

The Golden Age of SmCo

In the process of writing the report, *The Global Permanent Magnet Industry 2010-2020*, with Walt Benecki and Terry Clagett over the past few months, I realized one of the advantages of tackling a big project. It gave me time to ponder some subjects that are not readily obvious and to put some pieces of the puzzle together in a different way. For me, it is always enlightening to have an “aha moment,” especially when it involves permanent magnets.

As I wrote the section about the rare earths, I realized there is a lot of discussion in the industry these days about the market for neodymium and dysprosium. Recently, they have been drifting up in price and allocations have been announced on rare earth exports from China. This is causing serious concerns about their future pricing and availability. My aha moment came when I started to write about samarium. Its prices, in both the metal and oxide forms, are at all-time historic lows without any adjustment for inflation. While a limited amount of samarium is mined each year, compared to neodymium, the demand for samarium is roughly one-third or perhaps one-half of the annual production. Consequently there is downward pressure on the price for samarium as long as this condition prevails. This is a very nice place to be, compared to the other rare earths used in magnets.

Of course the wildcard in this story may be cobalt, which is actually the major alloy constituent in samarium cobalt magnets. It ranges from about 50 to 66 percent by weight, depending on the specific alloy. The samarium content ranges from about 25 to 33 percent by weight.

Cobalt prices have certainly gone through some gyrations in the past, as Figure 1 illustrates.

Despite historic fluctuations, recent cobalt prices have been relatively stable. According to the London Metals Exchange, for most of 2010, cobalt metal has traded in a narrow range around \$40/kg or about \$18/lb. This is not a historic low, but well below the peaks shown in Figure 1.

My aha moment happened when I thought about what happens to the relative prices of SmCo and sintered NdFeB magnets as they shrink in size. In most costing models, there is always a fixed cost included for coating NdFeB magnets, which is usually not neces-

sary for SmCo magnets. This means that there is a point where the cost of the two magnets is the same, even though NdFeB is cheaper than SmCo if one only considers cost per pound or per kilogram of the materials.

I tried to show this effect in Figure 2, which gives a generic idea of what happens. In my simple cost model, I looked at a cube and the point where the prices are equal occurs when the cube is about 10 mm on a side. I think the actual point may occur closer to 5 mm. So please don't take either number too seriously; the concept is valid, but the exact dimension where the prices are equal depends on the exact cost model used. However, this analysis does reveal two interesting points.

First, for very small magnets, the piece price of SmCo should actually be less than that of sintered NdFeB. In addition, since the difference in price does not escalate rapidly with increasing size, SmCo may be a better choice even when it is only slightly more expensive. A small premium for SmCo today may be well worth it, to avoid the uncertainty of the other rare earth prices in the future. The other benefit is that there are fewer temperature headaches with a SmCo design.

If you are using a small sintered NdFeB magnet, perhaps in a sensor application, should you immediately switch over to SmCo? It is well worth considering, but there is probably no rush to make the switch. However, you should have a SmCo design ready and priced out to see how they compare. Qualify your new design with your customers. You will be ready to make the switch at a convenient time, perhaps if neodymium and dysprosium prices increase further, or if cobalt prices decline.

Is this the golden age of samarium cobalt magnets? It may well be if cobalt prices remain steady. Will this golden age last forever? Don't count on it, but it would be a shame to let it pass without taking advantage of it.

I am sure that I may get some feedback on this idea. It would be interesting to compare prices on current SmCo and NdFeB magnet designs. If you can provide specific magnet dimensions and prices in your comparison, I will publish them in a future article.

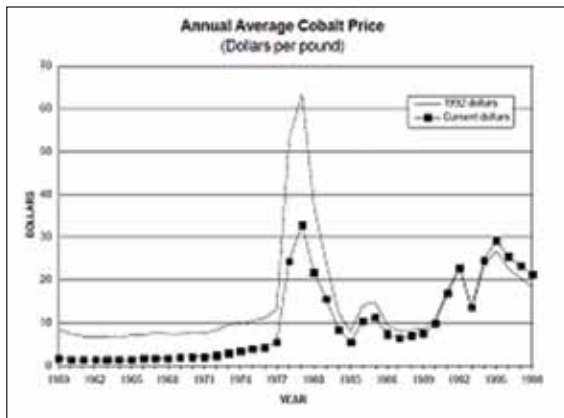


Figure 1. Cobalt prices from 1959 through 1998 in current and inflation adjusted dollars. Source: USGS [1]

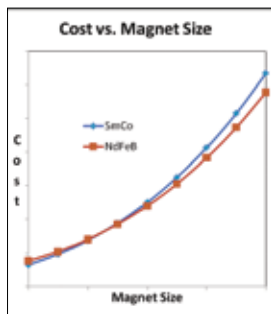


Figure 2.

[1] <http://minerals.usgs.gov/minerals/pubs/commodity/cobalt/210798.pdf>



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