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## **Process development of recovery of yttrium and europium from compact fluorescent lamps by liquid-liquid extraction**

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Compact fluorescent light bulbs (CFLs) require substantially less electricity than ordinary light bulbs to provide a similar lighting level, and have therefore become a preferred alternative to incandescent light bulbs. The visible light is produced by phosphorescent materials including oxides of rare earth metals, such as yttrium oxide and europium oxide. With the rapid increase in the price of these rare earth metal oxides, it has become a viable option to recycle the rare earth metal oxides from CFLs alongside the glass, mercury and other components. Up until now, the glass and mercury have been recovered from the CFLs, with the phosphorescent materials being sent to landfill sites. The paper presents the history of the process development from initial laboratory experiments and pilot plant tests to full commercialization of the process. The process has been patented. According to the patent, the process is divided into following sections:

1. After mechanical crushing the bulbs and separation of luminophorous powder from glass and bulb bases, the powder is dissolved in an inorganic acid;
2. Yttrium, and later europium ions are extracted with an organic solvent in a vibrating plate extraction column;
3. The extracts from the extraction column are treated to recover yttrium and europium compounds;
4. The raffinate contains mercury, which is removed by precipitation and filtration.

The commercial unit is based in Durban, South Africa. It is designed to process 4800 bulbs per hour. The unit operates under fully automatic control.