

SULPHUR AND PYRITES



# Indian Minerals Yearbook 2022

(Part- III : MINERAL REVIEWS)

61<sup>st</sup> Edition

**SULPHUR AND PYRITES**

**(ADVANCE RELEASE)**

**GOVERNMENT OF INDIA  
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# 46 Sulphur and Pyrites

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Sulphur is an essential raw material for many chemical industries and is essentially used for the production of sulphuric acid which in turn is used for the production of chemical fertilizers, textiles, dyestuffs, pickling and galvanising of steel, storage batteries, refining of petroleum, explosives and other acids.

In India, presently there are no mineable elemental sulphur reserves. Sulphur combines directly with almost all the elements with the exception of gold, platinum and the noble gases. In its native form, sulphur is a yellow crystalline solid. It can be found as a pure element or as sulphate or sulphide minerals. The crystallography of sulphur is complex. Depending on the specific conditions, the sulphur allotropes form several distinct crystal structures, with rhombic and monoclinic  $S_8$  best known.

Pyrites is naturally occurring mineral comprised of the elements iron and sulphur ( $FeS_2$ ). It is used for manufacture of sulphuric acid, and as direct feed for soil conditioning. Pyrite is a fairly ubiquitous mineral and it occurs most commonly in sedimentary rocks. Pyrite has a brass yellow colour, brownish black streak, metallic lustre and occurs as cubic crystals. Pyrites includes a range of sulphide materials, such as, marcasite, pyrite and pyrrhotite. Marcasite usually occurs in low temperature metasediments and sedimentary rocks. Pyrrhotite occurs usually in magmatic or contact metasomatic deposits associated with basic igneous rocks and high temperature sulphide veins and is often nickeliferous. Pyrites was used as a substitute for sulphur in the manufacture of sulphuric acid. However, there was no production of pyrites since 2003.

Native sulphur deposit has been reported in Puga Valley of Leh district in the Union Territory of Jammu & Kashmir. The grade of the deposit ranges from 9% to 24% of sulphur. Small occurrences of native sulphur are also reported from Barren Island of Bay of Bengal. Sulphur along

with hot springs were reported from various parts of Chamoli, Rudraprayag, Uttarkashi, etc. districts in Garhwal & Kumaun divisions of Uttarakhand. In Andhra Pradesh, native sulphur occurs in granular form with clay and silt in coastal areas of Krishna and East Godavari districts. Occurrences are also reported from Alappuzha district of Kerala and Kangra district of Himachal Pradesh.

Sulphide occurs naturally in mineral ores, oil and coal deposits. Natural waters containing elevated concentrations of hydrogen sulphide are used for therapeutic baths and have been consumed for medical purposes. Hydrogen sulphide ( $H_2S$ ), which exists as a colourless gas under normal conditions, has a characteristic odour of rotten eggs and occurs naturally in coal, natural gas, oil, volcanic gases and sulphur springs and lakes;  $H_2S$  is a central participant in the sulphur cycle, the biogeochemical cycle of sulphur on earth. Sulphides form an indispensable link in the sulphur cycle (the reversible interconversion of sulphide and sulphate) in nature.

Petroleum refineries and gas processing plants extract  $H_2S$  when making "clean fuels" and use it as a feed stock to produce sulphur and water. The domestic production of elemental sulphur is limited to by-product recoveries from petroleum refineries and fuel oil used as feedstock for manufacturing fertilizer. Tar sands-natural sand (Oil sands) formations contain about 10% bitumen and with high hydrogen sulphide content.

The sulphide ores contain sulphur and during the production of metal from sulphide ores, sulphur is released as  $SO_2$  which is used to produce sulphuric acid. The sulphuric acid thus produced contains about 32.7% of sulphur and contributes in the industries which otherwise would have used elemental sulphur.

## RESERVES/ RESOURCES

The total reserves/ resources of pyrites in the country as per NMI data, based on UNFC

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system as on 1.4.2020 has been placed at 1,674 million tonnes. There are no reserves and all resources are grouped under 'Remaining Resources' category. Out of these, about 27 million tonnes are under Feasibility (STD211) category.

Out of the total resources, Beneficiable grade resources are 62 million tonnes, Low grade 1,555 million tonnes and Soil Reclamation grade resources are about 6 million tonnes. The balance of about 51

million tonnes resources fall under Unclassified/Not-known grades. Major reserves/resources are located in Bihar (94%) and Rajasthan (5%) (Table - 1).

Reserves/resources of sulphur (native) have been estimated in the Inferred (STD333) category only. Entire resources are located in Jammu & Kashmir and are placed at 0.21 million tonnes as on 1.4.2020 as per NMI data, based on UNFC System (Table-2).

**Table – 1 : Reserves/Resources of Pyrites as on 1.4.2020 (P)  
(By Grades and States)**

(In '000 tonnes)

Grade/State	Reserves Total (A)	Remaining Resources					Total (B)	Total (A+B)
		Feasibility STD211	Pre- feasibility STD222	Measured STD331	Indicated STD332	Inferred STD333		
<b>All India : Total</b>	–	27129	32597	9590	77729	1527356	1674401	1674401
<b>By Grades</b>								
Soil Reclamation	–	–	3000	–	–	3024	6024	6024
Beneficiable	–	27129	29597	–	–	4902	61628	61628
Low	–	–	–	9590	26310	1519430	1555330	1555330
Unclassified	–	–	–	–	51419	–	51419	51419
<b>By States</b>								
Andhra Pradesh	–	–	–	–	–	880	880	880
Bihar	–	13462	9680	–	51419	1500000	1574561	1574561
Himachal Pradesh	–	–	–	–	–	2560	2560	2560
Karnataka	–	–	–	–	–	3000	3000	3000
Rajasthan	–	13667	22917	9590	26310	18392	90876	90876
Tamil Nadu	–	–	–	–	–	24	24	24
West Bengal	–	–	–	–	–	2500	2500	2500

*Figures rounded off*

**Table – 2 : Reserves/Resources of Sulphur (Native) as on 1.4.2020 (P)  
(By Grades and States)**

(In '000 tonnes)

Grade/State	Reserves Total (A)	Remaining Resources					Total (B)	Total (A+B)
		Feasibility STD211	Pre- feasibility STD221	Measured STD331	Indicated STD332	Inferred STD333		
<b>All India : Total</b>	–	–	–	–	–	210	210	210
<b>By Grades</b>								
Sulphur (Native)	–	–	–	–	–	210	210	210
<b>By States</b>								
Jammu & Kashmir	–	–	–	–	–	210	210	210

*Figures rounded off*

## PRODUCTION

### Sulphur (Only relates to Public Sector)

The production of Sulphur recovered as by-product from fertilizer plant and oil refineries were 881 Thousand Tonnes in 2021-22 as against 737 Thousand Tonnes in the preceding year.

The oil refineries in public sector reported production of Sulphur. During the year 2021-22, Indian Oil Corp. Ltd. contributed about 72.8% of the total production during the year. Among the states, Orissa accounted for 24% of the total Sulphur production and it was followed by Kerala 21%, Haryana 20%, Gujarat 13%, West Bengal 8%, Uttar Pradesh 7%, Maharashtra 6%, and remaining production was contributed by Bihar and Assam.

In addition, refineries of Hindustan Petroleum Corp. Ltd, RIL and Essar Oil also reported recovering of by-product sulphur which in turn is used as feedstock in manufacturing fertilizers and pharmaceuticals. The Vadinar refinery of Essar Oil Ltd is also reported to produce by-product sulphur. In Fertilizer Industry, the sulphuric acid is further used for manufacturing phosphoric acid and single superphosphate (SSP) from rock phosphate (Tables - 3 to 5).

### Pyrites

Pyrites Phosphates and Chemicals Ltd (PPCL) had two pyrites production units located at Amjhore (Bihar) and Saladipura (Rajasthan) besides phosphorite division in Dehradun. The Government approved closure and hiving off of these two units in July 2002 and Amjhore unit in June 2003 and since then no activity is reported.

### Petroleum Refining

In fossil fuels, sulphur is naturally present as an impurity when fuel is burnt, the sulphur is released as sulphur dioxide — an air pollutant. Hydrodesulfurisation (HDS) is a catalytic chemical process widely used to remove sulphur from natural gas and from refined petroleum products, such as, gasoline or petrol, jet, fuel, kerosene, diesel and fuel oils. Sulphur is a by-product produced in various refineries processing high sulphur crude oil. Sulphur is produced from the sulphur-rich fuel gas as a process to reduce the emission level of sulphur in

the atmosphere along with flue gases from the furnaces. Mathura refinery started production of sulphur from beginning itself and sulphur recovery units have been provided in Haldia, Koyali, Panipat, Mathura and Guwahati refineries.

Refinery-wise Sulphur (by-product) production capacity of Indian Oil Corporation Ltd is as under:

Unit	Production Capacity ('000 MTPA)
Mathura	48.0
Haldia	24.0
Koyali	18.0
Panipat	144.0
Barauni	12.0
Guwahati	0.6

Specification of sulphur at Mathura, Panipat, Koyali, Haldia, Barauni & Guwahati refineries is as under:

### Property

Purity	99.9
Colour	Yellow
Shape	Lump

**Table - 3 : Principal Producers of By-product Sulphur, 2021-22**

Name & address of producer	Location of plant/refinery	
	State	District(s)
Indian Oil Corporation Ltd, (Refineries Division), Scope Complex, Core-II, 7, Institutional Area, Lodhi Road, New Delhi -110 003.	Assam	Kamrup Metro, Tinsukia, Chirang
	Bihar	Begusarai
	Gujarat	Vadodara
	Haryana	Panipat
	Odisha	Jagatsinghpur
	Uttar Pradesh	Mathura
	West Bengal	Purba Medinipur
Numaligarh Refinery Limited, 122S, G. S. Road, Christianbasti, Distt- Guwahati, Assam - 781 005.	Assam	Golaghat
Bharat Petroleum Corporation Ltd, Bharat Bhavan, 4 & 6, Currimbhoy Road, Ballard Estate, Mumbai-400 001, Maharashtra	Maharashtra Kerala	Mumbai Ernakulam

*Note: Sulphur is recovered as by-product from fertilizer plants and oil refineries (excluding units working under Private Sector)*

**Table – 4 : Production of Sulphur (By-product)  
2019-20 to 2021-22  
(By States)** (In tonnes)

State	2019-20	2020-21	2021-22 (P)
<b>India</b>	<b>900942</b>	<b>737337</b>	<b>880858</b>
Assam	5955	6447	6545
Bihar	6843	7135	8160
Gujarat	97107	82450	117588
Haryana	170907	138025	178740
Kerala	227253	142166	182352
Maharashtra	55659	41375	53165
Odisha	253697	209387	207831
Uttar Pradesh	47955	54234	60307
West Bengal	35566	56118	66170

(P): Provisional

**Table – 5 : Production of Sulphur (By-product)  
2020-21 and 2021-22  
(By Sectors/States/Districts)** (In tonnes)

State/District	2020-21		2021-22 (P)	
	No. of units	Quantity	No. of units	Quantity
<b>India/ Public sector</b>	<b>12</b>	<b>737337</b>	<b>12</b>	<b>880858</b>
<b>Assam</b>	<b>4</b>	<b>6447</b>	<b>4</b>	<b>6545</b>
Chirang	1	1523	1	1678
Tinsukia	1	246	1	169
Kamrup Metro	1	218	1	372
Golaghat	1	4460	1	4326
<b>Bihar/ Begusarai</b>	<b>1</b>	<b>7135</b>	<b>1</b>	<b>8160</b>
<b>Gujarat/ Vadodara</b>	<b>1</b>	<b>82450</b>	<b>1</b>	<b>117588</b>
<b>Haryana/ Panipat</b>	<b>1</b>	<b>138025</b>	<b>1</b>	<b>178740</b>
<b>Kerala/ Ernakulam</b>	<b>1</b>	<b>142166</b>	<b>1</b>	<b>182352</b>
<b>Maharashtra/ Mumbai</b>	<b>1</b>	<b>41375</b>	<b>1</b>	<b>53165</b>
<b>Orissa/ Jagatsinghpur</b>	<b>1</b>	<b>209387</b>	<b>1</b>	<b>207831</b>
<b>Uttar Pradesh/ Mathura</b>	<b>1</b>	<b>54234</b>	<b>1</b>	<b>60307</b>
<b>W. Bengal/</b>				
Purba Medinipur	1	56118	1	66170

(P): Provisional

## USES

### Flowers of Sulphur (sublimed sulphur)

Powdered form of sulphur produced by sublimation process that which may contain up to 30% of the amorphous allotrope are generally used in rubber vulcanisation, agricultural dusts, pharmaceutical products and stock feeds.

### Sulphur dioxide (SO<sub>2</sub>)

Sulphur dioxide is a by-product gas generated during processing of sulphide ores as well from other industries. It is used in many industrial processes such as, chemical preparation, refining, pulp-making and solvent extraction and also is the feed stock to manufacture sulphuric acid. Sulphur dioxide is also used in the preparation and preservation of food because it prevents bacterial growth and browning of fruit.

### Sulphuric Acid

Sulphuric acid is a strong mineral acid with the formula H<sub>2</sub>SO<sub>4</sub>. It is soluble in water at all concentrations. Sulphuric acid has many applications and is produced in greater amounts than any other chemical besides water. Principal uses include ore processing, fertilizer manufacturing, oil refining, waste water processing and chemical synthesis.

### Miscellaneous

One of the direct uses of sulphur is in vulcanisation of rubber. Sulphur is a component of gunpowder. It reacts directly with methane to give carbon disulphide, which is used in the manufacturing of cellophane and rayon.

Elemental sulphur is mainly used as a precursor to other chemicals. Most of the sulphur is converted to sulphuric acid (H<sub>2</sub>SO<sub>4</sub>), which is of prime importance to the world economy.

The production and consumption of sulphuric acid are an indicator of a nation's industrial development. The principal use of sulphuric acid is in the manufacture of phosphatic fertilizer.

Other applications of sulphuric acid include oil refining, waste water processing and mineral extraction. Sulphur compounds are also used in detergents, fungicides, dyestuffs and agrichemicals. In silver based photography, sodium and ammonium thio-sulphate are used as "fixing agents". Sulphites, derived from burning sulphur, are used to bleach paper. They are also used as preservatives in dried fruit and processed fruit products.

Sulphur is used as a light-generating medium in the rare lighting fixtures known as "sulphur lamps". The sulphur lamp is a highly efficient full-spectrum electrodeless lighting system whose light is generated by sulphur plasma that has been excited by microwave radiation.

Nitrogen (N), phosphorus (P) and potassium (K) are critical components of a well-fertilized crop. But to achieve yields and more nutritious foods, crops need sulphur (S). It improves protein and oil percentage in seeds, cereal quality for milling and baking, marketability of dry coconut kernel (copra), quality of tobacco, nutritive value of forages, etc. It is associated with special metabolisms in plant and the structural characteristics of protoplasm. Judicious application in sulphur-deficient soils is a cost-effective way to produce more food and feed.

Concrete binder made with sulphur is an eco-efficient alternative to conventional Portland cement for paving stones, sidewalks and building foundations. In road construction, sulphur technology can replace up to 30 per cent of asphalt binder, a high energy-intensive input in blacktop roads. Sulphur-enhanced roads and parking lots offer a longer life cycle.

## INDUSTRY

Coromandel International Ltd, formerly Coromandel Fertilizers Limited (CFL), is a leading manufacturer of a wide range of fertilizers & pesticides. Manufacturing units are located at Vizag, Kakinada and Ennore. The plants have the flexibility to produce 13 products from multiple rock and acid combinations. The environmental concerns have been incorporated in the development of its products and produces Sulphur enhanced fertiliser grades, 24-24-0-8S & 20-20-0-13S are manufactured.

The present production facility of the Fertilizers and Chemicals Travancore Limited (FACT) includes manufacture of 3,30,000 metric tonnes per annum of sulphuric acid of Cochin Division. During the financial year 2020-21, FACT has started trading of Chemicals including Sulphuric Acid. Civil foundation work is in progress for construction of two Sulphuric Acid storage tank (5000 metric tonnes) at FACT Cochin Division. During the year 2021-22 **Udyogamandal Complex** produced 186192 metric tonnes of Factomfos, as compared to 215444 metric tonnes in the previous year. In Cochin Division, during the year 2021-22, the division produced 284495 metric tonnes of Sulphuric Acid as compared to 2986620 metric tonnes of Sulphuric Acid in the year 2020-21. Sulphur, a raw Material for Sulphuric Acid production, used in fertilizer production is sourced from refineries, is a by-product from crude processing. At present Company has a tie-up with BPCL-Kochi Refinery for sourcing about 60% of its annual requirement minimising import. Company also import Sulphuric Acid to meet its requirement for fertiliser production, mainly from metallurgical industry, where it is a waste / by-product during processing.

As per the Annual Report 2021-22 of Gujarat State Fertilizers & Chemical Limited, Company is considering to set up 600 metric tonnes per day Sulphuric Acid Plant on LSTK basis at Vadodara Unit. The company is considering to install 1800 MTPD Sulphuric Acid Plant at Sikka Unit. To expand GSFC's Agro-product portfolio, company is Considering to enter into organic fertilizers by setting up 2x200 MTPD Phosphate Rich Organic Manure (PROM) plant at Polymer unit by using available existing infrastructure.

HZL produce 98 % concentrated Sulphuric Acid at Chanderia, Debari and Dariba plants in the state of Rajasthan. The production capacity of Dariba plant and Chanderia plant is 0.6 million tonnes annually, while production capacity of Debari plant is 0.3 million tonnes annually. Sulphuric Acid is used in production of Single Super Phosphate Fertilizers/ Zinc Sulphate/Phosphoric Acid/LABSA for detergent/Chemical Gypsum for Cement Industries/ Metal Industry/Speciality Chemicals/ Dyes etc. for all spectrum of Industries.

## TRADE POLICY

Imports of sulphur of all kinds other than sublimed sulphur, precipitated sulphur and colloidal sulphur under Heading No. 2503 are allowed free under the Foreign Trade Policy (FTP), 2015-20. Similarly, the imports of unroasted iron pyrites under Heading No. 2502 are allowed free.

## World Review

Of the 14 countries that produced more than 1 million tonnes of sulphur, 12 obtained the majority of their production as recovered elemental sulphur. These 14 countries produced 88% of the total sulphur produced worldwide.

The world sulphur industry was composed of two sectors—discretionary and nondiscretionary. In the discretionary sector, the mining of sulphur or pyrites is the sole objective; this voluntary production of either sulphur or pyrites (mostly naturally occurring iron sulphide) is based on the mining of discrete deposits, with the objective of obtaining as nearly a complete recovery of the resource as economic conditions permit. In the nondiscretionary sector, sulphur or sulphuric acid is recovered as an involuntary byproduct; the quantity of output is subject to demand for the primary product and environmental regulations that limit atmospheric emissions of sulphur compounds irrespective of sulphur demand. Discretionary sources (Frasch, native, and pyrites), once the primary sources of sulphur in all forms, represented only 8% of the sulphur produced worldwide in 2018.

The Frasch process is the term for hot-water mining of native sulphur associated with the caprock of salt domes and in sedimentary deposits; in this mining method, the native sulphur is melted underground with superheated water and brought to the surface by compressed air. The United States, where the Frasch process was developed early in the 20th century, was the leading producer of Frasch sulphur until 2000. Poland, with 660,000 tonnes, was the only country that produced more than 300,000 tonnes of native sulphur by using either the Frasch process or conventional mining methods. Small quantities of native sulphur were produced in Asia, Europe, and South America. The importance of pyrites to the world sulphur supply has significantly decreased; China and Finland were the top producers of sulphur from pyrites with China accounting for 86% of the world pyrite production.

Native sulphur production, including production of Frasch sulphur at Poland's last operating mine, was estimated to be about the same as that in 2017.

Recovered elemental sulphur production and byproduct from metallurgy was slightly higher than that in 2017. Globally, production of sulphur from pyrites was estimated to have been the same as that in 2017. Pyrites is a less attractive alternative to elemental sulphur for sulphuric acid production, primarily because the environmental remediation cost of mining pyrites is high.

## Canada

Ranked fifth in the world in sulphur production, Canada was one of the leading sulphur and sulphuric acid exporters. In 2018, sulphur production, in all forms, in Canada was slightly lower than that in 2017. About 80% of Canada's sulphur was recovered at natural gas and oil sands operations in Alberta; some sulphur was recovered from oil sands operations in Saskatchewan, petroleum refineries in other parts of the country, and as byproduct sulphuric acid from metallurgy. Canada's sulphur production was expected to remain stable over the medium term and may increase during the long term as a result of expanded oil sands production.

Environment and Climate Change Canada (2019) published information on Canada's sulphur emissions in 2017, which indicated a 9% decrease from those in 2016 and a 69% decrease from those in 1990. Sulphur emissions in Canada have declined as the result of improved sulfur recovery technology at nonferrous metal smelters but also as a result of reduced emissions from coal-fired, electric-power-generating utilities and plant closures, as well as a reduction in emissions from the petroleum-refining sector. Further decreases in sulphur emissions were achieved through the implementation of low-sulphur fuel standards.

## China

China was the leading global producer of sulphur in all forms and the leading producer of pyrites, with about 25% of its sulphur in all forms coming from that source. The country was the leading sulphur importer with a total of about 11 millions tonnes, which was about one-third of global trade. Imports represented 55% to 60% of elemental sulphur consumption in China, the bulk of which was used to manufacture sulphuric acid. China's Ministry of Transport announced the expansion of its coastal Emission Control Areas to encompass China's entire coastline. Beginning January 1, 2020, all large vessels would be required to burn bunker fuels with 0.5% sulphur content and smaller vessels would be required to use bunker fuels with 10 parts per million sulphur when the vessels were inland waterways. The policy also required seagoing vessels to use bunker fuels with 0.1% sulphur when entering inland waterway areas in China.

## SULPHUR AND PYRITES

**Table – 6 : World Production of Sulphur & Pyrites  
(By Principal Countries)**

	In tonnes (sulphur content)		
Country	2019	2020	2021
<b>World: Total (Pyrites)</b>	<b>6400000</b>	<b>5900000</b>	<b>5600000</b>
<b>World: Total (Frash)</b>	<b>600000</b>	<b>400000</b>	<b>400000</b>
<b>World: Total (Recovered)</b>	<b>78500000</b>	<b>72600000</b>	<b>71100000</b>
<b>World: Total (Sulphur ore)</b>	<b>100000</b>	<b>50000</b>	<b>50000</b>
Austria			
Recovered (a)	*44000	*44000	*44000
Belarus			
Recovered (a)	65043	64336	*64000
Belgium(Recovered) <sup>(b)(a)</sup>	*400000	*400000	*400000
Bosnia & Herzegovina			
Recovered	*3700	*3700	*3700
Bulgaria			
Recovered (b)	414503	*420000	*420000
Recovered (a)	*60000	*60000	*60000
Croatia			
(Recovered)(a)	12640	8618	8659
Czech Republic			
(Recovered)(a)	*22000	*25000	*23000
Denmark			
(Recovered)(a)	3554	4140	4090
Finland			
Pyrites	233000	194000	182000
(Recovered)(b)	327300	358700	338400
(Recovered)(a)	*130000	*120000	*120000
France			
(Recovered)(a)	*370000	*370000	*370000
(Recovered)(c)	*55000	*55000	*55000
Germany			
(Recovered)(a)	460012	353293	382049
(Recovered)(c)	280660	213398	235769
Greece			
(Recovered)(a)	*330000	*330000	500000
Hungary			
(Recovered)(a)	*54000	*54000	*54000
Italy			
(Recovered)(d)	550000	*550000	*550000
Lithuania			
(Recovered)(a)	86041	71247	72988
Netherlands			
(Recovered)(b)	*86000	*90000	*90000
(Recovered)(a)	510000	*510000	*500000
Norway			
(Recovered)(b)	72900	73187	70948
(Recovered)(a)	*22000	*22000	
Poland			
Frasch	568240	422380	449100
(Recovered)(b)	*280000	*280000	*280000
(Recovered)(a)	25200	24740	24240

(contd)



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Country	2019	2020	2021
Portugal			
(Recovered)	*21000	*21000	*21000
Romania			
(Recovered)	*42000	*42000	*42000
Russia			
Pyrites	*71000	*71000	*71000
(Recovered)(a)	*6700000	*6100000	*6400000
(Recovered)(c)	*954000	*954000	*954000
Sulphur ore	57427	*28000	*28000
Serbia			
(Recovered)(b)	*29400	*29400	*29400
Slovakia			
(Recovered)(b)	*4900	*4900	*4900
(Recovered)(a)	*85300	*85300	*85300
Sweden			
(Recovered)(b)	178401	165500	172700
(Recovered)(a)	50021	39085	38248
Turkey			
Pyrites	173731	46408	39681
(Recovered)(a)(c)	*72900	*72900	*95300
United Kingdom			
(Recovered)(a)	130000	106000	107000
Algeria			
(Recovered)(a)	*10000	*10000	*10000
Egypt			
(Recovered)(a)	*80000	*80000	*8000
Morocco			
(Recovered)	*60000	*60000	*60000
Namibia			
(Recovered)	72923	81500	65500
South Africa			
(Recovered)(b)(a)	919624	575491	32044
Zambia			
(Recovered) (b)	960200	*1000000	*1000000
Canada			
(Recovered) (b)	520000	554746	*555000
(Recovered)(a)	6418000	4349262	4329112
Cuba			
(Recovered)	3234	3176	2846
(Recovered)(a)	*20000	*20000	*20000
Mexico			
(Recovered) (b)	*556000	*556000	*556000
(Recovered)(a)	364967	264078	176321
Trinidad & Tobago			
(Recovered)(a)	*10000	*10000	*10000
USA			
(Recovered) (b)	596000	*520000	*600000
(Recovered) (a)	8110000	*7600000	*7500000

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Country	2019	2020	2021
Argentina (Recovered) (b)	*20000	*20000	*20000
Brazil Pyrites	*20000	*20000	*20000
Recovered (b)	*292000	*292000	*292000
Recovered (a)	*239000	*239000	*239000
Chile (Recovered) (b)	1263119	1476154	1400388
Colombia (Recovered) (a)	*7000	*7000	*7000
Ecuador (Recovered) (a)(e)	*5000	*5000	*5000
Peru (Recovered) (d)	*556000	*556000	*556000
Venezuela (Recovered) (a)	*155000	*100000	*100000
Bahrain (Recovered) (a)	*120000	*120000	*120000
China Pyrites	*5900000	*5610000	*5300000
(Recovered)	*11600000	*11390000	*11000000
India (Recovered) (b)(f)	*1200000	*1200000	*1200000
(Recovered) (a)(f)	900942	737337	*723350
Indonesia (Recovered) (b)	*160000	*160000	*160000
(Recovered) (a)	*120000	*120000	*120000
Iran (Recovered) (d)	*2200000	*2200000	*1640000
Iraq (Recovered) (a)	*6792000	*5858000	*5823000
Israel (Recovered) (a)	70973	45184	43664
Japan (Recovered) (b)	1629656	1728654	1575032
(Recovered) (a)	1629365	1411860	1420094
Jordan (Recovered) (a)	*490000	*490000	*490000
Kazakhstan (Recovered) (b)	*604000	*604000	*604000
(Recovered) (a)	*2625000	*2484000	*2490000
Korea, Rep. of (Recovered) (b)	*1078000	*1078000	1078000
(Recovered) (a)	1999000	2000000	2000000
Kuwait (Recovered) (a)	*860000	*780000	*785000
Oman (Recovered) (a)	*48000	*48000	*48000
Pakistan (Sulphur ore)	20715	*20000	19398
Philippines Recovered) (b)	*169000	*169000	*169000
(Recovered) (a)	*2000	*2000	*2000

SULPHUR AND PYRITES

Country	2019	2020	2021
Qatar			
(Recovered) (a)	*1648500	*1593900	*1539700
Saudi Arabia			
(Recovered) (a)	*3700000	*3500000	*3400000
Singapore			
(Recovered) (a)	*300000	*300000	*300000
Syria			
(Recovered) (a)	*1500	*1500	*1500
Taiwan			
(Recovered)	195358	167336	192227
Thailand			
(Recovered) (a)	*205000	168526	147669
Turkmenistan			
(Recovered) (a)	*363000	*299000	*348000
UAE			
(Recovered) (a)	*2523000	*2318000	*2300000
Uzbekistan			
(Recovered) (b)	*131000	*131000	*131000
(Recovered) (a)	*81000	*61000	*78000
Australia			
(Recovered) (b)	*810000	*810000	*810000
(Recovered) (a)	*90000	*90000	*90000
New Zealand			
(Recovered) (a)	*35000	*35000	*35000

**Source:** BGS, *World Mineral Production, 2017-2021*

*a: From petroleum refining and/or natural gas*

*b: From metal sulphide processing*

*c: Other; d: Sulphur, all forms*

*e: Including Frasch*

*f: Years ended 31<sup>st</sup> March following that stated.*

**\*\* India's production of Sulphur (by-product) during 2018-19, 2019-20 and 2020-21, was 8,90,400 tonnes, 9,00,942 tonnes and 7,37,337 tonnes respectively.**

**\* Estimated**

**FOREIGN TRADE****Exports**

Exports of sulphur (excluding sublimed, precipitated and colloidal) increased to 12,90,620 tonnes in 2021-22 as compared to 8,02,713 tonnes in the preceding year. Exports were mainly to China (96%), Jordan and Morocco (2% each). On the other hand, exports of sulphur (sublimed, precipitated and colloidal) increased marginally by 12% to 17,607 tonnes in 2021-22 as compared to 15,756 tonnes in the preceding year. Exports were mainly to USA (15%), Indonesia & Netherlands (10% each), Brazil & Thailand (8% each) & Russia (7%) (Tables-7 to 11). Exports of sulphur (sublimed) increased to 17,607 tonnes in

**Table – 7 : Exports of Sulphur (Excl. Sublimed, Precipitated & Colloidal) : Total (By Countries)**

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
<b>All Countries</b>	<b>802713</b>	<b>4328627</b>	<b>1290620</b>	<b>21010530</b>
China P Rp	777803	4142691	1233483	19687695
Jordan	10000	37541	28500	696561
Morocco	-	-	21000	351372
Turkey	126	9396	829	59435
Sri Lanka Dsr	1069	18026	1361	39319
Tanzania Rep	183	3394	1068	33377
Nepal	836	12303	764	24554
Djibouti	169	3452	730	21996
Oman	40	1649	1348	16962
U Arab Emts	620	28779	209	10599
Other countries	11867	71396	1329	68662

Figures rounded off

2021-22 as compared to 15,765 tonnes in 2020-21 & export of sulphur precipitated was negligible in both the year 2020-21 and 2021-22.

**Imports**

Imports of sulphur (excluding sublimed, precipitated and colloidal) increased by 30% to 1.89 million tonnes in 2021-22 from 1.46 million tonnes in the previous year. Imports were mainly from Qatar (32%), UAE (25%), Oman (15%), Saudi Arabia (11%), Kuwait (9%), Japan & Iraq (2% each). Imports of sulphur (sublimed, precipitated and colloidal) increased by 11% to 959 tonnes in 2021-22 from 862 tonnes in the previous year. Imports were mainly from Taiwan (81%), Malaysia & China (5% each), Germany (4%), Belgium & Republic of Korea (2% each), and each (Tables-12 to 16). Imports of sulphur (sublimed) & precipitated were at 893 tonnes & 39 tonnes respectively.

**Table –8 : Exports of Sulphur (Sublimed, Precipitated & Colloidal) : Total (By Countries)**

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
<b>All Countries</b>	<b>15756</b>	<b>1777105</b>	<b>17607</b>	<b>1941916</b>
Netherlands	3367	413979	1699	212919
USA	2475	260094	2667	282792
Brazil	1317	143832	1338	146605
Indonesia	1378	141906	1728	183822
Russia	1237	136992	1230	124625
Thailand	1308	133794	1336	146119
Italy	789	97743	940	107934
South Africa	757	95890	1112	134059
Spain	605	68631	904	88319
Portugal	528	62421	840	99572
Other countries	1995	221823	3813	415150

Figures rounded off

## SULPHUR AND PYRITES

**Table – 9: Exports of Sulphur (Colloidal)  
(By Countries)**

Country	2020-21 (R)		2021-22 (P)	
	Quantity (t)	Value (₹'000)	Quantity (t)	Value (₹'000)
<b>All Countries</b>	++	<b>9</b>	++	<b>9</b>
Singapore	++	3	++	4
Korea Rp	-	-	++	4
Brunei	-	-	++	1
Spain	++	4	-	-
China P Rp	++	1	-	-
Taiwan	++	1	-	-

*Figures rounded off***Table – 10 : Exports of Sulphur (Sublimed)  
(By Countries)**

Country	2020-21 (R)		2021-22 (P)	
	Quantity (t)	Value (₹'000)	Quantity (t)	Value (₹'000)
<b>All Countries</b>	<b>15754</b>	<b>1776553</b>	<b>17607</b>	<b>1941891</b>
Netherlands	3367	413979	1699	212919
USA	2475	260094	2667	282792
Brazil	1317	143832	1338	146605
Indonesia	1378	141906	1728	183822
Russia	1237	136992	1230	124625
Thailand	1308	133794	1336	146119
Italy	789	97743	940	107934
South Africa	757	95890	1112	134059
Spain	605	68627	904	88319
Portugal	528	62421	840	99572
Other countries	1993	221275	3813	415125

*Figures rounded off*

## SULPHUR AND PYRITES

**Table-11 : Exports of Sulphur (Precipitated)  
(By Countries)**

Country	2020-21 (R)		2021-22 (P)	
	Quantity (t)	Value (₹'000)	Quantity (t)	Value (₹'000)
<b>All Countries</b>	<b>2</b>	<b>543</b>	<b>++</b>	<b>16</b>
Sri Lanka Dsr	++	302	-	-
Haiti	2	239	-	-
Swaziland	++	2	-	-
Ecuador	++	++	-	-
Greece	-	-	++	1
Quatar	-	-	++	3
Egypt A Rp	-	-	++	16
UAE	-	-	+	+

*Figures rounded off***Table – 12-: Imports of Sulphur (Excl. Sublimed, Precipitated & Colloidal): Total  
(By Countries)**

Country	2020-21 (R)		2021-22 (P)	
	Quantity (t)	Value (₹'000)	Quantity (t)	Value (₹'000)
<b>All Countries</b>	<b>1463291</b>	<b>10948268</b>	<b>1895211</b>	<b>35362092</b>
Qatar	781580	5767576	613000	12587182
UAE	227627	1436414	477998	7701252
Oman	150573	1417055	287017	5282758
Saudi Arabia	71251	519179	210168	3792684
Kuwait	93341	654667	169333	3400845
Japan	44899	319478	47997	947759
Iraq	-	-	39087	659967
Singapore	38195	363098	19499	424202
Bahrain Is	44943	354667	16442	276271
Namibia	-	-	9507	160186
Other countries	10882	116134	5163	128986

*Figures rounded off*

SULPHUR AND PYRITES

**Table – 13: Imports of Sulphur (Sublimed, Precipitated & Colloidal): Total  
(By Countries)**

Country	2020-21 (R)		2021-22 (P)	
	Quantity (t)	Value (₹'000)	Quantity (t)	Value (₹'000)
<b>All Countries</b>	<b>862</b>	<b>191861</b>	<b>959</b>	<b>335922</b>
Taiwan	345	104365	779	297938
Belgium	9	3541	18	7450
Malaysia	22	2744	48	6832
Korea Rp	95	13776	15	5867
China P Rp	50	6633	44	4779
Netherland	-	-	6	2833
Germany	15	5309	36	5710
Japan	4	1036	5	1837
Vietnam Soc Rep	1	793	2	1641
Indonesia	-	-	6	587
Other countries	321	53664	++	448

*Figures rounded off*

**Table – 14: Imports of Sulphur (Precipitated)  
(By Countries)**

Country	2020-21 (R)		2021-22 (P)	
	Quantity (t)	Value (₹'000)	Quantity (t)	Value (₹'000)
<b>All Countries</b>	<b>9</b>	<b>1568</b>	<b>39</b>	<b>6196</b>
Japan	4	990	3	854
Germany	5	578	36	5273
Uk	-	-	++	8
USA	-	-	++	61

*Figures rounded off*

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**Table – 15: Imports of Sulphur (Colloidal)  
(By Countries)**

Country	2020-21 (R)		2021-22 (P)	
	Quantity (t)	Value (₹'000)	Quantity (t)	Value (₹'000)
<b>All Countries</b>	<b>39</b>	<b>8477</b>	<b>27</b>	<b>10666</b>
Germany	9	3764	-	-
Belgium	9	3541	18	7450
Korea, Rep.	21	905	-	-
USA	++	159	++	1
UK	++	62	++	192
Japan	++	46	++	43
Netherlands	-	-	6	2833
Malaysia	-	-	3	147

*Figures rounded off*

**Table – 16: Imports of Sulphur (Sublimed)  
(By Countries)**

Country	2020-21 (R)		2021-22 (P)	
	Quantity (t)	Value (₹'000)	Quantity (t)	Value (₹'000)
<b>All Countries</b>	<b>814</b>	<b>181816</b>	<b>893</b>	<b>319060</b>
Taiwan	345	104365	779	297938
Slovenia	321	53018	-	-
Korea, Rep.	74	12871	15	5867
China, P Rp	50	6633	44	4779
Malaysia	22	2744	45	6685
Germany	1	967	++	437
Vietnam, Soc Rep	1	793	2	1641
USA	++	425	++	186
Japan	-	-	2	940
Indonesia	-	-	6	587

*Figures rounded off*

## FUTURE OUTLOOK

Worldwide recovered sulphur output is expected to increase as a result of higher sulphur recovery in the oil and gas sector. New sulphur supplies would mostly come from Kuwait, India, and Saudi Arabia.

Production from natural gas operations is expected to increase as more natural gas is recovered from shale formations as improved technologies reduce natural gas production costs. By-product sulphuric acid production in the United States has decreased by 36% since 2000. China's smelter acid production has nearly doubled in the past 10 years; however, the rate of increase had begun to slow.



## SULPHUR AND PYRITES

China has invested in new copper smelter capacity, Frasch sulphur and pyrites production, however, are unlikely to have significant long-term increases. Because of the continued increase in elemental sulphur recovery and by-product sulphuric acid production for environmental reasons, discretionary sulphur has become increasingly less important as demonstrated by the lack of expansion in the Frasch sulphur industry.

Pyrites, with significant direct production costs, are an even higher cost raw material for sulphuric acid production when the environmental

aspects are considered. Discretionary sulphur output is likely to decline. The decrease likely will be pronounced when large operations are closed for economic reasons. For the long term, sulphur and sulphuric acid likely will continue to be important in agricultural and industrial applications. Phosphate processing, mainly for agricultural uses, continues to be the dominant use of sulphuric acid (about 60%). Sulphuric acid are expanding in other industrial applications such as titanium dioxide pigment production in China and Europe and, caprolactam (used in the production of nylon 6 fibers manufacturing).