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Influence of operating parameters on neutralzation of alkaline wastewater using CO_2 in a jet loop absorption reactor

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The increased focus on global warming has resulted in an increase in studies regarding strategies for the control of CO_2 emissions from combustion processes. In this study, we tested the absorption of CO_2 in combustion gas into an alkaline dyeing wastewater to simultaneously control CO_2 and wastewater. During the experiment, we investigated the effects of operating parameters on neutralization characteristics of the wastewater by using CO_2 in a bench-scale semi-batch jet loop absorption reactor (0.1m diameter and 1.0m in height). The operating parameters investigated in the study are gas flow rate of 1.0 - 2.0 L/min and liquid recirculation flow rate of 4 – 32 L/min. We show that the initial pH of wastewater rapidly decreased with increased gas flow rate for a given liquid recirculation flow rate. This was due to the increase in the gas holdup and the interfacial area at higher gas flow rate in the reactor. At constant gas flow rate, the time required to neutralize the wastewater initial pH of 10.1 decreased with liquid recirculation flow rate (QL), reached a minimum value in the range of QL=16L/min and QL=24L/min, and then increased with further increase in QL. The fraction of CO_2 utilization, defined as the ratio of CO_2 used to neutralize the wastewater to CO_2 injected into the reactor, showed a higher value of 0.99 when the wastewater pH was above 9.0. However, the fraction of CO_2 utilization decreased to 0.88 as the wastewater pH lowers to 7.0. Our results suggest that CO_2 in the combustion gas could effectively be used to neutralize alkaline wastewater instead of sulfuric acid, which is a commercially used neutralizing agent in conventional wastewater treatment processes.