RARE-EARTH INFORMATION CENTER INSIGHT

Institute for Physical Research and Technology
Iowa State University / Ames, Iowa 50011-3020, U.S.A.

Volume 2 May 1, 1989 No. 5

More on Nd-Fe-B Markets (Correction and Clarification)

In the April issue we incorrectly reported that the current market of the Nd-Fe-B permanent magnets amounted to 1,020 metric tons worth $255 M. The correct values for the Western countries should be 650 metric tons worth $165 M for sintered magnets only. Of this amount about 55% is produced in Japan. Furthermore, the 1987 to 1988 growth rate was about 130% and not 15% as we stated last month. The editor wishes to thank Port Wheeler of Wheeler Associates for pointing out these errors and providing the correct values. Mr. Wheeler also noted that the market information for the sintered magnets is quite reliable, since the Japanese sintered magnet trade association collects and makes these numbers available, but this is not the case for the bonded permanent magnets. Since the bonded magnet market reportedly is as large or larger than the fully dense permanent magnet market, the total Nd-Fe-B market is at least twice the corrected values noted above.

A worldwide growth rate of 20% from 1988 to the turn of the century is predicted by M. Yokokura of Sumitomo Special Metals America, Inc., while Port Wheeler suggest a more optimistic 23%, both of which are larger than the 15% growth rate we gave last month, which applies to the U.S.A. market. In any event this represents a fantastic opportunity for this segment of the rare earth industry.

$RFe_{12-x}M_x$ Family of New Permanent Magnets?

In the first issue of **RIC Insight** we suggested that $RFe_{10}V_2$ alloy might be the next generation rare earth-iron permanent magnet material. During the past fifteen months there has been a flurry of activity and many papers have been published on the $RFe_{12-x}M_x$ materials, where M is a metal to the left of iron in the periodic table (i.e. M = Ti, V, Cr, Mo, W, Si, etc.). But the most interesting aspect of all, is that of this published information, little or none is concerned with neodymium or samarium containing $RFe_{12-x}M_x$ materials. The little information that is published on $NdFe_{12-x}M_x$ or $SmFe_{12-x}M_x$ at most concerns the compound's existence, lattice parameters and maybe a Curie temperature. This lack of information does not mean that the permanent magnetic properties of these Nd and Sm compounds are poor. If they were, there would be little reason not to publish more details. We believe that the permanent magnetic properties (such as the magnetization, coercive force, B-H loop, etc.) look sufficiently promising that the companies and institutions involved are carefully guarding their results until patent rights have been firmly established. Whether or not the $RFe_{12-x}M_x$ family can compete with Nd-Fe-B materials is still an unknown - the jury is

-Over-

Telephone: (515) 294-2272
Facsimile: (515) 294-3226
Telex: 269266
BITNET: RIC@ALISUVAX

still out. Regardless, however, once the first results are made public, expect a deluge of papers.

Rare Earths Improve Cemented Carbides

Chinese scientists have found that rare earth additions in the form of mischmetal or cerium improve the bending strength of cemented carbides by 10 to 20%. The cemented carbide studied was a WC-TiC-Co hard alloy with the relative portions specified in one study but not the other. The two studies were reported in the tungsten sections of the First International Conference on the Metallurgy and Materials Science of Tungsten, Titanium, Rare Earths and Antimony by Z. Luo and by G. Li, L. Yan, Z. Li and H. Zhang, pp. 702 and 669, respectively, in Vol. 2 of the Conference Proceedings (edited by C.-Y. Fu, J.-C. Li and S.-G. Li, Pergamon-CNPIEC, Oxford, 1988).

In the first paper (by Luo) the mischmetal (MM) concentrations were varied from 0 to 2.4% (wt.%?), while up to 1.7% (wt.%?) cerium was added. In both cases the bending strength initially rose to a maximum (at 1.2% MM and 0.8% Ce) and then fell off as additional amounts were added. The author found that the hardness, density and coercivity hardly changed with rare earth addition, except for the coercivity which dropped ~10% for the cerium additions. Luo noted that the rare earths tend to prevent the fcc form from transforming to "ϵ-Co" (hcp Co?) and this accounts for the improved bending strength.

In the second paper, Li et. al. reported on the improvement of the wear resistance of a chip plate which is used to clean-off mineral and coal powders which remain stuck on rubber belt conveyers. The chip plates are made of 4 to 12 wt.% TiC, 4 to 10 wt.% Co and the remainder WC. Mischmetal additions of 0.1 to 2 wt.% were studied. These authors also report an improvement of 10 to 20% in the bending strength with essentially no change in the density and hardness with rare earth addition. The life-time of the chip plates were increased by 2.5 to 5 times over the chip plates without mischmetal. They found that the rare earth addition decreases the alloy porosity and the size of the WC grains, and improves the alloy homogeneity. The authors claim that these changes in the microstructure account for the improved wearability and increased life-time (lasting up to 16 months).

As far as RIC is aware no rare earth containing cemented carbide alloys are in commercial use in the Western countries. If the Chinese experience is verified, this could be a small but important rare earth metal market some time in the future - 5 years down the road?

New Magnesium Corrosion Resistant Alloy

Allied-Signal, Inc. of Morristown, NJ has found that a Mg-Al-Zn-Nd alloy is much more resistant to pitting than conventional cast Mg alloys in saline solutions, while retaining its good mechanical properties. The new alloy is reported to match the corrosion resistance of 2024 Al alloys in aqueous saline environments.

Karl A. Gschneidner Jr.
K. A. Gschneidner, Jr.
Editor and Director, RIC