Research Article

Controlling of SO_2 by using low cost Adsorbents

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ABSTRACT

Sulphur oxides are formed during high temperature combustion processes from the oxidation of sulphur in the air. The principal source of sulphur oxides - sulphur oxide (SO) and sulphur dioxide (SO_2), collectively known as SO_x. SO and SO_2 concentrations are therefore greatest in industrial area. Other important sources are power stations, heating plants and industrial processes. Long-term exposure to sulphur dioxide may affect lung function and that exposure to sulphur dioxide enhances the response to allergens in sensitized individuals. The feasibility of using waste materials as adsorbent for air pollutant SOx was evaluated in the present study. The experiments were carried out in laboratory on certain waste materials like Neem leaf powder, orange peel powder, custard apple leaf powder, Horse gram seed powder, Ragi seed powder, mango bark dust, Mixed algae, and Neem bark dust. The experimental investigations were carried out by traditional adsorption studies and it showed that all substances have certain capacity to adsorb the SO_x from aqueous solution of SO_x. The order of adsorption by different low cost materials is Mango bark dust > Orange peel powder >Custard apple leaf powder> Neem leaf powder> Horse gram seed powder> Ragi seed powder> Neem bark powder mixedalgae. 98%>95%>88%>82%>80%>78%>77%>74%. At lower concentration the adsorption is more compared to higher concentration. It is found that the adsorption increases with increase in surface area.

Keywords: Sulphurdioxide, low cost adsorbents, Batch Adsorption, mixed algae.

INTRODUCTION

Sulphurdioxide is a colourless gas. It smells like burnt matches. It can be oxidized to sulphur trioxide, in the presence of water vapour is readily transformed to sulphuric acid mist. So_2 can be oxidized to form acid aerosols. So_2 is a precursor to sulphates and one of the main components of respirable particles in the atmosphere. It is estimated that so_2 remains in air for an average of two or four days.

SO_2 is emitted primarily during the combustion of fossil fuels and the processing of sulphur containing ores. The major source of sulphur dioxide are fossil fuels burning power plants, (generating, electricity) and industrial boilers. Another source of sulphur dioxide is vehicular exhaust emissions. It is emitted into the atmosphere either directly by fuel combustion, petroleum refining and smelting operations etc or through oxidation of H_2S obtained from decomposition of organic matter. The natural sources such as biological decay and sea spray emit about 130 million tones of sulphur per year and the anthropogenic sources such as coal combustion, petroleum and smelting operations release an additional 132 million tones of sulphur dioxide annually into the atmosphere. The largest signal contribution to the anthropogenic emission about 70% is made by coal combustion. The natural sources of sulphur dioxide are probably present in gases emitted through volcanic activity

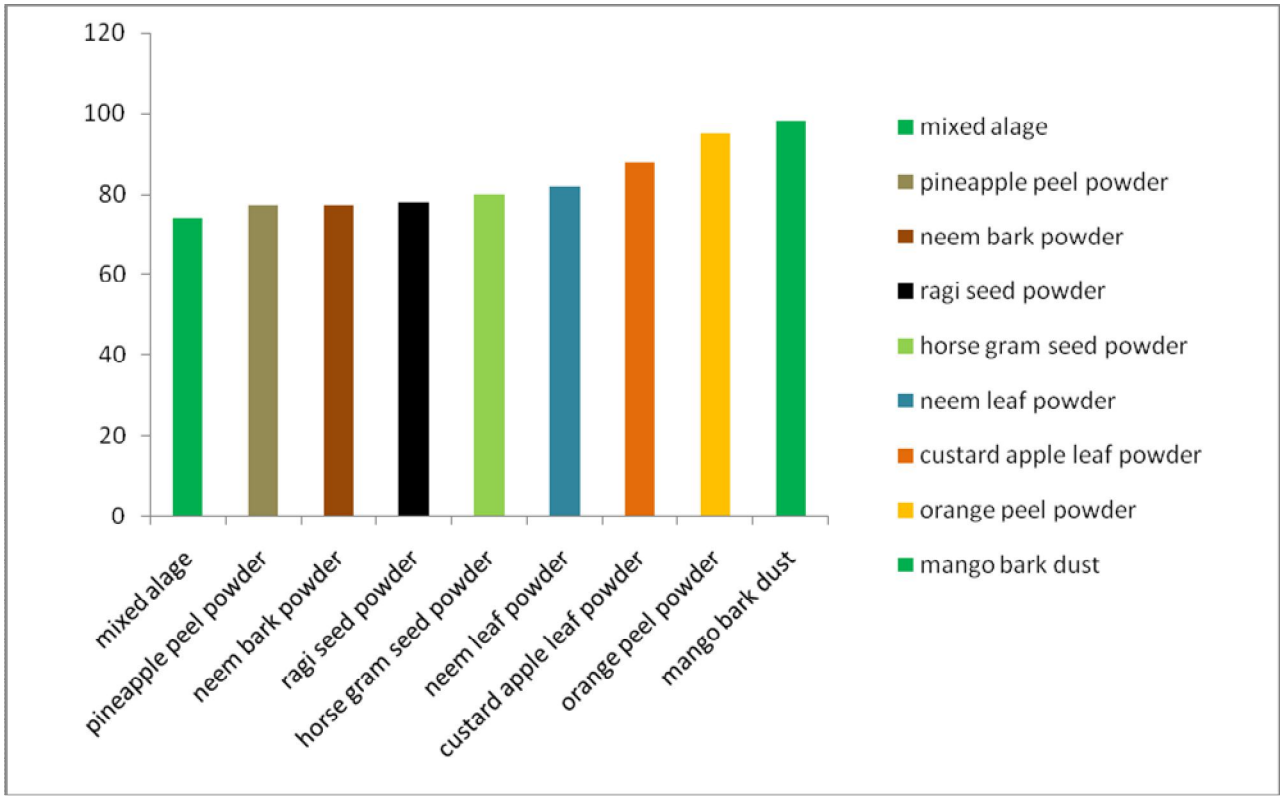
SO_2 and its derivatives produce strong irritation on the eyes and nasal passageways. It causes intense irritation to the eyes and respiratory tract. It is absorbed by the nasal system, leading to swelling and stimulated mucus secretion. SO_2 damages lung tissues and causes and promotes respiratory diseases. Raised levels of SO_2 in the atmosphere may also causes lung cancer. Higher concentration of SO_2linduces desquamation or peeling off the surface epithelium in the mucosa and cilia, which protects the respiratory tract, SO_2 also induces an involuntary coughing reflex. The taste threshold limit is 0.3ppm while SO_2 produces an unpleasant smell at 0.5ppm.

METHODS AND MATERIALS

Adsorption methods are adopted for non-combustible gas and these methods are suitable when pollutant gases are present in low concentrations. In this paper an attempt has been made to suggest certain waste materials as effective adsorbents of SO_x. The adsorbents primarily screened were Neem bark dust, Orange peel powder, Custard apple leaf powder, Neem leaf powder, Ragi seed powder, and Horse gram seed powder, Mango bark dust, mixed algae. Initially, all the sorbents are screened by adding 1 gm of each adsorbent to 100 mL of aqueous solution of SO_2 gas.. For this purpose, an aqueous solution of 100 mL of SO_2 of various concentrations is taken in 100 mL stoppered bottles and 1 gm of adsorbent is added to the solutions. Batch adsorption experiments are carried out at room temperature, a contact time of 24 hrs is maintained. The initial and final concentrations of aqueous solution of SO_2 were determined by Spectrophotometer and percentage removal of SO_2 was determined.

Table 1: Percentage removal of SO_2 with different Adsorbents

S. No.	Con. of SO_2 $\mu g/m^3$	Mango bark dust	Neem bark dust	Mixed algae	Ragi seed powder	Horse gram seed powder	Orange peel powder	Neem leaf powder	Custard apple leaf powder	Pine apple peel powder
1.	5	100	100	90	90	98	100	92	95	90
2.	10	100	98	86	87	95	100	90	95	86
3.	20	100	91	80	84	91	98	87	92	82
4.	30	99	82	78	81	84	96	86	91	79
5.	40	98	77	76	78	80	95	84	88	77



Order of effectiveness of Adsorbents

Mango bark dust > Orange peel powder >Custard apple leaf powder> Neem leaf powder> Horse gram seed powder> Ragi seed powder>pine apple peel powder> Neem bark powder> mixed algae.

RESULTS AND DISCUSSION

The adsorbents selected for the present study are Neem bark dust, Mango bark dust, mixed algae, Ragi seed powder, Horse gram seed powder, Orange peel powder, Neam leaf powder, and Custard apple leaf powder and they are tabulated in Table 1.it is observed that the order of adsorption is Mango bark dust, Orange peel powder, Custard apple leaf powder, Neem leaf powder, Horse gram seed powder, Ragi seed powder, Neem bark dust, Mixed algae. The adsorption capacity is more at lower concentrations compared to higher concentration. In the present study, it is observed that physical adsorption is taking place.

Mango bark dust is a waste material collected from the Timber industry. Mango bark dust is a bio adsorbent and it consists of lignin and cellulose and many hydroxyl groups such as lumens' or phenolic compounds. The composition of Mango bark dust is given by Cellulose – 36.5% and Lignin – 49.5%. The ligno-cellulosic components present in the Mango bark dust are responsible for complete adsorption observed in the present study. Mango bark dust is a cheap material and the adsorption capacity of the mango bark dust is high compared to other adsorbents, hence, it can be used as an effective adsorbent for removal of SO2.

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Orange peel (Citrus sinensis) is waste material collected from fields. Orange peel is a bio adsorbent and it consist of cellulose, essential oils, proteins and some simple carbohydrates. The cellulosic material which is responsible for complete adsorption observed in the present study. Hence it can be used as an effective adsorbent for removal of so_2.

Algae is a waste material collected from ponds. It acts as a bio adsorbent for the removal of so2, it consist of proteins, carbohydrates, lipids and nucleic acids.

Horse gram (Macrotyloma uniflorum) seed powder is collected from fields. It is a bio adsorbent and it consists of higher trypsin inhibitor and haemagglutinin activities and poly phenols. This material is responsible for complete adsorption observed in this present study. Hence it is an effective adsorbent for the removal of So2.

The most significant part of the neem (Azadrirachta indica)is the neem leaf which is collected from neem plant. It consists of iron and fibres, where so2 reacts with iron and forms iron oxide. It acts as a catalyst for so2 removal. Hence, it can be used as an effective adsorbent for removal of so2.

Custard (Annona squamosa) apple leaf is a waste material collected from garden. It consists of volatile oils and alkolids which acts as a catalyst for the removal of So_2.

Ragi (Eleusine coracana) seed is collected from fields. It consist of fibres which act as catalyst for the removal ofSO2.Hence it is considered as good adsorbent for the the removal osf SO_2.

Pine apple (Ananas cosmosus) peel powder is a waste material collected from fields. It consists of cellulose and Hemi cellulose. The cellulosic material present in that waste is responsible for complete adsorption of SO2 in the present stud

CONCLUSION

It is necessary for the environmental researcher to control the ill effects caused by air pollution for survival of the mankind. So the present study has helped to control the air pollution caused by SOx. Among eight different adsorbents studied, Mango bark dust proved to be the most effective adsorbent of SO2 from aqueous solution of SO2. Thus, our study proves that the effect of harmful chemicals like SOx can be reduced by using naturally available waste materials like Mango bark dust, Orange peel powder, Neem bark dust, Custard apple leaf powder, Neem leaf powder, Horse gram seed powder, Ragi seed powder and mixed algae. Hence, this study provides an economic solution for cleaning up environmental pollutant SOx and it is recommended to use these adsorbents in industries.

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