

# SUPPLY AND USE OF VANADIUM

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## SUMMARY

The sources, recovery, capacity for production and consumption of vanadium are discussed. Its use, particularly in the steel industry, is highlighted and some technical reasons for this use are given.

## SOURCES

Vanadium is the 17th most commonly occurring element in the Earth's crust. Consequently, it has a very wide distribution and Figure 1 shows some of the more important deposits. These include the titaniferous magnetites of China, Russia and South Africa, the oil-related deposits of Venezuela, Alberta, Canada, the Middle East and Queensland, Australia, in addition to ore and clay deposits in the USA.

Taking all of the deposits together it has been estimated<sup>(1)</sup> that total global resources of vanadium are in excess of 63 million tonnes. However, reserves which are commercially exploitable by existing technologies, using the current price levels, are less than this and have been estimated at 10.1 million tonnes vanadium, sufficient for almost three hundred years at current rates of consumption. As can be seen in Table I, these lie mainly in China, Russia and South Africa. These countries also figure largely in the reserve base of 27.6 million tonnes vanadium where they are joined by the USA, as also shown in Table I.

## RECOVERY

In most cases, recovery of vanadium from these various sources is as a by-product, associated with extraction and/or use of other metals, oils etc. Figure 2 indicates the flow lines of the various processes involved, for some of the more important sources. From this figure it can be seen that there are three basic routes for the recovery of vanadium.

Firstly, vanadium is recovered in a slag, in association with steel manufacture. This slag which, depending on source, can contain between 10% and 25%  $V_2O_5$  is converted, via a roast/leach process, to vanadates and vanadium oxides. It is then further converted to the different forms of vanadium product. Alternatively, the slag is converted directly to ferrovanadium. Recovery of vanadium from steelmaking slag constitutes the main method of recovery and approximately 75-80% of the world's vanadium is obtained in this manner.

The second route for recovery involves the direct conversion of ore, which contains typically up to 1.8%  $V_2O_5$ , via the roast/leach process, to vanadates and vanadium pentoxide, prior to further conversion. As far as is known there are only two companies, world-wide, which recover vanadium exclusively in this manner and this route is responsible for around 10-15% of world production.