TABLE A.4.1 (continued)
Copper/Nickel Smelter SO_2 Control Systems

Smelter Process				SO_2 Control System						
Technology	Relative Cost[3]	Technology availability	Energy consumption[5]	Technology	SO_2 Control %	Estimated Cost[6]	Technology availability[7]	Operating reliability	Energy consumption	By-product
Fluid-bed roaster electric furnace converter	100	High	Very High 106-156	Acid plant on roaster, electric furnace, converter plus FGD system on weak gas streams	To 95%	44	Med.	Med.	Med.	Sulfuric acid and sulfur compound for waste disposal
Direct furnace smelting, converter (Inco, Outokumpu, Noranda)	80	High	Low 60-80	Acid plant on flash furnace and converter	94-95%	40	High	High[4]	Low	Sulfuric acid
Direct frunace smelting, converter (Inco, Outokumpu, Noranda)	80	High	Low 60-80	Acid plant on flash furnace plus FGD system on weak gas streams	To 95%	43	Med.	Med.	Med.	Sulfuric acid and sulfur combound for waste disposal
Continuous smelting (Mitsubishi, Noranda)	135	Med.[1]	Low 60-80	Acid plant	98-99%	33	High	High	Low	Sulfuric acid
Hydrometallurgy	135	Low[2]	High to Very High 100-200	?	To 99.5%	?	?	?	?	Elemental sulfur

1 Can be used for clean copper concentrates
2 Problems with precious metals recovery, limited operating experience; could be considered for some special cases
3 Capital cost relative to a base case facility of calcine fed reverberatory furnace
4 Capture of off-gases from nickel converters and electric furnaces not yet developed
5 Smelter energy consumption is relative to base case of calcine fed reverberatory furnace taken as 100%
6 Estimated cost per tonne of SO_2 removed in 1980 U.S.$
7 High means technology is used at a number of smelters; medium means technology is used at a few smelters; low means technology is used at only one smelter or is being evaluated at a pilot scale facility

Source: Section C.2. References 1, 3, 4, 15