CHINA ASSOCIATION OF INVENTIONS

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Invention: Technology of electrochemical synergistic conversion and utilization of sulfur and nitrate resource in flue gas mediated by ammonium persulfate

硫酸铵介导烟气硫硝资源电化学协同转化利用技术

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Introduction:

To meet the urgent needs of low-cost simultaneous desulfurization and denitrification and their resource utilization of flue gas, the wet absorption of SO2 and NO was enhanced by the strong oxidation of ammonium persulfate in this project. Then, ammonium persulfate was synthesized by an electrochemical method using ammonium sulfate and ammonium nitrate as raw materials. In this way, the energy input can be used to replace the introduction of desulfurizing/denitrificating agent. Under the condition of almost no addition of separator, sulfur and nitrate can be simultaneously removed and recycled, which can solve the two major industry pain points of the high cost of desulfurizing and denitrification agents and difficult treatment of byproducts.

Desulfurizing/nitrating agents were used to enhance the oxidation and absorption of SO2 and NO in flue gas. In a low-pressure electric field, the generated SO42- from the liquid-phase oxidation absorption of SO2 could be transformed into persulfate ion S2O82- through a single electron transfer. The generated NO3- from the denitrification could be selectively reduced to NH4+ on the cathode, completing electron balance and ammonium supplementation. This project achieved the purpose of replacing desulfurizing/nitrating agents with electricity input. Through multiple cycles of oxidation and absorption, the absorption solution gradually accumulated salts. Through concentration and crystallization, ammonium sulfate and ammonium nitrate products could be obtained.

Application Case 1: It was applied in the desulfurization and denitrification project of a certain copper industry corporation.The project achieved the reduction of SO2 and NO emissions as well as the recycling of sulfur and nitrogen resources.

Application Case 2: It was applied in the desulfurization and denitrification project of a certain coal-fired power plant.The benefits of reducing SO2 and NO emissions were evident. The concentration of major pollutants in the desulfurization and denitrification wastewater was below the standard limit.

Economic and environmental benefit

This technology achieved a sulfur removal rate of 100% and a nitrogen oxide removal rate of 90%. It obtained a cumulative benifit from pollutant emissions with total of $4,000,000,000, reducing SO2 emissions by 4,800 tons and NO emissions by 1,200 tons. This significantly reduced the emissions of these harmful gases, decreased air pollution levels, improved air quality, and protected the health of both humans and the environment, while promoting sustainable development and environmental conservation.

Furthermore, this technology allowed for the recovery of ammonium persulfate, which was used as an oxidizer in the desulfurization and denitrification processes. The synthesis rates of ammonium persulfate reached 80%. This approach offered the advantages of simplicity, environmental friendliness, and energy efficiency, leading to significant cost savings by reducing desulfurizing agents, pollution fees, and solid waste disposal costs. Approximately 5,000 tons of sulfur and nitrogen resources were recovered, resulting in economic benefits equivalent to a profit of $27,000,000 over the past three years.

The research findings can provide a theoretical foundation and practical basis for the coordinated conversion and utilization of sulfur and nitrogen resources in flue gas development

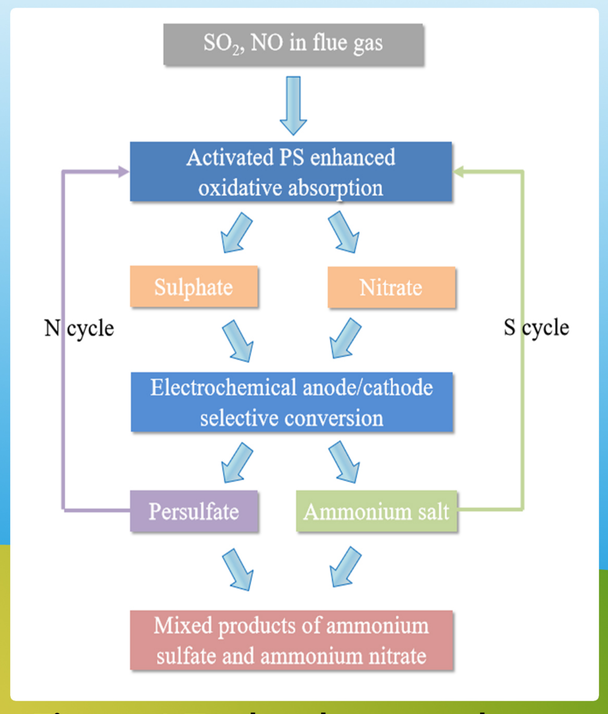

Figure 1 Technology roadmap

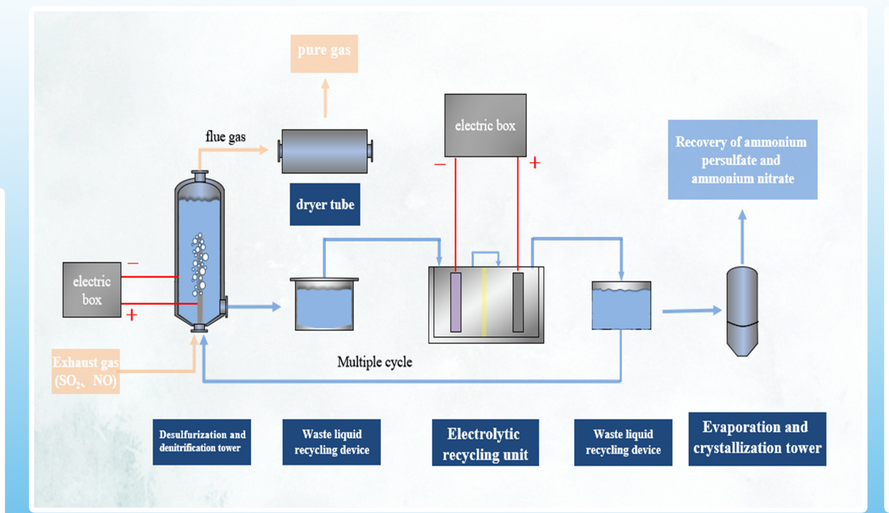

Figure 2 Flow diagram of desulfurization and denitration process

Figure 3 Application Case 1

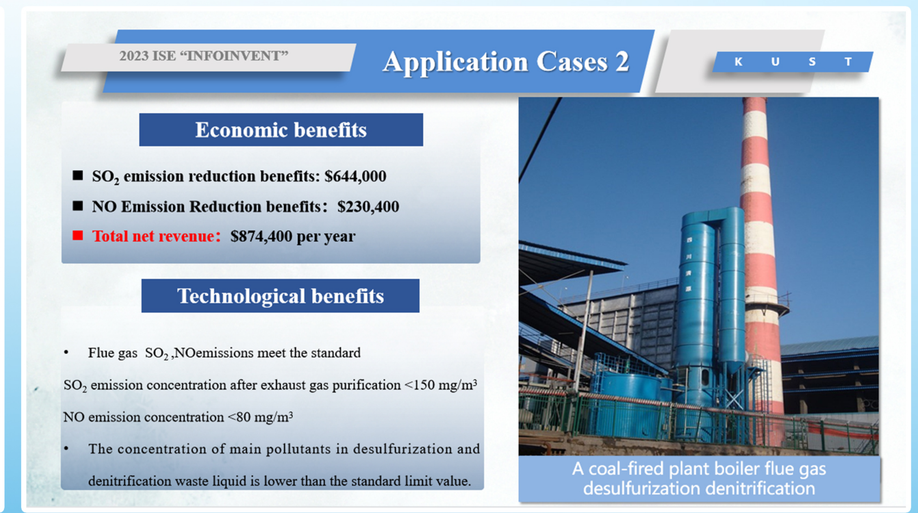

Figure 4 Application Case 2

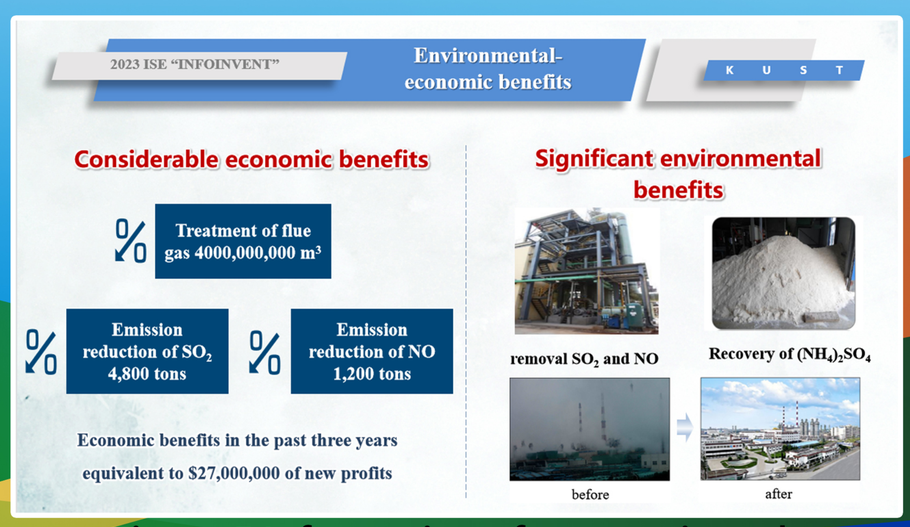

Figure 5 Information of economic and environmental benefits

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