

Adding yttrium oxide (Y_2O_3) to zirconium results in a ceramic material that exceeds high-tensile steel in terms of strength and shock/heat-resistance. Only 5 mol per cent of Y_2O_3 is required for partially stable zirconium, while a fully stable state can be achieved with 8 mol per cent. Ideal applications include dies, machine parts and structural materials for chemical pumps and engines. Automotive engine use is a likely area for future growth due to features such as low heat-conductivity and low specific gravity.

With respect to silicon nitride -- noted for high-temperature and corrosion resistance -- yttrium oxide is also used as an additive.

Electro ceramics is another area in which rare earths are used extensively. This field includes ceramic application products such as insulation materials, semiconductor condensers and thermistors. Rare earths primarily used are yttrium, lanthanum, cerium, praseodymium, neodymium, gadolinium and dysprosium. In terms of volume, neodymium is the most widely used.

Gadolinium is rapidly increasing in demand. Used as an additive to YIG, the result is a high-frequency magnetic material suitable for enhancing the temperature-resistance properties of isolators.

Forty per cent of the ceramic condensers produced in Japan are low-loss, heat-compensating condensers. Neodymium and lanthanum are considered invaluable in upgrading the temperature-resistance capabilities of these condensers used as microwave filters in high tech equipment such as satellite broadcast tuners and car telephones. In addition, the condensers are used in YAG and other laser oscillators.

Glass Additives (Neodymium, Cerium, Lanthanum, etc.)

Optical Glass

Complex glasses, such as lenses for cameras and binoculars containing rare earth oxides, have very high refractive indexes and low dispersions. For example, camera lenses are known to contain as much as 40 per cent lanthanum oxide.

Overall demand for lanthanum oxide was 400 tons in 1988, 20 tons more than the previous year. Taking into account that this volume includes ceramic condenser demand volume, the use of lanthanum oxide for this application sector is decreasing, a downtrend that was expected to continue into 1989.

Television Picture Tubes

Cerium and neodymium are used in the glass surfaces of television picture tubes. Cerium acts as a decolourizing agent and is also capable of cutting down electromagnetic radiation from the picture tubes. Neodymium absorbs medium-range (570 to 585 nm) fluorescence to significantly improve picture contrast.

Polishing Agents (Cerium, Rare Earth Compounds)

Glass polishing is by far the most traditional industrial application area for rare earths. Cerium oxide as well as rare earth compounds are extensively used to enhance polishing agents for products such as glass, television picture tubes, lenses and IC photomasks.

The demand volume for rare earth polishing agents totalled 2 100 tons in 1988. (Table 29 shows the materials to market flow for rare earth polishing powders in 1988.) Of this figure, imports accounted for approximately 400 tons. Polishing agent imports have been growing over the last few years primarily due to the strength of the yen. However, for high tech applications such as the polishing of magneto-optical disks, Japanese manufacturers prefer to use domestically processed polishing agents of higher quality.

In general, the demand for cerium oxide with respect to additives and polishing agents has levelled off at around 3 100 tons.