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ADSORPTION STUDIES ON MIXED ALGAE TO CONTROL SO_2 AND NO_2 POLLUTION

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ABSTRACT

It has long been recognized that poor ambient air quality has adverse effects on public health. Biological indicators are Species used to monitor the health of an environment or ecosystem. Algae are generally known to be biological indicators of environmental pollution caused by SO_2 and it is also known to be indicator of water pollution caused by certain heavy metals. Based on this known fact the present work was carried out to study the adsorption of hazardous air pollutants like NO_2 and SO_2 on mixed algae. The adsorption experiments were conducted with respect to contact time, algae doses and initial concentration of NO_2 and SO_2. It was found that percentage removal increased with increase in contact time and with increase in adsorbent dosage. It follows first order kinetics. The amount of NO_2 and SO_2 pollutants adsorption is more at lower concentration than at higher concentration.

Key words: **Adsorption, Air pollutants, mixed algae, Contact time, Bio-accumulation.**

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INTRODUCTION

Sulfur dioxide is a heavy, colorless, poisonous gas with a pungent, irritating odour familiar as the smell of a just-struck match. Sulfur dioxide (SO_2) is one of a group of highly reactive gases known as "oxides of sulfur." The largest sources of SO_2 emissions are from fossil fuel combustion at power plants (73%) and other industrial facilities (20%). Smaller sources of SO_2 emissions include industrial processes such as extracting metal from ore, and the burning of high sulfur containing fuels by locomotives, large ships, and non-road equipment. SO_2 is linked with a number of adverse effects on the respiratory system (1-5). Occurring in nature in volcanic gases and in solution in the waters of some warm springs, sulfur dioxide usually is prepared industrially by burning in air or oxygen of sulfur or such compounds of sulfur as iron pyrite or copper pyrite. Large quantities of sulfur dioxide are formed in the combustion of sulfur-containing fuels; in the second half of the 20th century, measures to control atmospheric pollution by this compound were widely adopted. In the laboratory the gas may be prepared by reducing sulfuric acid (H_2SO_4) to sulfurous acid (H_2SO_3), which decomposes into water and sulfur dioxide, or by treating sulfites (salts of sulfurous acid) with strong acids, such as hydrochloric acid, again forming sulfurous acid. Sulfur dioxide can be liquefied under moderate pressures at room temperatures; the liquid freezes at -73° C (-99.4° F) and boils at -10° C (+14° F) under atmospheric pressure. Although its chief uses are in the preparation of sulfuric acid, sulfur trioxide, and sulfites, sulfur dioxide also is used as a disinfectant, a refrigerant, bleach, and a food preservative, especially in dried fruits (6-12).

METHODS AND MATERIALS

Selection of adsorbent: Green algae, especially *Cladophora* species, are generally considered as the best bioindicator of aquatic bodies' contamination by nutrients as well as by toxic gases (Eva Chmielewská et al., 1999). Mono-species cultures of green algae contain protein (over 50% of dry weight), nutrients (nitrogen, phosphorus) and may contain various bioaccumulated toxic elements. The present work, examines the possibility of using a well-known physicochemical method like adsorption for removal of so_2 from aqueous solution. The initial screening studies have been carried by introducing a known amount of adsorbent into the aqueous solution of SO_2. It was found that algae have large adsorbing capacity. Taking all these factors into consideration, algae have selected as a bio adsorbent for removal of SO_2 from air. Algae sample was collected from the water storage tank located at dairy farm. The experiments are carried with respect to contact time, initial concentration of SO_2 and algae dosage.

Preparation of samples: 40 ppm concentration of NO_2 and SO_2 were prepared by using $NaNO_2$ and Na_2SO_3 in 1000 ml of distilled water respectively. Batch adsorption studies were carried out to check the removal of NO_2 and SO_2 concentrations in aqueous solution. The percentage of removal and amount adsorbed by bio mass of algae was determined by using spectrophotometer.

Effect of contact time: The initial and final concentrations are determined at regular intervals of time. The results are given in Figure-1 & 2.

Effect of concentration of aq.SO_2 and NO_2 sol. on mixed algae: Different concentrations of aq.sol of SO_2 and NO_2 were studied, which consist of a fixed amount of adsorbent. The experiments are carried out with constant contact time and the contact time is fixed depending upon contact time experiments. The results are given in Figure-3 & 4.

Effect of Algae dosages: Definite concentration of SO_2 and NO_2 is studied with

different amount of adsorbent dosage i.e. 0.2 gms, 0.4 gms, 0.6 gms, 0.8gms respectively. The experiments are carried out with constant contact time of 60 minutes.

RESULTS AND DICUSSION

EFFECT OF CONTACT TIME BETWEEN AQ.SOL.SO_2, NO_2AND MIXED ALGAE

Volume of aq.SO_2 & NO_2 solution: 100 ml
Amount of mixed algae: 1.0 gms
Concentration of aq.SO_2 sol.: 40 ppm
Concentration of NO_2 solution: 40 ppm

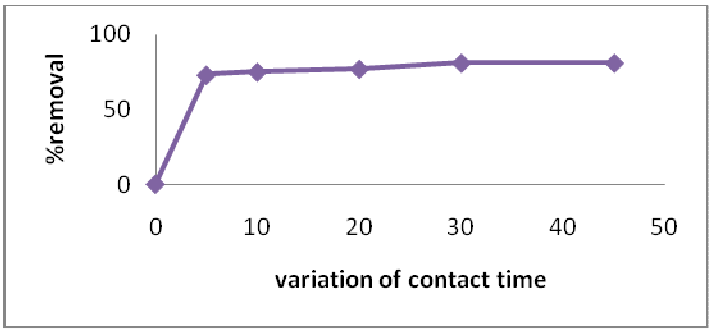

Figure 1
Variation of contact time between aqueous So_2 solution and mixed algae

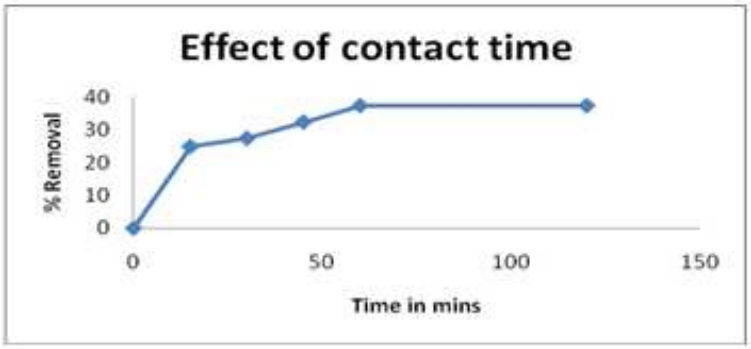

Figure2
Variation of contact time between aqueous NO_2 solution and mixed algae

The experimental runs measuring the effect of contact time on the batch adsorption of aqueous SO_2 solution, and at initial concentration of 40 ppm indicated that increase in contact time from 5 to 45 minute enhanced the percent removal of aqueous SO_2 solution significantly. The initial rapid adsorption gives away a very slow approach to equilibrium. The nature of adsorbent and its available sorption sites affected the time needed to reach the equilibrium. For mixed algae this time was 45 min. Results are given in Figure-1. The optimum contact time for the removal of aqueous NO_2 is 60 minutes. From figure-2, it is observed that initially the adsorption of NO_2 increased with the increase in contact time.

EFFECT OF INITIAL AQ.SO_2 & NO_2 SOL.CONCENTRATION ON MIXED ALGAE

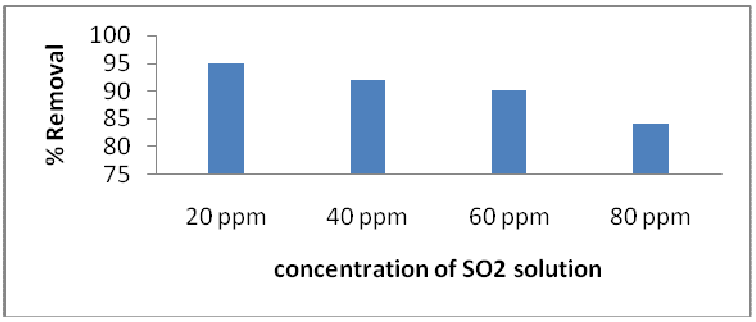

Figure 3
Variation of initial concentration of aq.so_2 sol.

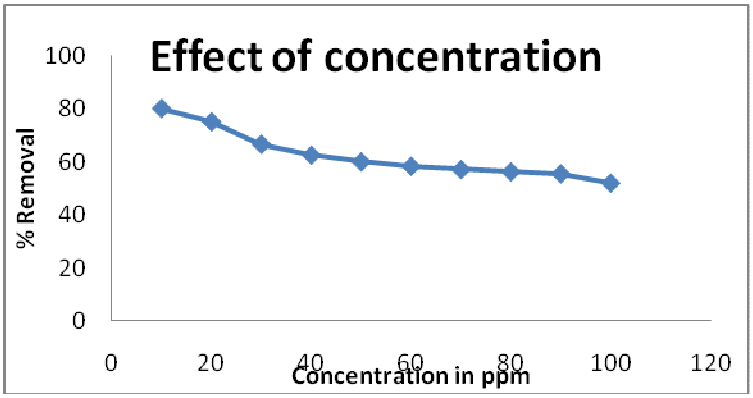

Figure -4
Variation of initial concentration of aqueous NO_2 solution.

The adsorption data of aqueous SO_2 solution at different initial concentrations ranges from 20 ppm to 60 ppm. However, the experimental data were measured at 60 minutes to make sure that full equilibrium was attained. Increasing the concentration, the percentage removal decreases. Results are given in Figure-3. The percentage removal of aqueous solution of NO_2 decreased with increase in concentrations indicated by the figure- 4. The maximum percentage removal of NO_2 is observed at the lower concentrations compared to higher concentrations.

EFFECT OF MIXED ALGAE DOSAGES

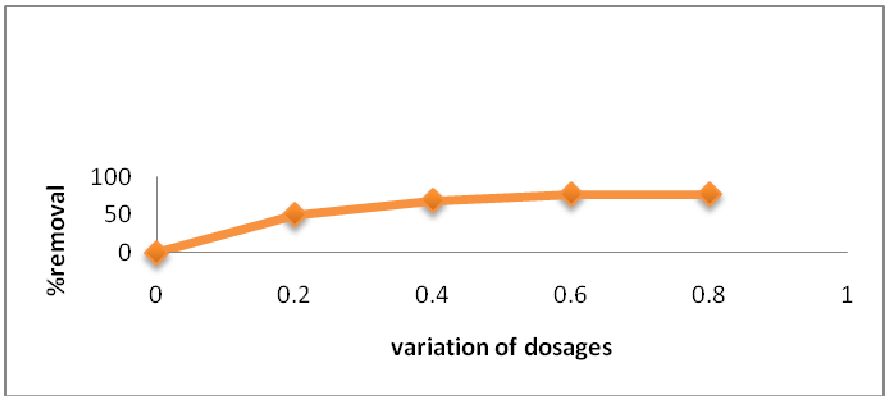

Figure 5
Variation of mixed algae dosages on SO_2

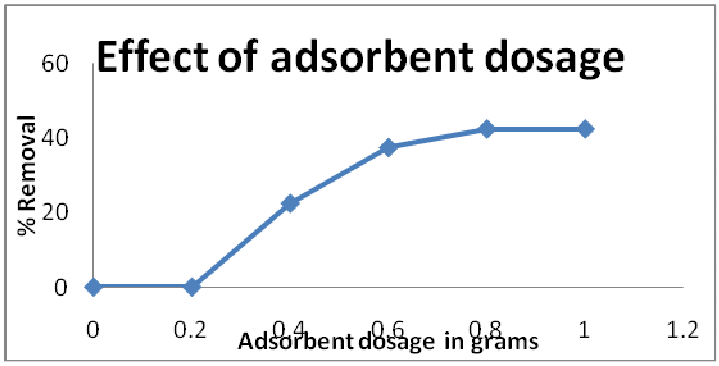

Figure 6
Variation of mixed algae dosages on NO_2

To study the effect of adsorbent dose (g) on the uptake of aq. SO_2 and NO_2 solution experiments were done with 100 ml of 40 ppm of SO_2 and 40 ppm of NO_2 solutions, while the amount of adsorbent added varied from (0.2 – 0.8 g). Results in Figure-5, showed that the percentage removal of SO_2 and NO_2 from aqueous solution increased with the adsorbent dose and reached an optimum at 0.8 gm of sorbent. The increase in removal was due to the increase in the available sorption surface area.

CONCLUSIONS

Lichens a combination of fungi and algae are bio indicators of air pollution. Taking that factor into consideration in the present work mixed algae has been introduced into aqueous solution of SO_2 and NO_2 as an adsorbent. As the percentage removal is ranging between 40-60% for both SO_2 and NO_2 aqueous solution, it can be used as bio adsorbent for the removal of SO_2 and NO_2. The methodology adopted for controlling of SO_2 and NO_2 pollutants from the environment is economically feasible, as algae is waste material and available in wide range. It was found that the optimum contact time is 40 minutes in case of SO_2 and 60 minutes in case of NO_2 respectively.

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