



ISSN 0975-413X
CODEN (USA): PCHHAX

Der Pharma Chemica, 2017, 9(7):54-56
(<http://www.derpharmachemica.com/archive.html>)

Study on Adsorption Capability of Locally Available Adsorbents for the Removal of Iron Impurities from Crude Sodium Sulphide

Jyotsna Agarwal*

MS Ramaiah School of Advanced Studies, Bangalore, India

ABSTRACT

The paper discusses the adsorption ability of precipitated barium sulphate and dolomite for the ferri/ferrous impurities found in commercial grade sodium sulphide. Due to the presence of iron impurities, later chemical is not suitable for the manufacture of pharmaceutical grade chemicals and dyes chemicals. Author had carried out experiments for the usage of both the adsorbents (separately) in different proportions in aqueous solution of crude sodium sulphide. Results are quite promising and can be reasonably valuable for barium industries.

Keywords: Sodium sulphide, Adsorption, Barium sulphate, Dolomite

INTRODUCTION

Sodium sulphide, a commercially important compound is a major by-product of barium industries. It is broadly used in tanneries, dyestuff, textile industries, pharmaceutical grade chemicals etc. The is most extensive use is in the depilation of hides for leather before tanning, wood pulp processing, desulfuration of rayon and cellophane, elastomers, lubrication, and organic compounds [1-7]. Presence of iron impurities even in traces adversely affects its cost and applications especially in manufacture of pharmaceutical grade chemicals and dyes. Thus to improve the cost and quality of crude sodium sulphide by reducing the iron impurities, author tried several adsorbents.

Present investigations are restricted to confer the adsorbability of precipitated barium sulphate and dolomite for the removal of iron contents from crude sodium sulphide. Experimental work was carried out by using precipitated barium sulphate and dolomite as adsorbents. It was found that they acted as fairly strong adsorbents.

Selection of adsorbents

Precipitated barium sulphate had been chosen purposefully since it is readily available as a by-product of barium ore processing. It also possess large specific surface area which plays an important part in the adsorption process [1,2,5,8-9].

Literature seems to be silent about usage of dolomite as an adsorbent for the removal of iron contents from commercial sodium sulphide. Author had selected it as a trial keeping in mind the tendency of phosphate materials to absorb iron contents on account of formation of insoluble layers of iron phosphates over them through the residual valencies of crystal faces. Dolomite, a double carbonate mineral of $\text{CaMg}(\text{CO}_3)_2$ is a potential inexpensive and readily available adsorbent with a structure of alternative layers of calcite and magnesite [10]. Many studies showed that dolomite have the potential to act as an adsorbent [11-16].

Results obtained from experimental investigations prove that precipitated barium sulphate and powdered dolomite both acted as strong adsorbents. Both the adsorbents even in less quantity (as small as 1%) are sufficient to reduce iron contents from 1.50 mg to 0.10 mg which amounts to a very smooth and convenient removal of iron to the extent of 0.005% or even less from the iron contaminated solution of sodium sulphide.

MATERIALS AND METHODS

Experiments were conducted to investigate the adsorbability of precipitated barium sulphate and dolomite for iron contents present in commercial crude sodium sulphide and materials used for study were procured from the following sources.

Sodium sulphide (crude commercial product)

The supernatant solution obtained after soda ash treatment of barium sulphide extract contained sodium sulphide as the main by-product. This supernatant solution on evaporation gave flakes of crude sodium sulphide, which is usually contaminated with iron contents. The crude sodium sulphide was prepared by the author in the lab by carbothermal reduction of barite.

Potassium thiocyanate solution

20 g of AR Potassium thiocyanate was dissolved in 100 ml of distilled water.

Potassium permanganate solution

2 g of Potassium permanganate AR was dissolved in 50 ml of distilled water and volume was made up to 1 L.

HCl (4N)

36 ml of pure conc. HCl was added into 50 ml of distilled water and volume was made up to 100 ml.

Preparation of sample solutions

5 g of sodium sulphide (iron contaminated) was dissolved in 100 ml of distilled water. In each solution different amounts of precipitated barium sulphate and dolomite (1, 5, 10, 15 and 20% by weight of sodium sulphide) were added separately. The solutions were warmed slightly (up to 30-40°C) on low heat with vigorous shaking for 15 min and filtered. In the filterers 25 ml of conc. AR HCl was added. To expel the excess of acid, the solutions were evaporated nearly too dry state. The residues obtained were diluted with water. To oxidise the iron to the ferric state, a dilute solution of potassium permanganate was added in the above solution till it became slightly pink in appearance. The volume of the solutions was made up to 250 ml with double distilled water. From these solutions, estimation of iron was done as per the standard procedures [17-21].

To find out the percentage of iron contents in treated sodium sulphide, known amount of 50 ml sample solution was placed in a Nessler cylinder. To the above solution 5 ml of potassium thiocyanate solution and 2-4 ml of 4 N-HCl were added. In another Nessler tube containing 50 ml of double distilled water, all the above reagents were added and the standard iron solution was run from the burette till the colors matched. Calculations were made according to the available Indian Standards [17-21].

RESULTS AND DISCUSSION

Comparative adsorbability of iron contents by precipitated barium sulphate and dolomite as an adsorbent in varying amounts is shown in Figure 1.

Effect of adsorbent dosage

The amount of precipitated barium sulphate and dolomite (separately) were varied from 0.0 g to 1.00 g in several samples of sodium sulphide solution. Each solution contained 5 g of sodium sulphide.

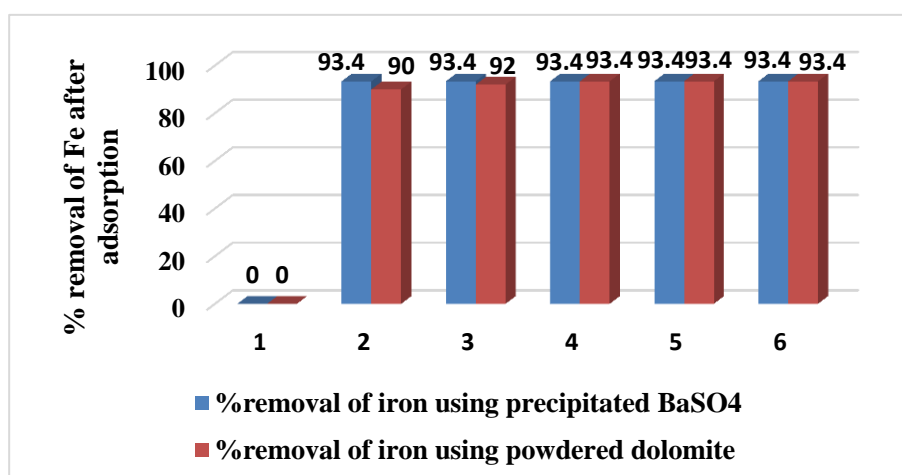


Figure 1: Comparative percentage removal of Iron by using precipitated barium sulphate and powdered dolomite as an adsorbent

Precipitated barium sulphate as an adsorbent

As expected, results with precipitated barium sulphate were quite favorable. This might be due to the formation of oppositely charged colloidal systems by iron and precipitated barium sulphate in the solution. After stirring these solutions, a gelatinous co-precipitate is coagulated which is easily filterable and therefore can be removed by filtration. It is important to note that according to the above proposed mechanism, elimination of iron contents should be improved further by increasing the surface area of precipitated barium sulphate and efficiency of filtration.

Powdered dolomite as an adsorbent

Adsorption of iron contents from crude sodium sulphide using dolomite as an adsorbent can be explained on the basis that in finely divided state dolomite provides a large surface area which leaves a large number of residual free valencies. Iron contents interact with the surface through these residual valencies to form an almost insoluble layer of iron phosphates over dolomite [22-24]. Thus a sort of chemisorption takes place and a remarkable decrease in the levels of iron is expected.

CONCLUSION

Precipitated barium sulphate and powdered dolomite are good adsorbents for removal of iron from crude sodium sulphide even in very minute amounts. Main advantage is that dolomite is a low cost and readily available mineral whereas precipitated barium sulphate is a major by-product of the barium industry itself. By using only 1% (by weight, of sodium sulphide) of both i.e., precipitated barium sulphate and powdered dolomite, the amount of iron reduces from 1.50 mg to 0.10 mg in crude sodium sulphide.

REFERENCES

- [1] K. Othmer *Encyclopaedia Chem. Technol.*, John Wiley & Sons, NY, USA, **1978**, vol. II.
- [2] K. Othmer, *Encyclopaedia Chem. Technol.*, John Wiley & Sons, NY, USA, **1978**, vol. XVIII.
- [3] C. Roland Francis, *Anesthesiol.*, NIHMSID: NIHMS502852, **2011**, 115(5), 1012-1021.
- [4] K. Othmer, *Encyclopaedia Chem. Technol.*, John Wiley & Sons, NY, USA, **1978**, vol. XIX.
- [5] R. Shereve Norris, *Chem. Proc. Industries.*, McGraw hill book Company, New York, **1976**, 3rd edn.
- [6] A. Esehie, *Br. J. Pharmacol.*, **2009**, 158, 1442-1453.
- [7] J. Mitchell, N. Best, L.E. Sundstrom, H.V. Wheal, PMID: 8468197, *Histrochemical*, **1993**.
- [8] Kirk, Othmer, *Encyclopaedia Chem. Technol.*, John Wiley & Sons, NY, USA, **1978**, vol. I.
- [9] H. Perry Roberts, C. Chilton, *Chem. Eng. Handbook.*, McGraw Hill, NY, USA, **1973**.
- [10] J.A. Thomas, J.M. Longo, *Chem. Geol.*, **1993**, 109, 201-213.
- [11] P.V. Brady, J.L. Krumhansl, H.W. Papenguth, *Geochimica et Cosmochimica Acta*, **1996**, 60, 727-731.
- [12] S.J. Allen, B. Koumanova, *J. Univ. Chem. Technol. Metallurgy.*, **2005**, 40, 175-192.
- [13] A. Godelitsas, *J. Radioanal. Nuc. Chem.*, **2007**, 272(2), 339-344.
- [14] G. Walker, L. Hansen, J.A. Hanna, S.J. Allen, *Wat. Res.*, **2003**, 37, 2081-2089.
- [15] A.B. Albadarin, C. Mangwandi, A.a.H. Al-Muhtaseb, G.M. Walker, S.J. Allen, M.N.M. Ahmad, *Chem. Eng. J.*, **2012**, 179, 193-202.
- [16] G.M. Walker, G. Connor, S.J. Allen, **2004**, 82, 961-966.
- [17] IS 297, Specification for sodium sulphide-technical? New Delhi, Indian Standards Institution: 2001.
- [18] IS 915, Specification for one mark volumetric flasks? New Delhi, Indian Standards Institution: 2001.
- [19] IS 4161, Specification for Nessler Cylinders. New Delhi, Indian Standards Institution: 2001.
- [20] IS 1997, Specification for Burettes. New Delhi, Indian Standards Institution: 2001.
- [21] A.I. Vogel, *Quantitative Inorganic Analysis*, Longman, NY, USA, **1966**.
- [22] M. Irani, *Chem. Eng. J.*, **2011**, 178, 317-323.
- [23] S. Kocaoba, *J. Hazard. Mat.*, **2007**, 147, 488-496.
- [24] E. Pehlivan, *J. Hazard. Mat*, **2009**, 167, 1044-1049.