquired with an X'Pert Pro Panalytical diffractometer (with Ni filtered Cu-K α radiation) equipped with an Anton Paar HTK120 heating stage. The powder solid, located in an alumina heater purged with air, was heated up to 800°C at 10°C min⁻¹. Each 100°C, the temperature was maintained for 130 min and the XRD pattern was recorded in the 3–70° 2θ region with a scanning rate of 0.6° min⁻¹. The N₂ adsorption-desorption isotherms were performed at -196°C with a Micromeritics Tristar 123 equipment. The surface area was calculated by the BET method in the relative pressure range from 0.05 to 0.2 [23], while the De Boer's method [24] was used to calculate the external and micropore surface areas and the micropore volume. A Shimadzu 2501PC UV-vis diffuse spectrophotometer was used to acquire the solid-state absorption and diffuse reflectance spectra (DRS) of the materials within the 300–900 nm range. The band gap values were evaluated using the Tauc Plot method by plotting $(F(R) \times h\nu)^{1/2}$ versus $h\nu$ (photon energy, eV), where $F(R)$ is the Kubelka-Munk transformation of the reflectance data, considering that all the solids are indirect semiconductors, like TiO₂ [25,26]. The morphology of the heterostructures and the presence of cerium were examined by field emission scanning electron microscopy using a FEI microscope (NOVA NANOSEM 230) equipped with an EDX detector (EDAX Genesis XM2i) for mapping the main elements of the heterostructures.

3.4. Photocatalytic activity evaluation

The activity of the heterostructures has been tested for the photocatalytic degradation of rhodamine B and phenol in aqueous medium. Following previous results [13], the adsorption of the target pollutants over each heterostructure was evaluated prior to the reaction. Phenol showed a low adsorption (below 5%) while RhB adsorption achieved higher values (about 40%). From those tests, the adsorption time and the initial concentration of each pollutant were both fixed prior to each photocatalytic experiment. The suspension was stirred in dark for 2 h and then the starting concentration of the pollutant was adjusted to 25 mg L⁻¹ in all experiments. The photocatalytic experiments were made in a glass reactor containing 300 mL volume, using a catalyst concentration of 500 mg L⁻¹. A (50 mL min⁻¹) air flow was continuously passed. The reactor was placed inside a Suntest solar simulator (Suntest XLS, ATLAS) equipped with a 765–250 W m⁻² Xe lamp and a "Daylight" filter (cuts off 290 nm). The light emission range of this lamp simulates the solar radiation and the intensity was adjusted to 550 W m⁻² in the experiments. The temperature of the chamber was monitored, reaching values ca. to 38 ± 1°C.

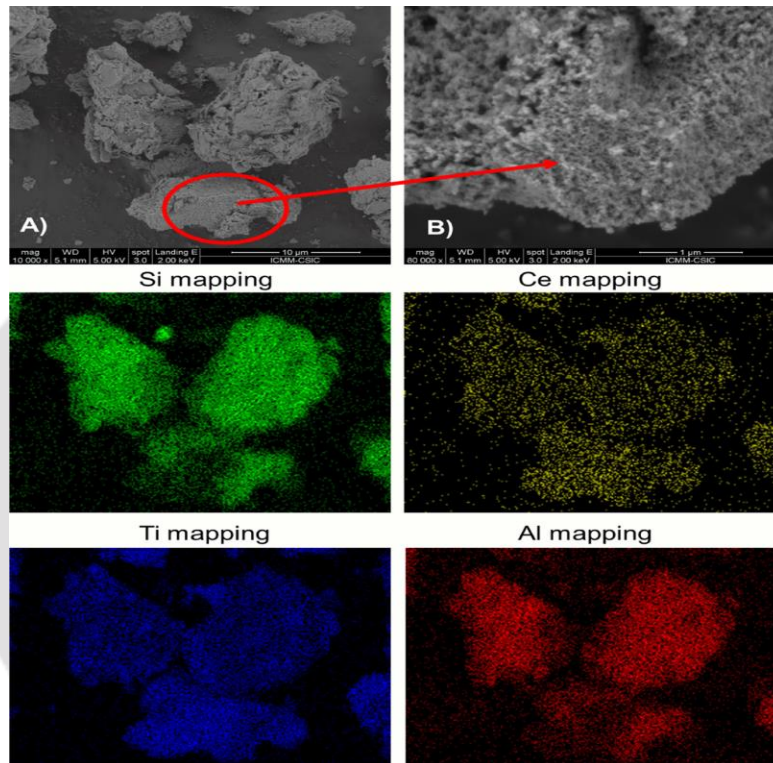


Figure 1 FE-SEM image of 1C/1Ti-Ce3 (A), the marked region at zoom in (B), and their corresponding EDX mapping images for Si, Ce, Ti and Al elements.

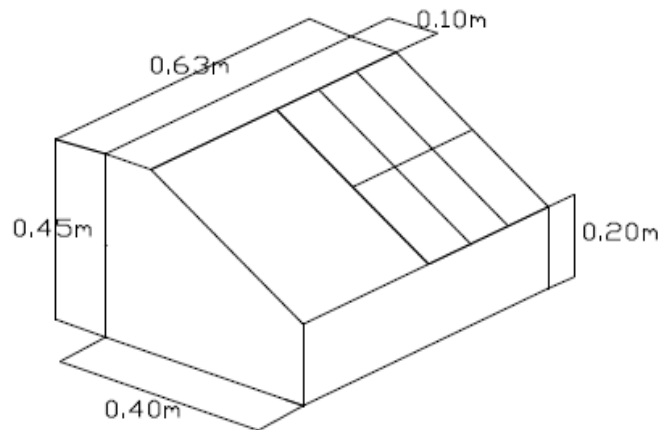


Figure 2 isometric view

4. Advantages & limitations

4.1 Advantages

1. These Purifier Device are cheap and affordable.
2. Easy to use and handling.
3. Low maintenance cost.
4. Maintenance is almost negligible.
5. The system will not involve any moving parts and will not require electricity to operate.
6. Wastage of water will be minimum unlike reverse osmosis in which almost 30% of the loaded water flows out in form of unusable water that can only be used for toilet or other cleaning purposes.

4.2 Limitations

1. Dependence on whether .
2. slow process it takes much time as compare to other water purification system.

4.3 Application

1. The basic principles of solar water distillation are simple yet effective, as distillation replicates the way nature purifies water. The sun's energy heats water to the point of evaporation. As the water evaporates, purified water vapor rises, condensing on the glass surface for collection. This process removes impurities such as salts and heavy metals, as well as destroying microbiological organisms. Is a passive solar distiller that only needs sunshine to operate. There are no moving parts to wear out.

2. The distilled water from a still does not acquire the flat taste of commercially distilled water since the water is not boiled (which lowers pH) . Solar stills use natural evaporation, which is the rainwater process. This allows

for natural pH buffering that produces excellent taste as compared to steam distillation. Solar stills can easily provide enough water for family drinking and cooking needs.

5. Discussion

It was noticed that it was conducive to carry out the activity on a cloudless day, preferably over the mid-day period. The purifier works by letting the sun's rays warm the water. The sunlight entering the still is absorbed by the water and the container. The molecules and ions absorb the energy. Some of the water molecules absorb enough energy to break free from the liquid water and become gaseous molecules (speculated) flying about inside the container. Some of these flying molecules collide with the plastic film, lose energy to the film and stick to the film. The water molecules lose more energy as they join together forming droplets of pure water which run down into the output container. The water vapour turns back into liquid when it touches the perspex glass and the drops turn down to the pebble and fall into the outlet container. Though it takes longer time, but the amount of the collected water is directly proportional to the percentage of purified water.

For the SODIS, the UV rays emitting from the sun penetrate the PET (Polyethylene terephthalate) bottles and due to the reflecting of the aluminum base, the rays are trapped into this bottle and thereby purify the water and makes it fit for drinking and other domestic uses.

6. CONCLUSIONS

this purification system is more advantageous than the normal solar distillation systems. The collected distillate from this system is very much suitable for modern engineering applications like in chemical laboratories, pharmaceutical industries, maintenance of vehicle batteries, domestic purpose and so on. This solar water purification system is portable and maintenance free (cleaning is required through), it is an inexhaustible fuel sources, doesn't cause any pollution. it is an excellent supplement to other renewable sources. The collected water from the device as better taste when compared to rain water because it doesn't boiled.

7. REFERENCES

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