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研究论文

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乙醇胺热降解-氧化降解循环过程及SO_2在其中的影响

Monoethanolamine thermal-oxidative degradation in CO_2 capture process and the effect of SO_2

关键词：乙醇胺 热降解 氧化降解 循环过程 二氧化硫

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摘要：使用半连续式不锈钢搅拌反应釜，研究了质量分数30%的乙醇胺（MEA）水溶液（CO_2负载量0.4 mol·mol^{-1}）的热降解-氧化降解循环过程，旨在探讨循环过程对MEA降解的影响，以及SO_2对MEA热降解、氧化降解和循环过程产生的影响.其中，热降解的实验条件为120 ℃，降解时间为2周，在密闭反应器内进行；氧化降解的实验条件为55 ℃，约121.59 kPa，向溶液中持续通入模拟烟气，总气量为7.5 L·min^{-1}，其中包括2% CO_2、0~150 ppm SO_2和空气.实验结果表明，在先进行热降解再进行氧化降解的过程中，MEA的热降解产物N-（2-羟乙基）乙二胺等会在氧化降解的过程中发生进一步反应，且原本氧化降解中生成的亚硝酸根会有部分进一步被氧化，生成硝酸根.在循环过程中，MEA的整体降解程度比单独进行热降解、氧化降解实验中有所提高.研究表明，添加亚硫酸根会加剧热降解中的氨气生成量，而在氧化降解中，SO_2又表现出了明显的抑制作用.在循环过程中，这两者均有体现，SO_2仍起到一定的抑制降解的作用.

Abstract：We studied thermal-oxidative degradation of 30% aqueous monoethanolamine (MEA) with 0.4 mol·mol^{-1} CO_2 loading during CO_2 capture process. This work aimed at studying the thermal-oxidative cycle and SO_2 effect on MEA degradation during the entire process. For thermal degradation, MEA was degraded at 120 ℃ in an airtight reactor for 2 weeks; for oxidative degradation, MEA was degraded with 7.5 L·min^{-1} mixed gas (Air/2% CO_2/0~150 ppm SO_2) under 55 ℃ and 121.59 kPa; for the thermal-oxidative cycle, 250 g thermal-degraded MEA was mixed with 300 g fresh MEA for the oxidation. Degraded samples were analyzed by ion chromatography (IC). It was suggested that MEA thermal degradation product N-(2-hydroxyethyl)-ethylenediamine (HEEDA) was consumed in the oxidative process and MEA oxidative product nitrite was further oxidized into nitrate with the thermal-oxidative cycle. Besides, MEA total degradation rate increased with the cycle. SO_2 may exacerbate the generation of ammonia in thermal degradation, and is a potent inhibitor of oxidative degradation. SO_2 has multiple effects during the thermal-oxidative cycle process.

Key words：monoethanolamine thermal degradation oxidative degradation cycle SO_2