Attrition characteristics of oxygen carrier particles for chemical-looping combustion process

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The chemical-looping combustion (CLC) process has an advantage of no energy loss for CO_2 separation without NO_x formation. This process consists of an oxidizer in the riser section and a reducer in the downcomer section of a circulating fluidized bed reactor that has excellent gas-solid mixing characteristics. However, it has inherent particle attrition problems in operation. The attritions of each metal oxides particles were determined in an attrition tester (ASTM D5757-95): attrition tube (0.035 m-ID, 0.071 m-height) and settling chamber (0.11 m-ID, 0.63 m-height), and the particulate collected in a flask at the top part of the tester was weighed. The obtained attrition data was analyzed in terms of the attrition index (AI) and the corrected attrition index (CAI). The particles were characterized by SEM image and particle size distributions. The values of AI and CAI are found to be 0 - 62.50 and 0 - 23.61, respectively. The metal oxides particles supported on TiO_2 and Al_2O_3 exhibit good resistance, but those on bentonite do not have good resistance against attrition. The optimum condition for good resistance against attrition of NiO-Fe_2O_3/bentonite particles is found to be around NiO:Fe_2O_3 = 3:1.