

Titanium

Titanium is the ninth most abundant element in the Earth's crust. It does not occur freely in nature but is always combined with other elements. Titanium is as strong as steel but much lighter. It is essentially inert and highly corrosion resistant and can withstand sea water, aqua regia and weak acid; it also has a high melting point and is biocompatible.

Due to these characteristics, titanium and its alloys are extensively used in a variety of applications including the aerospace, marine, manufacturing and automobile industries, surgical implants as well as for architectural applications and the production of sporting goods.

Over 90% of the titanium produced is consumed in its oxide form as a white and opaque pigment. Consequently it can also be used in the production of white paper, plastics, food coloring, paint, cosmetics and in skin products as protection from UV.

Sources of Titanium

There are many different types of titanium minerals such as arizonite, brookite, anatase, leucoclene, perovskite, etc. However, ilmenite and rutile are the major sources of commercially produced titanium products.

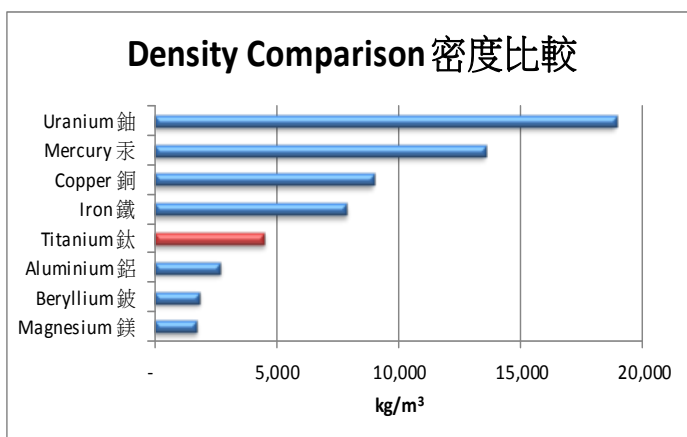
Ilmenite (FeTiO₃)

Ilmenite is a weakly magnetic iron-titanium oxide although it is sometimes associated with magnesium and manganese. Ilmenite is found in metamorphic and igneous rock but is largely recovered from mineral sands (in alluvial deposits). The major ilmenite producers are Australia, South Africa, Canada, and China. Rockhound was involved in an iron-titanium project in Shanxi, PRC.

Titanium is sometimes added to iron during steel manufacture, however only a small percentage can be used, as a high amount of titanium will have a negative impact on the steel. Therefore, ilmenite cannot directly be used in steel manufacturing.

鈦

鈦是地球地殼第九最常見的元素，在自然裡並不單獨存在，而是經常與其他元素合成。鈦的堅硬程度可以媲美鋼，卻又比鋼輕。鈦具有惰性，有良好的抗腐蝕能力，可抵抗海水、王水和弱酸的腐蝕，同時熔點高和對人體無害。



基於鈦的種種特質，鈦與鈦合金在不同領域均得到廣泛應用，例如航天業、航海業、製造業、汽車工業、外科植入物、建築工程以及運動產品製造。

超過百分之 90 生產出來的鈦都會在其白色遮光體的氧化鈦的形態時被應用，因此可用於製造白紙、塑膠、食用色素、顏料、化妝品，以及防紫外線護膚產品。

鈦的來源

鈦礦石種類繁多，例如紅鈦鐵礦、板鈦礦、銳鈦礦、二氧化鈦及鈣鈦礦等。雖然如此，商業生產的鈦產品主要還是從鈦鐵礦和金紅石生產出來的。

鈦鐵礦 (FeTiO₃)

鈦鐵礦是一種帶有弱磁性的鈦鐵氧化物，有時會與鎂和錳共生。鈦鐵礦可於變質岩和火成岩中找到，但大多數均是從礦砂(沉積物)中發掘得來。世界上主要的鈦鐵礦生產國包括澳洲、南非、加拿大及中國。石犬就曾參與中國山西省一個鈦鐵礦項目。

雖然製鋼時有時候會加入鈦金屬，但所需的份量很少，因為過多的鈦會對鋼材有負面

影響。因此鈦鐵礦不能直接用於煉鋼廠。

金紅石 (TiO₂)



The new Boeing 787 Dreamliner aircraft and its Rolls Royce engine used titanium to reduce its own weight for fuel efficiency purposes

新波音787夢幻客機及其採用的勞斯萊斯引擎用上鈦金屬減輕重量達到節省能源的目的



Rutile (TiO₂)

Rutile is a mineral primarily composed of titanium oxide. It is closely related to ilmenite but has less impurities; thus, rutile has a higher titanium oxide content than ilmenite and can be directly used to manufacture titanium metal or titanium dioxide. Major rutile producers are Australia, South Africa, Sierra Leone and Ukraine.

Like ilmenite, rutile is largely sourced from alluvial deposits which are referred to as heavy mineral sands and these usually comprise a mixture of ilmenite, rutile, zircon, leucoxene and other gangue minerals.

	2009	2010	Reserves
South Africa 南非	1,050	1,120	63,000
Australia 澳洲	1,020	1,070	100,000
Canada 加拿大	650	700	31,000
China 中國	500	600	200,000
India 印度	420	420	85,000

Mining Method

Although some titanium mines are hard rock (mostly mined as open pits using conventional drilling and blasting methods), titanium is largely worked from mineral sand deposits. Some of these deposits are at high levels in the terrain while others can be coastal or estuarine. Deposits on higher ground (e.g. hill slopes) are typically mined by high pressure jets which wash down the mineral sands while those deposited under water or on the coastal/estuary fringes can be mined by dredger.

To process hard rock titanium minerals, it is necessary to grind the rock blast products into finer grain sizes. This enables them to be processed in a similar way to heavy mineral sands by means of magnetic separation (for weakly magnetic ilmenite), gravity separation, and flotation. Typically the concentrate has to reach a TiO₂ concentration level of 40% or more before further processing.

Processing

Titanium Metal

Producing titanium metal from ilmenite and from rutile involves slightly different processes. For ilmenite, the processes involve refining to decrease iron content and subsequently produces titanium slag. From here onward, the processes for the two are the same which is a chloride reduction (Kroll) process which ultimately produces titanium metal.

Titanium Dioxide

To produce titanium dioxide, sulfate process (use of sulfuric acid) is employed but it is considered inferior to the chloride process which produces less waste products and a better quality end-product.

Most Chinese producers adopt the sulfate process still, this is due to the lack of advanced technology for the chloride process to take place.

金紅石是一種主要成分為二氧化鈦的礦石，與鈦鐵礦十分相似，但含較少雜質。正因如此，金紅石的氧化鈦含量比鈦鐵礦要多，可以直接用於生產鈦金屬或二氧化鈦。主要的金紅石生產國有澳洲、南非、塞拉里昂和烏克蘭。

一如鈦鐵礦，大多數金紅石也是從沉積物中發掘得來。這些沉積物又稱重砂礦，通常混有鈦鐵礦、金紅石、鉛石、白鈦石及其他脈石礦物。

	2009	2010	Reserves
Australia 澳洲	266	280	18,000
South Africa 南非	127	130	8,300
Sierra Leone 塞拉里昂	61	67	3,800
Ukraine 烏克蘭	57	57	2,500
India 印度	20	20	7,400

開採方式

雖然某些鈦礦場位處硬石岩(主要還是利用傳統的鑽探及爆破方式進行露天開採)，但大部分鈦礦都是從礦砂沉積物中開採得來的。這些沉積物有些處於高地，有些位處海岸或入海位，位處較高地帶(例如山坡)的沉積物通常會以高壓噴射器射出的水力把礦砂沖出，至於位於海底或在海岸/入海口的邊沿地帶的沉積物則可靠挖泥船開採。

要處理堅硬的鈦礦石，需事先將這些由岩石爆破出來的礦物磨成更細小的粒狀，因為這樣就可以像處理重砂礦一樣以磁選(適用於弱磁性鈦鐵礦)、重力分離及浮選作處理。通常濃縮物中的二氧化鈦濃度需要達到百分之 40 或以上才可作進一步處理。

處理方法

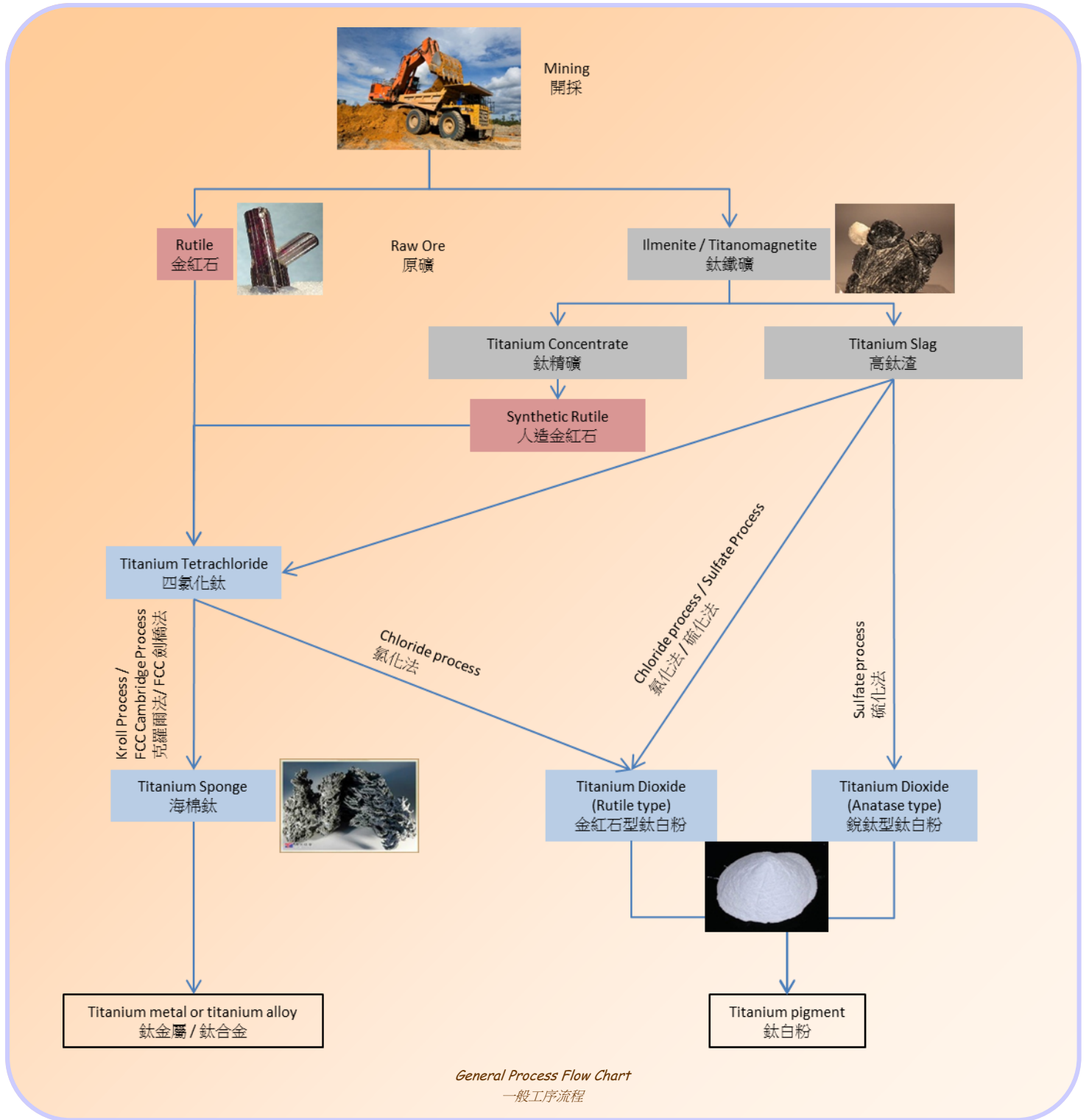
鈦金屬

要分別從鈦鐵礦及金紅石中提煉出鈦金屬，當中涉及的步驟略有不同。鈦鐵礦的處理工序主要是透過精煉減少礦物中的鐵含量從而產生高鈦渣。此後的工序與金紅石相同，利用減氯法(克羅爾法)，最終可生產出鈦金屬。

鈦白粉

生產鈦白粉可使用硫酸鹽法(利用硫酸)，但一般認為此法比氯化法遜色，因為過程中會產生較多廢料而且最後製成品的質量也較差。

目前大部份的中國鈦白生產商仍然採用硫酸鹽法，原因是中國生產商未有掌握氯化法的先進技術。



Written by Mr. Dominic Kot 葛日峰
BASc (Geological Engineering), MCIM

Technical Side Edited by Dr. Gordon Anderson 歐達成 博士
BSc, PhD, CGeol, CEng, FGS, RPE, MIMMM, FHKIE
Mr. Paul Fowler 方保羅
MSc, MBA, CGeol, CEng, FGS, MIMMM, FIQ, MHKIE

Commercial Side Edited by Mr. Joseph Lau 劉允培
BSc, MBA, MCIC, MCIM

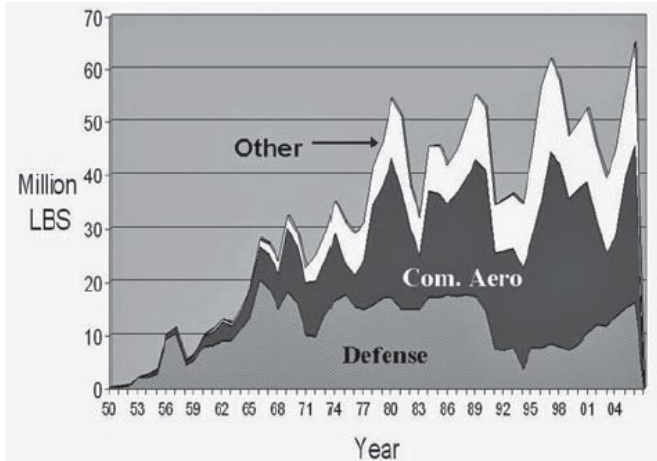
Legal Review by Miss Helen Tang 鄧凱琳
LLB, LLM

FGS – Fellow of the Geological Society (UK)
FIQ – Fellow of the Institute of Quarrying (UK)
MCIC – Member of the Chemical Institute of Canada

MIMMM – Member of the Institute of Materials, Minerals and Mining (UK)
MHKIE – Member of the Hong Kong Institute of Engineers
MCIM – Member of the Canadian Institute of Mining and Petroleum

Commercialized Titanium Products

Titanium metal is a relatively new industrial material. At first, it was expensive to manufacture and was mostly used by the military.

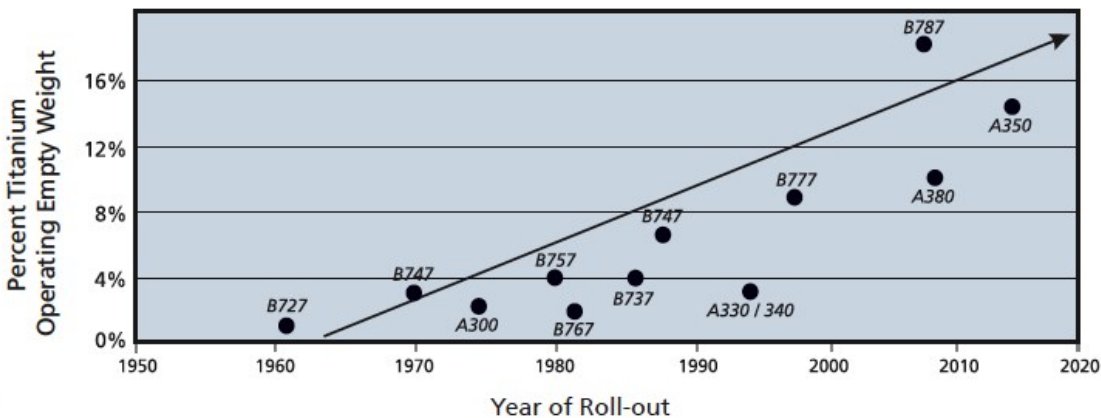


Approximate U.S. Titanium Mill Products Shipments
美國鈦製品的出貨量概況

Source: ITA

As technology advanced, the manufacturing costs became cheaper and it became more widely used. It was advertised as an advanced and durable space metal. Within the past couple decades, titanium has become a symbol of premium products. Titanium is used in our everyday lives, such as, golf clubs, tennis rackets, watches, glasses and even in jewelries.

Since the increase of oil price, airline companies have concern in the operating costs. As a result, aeroplane manufactures, Boeing and Airbus have therefore increased the use of titanium in their aircrafts to reduce the weight. This can be seen from the graph presented below.



Titanium Usage on Aircraft
航用鈦的概況

Source: ITA

中國鐵鈦 (0893.HK)

14/11/2011

<統一證券(香港)>

中國鐵鈦(0893)財政非常健全，利潤率一向較高及穩定(金融海嘯時仍高達35%以上，較高峰時僅低不到10個百分點)，現時因鐵礦價下挫而造成的極低估值屬不合理。上市以來平均市盈率(PE)16.2倍，如以2012年預估每股盈利(EPS)及保守的8倍PE計算，目標價2.95港元。

「十二五」已推出鈦資源綜合利用及產業基地規劃，其中擁有龐大鈦鐵礦資源的攀枝花為重點地區之一。公司現有鈦金屬探明儲量的可採年限達30年以上，尚有很大發展空間。公司目標於3-5年內動用30億元(人民幣，下同)收購四川省內項目，並將總產能提升至500萬至600萬噸(較2010年增加1.5至2倍)。

新鐵礦投產大增產能

2011年5月公司完成收購阿壩礦業，整體產能增長5.5%；近日新鐵礦球團廠投產，相關自製產能更大增4倍以上。故此公司預期2011年下半年球團產量將增長50-60%，而鈦精粉將增長1倍以上，可見整體收入將大幅成長。新增的陽雀箐及茨竹箐鐵礦為公司增加5%鐵及鈦探明資源。

2011年上半年收入增長21%至8.5億元；毛利率跌1.2個百分點至51%；原材料銷售淨收益大減下，經營溢利率跌3.1個百分點至42.3%；由於來自印尼的股權投資收益入賬及非控股權益大減下，每股盈利(EPS)仍增長27%至0.14元。

期內收入增長主因鐵精礦產量增加及鈦粉收入大增抵銷了承包球團產量大減；毛利率降主因折舊大增加上承包單位費用急升，抵銷了承包比重的下降。

2011年8月與兩公司合營開發估計達5,000萬噸資源量的四川平川鐵礦，公司佔權益51%(應佔2,550萬噸，較2010年底約增60%)，目標2013年6月投產。

股價自今年10月初尋得底部後大幅反彈，且反彈以來成交較9月急跌時更大，反映資金進場訊號明顯。現時股價隨20天線反覆上揚，假如長陽突破1.86港元將使10日20日50日線多頭排列進而展開另一波上揚行情，可上試2.95港元目標價。(摘錄)

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