RHENIUM

(Data in kilograms of rhenium content, unless otherwise noted)

Domestic Production and Use: During 1998, ores containing rhenium were mined by nine operations. Rhenium compounds are included in molybdenum concentrates derived from porphyry copper deposits in the southwestern United States, and rhenium itself was recovered as a byproduct from roasting such molybdenum concentrates. Rhenium-containing products included ammonium perrhenate, perrhenic acid, and metal powder. The major uses of rhenium were in petroleum-reforming catalysts and in high-temperature superalloys used in jet engine components, representing about 20% and 60%, respectively, of the total demand. Rhenium was used in petroleum-reforming catalysts for the production of high-octane hydrocarbons, which are used in the production of lead-free gasoline. Bimetallic platinum-rhenium catalysts have replaced many of the monometallic catalysts. Rhenium is used in superalloys, improving the strength properties, at high temperatures (1,000° C), of nickel-based alloys. Some of the uses for rhenium alloys were in thermocouples, temperature controls, heating elements, ionization gauges, mass spectrographs, electron tubes and targets, electrical contacts, metallic coatings, vacuum tubes, crucibles, electromagnets, and semiconductors. The estimated value of rhenium consumed in 1998 was \$35 million.

Salient Statistics—United States:	<u> 1994</u>	<u> 1995</u>	<u> 1996</u>	<u> 1997</u>	<u> 1998°</u>
Production ¹	15,500	17,000	14,000	15,400	16,000
Imports for consumption	8,200	12,800	20,800	15,100	20,000
Exports	NA	NA	NA	NA	NA
Consumption: Estimated	12,900	16,200	24,100	17,900	22,000
Apparent	NA	NA	NA	NA	NA
Price, average value, dollars per kilogram:					
Metal powder, 99.99% pure	1,560	1,100	900	900	1,100
Ammonium perrhenate	1,100	700	500	300	700
Stocks, yearend, consumer, producer,					
dealer	NA	NA	NA	NA	NA
Employment, number			Small		
Net import reliance ² as a percent of					
apparent consumption	NA	NA	NA	NA	NA

Recycling: Small amounts of molybdenum-rhenium and tungsten-rhenium scrap were processed during the past few years by several companies.

Import Sources (1994-97): Chile, 52%; Germany 18%; Kazakhstan, 8%; Netherlands, 6%; and other 16%.

Tariff: Item	Number	Normal Trade Relations (NTR) 12/31/98	Non-NTR ³ 12/31/98
Other inorganic acids, other—rhenium, etc.	2811.19.6050	4.2% ad val.	25% ad val.
Salts of peroxometallic acids, other—			
ammonium perrhenate	2841.90.2000	3.1% ad val.	25% ad val.
Rhenium, etc., (metals) waste and scrap	8112.91.0500	Free	Free.
Rhenium, (metals) unwrought; powders	8112.91.5000	3.3% ad val.	25% ad val.
Rhenium, etc., (metals) wrought; etc.	8112.99.0000	4.6% ad val.	45% ad val.

Depletion Allowance: 14% (Domestic), 14% (Foreign).

Government Stockpile: None.

RHENIUM

Events, Trends, and Issues: During 1998, the average rhenium prices were \$1,100 per kilogram for metal and \$700 per kilogram for ammonium perrhenate, rises of 22% and 133%, respectively, over those of 1997. Imports of rhenium increased by about 32% for 1998 compared with those of 1997. Chile and Germany supplied the majority of the rhenium imported. The United States relies on imports for much of its supply of rhenium. The increased estimated consumption, was in the areas of catalysts for petroleum refining and superalloys for jet engines.

It is estimated that in 1999 U.S. consumption of rhenium will be about 30,000 kilograms.

Owing to the scarcity and minor output of rhenium, its production and processing pose no known threat to the environment. In areas where it is recovered, pollution control equipment for sulfur dioxide also prevents most of the rhenium from escaping into the atmosphere.

World Mine Production, Reserves, and Reserve Base:

	Mine production ^e		Reserves⁴	Reserve base⁴
	<u> 1997</u>	<u>1998</u>		
United States	15,400	16,000	390,000	4,500,000
Armenia	NA	NA	95,000	120,000
Canada	_		_	1,500,000
Chile	11,400	13,600	1,300,000	2,500,000
Kazakhstan	1,800	2,400	190,000	250,000
Peru	2,000	2,300	45,000	550,000
Russia	NA	NA	310,000	400,000
Uzbekistan	NA	NA	59,000	400,000
Other countries	<u>5,000</u>	3,200	91,000	<u>360,000</u>
World total (may be rounded)	35,600	37,500	2,500,000	11,000,000

<u>World Resources</u>: Most rhenium occurs with molybdenum in porphyry copper deposits. Identified U.S. resources are estimated to be about 5 million kilograms, and the identified resources of the rest of the world are approximately 6 million kilograms. In Kazakhstan, rhenium also exists in sedimentary copper deposits.

<u>Substitutes</u>: Substitutes for rhenium in platinum-rhenium catalysts are being evaluated continually. Iridium and tin have achieved commercial success in one such application. Other metals being evaluated for catalytic use include gallium, germanium, indium, selenium, silicon, tungsten, and vanadium. The use of these and other metals in bimetallic catalysts may decrease rhenium's share of the catalyst market. Materials that can substitute for rhenium in various end uses are as follows: cobalt and tungsten for coatings on copper X-ray targets, rhodium and rhodium-iridium for high-temperature thermocouples, tungsten and platinum-ruthenium for coatings on electrical contacts, and tungsten and tantalum for electron emitters.

^eEstimated. NA Not available. W Withheld to avoid disclosing company proprietary data.

¹Calculated rhenium contained in MoS₂ concentrates. Recovered quantities are considerably less and are withheld.

²Defined as imports - exports + adjustments for Government and industry stock changes.

³See Appendix B.

⁴See Appendix D for definitions.