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过渡金属离子液相催化氧化低浓度烟气脱硫

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摘 要：对Mn^{2+},Fe^{2+},Zn^{2+} 3种过渡金属离子液相催化氧化低浓度烟气脱硫的效果进行了对比,并对Mn^{2+}液相催化氧化烟气脱硫的相关工艺参数进行了优化;运用溶液化学原理,对SO_2及Mn^{2+}在溶液中的组分进行了计算,研究了Mn^{2+}液相催化氧化烟气脱硫的机理.研究结果表明:Mn^{2+},Fe^{2+}和Zn^{2+} 3种过渡金属离子对烟气脱硫都有催化作用,Mn^{2+}的催化效果最佳;在烟气中,当SO_2体积分数为1.4%,O_2体积分数为10%,烟气流量为140 L/h,吸收液体积为200 mL,温度为24℃,吸收液pH为5~6及吸收液中Mn^{2+}浓度为0.15 mol/L时,经过一段吸收反应,SO_2转化率大于80%,烟气脱硫率大于75%;当吸收液pH=5~6时,锰主要以Mn2+形式存在,SO_2主要以HSO_3^-的形成存在;其催化反应的机理为:Mn^{2+}与HSO_3^-反应形成络合物,成为反应链的引发剂来诱发氧化反应.

关键字：二氧化硫烟气;过渡金属离子;液相催化氧化脱硫;环境保护

Transition metal ions for liquid catalyzed oxidation desulphuration of flue gas of low SO_2 concentration

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Abstract: The effect of three kinds of transition metal ions Mn^{2+}, $Fe^{2+}$and Zn^{2+}on the liquid catalyzed oxidation desulphurization of flue gas of low SO_2concentration was studied. The optimization of the process parameters of catalyzed oxidation desulphurization by $Mn^{2+}$was carried out, which includes volumetric fraction of SO_2 and O_2, and flow rate of flue gas, pH value , volume and concentration of $Mn^{2+}$of absorbent liquid. Based on the aqueous chemistry theory, the composition of SO_2 and Mn^{2+}in aqueous is determined, and the mechanism of Mn^{2+}catalysis oxidation desulphurization in liquid is demonstrated. The results show that the three ions can all catalyze the desulphurization of flue gas in solutions, but manganese ion is the best. When the flue gas containing(volume fraction) 1.4% SO_2 and 10% O_2 at 140 L/h flow rate was desulphurized by absorbent solution at pH 5~6 and 0.15 mol/L Mn^{2+}, above 80% of the transformation rate of SO_2 into $SO_3$and 75% of desulphuriation rate were achieved only once. The results of aqueous-chemistry calculation reveal that the mainly existing composition of manganese ion and SO_2 are $Mn^{2+}$and HSO_3^-, respectively, at pH 5-6 of absorbent solution. The catalysis mechanism of Mn^{2+} is that Mn^{2+} triggers the oxidation of SO to occur

by forming a complex with
HSO_3^-, which induce a chain of oxidation reactions in the solution.

Key words:flue gas of SO_2 concentration; transition metal ions; liquid catalyzed oxidation desulphurization; environment protection