By Stan Trout

# Magnet Recycling

First, let me welcome Dr. Peter Campbell to Magnetics Magazine as my fellow columnist and to wish him well in this endeavor. Peter and I have been colleagues in the magnet business for the last couple of decades and even share one common past employer. It will be nice to read some articles in Magnetics Magazine written with a British accent.

Second, I just returned from Magnetics 2007 and have to say that this was the best conference in some time. Not only was it well attended, including my pre-conference Magnetics Bootcamp, but there was actually a sense of optimism about our industry among the participants, something that has been missing for a number of years. Of course we all hope that this will continue, in spite of some of the challenges we face. A few companies were conspicuously absent and may have thought that the status quo was still the order of the day, but I think we all have reason to be encouraged.

As you have read in several of our recent articles, there is industry-wide concern about the increased prices and potential limited availability of the rare earths, particularly neodymium and dysprosium, found in NdFeB magnets. We are clearly in a transitional period in the balance of supply and demand for these materials. Most of the discussion has focused on supply from the raw material producers, with the idea that things would be better off if we increase the supply. But rather than continuing to kvetch about the mining, processing and allocations, I thought it would make sense to look at some strategies to increase supplies without mining. In this column we will look at three ideas that may be timely: recycling, recovery and some design considerations. But first, a joke.

When does a doorstop become a valuable source of cobalt in an Alnico foundry? When the price of cobalt exceeds $10 per pound.

I start with this joke to remind us how the magnet industry has historically approached recycling. It was really only of interest when the price of raw materials went up and not really an ongoing part of any business strategy. Recycling was a way to circumvent high raw material prices, at least partially. However, when prices were low or falling, there was little motivation to consider recycling and the idea was shelved, both literally and figuratively. As an industry, we have tended to look at magnets as consumables, something that someone bought and eventually would throw out.

The other bit of baggage that we carry as an industry is a misguided idea of the true value of scrap material. There is a huge gap between what people who have scrap believe it is worth and what those who might buy and process scrap can afford to pay for it and remain in business. I remember one magnet maker insisting that his grinding sludge, which also contained cigarette butts and banana peels, was at least as valuable as any rare earth ore. While this comparison is wrong for a myriad of reasons, it illustrates that people have an inflated view of what they have and do not understand the relative consistency and volume of rare earth ores as compared to a few odd 55-gallon drums of grinding sludge. We need a common sense approach to the recycling of magnets, free from a preconceived notion of an essentially unknown and untested value chain.

In addition, we have new external reasons to think about recycling in a far more serious way. The reasons are ISO 14000 and the European Union's Waste Electrical and Electronic Equipment (WEEE) and the Reduction of Hazardous Substances (RoHS) directives. All are pushing us to consider the entire lifecycle of a magnet and related materials, not just the few short months or years between mining and throwing out the device. These programs are asking us to be good stewards of our materials, not just when the prices of raw materials are high, but as an integral part of the process.

At Magnetics 2007, Dr. H. Yamamoto gave a very nice presentation on the status of Neomax, now Hitachi Metals since April 1, 2007. One slide discussed their approach to recycling. They are able to recycle scrap magnets from within their process and from customers. In addition, they are able to reclaim Nd from grinding sludge. This approach is state of the art in recycling materials in a production environment. Every manufacturer needs to look carefully at this slide to see if they can duplicate Hitachi's high standard. This is where everyone needs to be. We can no longer afford to be wasteful in our use of neodymium.

In addition to recycling, I would like to discuss a newer concept of magnet recovery: removing and reusing magnets once a device reaches the end of its life. If we think about the lifetime of a device like a disc drive, we realize that the device lasts just a few years and is usually thrown out containing completely functional magnets. After all, these are permanent magnets, not temporary magnets. The main obstacle is that the magnets are difficult to remove because of the adhesives used to bond them in the return structure. However, adhesives are available that can be deactivated with UV, heat or even water to break the bond and free the magnets. It seems that with some planning in the early design stages, an adhesive can be specified that will allow the magnets to be removed with relative ease when the device has reached the end of its useful life. Once magnets have been recovered, there is the chance to use them again, the ultimate form of recycling.

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And, finally, there are some design considerations to reconsider in light of higher neodymium prices. In his presentation at Magnetics 2007, Walt Benecki brought up the idea that we need to consider the ferrite option for some designs. This is a valid point, but I want to look at another corner of the design world. As we think about small magnets, we have known for some time that there is a point where samarium cobalt magnets become more economical than neodymium magnets because they usually do not need to be coated. The cost to coat a magnet doesn't change much as the magnet becomes smaller and this favors Sm for the smallest magnets. However, an increase in the cost of neodymium while samarium remains steady means that this crossover point is moving toward larger magnets. In other words, designs that were just marginal in samarium a few years ago may now be preferred over neodymium. This is something for anyone involved with small magnets to keep in mind.

Magnet design is all about obtaining the most flux from the least amount of material. We need to apply this concept to our use of raw materials as well.

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