

## Rare Earth Elements

There are several metals that are not yet a significant part of the electronic waste stream but are certainly going to be a larger part of the e-waste conversation in the future. Every iPhone or iPad, and most of the other smart phones and tablets that are dominating the sales of personal-computing electronics today, contain many of the elements that are called “rare earths.”

The amounts of these elements in today’s mobile devices are miniscule. This circumstance, combined with the fact that most of these devices are still in use today, means that the recycling industry has not yet found a way to make it economically viable to recycle these rare-earth materials.

According to SIMS Recycling Solutions President Steve Skurnac, “Rare earths come in very minute concentrations in electronic scrap,” which means that recyclers need a high volume and super efficient processes to recover any reasonable amount of rare earths from electronics. The technology just isn’t there to make it economically feasible for most recyclers.<sup>11</sup>

According to CNET’s Jay Greene, writing in an article posted September 26, 2012, an iPhone (as well as most of the new mobile devices currently sold, further research confirms) contains the following Rare Earth elements:<sup>12</sup>



**Cerium** is used as a glass-polishing agent. Long-term exposure can cause lung embolisms, and cerium has been shown to be a threat to the liver when it accumulates in the body. Cerium will also accumulate in soil and water when it is dumped into the environment.

**Dysprosium** is an element used in the vibration system. It is not known to have negative effects on humans or the environment.

**Europium** is part of the screen. Europium is not known to pose threats to humans, plants, or animals.

**Gadolinium** is found in the screen, circuitry, and speakers of the iPhone. It is considered to be of low toxicity and poses no threat to plants or animals.

**Lanthanum** is found in the screen and the phone’s circuitry. It has been found to have negative effects on lung function and, when inhaled, is linked with an increased risk of developing cancer.

**Neodymium** is used in the device’s circuitry and speakers, primarily in magnets. Neodymium is not considered to be toxic but can be very irritating to the eyes. It can affect cell membranes in water animals that suffer from overexposure.

**Praseodymium** is another glass-polishing agent. Exposure to praseodymium can lead to negative effects on the lungs and liver.

**Terbium** is used in the vibration unit, speakers, and screen of the device. There is a possibility of eye or skin irritation if one comes into physical contact with terbium.

**Yttrium** is used in the coloured screen. It has been linked with an increased risk of developing lung cancer or of experiencing other lung issues when it is ingested by inhalation. When dumped into the environment, yttrium can accumulate in soil and water. It has been shown to cause damage to cell membranes in water animals, leading to them having reproductive and nervous system problems.

<sup>11</sup> *iFixit.org Blog*; “Why the iPad has to be Made in China,” blogentry by Elizabeth, April 19, 2012, <http://ifixit.org/1856/why-the-ipad-has-to-be-made-in-china/>.

<sup>12</sup> Jay Greene, “Digging for Rare Earths: The Mines Where iPhones Are Born,” CNET, September 26, 2012, [http://news.cnet.com/8301-13579\\_3-57520121-37/digging-for-rare-earths-the-mines-where-iphones-are-born/](http://news.cnet.com/8301-13579_3-57520121-37/digging-for-rare-earths-the-mines-where-iphones-are-born/).

Such extremely small amounts of these materials are present in these devices that, for now, it is not economically feasible to recycle them from the devices. The recycling industry or the electronics industry may be forced to change that as the worldwide market for mobile devices shifts.

Right now, most of these devices are still in use, either by a first or subsequent owner. But as the technology gets increasingly desirable with more functionality, many are replacing their devices with new ones. According to the EPA, the average lifespan of a new mobile device is only 18 months, and over 152 million mobile devices were disposed of in 2010.

The 2011 EPA report *Electronics Waste Management in the United States Through 2009* predicts that, in the United States in 2012, consumers will have bought 36 million tablets, 81 million iPads, over 100 million smart phones, and 190 million iPhones. That adds up to roughly 400 million devices in that one year alone.

Worldwide, smart phone sales are expected to reach over a billion by 2015. In Canada, a report by the Media Technology Monitor, a research product of the CBC, estimated that, as of autumn 2012, 26% of the population owned a tablet, more than five times the number that owned one when a similar study was done in the spring of 2011.<sup>13</sup>

What all this means is that, with demand for these devices skyrocketing, demand for rare earth elements is going to increase as well. Many of these elements are not actually rare, but expensive and difficult to extract.

Global production of the elements ranges from 23,000 tonnes per year for cerium to only 10 tonnes per year for terbium.

In between are lanthanum (12,000 tonnes per year), neodymium (7000), praseodymium (2500), yttrium (600), gadolinium (400), and europium and dysprosium (100).

But there is more than just global production to be considered. The EC's working group considers this entire group of elements to be "critical."

Not only are rare earths in high demand for electronic devices, they are also needed for emerging technologies such as hybrid vehicle batteries. They are also difficult to recycle and to replace with a substitute material. But the primary reason that the entire rare earth group of elements is on the list of critical raw materials is that production is dominated by China, which has imposed export restrictions and quotas. These not only could but already have disrupted world supply.

Above that, the EC's working group considers China to be an "environmental risk country," meaning that there is a possibility that the country could impose new environmental regulations that could affect the supply by curtailing the mining industry. (Since the working group's report on critical materials, there is now some mining in the United States and Australia, which has slightly reduced China's share of world production.)

So we have materials that are highly sought after but extremely difficult to obtain, yet there are millions of miniscule amounts of them in our pockets and purses. The need to recycle these materials may define electronics recycling in the future.

<sup>13</sup> Michael Oliveira, "Tablet Ownership Canada: 1 in 4 Have One, and the iPad Is Still King," *The Huffington Post*, February 20, 2013, [http://www.huffingtonpost.ca/2013/02/20/tablet-ownership-canada-ipad\\_n\\_2726499.html](http://www.huffingtonpost.ca/2013/02/20/tablet-ownership-canada-ipad_n_2726499.html).