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Adsorption Studies on Alum sludge

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ABSTRACT

Sulphur dioxide (SO_2) gas is colourless with a pungent smell and is efficiently absorbed in upper respiratory tract. Lacrimation, rhinorrhoea, cough, bronchial secretion and bronchoconstriction occur at high concentrations of SO_2. The combustion of fossil fuels and power generation is a major source of SO_2 gas in the environment. The present study deals with the experimental investigations carried out for controlling SO_2 gas by alum sludge. It was found that the amount of gas adsorbed by alum sludge is 100% at low concentrations and 89% at high concentrations. The experiments are conducted with respect to contact time, with respect to particle size, with respect to initial concentration of SO_2, and with respect to alum sludge dosages.

Key words: Adsorption, Alum sludge, Sulphur dioxide, Bronchoconstriction

INTRODUCTION

SO_2 is very harmful and its effects may be felt at the source and extended to the far places. SO_2 pollution is becoming an international problem. Today one of the wonders of world, Taj Mahal is slowly dying and pleading before its right to survive. Taj Mahal is losing its luster and developed yellow spots at various places on its translucent white surface. Many scientists and environmentalists found that the greatest polluter causing damage to the Taj Mahal has been refinery at Mathura which has started functioning in the early 1980's and which is releasing SO_2. By studying all the ill effects caused by SO_2 Alum sludge is selected as adsorbent for the removal of SO_2 by adsorption techniques. [(1-4)]

MATERIALS AND METHODS

SELECTION OF ADSORBENT:

Alum sludge is the waste material obtained from water works department. The adsorbent selected satisfy the requirement such as low-cost, safety to use, thermally stable and handling this material is very easy. It can be used in fixed bed through which gas flow and it is not changed during the process. In many waste treatment plants, aluminum and Iron salts such as Aluminum sulphate, Ferric sulphate and ferric chloride are used. These salts are acting as coagulants. These coagulants forms aluminum hydroxide flocs entrap the solid particles. These solid particles of aluminum hydroxide are used as adsorbent for controlling sulphur dioxide. For the present studies adsorption techniques are selected because SO_2 gas and it is incombustible and it is present in very low concentrations. The adsorption experiments are carried out with respect to Contact time between adsorbate and adsorbent with respect to initial concentration of SO2, with respect to Alum sludge (adsorbent) dosage.

EFFECT OF CONTACT TIME BETWEEN SO_2 AND ALUM SLUDGE

182 mg/m^3 of SO_2 gas is made to pass through the Alum sludge which is taken in a catalytic tube Batch adsorption experiment are carried out by placing the catalytic tube in a temperature controlled systems. The amount of the SO_2

gas adsorbed is determined at different intervals of time. The experiments are carried out with the different particle sizes i.e. 710mic, 500mic, and 250mic. The results are given in table I, II and III respectively.

EFFECT OF INITIAL SO_2 GAS CONCENTRATION:
To study the effect of initial concentration following experimental procedure is adopted various concentration of SO_2 gas diluted with N_2 gas is made to pass through the catalytic tube which is filled to with the fixed amount of adsorbent. The concentration of SO_2 gas determined before and after adsorption of SO_2 gas. The experiments are carried out at room temperature with the particle sizes of 710mic, 500mic, and 250mic. And the results are given in table- IV.

EFFECT OF ALUM SLUDGE DOSAGES:
The effect of alum sludge dosages on the removal of SO_2 gas is studied by passing SO_2 gas in to the various amount of adsorbent taken in the column. The experiments are performed for particles 500mic and 250mic, and the results are given in table- V and VI.

RESULTS AND DICUSSION

Table – I Variation of contact time between Alum sludge and SO_2 (710mic)

Particle size : 710mic
Volume of SO2 gas : 100ml
Amount of Alum sludge : 0.8gms
Surface area : 67.6 cm2

S.NO	Contact Time (min)	Initial conc. (mg/ m^3)	Final conc. (mg/ m^3)	Amount of Gas adsorbed (mg/ m^3)	%Removal	%Removal For 1sq.cm
1.	10	182.0	91.0	91.0	50.0	0.7396
2.	20	182.0	72.8	109.2	60.0	0.8875
3.	30	182.0	62.4	119.6	66.0	0.9763
4.	40	182.0	13.3	168.7	92.8	1.3727
5.	50	182.0	5.5	176.5	97.0	1.4363

Table – II Variation of contact time between Alum sludge and SO_2 gas (500mic)

Particle size : 500mic
Volume of SO2 gas : 100ml
Amount of Alum sludge : 0.8gms
Surface area : 90cm2

S.NO	Contact Time(min)	Initial conc. (mg/ m^3)	Final conc. (mg/ m^3)	Amount of Gas adsorbed (mg/ m^3)	%Removal	%Removal For sq.cm
1.	10	182.0	83.7	98.2	54.0	0.6000
2.	20	182.0	65.4	116.6	64.0	0.7111
3.	30	182.0	56.4	125.6	69.0	1.3040
4.	40	182.0	10.9	171.1	94.0	1.0440
5.	50	182.0	0	182.0	100.0	1.1111
6.	60	182.0	0	182.0	100.0	1.1111

Table – III Variation of contact time between Alum sludge and SO_2 gas (250mic)

Particle size : 250mic
Volume of SO2 gas : 100ml
Amount of Alum sludge : 0.8gms
Flow rate : 60ml/min

S.NO	Contact Time(min)	Initial conc. (mg/ m^3)	Final conc. (mg/ m^3)	Amount adsorbed (mg/ m^3)	%Removal	%Removal With 1sq.cm
1.	10	182.0	72.8	109.2	60.0	0.3255
2.	20	182.0	78.2	123.8	68.0	0.3665
3.	30	182.0	54.6	127.4	70.0	0.3768
4.	40	182.0	3.6	178.5	98.0	0.5268
5.	50	182.0	0	182.0	100.0	0.5376
6	60	182.0	0	182.0	100.0	0.5376

Figure – I: Variation of contact time between alum sludge and SO_2

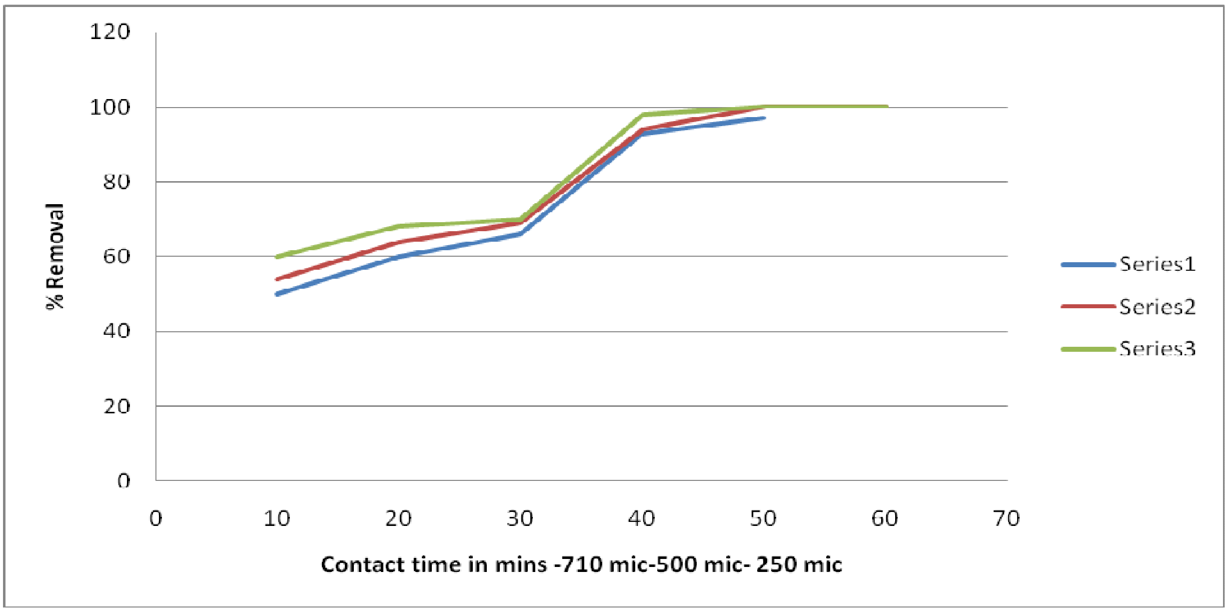


Table – IV Variation of initial concentration of SO_2 on Alum sludge

Amount of Alum sludge : 0.6gms
Flow rate : 60ml/min
Volume : 250 ml

S.NO	Initial conc. (mg/m^3)	% Removal With 710mic	% Removal with 500mic	% Removal with 250mic
1	26.0	100.0	100.0	100.0
2	52.0	100.0	100.0	100.0
3	78.0	100.0	100.0	100.0
4	104.0	82.0	100.0	100.0
5	130.0	75.0	100.0	100.0
6	156.0	69.0	96.0	98.0
7	182.0	54.0	93.0	90.0
8	204.0	48.0	87.0	90.0
9	236.0	39.0	83.6	86.0
10	260.0	39.0	84.0	89.0

Figure – II: Variation of initial concentration of SO_2

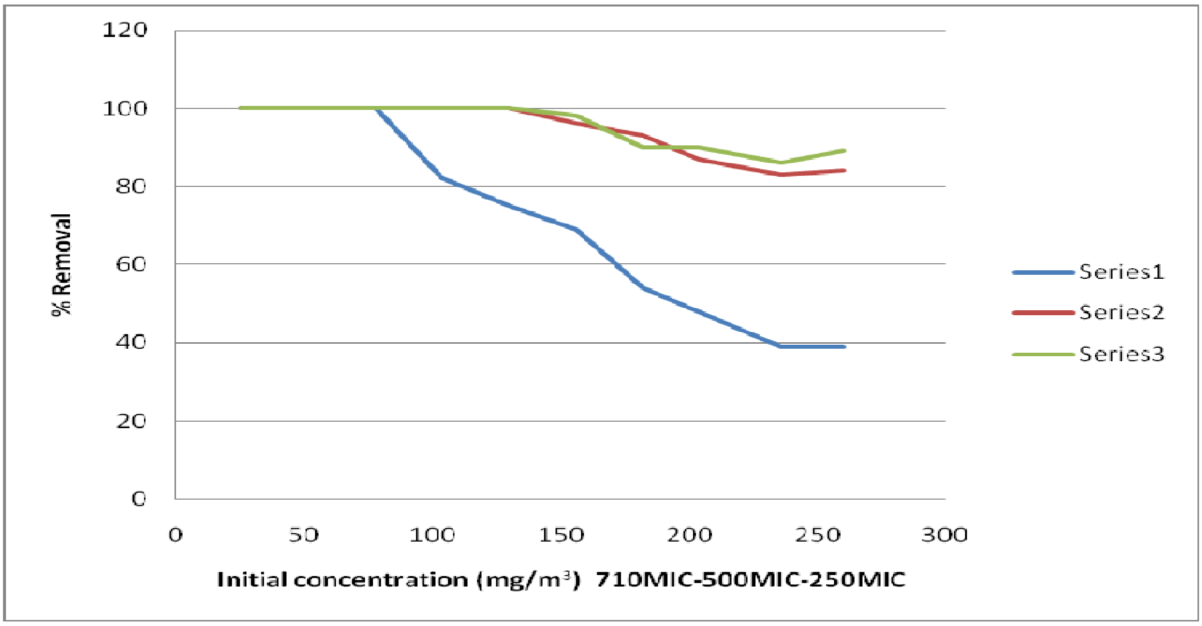


Table – V Variation of Alum sludge dosages (on 500mic)

Amount of SO_2 : 250 ml
Flow rate : 60ml/min
Particle size : 500 mic

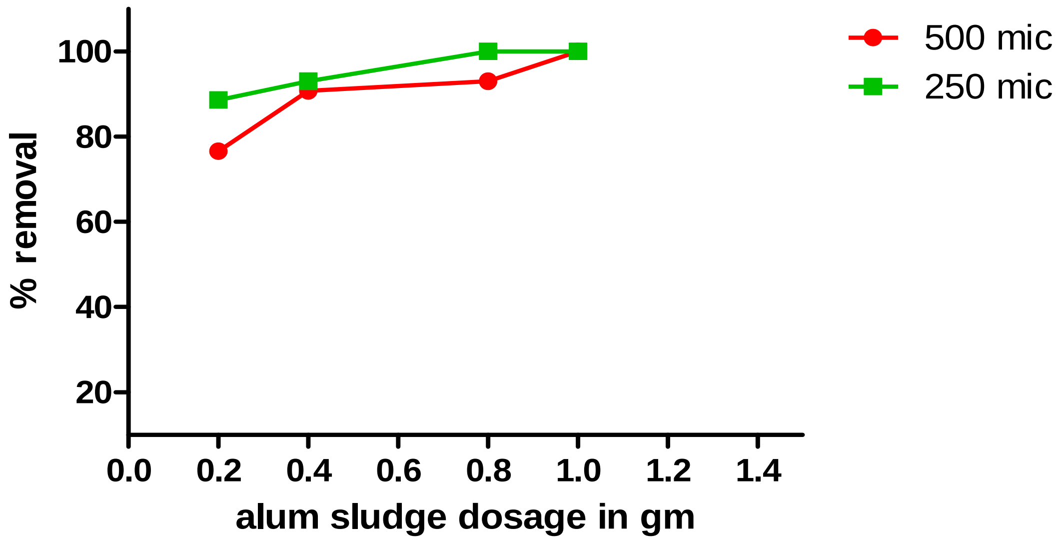
S.NO	Initial conc. (mg/m^3)	% Removal With 0.4gms	% Removal With 0.2gms	% Removal With 0.4gms	% Removal With 0.6gms
1	26.0	88.0	100.0	100.0	100.0
2	52.0	87.0	100.0	100.0	100.0
3	78.0	83.8	100.0	100.0	100.0
4	104.0	83.4	94.0	100.0	100.0
5	130.0	80.6	92.0	96.0	100.0
6	156.0	76.6	90.8	93.0	100.0
7	182.0	82.8	89.2	87.1	98.7
8	204.0	65.0	87.2	87.8	97.7
9	234.0	61.1	75.0	88.4	97.7
10	260.0	47.0	57.0	84.0	96.0

Table – VI Variation of Alum sludge dosages (on 250mic)

Amount of SO2 : 250 ml
Flow rate : 60ml/min
Particle size : 250mic

S.NO	Initial conc. (mg/m^3)	% Removal With 0.2gms	% Removal With 0.6ms	% Removal With 0.8gms	% Removal With 1.0gms
1	26.0	100.0	100.0	100.0	100.0
2	52.0	100.0	100.0	100.0	100.0
3	78.0	100.0	100.0	100.0	100.0
4	104.0	100.0	100.0	100.0	100.0
5	130.0	100.0	100.0	100.0	100.0
6	156.0	88.6	93.0	100.0	100.0
7	182.0	76.0	93.0	96.0	96.0
8	204.0	73.0	85.0	96.0	96.0
9	234.0	64.0	80.0	94.0	94.0
10	260.0	59.0	63.0	94.0	94.0

Figure- III: Variation of adsorbent dosage on SO_2



The optimum contact time for the adsorption of So_2 by Alum sludge is 50 min. The percentage removal of So_2 increased with increase in contact time. The initial rise in the curve is due to vacant space on the surface of adsorbent; once it reaches the equilibrium the line in the graph becomes parallel to x-axis. The curve indicates the adsorption of So_2 follows a smooth curve indicating unimolecular layer formation. It follows first order kinetics. The percentage removal of So_2 increased with particle size which is observed in fig1.

Fig-2 and table IV indicates that percentage removal of SO_2 decreased with increase in concentration. The percentage removal is more at lower concentration compared to higher concentration. It is due to few So_2 molecules. The fig also indicates that as the particle size decreases the percentage removal is more at all concentrations.

Fig- 2 and table IV, V and table VI indicates that the percentage removal of SO_2 increased with dosage for 500mic is 0.4gms and for 250mic 0.2gms. The percentage removal is rapid at the beginning which is slowed as the dosage is increased. These phenomena can be explained on the basis of the establishment of equilibrium between alum sludge and SO_2 gas

CONCLUSION

In the present studies the Aluminum hydroxide is reacting with the SO_2 gas. The chemical adsorption is taking place between So_2 and Alum sludge that from the present study it is observed Alum sludge is best and cheapest adsorbent for controlling $SO_{2.}$

REFERENCES

[1] Moreira , R.F.P.M . Peruch, M.G and Kunnen, N.C Braz., *J. Chem.eng* 15(1), **1998**, 78-84.
[2] Kimura Ireno.y Concalves Jr. Affonso, C. Stolbero *Polimeros* **1999**, 9(3), 51-57.
[3] Agarwal, A and Sahu, K.K *Adsorption science and technology* **2004**, 22(2), 107-118.
[4] Montes, S. Valero. G. Morles.S, Vilches, R.M Schmidt *J. Chil.chem.soc*. **2003**, 48(4), 9324-9717
[5] ElisaneLonghinotti, Fabiola Pozza, Ligia Furlan, Maria De Naarre de m sanchez., Marilene Klung, Mauro G.M, Larenjeira and Valfredo, T. Favero. *J. Braz., chem..,soc*, **1998**, 9(5), 435-440
[6] Maaya. A.K. *Journal of corrosion science and engineering* **2002**, 3, 8850-8858.
[7] Segoe, R.D. Madison Soil Science Society of America **2002**,
[8] Isabel Achaerandio, Vesselina Pachova, Carme GUell and Francisco Lopez *Am. J. Enol. Vatic*, **2001**, 52(2), 122-126.
[9] Guin, R. , Das, S.K and Saha , S.K Oldenbourg, *Radiochimica Acta* **2002**, 53-56
[10] Ahmed, A.L., Bhatia, S Ibrahim. N and Sumathi.S *Brazilian Journal of chemical engineering* **2005**, 22(3), 371-379
[11] Goel Jyothsna Kadirvelu Raja Gopal Chitra, Gurg Vinod Kumar *Journal of chemical technology and biotechnology* **2005**, 80(4), 469-476.