Pak. J. Sci. Ind. Res. 2004 ***47****(2) 163 - 165*

Studies on Sodium Sulphide Prepared from Sodium Sulphate

Hajra Masood* and Lal Khan

National Physical and Standard Laboratory, 16, H/9, Islamabad, Pakistan

(Received January 22, 2002; accepted November 13, 2003)

The aim of this investigation was to prepare purified sodium sulphide which is utilized for multiple purposes. The reaction between commercial sodium sulphate and coal gives sodium sulphide and various products. The effect of reaction temperature and maximum composition were studied to establish the optimum conditions for maxium yield. The reaction is found suitable for large scale production of sodium sulphide from commercial sodium sulphate.

Key words**:** Commercial sodium sulphate, Coal, Sodium sulphide.

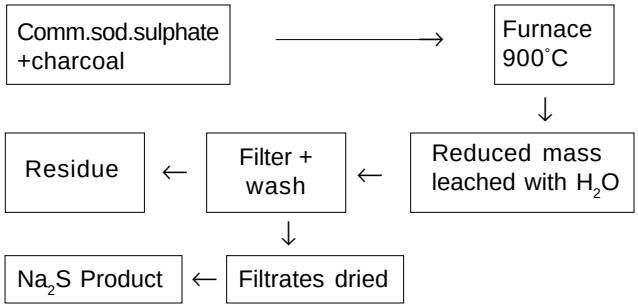
Indroduction

The alkali and alkaline earth sulphides are colorless, whereas, the heavy metal sulphides are usually deep colored. Sodium sulphide has attained a very important position in the chemical industry (Meraw-Hill 1987; Lide 1996). It is used as a reducing agent and to dissolve cellulose ester in the manufacture of pigments and also used in drugs and drug intermediate industries. (Huheey *et al* 1993). It is main ingredient in dying of textiles. Sulfur dyes are applied from dye bath containing sodium sulfide which gives good to moderate light fastness and good fastness at low cost and rapid processing and also as a solvent for water insoluble dyes. Sodium sulphide plays a very important role of a chemical compound used in liming and in manufacturing of lubricating oil and production of heavy water used for atomic power plants (Greenwood and Earnshaw 1997). In the production of pulp and paper, it is main component to maintain the sodium balance of the mill, the oxygen stage normally uses the oxidized white liquor and sodium sulphide has been oxidized to thiosulphate. In rubber industry, its main area of application is of vulcanizing agent in processing. It is also used in tanneries for dehairing because sulphide of sodium provides stronger alkalinity but less sulphidity than hydrosulphides.

In froth flotation, it is usually used to separate one solid from another, for solid-liquid separation, as in dissolved air flotation and for liquid-liquid separation as in foam fractionation and in flotation of sulphide ores. (Huang and Ling 2001). The mining industry uses sodium sulphide to form (insoluble) metal sulphide of copper, lead and molybdenum. The same raction is used to remove heavy metals like copper cadmium, mercury, lead from wastes water in many industries because of toxicity their concentration must be reduced to very low levels. (Krik Othmer 1983; Cotton *et al* 1999).

*Author for correspondence. E-mail: drhajra@yahoo.com

In kraft wood pulping process, the sulphide is used as cooking liquor. Other uses include the preparation of lubrication of oil and the production of polysulphide elastomer and plastics (Krik Othmer 1983).



Flow diagram of sodium sulphide

Materials and Methods

General procedure. Sodium sulphide was prepared by mixing known quantity of commercial sodium sulphate with known quantity of coal and heating in furnace at known temperature. The reaction product was crushed into course fragments and leached with water, filtered and the clear solution was evaporated to dryness. The light yellowish gray color dehydrated sodium sulphide was formed. The reaction involved in Na_2S production is as follow (Brady and Clauser 1986).

$$Na_2SO_4 + 2C = Na_2S + 2CO$$

The yield of sodium sulphide (Na_2S) was calculated by taking a known weight from the dried Na_2S product and titrating it again sodium sulphate and I_2 using starch as an indicator (Vogel 1987).

Results and Discussion

The present work demonstrates the optimum conditions for the preparation of sodium sulphide from commercial sodium

sulphate by varying the temperature, time period of heating and the ratio of commercial sodium sulphate and charcoal. The discussion follows:

a) The effect of temperature on maximum recovery of sodium sulphide was noted by raising the temperature from 650˚C to 1000˚C, the maximum yield have been obtained as shown in Table 1and Fig 1 at 900˚C and further increase in temperature is not important.

b) The effect of charcoal on maximum recovery of sodium sulphide from commercial sodium sulphate was studied by varying proportions of charcoal used for maximum recovery of sodium sulphide. The maximum yield obtained was shown

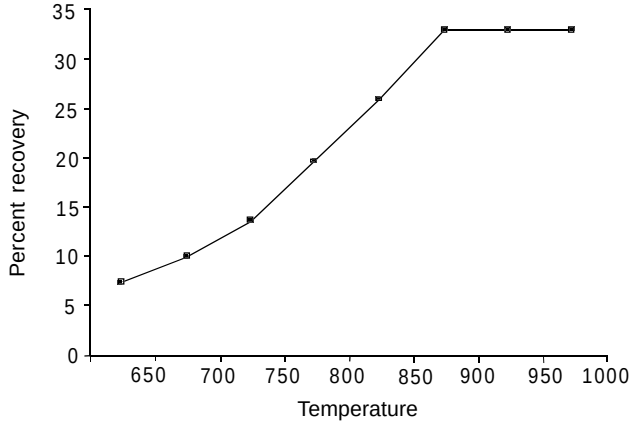


Fig 1. Effect of temperature on maximum recovery of sodium sulphide.

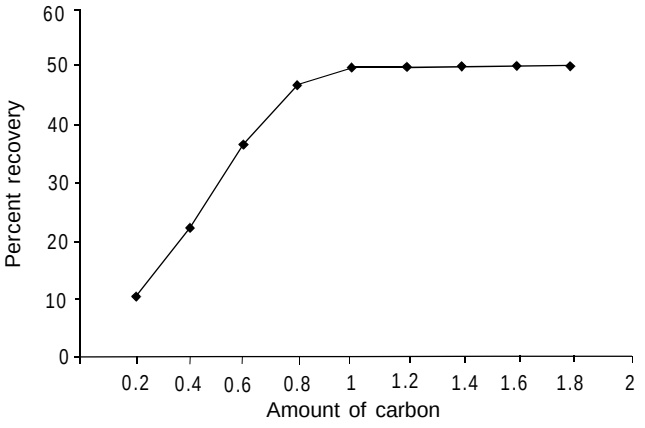


Fig 2. Effect of carbon on maximum recovery of sodium sulphide.

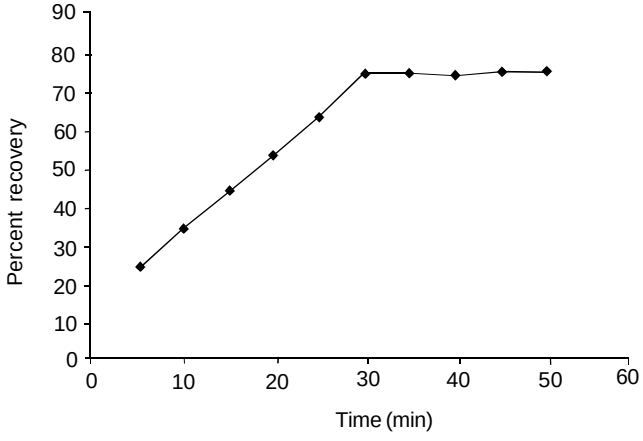


Fig 3. Effect of time on maximum recovery of sodium sulphide.

Table 1
Effect of temperature on maximum recovery of sodium sulphide

Sodium sulphate + Charcoal (g)	Temperature (˚C)	Recovery of sodium sulphide (%)
1:1	650	7.40
1:1	700	9.90
1:1	750	13.50
1:1	800	19.60
1:1	850	25.90
1:1	900	32.90
1:1	950	32.88
1:1	1000	32.89

Table 2
Effect of charcoal on recovery of sodium sulphide

Sodium sulphate (g)	Charcoal (g)	Ratio	Sodium sulphide (%)
2.0	0.20	1:0.1	10.00
2.0	0.40	1:0.2	22.00
2.0	0.60	1:0.3	36.10
2.0	0.80	1:0.4	46.20
2.0	1.00	1:0.5	49.10
2.0	1.20	1:0.6	49.08
2.0	1.40	1:0.7	49.09
2.0	1.60	1:0.8	49.10
2.0	1.80	1:0.9	47.05

Table 3
Effect of time on maximum recovery of sodium sulphide

Sodium sulphate + Charcoal	Time (min)	Recovery (%)
2:1	05	25.50
2:1	10	36.20
2:1	15	46.30
2:1	20	56.50
2:1	25	66.70
2:1	30	78.88
2:1	35	78.72
2:1	40	77.95
2:1	45	78.80

in Table 2 and Fig 2, in the ratio of 1:0.5 is more appropriate for maximum yield.

c) The effect of time from 5 - 40 min at a temperature 900°C was observed to get maximum extraction. The time was noted 30 min for the maximum recovery of sodium sulphide as shown in Table 3 and Fig 3. Further increase in time doesn't raise more yield.

Conclusion

Sodium sulphide of metallurgical grade was obtained by the reaction of commercial sodium sulphate with charcoal (ratio 1:0.5) at a temperature of 900°C. The reaction was completed in 30 min. The maximum recovery by 79.1% was found. The commercial sodium sulphate appears to be amenable to processing for the extraction of metallurgical sodium sulphide, as per experimental procedure given above.

References

Brady C 1986 *Material Hand Book.*Donnslley & Sons, New York, USA, 12th ed, pp 794, 795.

Cotton F A, Wilkinson G, Murillo C A, Bochmann M 1999 *Advance Inorganic Chemistry,* John Wiley & Sons, UK, pp 189 - 194.

Greenwood N N, Earnshaw A 1997 *Chemistry of the Elements.* Butterworth-Heinemann Formate, UK, 2nd ed.

Huheey J E, Keiter E A, Keiter R L 1993 *Inorganic Chemistry: Principles of Structure and Reactivity.* Harper Collins, New York, USA, 4th ed.

Huang K, Ling J 2001 Fundamentals in minerals. In: *Proceedings on 4th UBC - Mc Gill International Symposium.* McGill University, Canada, 217.

Krik O 1983 *Encyclopedia of Chemical Technology.* **2** 256, 258.

Lide D R 1996 *Chemical Rubber Company: Handbook of Chemistry and Physics.* CRC Press, Boca Raton, Florida, USA, 77th ed.

Meraw-Hill 1987 *Encyclopedia of Science and Technology.* **17** 558.

Vogel A I 1987 *Text Book of Quantitative Inorganic Analysis.* revised by J Bassett and Coworkers, London, UK, 4th ed. pp 384 - 385.