

## Rising Rare Earth Prices



High energy density and improved pricing have allowed rare earth magnets to grow market share over the years, mostly at the expense of ceramic ferrite magnets. But at all of the magnetics meetings and conferences throughout the world recently, the dominant topic of discussion has been the skyrocketing price of rare earth raw materials. Mostly the concern is about

the price of neodymium, the most commonly used rare earth material in both sintered and bonded neodymium-iron-boron (Neo) rare earth permanent magnets. The market had become accustomed to low pricing under \$8/kg for neodymium metal, but this started climbing in late 2005 and had doubled by mid-2006. By the end of last year, the price of neodymium metal appeared to have stabilized in the range of \$25 to \$30/kg. The fact is that the global permanent magnet market is still dominated by ceramic ferrite, because it is by far the most economical material. The tonnage sold of sintered Neo is only about 6 percent that of ceramic ferrite, while bonded Neo sells only about 1 percent of ferrite. So what is the real opportunity for these rare earth magnets to gain significant further market share from ferrite now that their raw materials pricing has risen so high?

I am reminded of what happened after the introduction of samarium-cobalt, the first commercial rare earth magnet. In this material the costs of samarium and cobalt were both of concern, the latter coming mainly from politically volatile regions of Central

Africa and suffering wild price fluctuations over the years. In the late 1970's, after finding only limited use in a variety of specialized applications for several years, sintered samarium-cobalt magnets enabled the introduction of a ground-breaking consumer product - the Sony "Walkman". Key to the miniaturization offered by the Walkman was the use of sintered samarium-cobalt for the capstan motor and the ear-phones. But the high cost of samarium-cobalt was never overcome and this magnet material now serves only niche applications which mainly draw upon its superior stability over a very wide temperature range.

Major commercial applications were ceded to neodymium-

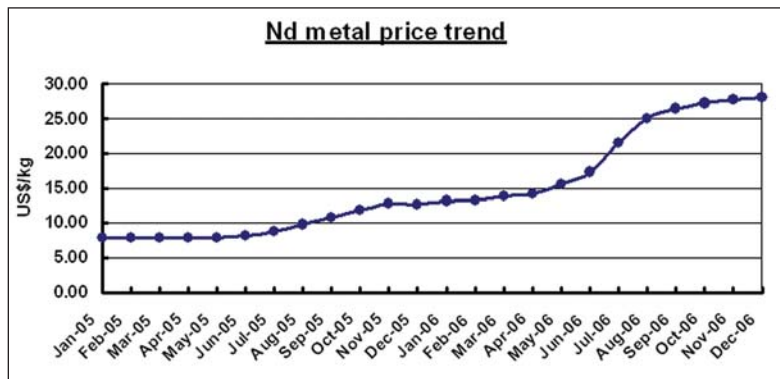
iron-boron following its invention in 1983. Some of today's commercial Neo materials still use a little cobalt, but iron mostly replaces it at much lower cost. This leaves neodymium as the main constituent of Neo magnets whose price sensitivity can affect the commercial viability of its application and whose weight will typically comprise 25 to 30 percent of a Neo magnet's weight. Neodymium metal had not always been as low as \$8/kg, but this did not matter when in the late 1980's rare earth magnets were again the enabler for miniaturization of a major consumer product component - the hard disc drive, with sintered Neo for the head actuator and bonded Neo for the spindle motor. In recent years, significant improvements to magnetic media's storage density have driven a gradual reduction in size, from the 3.5 inch disc drive which prevailed five years ago to the 2.5 inch, 1.8 inch and now 1.0 inch drives of today. The sintered and bonded Neo magnets which still enable this progression are themselves becoming miniature, so their cost is dominated by the magnet's process cost rather than by its raw materials pricing. Despite the constant downward pricing pressure for hard disc drive components, such miniature Neo magnets are commercially viable in this application even at today's elevated neodymium metal prices.

Hard disc drives and other consumer electronic products are still the leading markets for Neo magnets, but major new applica-

tions are said to be in such areas as automobiles, office automation and appliances, which are mostly not "miniature". So unless the application requires some other performance benefit which can only be provided by a Neo magnet, the successful gain of significant further

market share from ferrite will depend very much upon lowering its cost - via raw materials pricing and/or magnet process cost. Just as the cost of very small magnets depends more upon process rather than upon materials, the cost of larger magnets generally becomes more dependent upon raw materials pricing. This brings us back to the skyrocketing price of neodymium, and its effect upon future opportunity for Neo magnets to gain significant market share from ferrite.

The rapid rise in rare earth pricing over the past year was mainly driven by actions taken by the Chinese government, China being the principal source of rare earth ores. New



measures were implemented to improve environmental protection by controlling waste pollution of Chinese smelters, tax incentives on the export of rare earth materials from China were withdrawn, and some important new products for sintered Neo have created strong demand for neodymium. As I have said, it appears that the price of neodymium metal had stabilized as 2006 ended, but I believe that the foregoing reasons for its precipitous rise suggest that we should not expect an imminent return to the low levels of 2005, if ever.

If not driven by an overwhelming factor such as miniaturization which enables a product's evolution, then the investment needed to convert it from ferrite to Neo magnets may not be justified either by a sustained higher neodymium price or by the uncertainty of future long-term price fluctuations of the kind we have recently experienced. Clearly the opportunity for an application to adopt Neo magnets in a significant amount in place of ferrite needs careful analysis of both the technical benefits and the economic forecast.

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