

## THALLIUM

Present technology limits thallium supply to quantities present in certain base metal ores, notably zinc. Commercial supply is derived wholly from processing selected smelter flue dusts. Thallium association with certain gold, potash, and other deposits are of academic interest only. Although only a fraction of total contained thallium currently is recovered, dispersal of thallium into various smelter products not amenable to economic separation militates against marked improvement in recovery. Consumption of thallium is so much below supply that thallium-bearing residues at the plant of the one thallium producer reportedly have become a burdensome quantity. It is estimated that the thallium containing residues are generated at three times the rate of consumption.

The dominant consumption until 1965 was as a rodenticide. This was sharply curtailed because of Government action, which encouraged substitution of alphanaphthyl thiorurea or other chemicals less toxic to humans. However, the market loss was compensated for by increased use of thallium in solder and fusible alloys. Only modest increases in demand are expected.

## THORIUM

Domestic supply exceeds the demand. Except during a short period when traditional foreign sources were being nationalized and a stockpile was being acquired, world supply usually included surpluses. Thorium is a product of monazite which, in turn, is a byproduct from the production of titanium and zirconium minerals from beach sands. While a small growth in demand for illumination and alloying purposes is foreseen, the possible employment of thorium in breeder-type nuclear applications continues to be the basis for speculation on ultimate needs (see sections on titanium and zirconium).

If consumption should increase substantially as a result of successful development of thorium-fueled breeder reactors the demand could be met by production from the relatively high grade thorite deposit of Idaho and Montana. Research has demonstrated the feasibility of treating the thorite ore if it is needed.

Recovery of monazite from beach properties may conflict with urban and recreational development in some areas. Some monazite sands have already been lost to beach development. On the other hand, some dredging operations on both river and beach placers have established models for mined land reclamation.

## TIN

The United States is the major consumer of both primary and secondary tin and uses about 40 percent of the world's supply. Domestic production and foreseeable potential are negligible. A unique international agreement among several producer and consumer nations that seeks to stabilize supplies and prices has been only partially successful in its objectives. Rising prices and uncertainty in regard to future supply provide incentives for finding substitutes for tin in the major end-use applications.

In the concentration of tin ores from both placer and lode deposits, there is evidence that as much as 30 or 40 percent of the tin mined is lost in the slimes. In addition, the presence of impurity metals in the concentrate requires complex metallurgical processing resulting in further losses.

Considerable work has been done on volatilization processes for the removal of tin from low-grade ores but the method is seldom used except in special cases where fuel, volatilization agent and raw materials are available at low cost. The current economic situation has stimulated a renewed appraisal of the potential of sulfide volatilization for Bolivian ores. It is unlikely, even if the study is successful, that output of tin from Bolivia will increase significantly during the next five or ten years. Technical assistance to Bolivia by the United States has become traditional and additional cooperation is likely to be called for in the foreseeable future.

## TITANIUM

Present technology dictates distinct end-use patterns for the two principal mineral sources, ilmenite and rutile. The United States is a major source of the former but not the latter. In fact, long term adequate world supply of titanium will depend to a large extent on successful development of an increased capability to use ilmenite instead of rutile. A variety of submarginal occurrences of titanium minerals are known both domestically and abroad. Domestic occurrences