Greener extraction of one of nature's whitest minerals

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From medicine to make-up, plastics to paper - hardly a day goes by when we don't use titanium dioxide. Now researchers at the University of Leeds have developed a simpler, cheaper and greener method of extracting higher yields of one of this most useful and versatile of minerals.

In powder form titanium dioxide (TiO2) is widely used as an intensely white pigment to brighten everyday products such as paint, paper, plastics, food, medicines, ceramics, cosmetics - and even toothpaste. Its excellent UV ray absorption qualities make it perfect for sunscreen lotions too.

TiO2 is also a precursor material for titanium metal production. In metal form it's strong and lightweight and is used in the aerospace and electronics industries as well as being used to strengthen golf clubs and fishing rods. It is also inert and biocompatible, making it suitable for medical devices and artificial implants.

As such, it's hardly surprising that the global market for this important mineral is some £7 billion per year.

Unfortunately, despite its relative abundance in nature, it's natural occurrence is never pure, being bound with contaminant metals such as iron, aluminium and radio-active elements.

Pigment grade TiO2 is produced from mineral ore by smelting, then treating the slag with chlorine, or by directly introducing it into a sulphuric acid solution. These two processes generate toxic and hazardous wastes. The treatment of such wastes is expensive and complex.

Prof Jha's patented process consists of roasting the mineral ore with alkali to remove the contaminants, which are washed and leached with acid to yield valuable by-products for the electronics industry. The coarse residue left behind is then reacted with 20 times less than the usual amount of chlorine to produce titanium dioxide powder.

The Leeds process gives an average yield of up to 97 per cent TiO_2, compared with the current industry average of 85 per cent. This level of purity will reduce production costs of pigment grade materials and waste disposal costs. In addition, the process also recycles waste CO_2 and heat.

Furthermore, Prof Jha is confident that the process can be further refined to yield 99 per cent pure titanium dioxide.

"Researchers have sought a sustainable replacement for current processes for many years," says Professor Animesh Jha, from the University's Faculty of Engineering. "Our aim was to develop new technology for complex minerals of titanium dioxide that are particularly low-grade and whilst readily available in the world market, can't yet be extracted economically," he says.

"Our process is a real world breakthrough, because it can be used for both lower and richer grades of ores and it overcomes major environmental concerns about having to neutralise and discharge wastes generated in the process that end up going into contamination ponds."

"We're excited about the possibilities for this method of mineral purification; we believe it could be applied to other important minerals with similar complexity, making it a credible potential extraction process for the future," he says.

Source: University of Leeds

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