

73 Sulphur and Pyrites

In India, there are no mineable elemental sulphur reserves. Pyrites was used as a substitute for sulphur in the manufacture of sulphuric acid by M/s Pyrites Phosphates and Chemicals Ltd (PPCL). There was no production of pyrites since 2003.

The domestic production of elemental sulphur is limited to by-product recoveries from petroleum refineries and fuel oil used as feedstock for manufacturing fertilizer. In addition, during the production of non-ferrous metals from sulphide ores, sulphur is recovered in the form of by-product sulphuric acid. HZL and HCL together produced about 630,782 tonnes and 795,958 tonnes by-product sulphuric acid from indigenous lead-zinc and copper ores in 2006-07 and 2007-08, respectively, equivalent to about 205,000 tonnes and 259,000 tonnes of contained sulphur. In addition, about 1.9 million tonnes and 1.8 million tonnes sulphuric acid equivalent to 619,000 tonnes and 587,000 tonnes of sulphur was indigenously produced from imported copper and zinc concentrates as by-product by Sterlite Industries, Binani Zinc Ltd and Hindalco during 2006-07 and 2007-08, respectively. The total

production of sulphuric acid from sulphide ores was thus about 2.5 million and 2.6 million tonnes, respectively, equivalent to about 821,000 tonnes and 846,000 tonnes of sulphur during 2006-07 and 2007-08, respectively.

The sulphuric acid is further used for manufacturing phosphoric acid and single superphosphate (SSP) from rock phosphate imported from Jordan, Morocco, Togo, Egypt, Algeria, etc.

RESOURCES

Resources of sulphur (native) were estimated in the possible category. The resources are located in Jammu & Kashmir and are placed at 0.21 million tonnes as on 1.4.2005 as per UNFC System.

Total resources of pyrites in the country as per UNFC system as on 1.4.2005 are placed at 1,674 million tonnes of which about 57 million tonnes are under 'reserves' category. Out of the total resources, beneficiable grade resources are 62 million tonnes, low grade 1,553 million tonnes and soil reclamation grade resources are about 6 million tonnes. Major resources are located in Bihar and Rajasthan (Table - 1).

**Table - 1 : Reserves/Resources of Pyrites as on 1-4-2005
(By Grades and States)**

(In '000 tonnes)

Grade/State	Reserves			Remaining resources					Total resources (A+B)
	Proved STD111	Probable STD122	Total (A)	Pre- feasibility STD222	Measured STD331	Indicated STD332	Inferred STD333	Total (B)	
All India : Total	27129	29597	56726	3000	9590	77729	1527356	1617675	1674401
By Grades									
Soil Reclamation	-	-	-	3000	-	-	3024	6024	6024
Beneficiable	27129	29597	56726	-	-	-	4902	4902	61628
Low	-	-	-	-	9590	26310	1516870	1552770	1552770
Unclassified	-	-	-	-	-	51419	-	51419	51419
Not known	-	-	-	-	-	-	2560	2560	2560
By States									
Andhra Pradesh	-	-	-	-	-	-	880	880	880
Bihar	13462	6680	20142	3000	-	51419	1500000	1554419	1574561
Himachal Pradesh	-	-	-	-	-	-	2560	2560	2560
Karnataka	-	-	-	-	-	-	3000	3000	3000
Rajasthan	13667	22917	36584	-	9590	26310	18392	54292	90876
Tamil Nadu	-	-	-	-	-	-	24	24	24
West Bengal	-	-	-	-	-	-	2500	2500	2500

PRODUCTION & STOCKS

Sulphur

The production of sulphur recovered as by-product from fertilizer plants and oil refineries was at 227 thousand tonnes in 2007-08 as against 204 thousand tonnes in the preceding year. Besides, substantial quantity of sulphur is believed to be recovered from crude petroleum refining by Reliance Petroleum Ltd, data on which is not available.

Two fertilizer plants and seven oil refineries, all in public sector, reported production of sulphur during the year. Of the total quantity produced in 2007-08, Indian Oil Corp. Ltd contributed about 77% of the total production during the year under review. Haryana accounted for 48%, Tamil Nadu 20%, Uttar Pradesh 14%, West Bengal 8%, Gujarat 6% and the remaining 4% was contributed by Bihar, Punjab and Assam (Tables - 2 to 4).

Table - 2 : Producers of By-product Sulphur 2007-08

Name & address of producer	Location of plant/refinery	
	State	District
Indian Oil Corporation Ltd, (Refineries Division), Scope Complex, Core-II, 7, Institutional Area, Lodhi Road, New Delhi -110 003.	Bihar	Begusarai
	Gujarat	Vadodara
	Haryana	Panipat
	Uttar Pradesh	Mathura
	West Bengal	Midnapur
Chennai Petroleum Corp. Ltd, 536, Anna Salai, Teynampet, Chennai - 600 018.	Tamil Nadu	Chennai
National Fertilizers Ltd, Scope Complex, Core-III, 7, Institutional Area, Lodhi Road, New Delhi -110 003.	Haryana Punjab	Panipat Ropar

Table - 3 : Production of By-product Sulphur 2005-06 to 2007-08 (By States)

State	(In tonnes)		
	2005-06	2006-07	2007-08(p)
India	152090	204186	227311
Assam	22	259	224
Bihar	8262	7679	8150
Gujarat	13296	12887	13608
Haryana	31838	83659	108064
Punjab	3649	3721	3456
Tamil Nadu	43852	36721	44932
Uttar Pradesh	32201	37751	31673
West Bengal	18970	21509	17204

Table - 4 : Production of By-product Sulphur 2006-07 and 2007-08 (By Sectors/States/Districts)

State/District	(Qty. in tonnes)			
	2006-07		2007-08 (p)	
	No. of units	Quantity	No. of units	Quantity
India/Public sector	9	204186	9	227311
Assam/Guwahati	1	259	1	224
Bihar/Begusarai	1	7679	1	8150
Gujarat/Vadodara	1	12887	1	13608
Haryana/Panipat	2	83659	2	108064
Punjab/Ropar	1	3721	1	3456
Tamil Nadu/Chennai	1	36721	1	44932
Uttar Pradesh/Mathura	1	37751	1	31673
West Bengal/Midnapur	1	21509	1	17204

Pyrites

Pyrites, Phosphates and Chemicals Ltd (PPCL) was entrusted with the responsibility of exploiting country's pyrites deposits. The company 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 the Dehradun and Saladipura units in July 2002 and Amjhore units in June 2003. Hence, there was no production of pyrites since 2003.

APPLICATIONS & USES

Elemental sulphur is mainly used as a precursor to other chemicals. Approximately 85% is converted to sulphuric acid (H_2SO_4), which is of such prime importance to the world's economies that the production and consumption of sulphuric acid is an indicator of a nation's industrial development. Production of sulphuric acid during 2006-07 and 2007-08 was 7.16 million tonnes and 6.57 million tonnes, respectively. One of the principal uses for the sulphuric acid is in the production of phosphatic fertilizer. Other applications of sulphuric acid include oil refining, wastewater processing and mineral extraction.

One of the direct uses of sulphur is in vulcanisation of rubber. Sulphur is used in gunpowder which is a mixture of sulphur, charcoal and potassium nitrate. Sulphur is also used in fireworks. Sulphur reacts directly with methane to give carbon disulfide, which is used to manufacture cellophane and rayon. Sulphur compounds are also used in detergents, fungicides and dyestuffs.

Sulphites, derived from burning sulphur, are used to bleach paper and also as preservative 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.

CONSUMPTION

The total reported consumption of elemental sulphur in 2007-08 was about 1.71 million tonnes. The main consumer of sulphur was fertilizer industry which accounted for more than 75%. Chemical industry, the next important consuming industry, accounted for about 15% consumption for manufacturing carbon disulphide & dye-stuffs. Other industries like explosives, iron & steel, paint, paper, pesticides and sugar consumed about 10% (Table - 5).

**Table - 5 : Reported Consumption of Sulphur
2005-06 to 2007-08
(By Industries)**

Industry	(In tonnes)		
	2005-06	2006-07(R)	2007-08(p)
All Industries	1734300	1775500	1705700
Alloy steel	3600 (4)	3600 (4)	3600 (4)
Chemicals	260200 (31)	275000 (31)	264100 (31)
Explosives	1200 (2)	1200 (2)	1200 (2)
Fertilizers	1310900 (36)	1332400 (37)	1271100 (37)
Iron & steel	26400 (4)	33200 (4)	33300 (4)
Paint	2200 (2)	2200 (2)	2200 (2)
Paper	3900 (6)	4000 (7)	3900 (7)
Pesticides	25400 (6)	23400 (6)	25800 (6)
Pharmaceuticals	4100 (4)	4100 (4)	4100 (4)
Sugar ^c	95500(500)	95500(500)	95500(500)
Others (Abrasives, asbestos products, dry cells battery, electrical, glass, petroleum refining, rubber & textiles)	900 (18)	900 (18)	900 (18)

Figures rounded off. Data collected on non-statutory basis.

Figures in parentheses denote the number of units in organised sector reporting consumption.

Sulphur consumption in manufacture of sulphuric acid has been included in chemical and fertilizer industries. In addition, substantial quantities of by-product sulphuric acid (obtained from indigenous and imported sulphide ore concentrates of lead, zinc and copper during smelting) equivalent to 563.6 thousand tonnes, 821.6 thousand tonnes and 846.7 thousand tonnes of sulphur are believed to have been consumed during 2005-06, 2006-07 and 2007-08, respectively.

TRADE POLICY

Imports of sulphur of all kinds other than colloidal sulphur, precipitated sulphur and sublimed (flowers) sulphur are allowed freely under the Foreign Trade Policy, 2004-09.

WORLD REVIEW

Reserves of sulphur in crude oil, natural gas and sulphide ores are large. Considering that most sulphur production is a result of the processing of fossil fuels, supplies should be adequate for the foreseeable future.

In 2007, the world production of sulphur was estimated at 66.30 million tonnes and that of pyrites at 4.8 million tonnes. Canada (14%), USA (13%), Russia (11%), China (8%), Rep. of Korea and Japan (6% each) were the major producers of sulphur. China (86%), Russia and Finland (4% each) were the major producers of pyrites (Table - 6).

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

Country	(In '000 tonnes of sulphur content)		
	2005	2006	2007
World : Total (Sulphur)	62600	63100	66300
(Pyrites)	4700	4700	4800
Abu Dhabi (Sulphur)	2060	2045	2183
Canada (Sulphur)	8973	9082	8967
China (Sulphur)	4145	4588	5458
(Pyrites)	4011	3986	4122 ^e
Chile (Sulphur)	1788	1574	1699
Finland (Pyrites)	184	200	194
Finland (Sulphur)	375	396	451 ^e
Iran (Sulphur)	1440	1440	1456
Germany (Sulphur)	1671	1749	1686
Japan (Sulphur)	3555	3629	3714
Kazakhstan (Sulphur)	1825	1821 ^e	1895 ^e
Korea, Rep. of (Sulphur)	1521	1559	3460 ^e
Mexico (Sulphur)	1719	1698	1648
Poland (Sulphur)	1277	1311	1349 ^e
Russia (Sulphur)	6941	7084	7162
(Pyrites)	304	198	194
Saudi Arabia (Sulphur)	2700	2900	2900
South Africa (Sulphur)	642	640 ^e	640 ^e
Turkey (Pyrites)	55	59	61
USA (Sulphur)	9501	9054 ^e	8820 ^e
Zimbabwe (Pyrites)	20	40	NA
Other Countries(Sulphur)	12467	12530	9288
(Pyrites)	126	217	229

Source: World Mineral Production, 2003-2007.

SULPHUR AND PYRITES

Elemental sulphur is obtained from ores by conventional mining or by the Frasch method of mining sulphur (mined sulphur) or as a by-product of sour natural gas processing, sour crude refining, tar sand processing and stack gas clean-up (recovered sulphur). Recovered sulphur production accounted for over 98% world elemental sulphur production.

In Frasch method, three concentric pipes are used. The outermost pipe contains superheated water, which melts the sulphur, and the innermost pipe is filled with hot compressed air, which serves to create foam and pressure. The resulting sulphur foam is then expelled through the middle pipe. The Frasch process produces sulphur with a 99.5% purity content, and it needs no further purification. Frasch sulphur production on a commercial scale takes place in USA, Poland and Iraq. The only Frasch sulphur mine currently in operation is located in Poland.

FOREIGN TRADE

Exports

Exports of sulphur (excl. sublimed, precipitated and colloidal) decreased substantially to 3,578 tonnes in 2007-08 from 1,36,584 tonnes in the previous year. Exports were mainly to Bangladesh (23%), Nepal (15%), Sri Lanka (13%) and Italy (10%).

Exports of sulphur (sublimed, precipitated and colloidal) increased to 7,206 tonnes in 2007-08 from 5,119 tonnes in the previous year. Sulphur (sublimed) alone accounted for more than 72%. The precipitated & colloidal sulphur together shared 28% exports in 2007-08. Exports were mainly to Germany, Turkey, Indonesia, Iran, UK, Rep. of Korea, etc. (Tables - 7 to 11).

Imports

Imports of sulphur (excl. sublimed, precipitated and colloidal) increased marginally to 14.06 lakh tonnes in 2007-08 from 14.02 lakh tonnes in the previous year. Imports were mainly from Saudi Arabia (23%), Iran (17%), UAE (16%), Qatar (15%), Kuwait (14%) and Ukraine (7%).

Imports of sulphur (sublimed, precipitated and colloidal) decreased marginally to 1,085 tonnes in 2007-08 from 1,130 tonnes in the previous year. Out of total imports, 597 tonnes was precipitated sulphur, 373 tonnes sublimed sulphur and 115 tonnes colloidal sulphur (Tables -12 to 16).

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

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	136584	1386068	3578	53604
Bangladesh	356	7730	807	12770
Nepal	693	3135	525	7817
Italy	232	2694	374	5744
Sri Lanka	1321	11299	450	5568
South Africa	658	6168	295	3541
Tanzania	16	213	296	3068
Greece	80	797	212	2665
UAE	82	674	119	2012
Morocco	103	993	112	1643
Singapore	132500	1342549	-	-
Other countries	543	9816	388	8776

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

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	5119	319521	7206	330859
Germany	1158	83395	1030	72614
Turkey	365	20034	945	58028
Indonesia	353	20626	468	28527
Iran	315	23003	347	24598
UK	86	5218	340	20565
Korea, Rep. of	480	30773	303	17516
South Africa	197	12530	252	15731
Thailand	103	6318	270	14932
Spain	202	15855	289	13660
Estonia	450	27428	144	7749
Other countries	1410	74341	2818	56939

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

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	65	723	1283	6011
Nepal	38	371	71	2587
Netherlands	-	-	9	1153
Thailand	-	-	32	1012
UK	-	-	17	797
Italy	-	-	1151	278
Myanmar	-	-	2	176
Congo, P. Rep.	-	-	1	8
Sri Lanka	22	165	-	-
USA	5	187	-	-

**Table - 10 : Exports of Sulphur (Precipitated)
(By Countries)**

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	111	2463	758	4444
Kenya	++	7	560	2344
Nepal	81	586	78	1565
Spain	-	-	120	522
Jordan	-	-	++	9
Kuwait	-	-	++	4
Korea, D.P. Rep. of	30	1870	-	-
Other countries	-	-	-	-

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

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	4943	316335	5165	320404
Estonia	450	27428	144	7749
Germany	1158	83395	1030	72614
Indonesia	353	20626	468	28527
Iran	315	23003	347	24598
Korea, Rep. of	480	30773	303	17516
South Africa	197	12530	252	15731
Spain	202	15855	169	13138
Thailand	103	6318	238	13920
Turkey	365	20034	945	58028
UK	86	5218	323	19768
Other countries	1234	71155	946	48815

**Table - 12 : Imports of Sulphur
(Excl. Sublimed, Precipitated & Colloidal)
(By Countries)**

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	1401893	4944410	1405540	14560588
Saudi Arabia	154490	570044	324192	3578482
Iran	373351	1333826	240628	3271611
Kuwait	153057	543776	195878	2368469
Qatar	177974	623713	210734	1862325
UAE	427728	1458404	226134	1841620
Ukraine	-	-	95184	471870
Baharain	10791	38417	35256	312064
Japan	59966	208107	39973	310068
Indonesia	-	-	18169	282728
Morocco	-	-	10360	124151
Other countries	44536	168123	9032	137200

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

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	1130	60337	1085	61924
Malaysia	681	45038	609	38398
Germany	12	1697	106	8886
Japan	49	4536	39	3671
China	94	5109	87	2860
Italy	++	4	35	2417
Turkey	-	-	100	1843
USA	15	655	37	1350
UK	18	1029	9	457
Saudi Arabia	260	2187	-	-
Unspecified	1	62	15	1021
Other countries	++	20	48	1021

**Table - 14 : Imports of Sulphur (Colloidal)
(By Countries)**

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	309	6271	115	6965
Germany	7	1128	18	2654
China	24	1440	64	2052
Malaysia	16	1138	16	1135
Japan	2	365	16	1058
Korea, Rep. of	-	-	++	39
USA	++	13	1	20
France	-	-	++	7
Saudi Arabia	260	2187	-	-

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**Table - 15 : Imports of Sulphur (Precipitated)
(By Countries)**

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	307	20784	597	36574
Malaysia	260	16903	430	27311
Germany	1	222	57	4040
Japan	20	2102	23	2613
USA	++	1	36	1330
Iran	-	-	48	967
China	23	1368	3	305
Denmark	++	7	++	8
UK	3	181	-	-

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

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	514	33282	373	18385
Malaysia	405	26997	163	9952
Italy	++	4	35	2417
Germany	4	347	31	2192
Turkey	-	-	100	1843
China	47	2301	20	503
UK	15	848	9	457
Chinese Taipei/Taiwan	++	13	-	-
Japan	27	2069	-	-
USA	15	641	-	-
Unspecified	1	62	15	1021