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ADSORPTION OF ACID BROWN-340 ON SILICA BASED ADSORBENT

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This research worked did by Salman Khan in the Lab of Separation Science at University of Malakand During BS Degree

Abstract:

Acid Brown-340 is a valuable and prominent dye which Having Serious effect on our environments due to its acidic nature. Usually, this dye is coming out of different industries and accumulate in various water bodies such as lakes, ocean and freshwater ecosystem. In this Present study silica monolith particles were synthesized by the renovated sol-gel process under controlled environment of heating steps. The newly prepared functionalized silica monolith particles were used as an adsorbent for the removal of acid brown-340 from aqueous solution. particles originating from silica monolith were effective adsorbent for the removal of selective dye due to its various sorts such as enlarged surface area, high permeability due to monolith like nature leading to high loading capability, and mechanical strength to various PH. Adsorption capacity of silica was firm with respect to different parameters at certain point of time. By adjusting certain parameter such as PH at range 2-8 Concentration taken as range from 0.02-0.1 and time as taken as range from 15mins to 75mins. Then Acid brown-340 shows the greatest adsorption with particles originating from silica monolith when the optimized values of the parameters for acid brown-340 are PH is 2, adsorbent dose is 0.06g, and Contact time is 75 min.

Introduction:

Dyes are mainly chemical compounds that can assign themselves to surfaces or stuffs to impart colour. The majority of dyes are complex organic molecules that must be impervious to a variety of aspects, including detergent act. Synthetic dyes are broadly used in a variety of fields of advanced technology, such as textiles. More than 10 000 types of Dyes is present in the environments for example methylene Blue, Acid Red, Congo Red, Acid brown 340, Acid Brown 98 and Many others all are Carcinogens [1] Dye-containing waste water not only pollutes surface and groundwater, but it also harms human health and disturbs the environment. Many dyes are resistant to fading due to their high thermal and chemical stability. Textile and protective wastes are two of the most polluting industrial wastes, and the issues of treatment and removal of such wastes need a great deal of attention. Because most dyes are light and heat stable and are not biodegradable, it is difficult to remove them from effluents [2] Wastewater from industries polluting water bodies with toxic pollutants at concentrations faraway beyond the World Health Organization's (WHO) limits. Synthetic dyes are widely used, with over 100,000 varieties currently on the marketplace. The entire yearly production of these dyes is nearly 7 105 – 1 106 tons, and nearly 10–15 percent of unused dyes reach the ecosystem through wastewater from textile, plastic, cosmetics, grin. And Removal of waste water from industries into the environment can pollute freshwater reservoirs, Dissembling hazardous effects on the environment and human beings. If dyes are exposed to the skin or swallowed, they increase the risk of skin cancer and other skin complications such as allergies, irritation, and sensitization. Dyes are toxic, cancer-causing, and cause genetic problems. [3] Due to the environmental and health fears related with wastewater sewages, a wide range of procedures for removing dyes has been developed and used, which can be considered into three main categories: chemical, physical, and biological methods. Membrane filtration, coagulation and flocculation, sedimentation, chemical precipitation, ion exchange, and adsorption these all are some of these conventional techniques [4] Various other analytical methods are also used such as G–MS, L-MS, and HL-DD, have been established for the detection of dyes. These hyphened techniques are pretty advanced and give fast and Precise results but have many also drawbacks such as high cost, Complex instrumentation, and use of organic regents'.[5] However, mostly researcher were desire to work on these techniques because of the extra benefits and ease of use, We prefer this Process of Adsorption, as a combination of physical-chemical methods, is found to be the most favorable and cheaper method to Remove dye pollutants This method has been extensively accepted as one of the most effective waste treatment techniques for removing hazardous inorganic and organic pollutants because it is fast, inexpensive, effective, and is ease of use[6] Removal is possible through best Adsorbent name is silica monolith through Adsorption process a well-known Adsorbent for removal process. Many studies have observed into the synthesis of well-ordered mesoporous aluminosilicates or Silica Monolith, including direct synthesis and post-synthesis methods. Direct synthesis, for example, has the advantage of varying the l/Si ratio, A few examples of the use of silica monolith also contain the Removal of waste from water through adsorptions process. organic-modified silica monoliths are also used to remove heavy metals from waste water. Because of their harmfulness, the removal of these compounds by means of adsorbent materials is of environmental concern and a great issue for human health. [7] Due to these properties Because Silica Monolith is a porous materials possess high surface area, high pore volume, and large pore size, they originally have limited adsorption capacity and low selectivity for CO_2 in the presence of the other gases such as N2. [8] Many other adsorbents is used in adsorption process such as well-known adsorbent Activated carbon but they have many drawbacks therefore we prefer adsorption process.

Experimental Work:

Chemicals and materials

Acid brown 340, Distal water, Silica Monolith Adsorbent, Boric Acid (H3BO3), Phosphoric Acid, (H3PO4), Acetetic Acid (CH3CHOOH), Hydrochloric Acid (HCL), Sodium Hydroxide (NaOH), Buffer Solution, Round Bottom Flask, Beakers, Pipette, Spatula, filter Paper, Stand, Dropper, 25ml Flasks, funnel, 100 ml Graduated Cylinder, Desiccator, 100ml flask, Tubes, Volumetric Flask, Reagent Bottle, Lab Coat, Glows, Mask, Computer (Recorder) Micro Syringe

Instruments

Digital Balance (BSA2245), Oven (BOV-V30F) Shaker (001) Uv spectrophotometer (UV 1900) Spectronic 20(SP-300) Cuvettes (100-40-10) Water Bath(DSB-1000D) PH meter (Hanna),

PROCEDURE:

100ml stock solution (100ppm) of acid brown-340 was prepared using acid brown-340.For preparation of stock solution 0.01g of acid brown-340 were dissolved in 100ml flask by addition of Distilled water.

5 different Solutions were prepared from stock solution using the standard Dilution formula. Batch Experiments were carried out to explore the dye removal efficiency from synthetic solution

For preparation of buffer solution, first 0.04 molar solutions of boric acid, acetic acid and phosphoric acid were prepared. 0.04 molar solution of boric acid was prepared by dissolving 0.24g of boric acid in 100ml of distilled water. The same process was repeated for 0.447ml of phosphoric acid and 0.22ml acetic acid

Adsorption process was optimized for important parameter like PH, adsorbent dose, contact time by changing the parameter under observation while keeping other parameters and accordingly optimum value of each parameter for maximum removal of dye ion was determined.

The Removal percentage (R%)or % Adsorption is the Defined as the Ratio of Concentration before Adsorption to Ratio of Dye Concentration After Adsorption Process (Ci-Cf) to initial concentration of Dye in aqueous Solution. It was being Calculated following Formula.

$$R\ (\%)\ \text{Removal} = (Ci-Cf)/Cf$$

R%: Removal Percentage of Dye or Percent Adsorption

Ci: initially concentration before adsorption (Mg /L)

Cf: Final concentration After Adsorption (Mg /L)

PH of the different solutions was maintained and adjusted range from 2 to 8 with the addition of Buffer solution prepared in laboratory, Buffer solutions of acetic acid, phosphoric acid, and boric acid were used to maintain PH of the solutions. The solutions were prepared both in acidic medium and basic medium. shaking and filtration were carried out for further analysis.

Solutions having different adsorbent dose were prepared in 100ml flask by adjusting range from 0.02g to 0.1g. Different Adsorbent concentration and 2ml of dye both were dissolved by addition of distilled water. shaking and filtration were carried out for further analysis.

Solutions having different contact time were prepared in 100ml flask by adjusting range from 15mins to 75mins. 0.02g of adsorbent and 2ml of dye both were dissolved by addition of disttled water. Shaking was carried out between adjusting range. filtration was carried out for further analysis.

RESULT AND DISCUSSION:

3.1 Effect of PH on adsorption

The effect of PH on the Adsorption of Acid Brown 340 on silica based Adsorbent originating from Silica Monolith was studied at PHs ranging from 2 to 10, while all other parameters remained constant. The results and effects of Ph on adsorption are shown in Table, and the best adsorption was seen at PH 2 in the acidic range. Because dye was acidic in nature. The adsorption of dye increased particularly up to PH 2 and decreased. It might also be possible that the surface of sorbent might remain more stable at PH 2 rather than highly acidic medium between (1to 2) PH. Dye adsorption strongly dependent upon the PH. The Change in the potential between sorbate and sorbent may be protonation and deprotonation of the groups attached to the adsorbent. In acidic medium the presence of functional groups on the surface of the adsorbent is positively charged due protonation of strong acidic solution and hence negative sites of anionic dye can easily approach to positively charged surface of the adsorbent and increase the effectiveness of adsorbent acid brown-340 dye while in the basic range adsorption get Decreased due to nature of dye is acidic Data was Showed in Table 5.

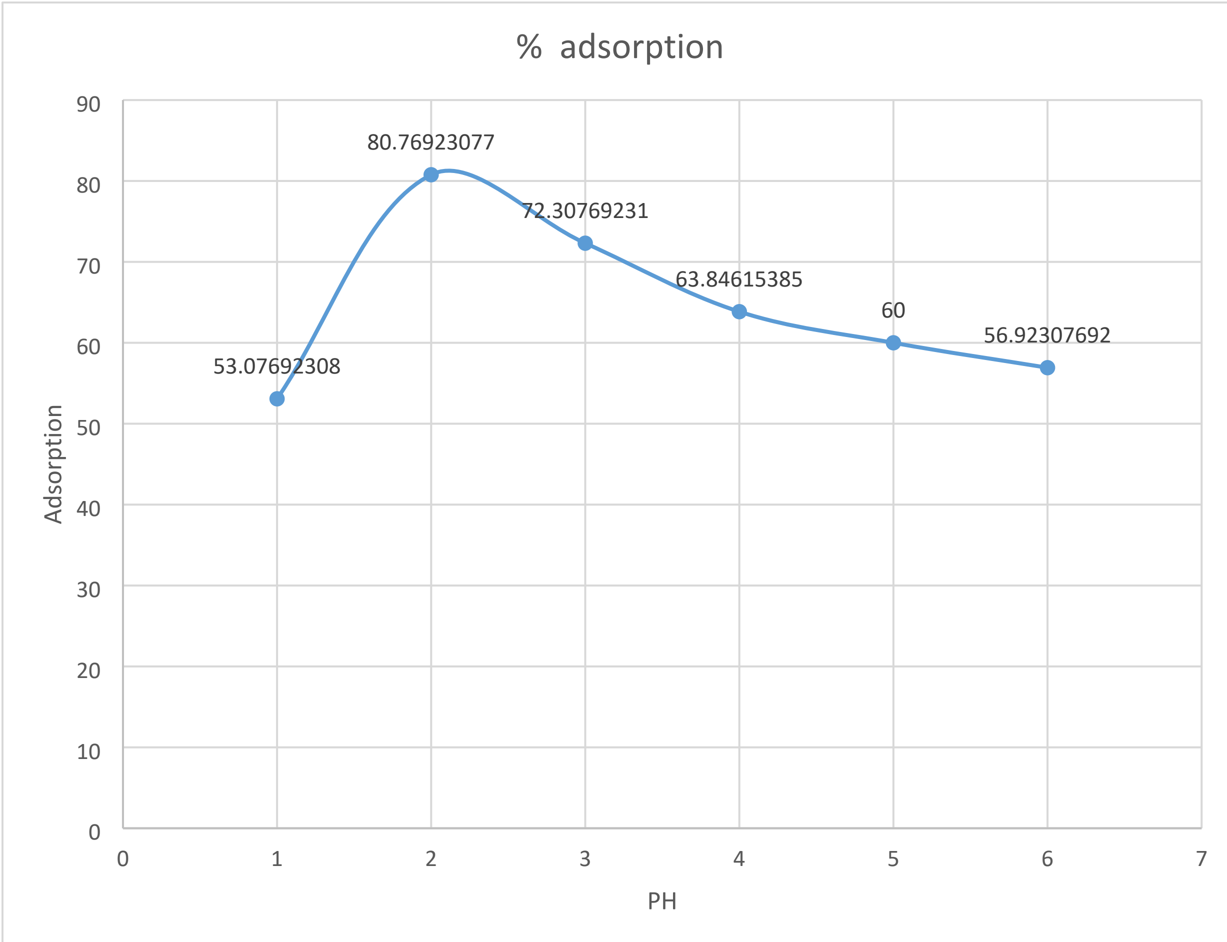

Figure 1: Effect of PH on adsorption

3.2 Effect of adsorbent dose on adsorption

The effect of Adsorbent on the Adsorption of Acid Brown 340 on Silica based adsorbent originating from Silica Monolith was studied at ranging from 0.02g to 0.1g, of adsorbent. while all other parameters remained constant. Shaking was carried out for 30mins and then filtration was taken out followed by filtration process. Filtrate were collected for batch analysis for every Solutions. The best adsorption was observed at 0.06g(6mg). The result of adsorbent dose on adsorption is showing in Table 6.

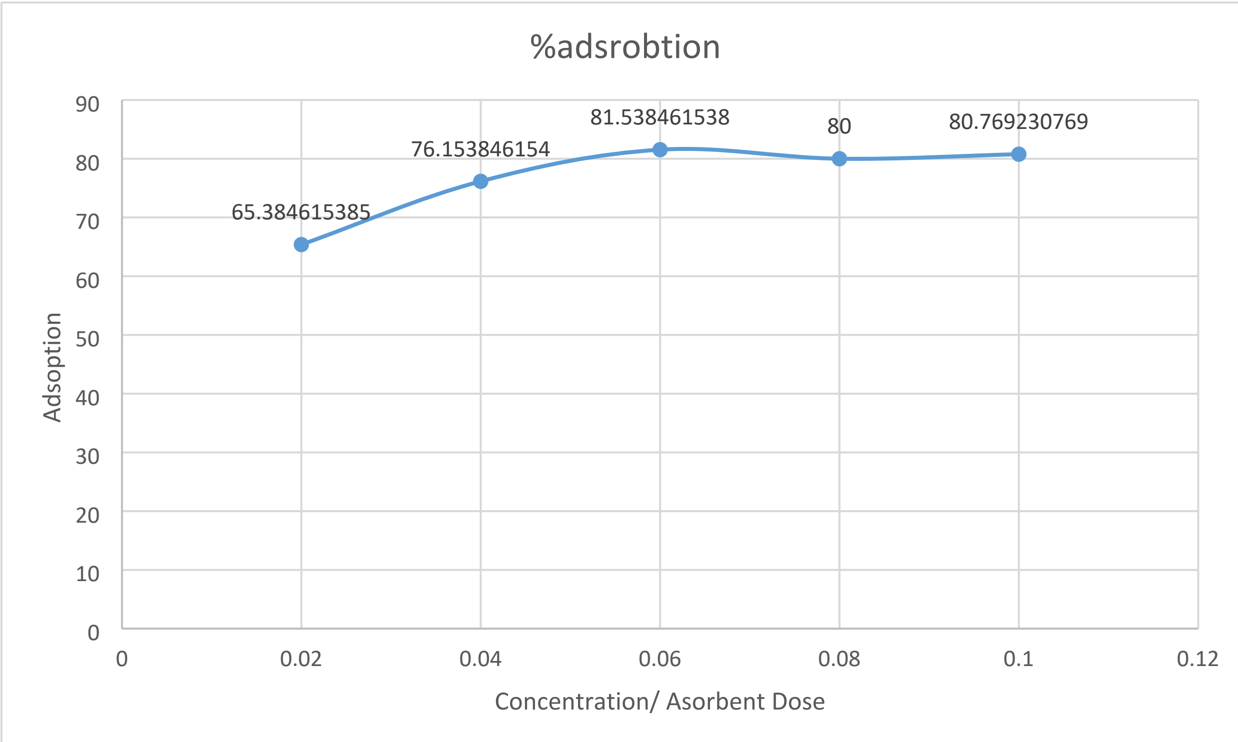

Figure 2: Effect of Adsorbent Dose on Adsorption

3.3 Effect of contact time on adsorption

The effect of contact time on the Adsorption of Acid Brown 340 on Silica based adsorbent originating from Silica Monolith was studied at ranging from 15mins to 75mins, while all other parameters remained constant. The Adsorption proportion of dye was high due the presence of adsorbate vacant site on sorbent surface After that adsorbate molecules entering into pores of inner surface which was comparatively slow process. Then the equilibrium is established and the process remain constant. The best adsorption was seen on 75mins.The result were Showed in Table

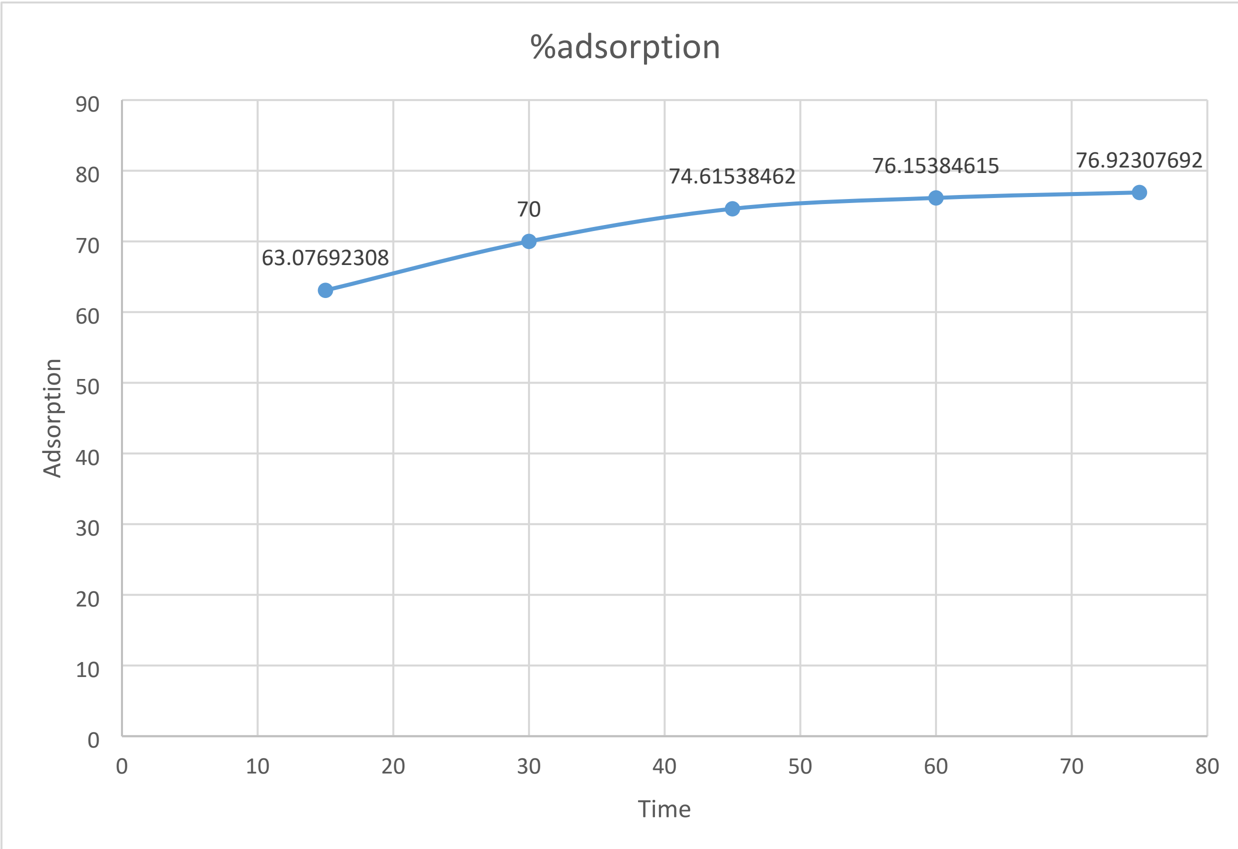

Figure 3: Effect of Contact time on Adsorption

CONCLUSION

To sum up, this study specifies that the particles originating from fused Silica monolith can be successfully used for removal of Acid brown-340 from aqueous media, and also shows the efficiency of Adsorption method for the removal of dyes. Different parameter was checked which Effect adsorption process such as contact time, adsorbent dose and PH. The optimum PH for acid brown-340 was 2 contact time 75, adsorbent dose 0.06g and concentration 10ppm.

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