A Holistic Approach to Magnet Development

I ended my last article with a plea for a more holistic approach to attacking the critical materials problem we face with rare earths, especially neodymium and dysprosium. Several people have challenged me to expand on this point, and so I shall. But first I need to tell a short story to help make my point.

A long time ago, circa 1980, I was the process manager for a small magnet plant in New Jersey making $SmCo_5$ magnets. We used both die pressing and isostatic pressing to make magnets in the 20 to 24 MGOe range, pretty good for the days before sintered NdFeB. One problem we faced was making a specific arc segment for a rather demanding customer. The magnets seemed to break and chip, just as they were being ejected from the press. One day my press operator came to me claiming to have a solution to the problem. He was very excited to share his idea, which was to turn off the alignment field. To prove his point, he ran a few pieces without any aligning field and sure enough he was right, the parts did not break and they looked beautiful. As you might be thinking already, this solution comes with just one small problem. Turning off the alignment field seriously degrades the magnetic properties. Our once glorious 20 MGOe magnets would now be 5 to 6 MGOe pieces of scrap: beautiful yes, but unsalable.

The fundamental problem is that it is often possible to make a small change, which appears to be a major improvement when considered from the narrow perspective of someone doing a single step. The lesson is that we need to think about the entire process from beginning to end, even though we may ultimately optimize things by focusing on a single step at a time. We can't ignore the big picture. It is a key concept to keep in mind as we plot our future.

The permanent magnet industry is particularly prone to this type of error because our industry is so fragmented. There is a real weakness in our understanding of what happens outside our particular plant, which we re ally need to overcome in order to be successful.

The Critical Materials Institute (CMI), which was funded by DOE earlier this year, marks a transition in magnet research from a more ad hoc and fragmented collection of research projects to a more integrated and thorough investigation of ways to reduce the criticality of the rare earths and other elements that are part of our modern technology. The CMI has two groups charged with guiding the research work, an advisory board and an industry council. Not to disparage the researchers, but the advisory board and the industry council may have the most important roles to play within the CMI because of their potential to provide valuable feedback directly from the marketplace. Without this feedback, it would be easy for the research to produce good results that might not help our industry. But if it is done well, it has the potential to provide us with very useful developments for the next generation of magnetic materials. That's why I think these two groups are so important, and why they need to be heard and followed.

About the Author - Dr. Stan Trout has more than 35 years' experience in the permanent magnet and rare earth industries. Dr. Trout has a B.S. in Physics from Lafayette College and a Ph.D. in Metallurgy and Materials Science from the University of Pennsylvania. Stan is a contributing columnist for Magnetics Business & Technology magazine. Spontaneous Materials, his consultancy, provides practical solutions in magnetic materials, the rare earths, technical training and technical writing. He can be reached at strout@ieee.org.