MgO-based CO_2 sorbent promoted by carbonate and nitrate salts for better sorption performances

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CO_2 is major greenhouse gas contributing a serious global warming problem. Fossil fuel-based power plants are emitting large amount of effluent gases containing CO_2 (conc. 10 ~ 15%) at the pre-combustion stage [1]. The most effective route for CO_2 control is capturing CO_2 from fast effluent gases by using sorbent that can capture CO_2 via either physical or chemical interactions depending on the sorbent properties [2]. The first commercialized sorbent is aqueous solutions containing amines, aqueous ammonia and alkali hydroxides [3]. Another promising sorbent is based on solid-materials, where solid sorbent should selectively capture CO_2 from effluent gases containing various gases and it can reversibly desorb CO_2 at elevated temperature for regeneration of sorbent without any damages during the repeating process of sorption-regeneration. In addition, cheap cost for mass production is also important requirement to be commercialized. Among various solid sorbents, MgO-based sorbents can capture CO_2 as the form of $MgCO_3$ at intermediate temperature range (300 ~ 450°C) and can be regenerated at above 450°C (normally at 500°C) [4]. It was reported that alkali metal nitrate salts could increase the sorption capacity of MgO. Double sodium salts could also allow MgO to possess high CO_2 sorption capacity with 15.4 wt% at 380°C [5].

It is widely accepted that the metal salts could make an interface with MgO, which plays a pivotal role for promoting sorption performance of MgO-based sorbents. In this presentation, MgO-based sorbents are promoted by various metal carbonate and nitrate salts, for investigation of their absorption capacity with kinetics. CO_2 absorption capacity was analyzed with thermal gravimetric analyzer, and the absorption kinetics were investigated by deriving rate constant using Linear Driving Force (LDF) model [6], with the assumption that the CO_2 sorption process followed 1st order kinetics. Effects of metal carbonate and nitrate salt types, mole ratios of Mg/carbonate/nitrate, and type of Mg precursor on the capacity and rate for CO_2 sorption were investigated comprehensively. According to the change of metal types among Li, Na, K and Ca with varying the composition of MgO/carbonate/nitrate, CO_2 absorption capacity and rate were changed dramatically [Fig. 1]. The details of the preparation of MgO-based sorbents and their evaluation as CO_2 sorbent at intermediate temperature range (300 ~ 500°C) will be addressed in this presentation.

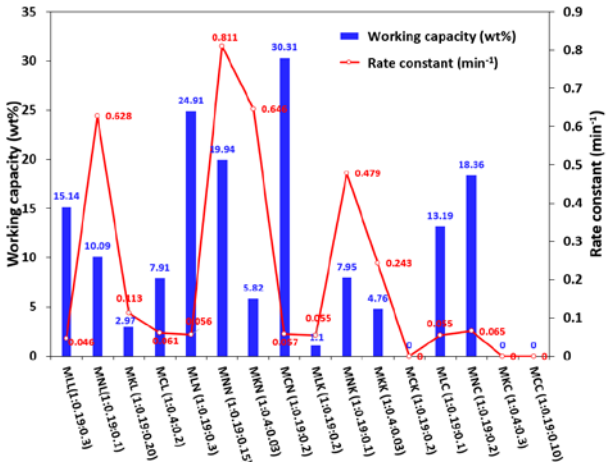

Fig. 1. CO_2 absorption capacity (wt%) and rate constant (min^{-1}) of MgO-based sorbents

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