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COMMERCIAL DEMONSTRATION OF THE NOXSO SO_2/NO_x REMOVAL FLUE GAS CLEANUP SYSTEM

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Project Definition Phase

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1.0 INTRODUCTION

The NOXSO Process is a dry, post-combustion flue gas treatment technology which uses a regenerable sorbent to simultaneously adsorb sulfur dioxide (SO_2) and nitrogen oxides (NO_x) from the flue gas of a coal-fired utility boiler. In the process, the SO_2 is reduced to elemental sulfur and the NO_x is reduced to nitrogen and oxygen. It is predicted that the process can economically remove 90% of the acid rain precursor gases from the flue gas stream in a retrofit or new facility.

Details of the NOXSO Process are described with the aid of Figure 1. Flue gas from the power plant is drawn through a flue gas booster fan which forces the air through the fluid bed adsorber and centrifugal separator before passing to the power plant stack. Water is sprayed into the flue gas as required to lower the temperature by evaporative cooling. The fluid bed adsorber contains active NOXSO sorbent. The NOXSO sorbent is a 1.6 mm diameter γ-alumina bead impregnated with 5.2 weight % sodium. The centrifugal separator separates sorbent which may be entrained in the flue gas and returns it back to the adsorber.

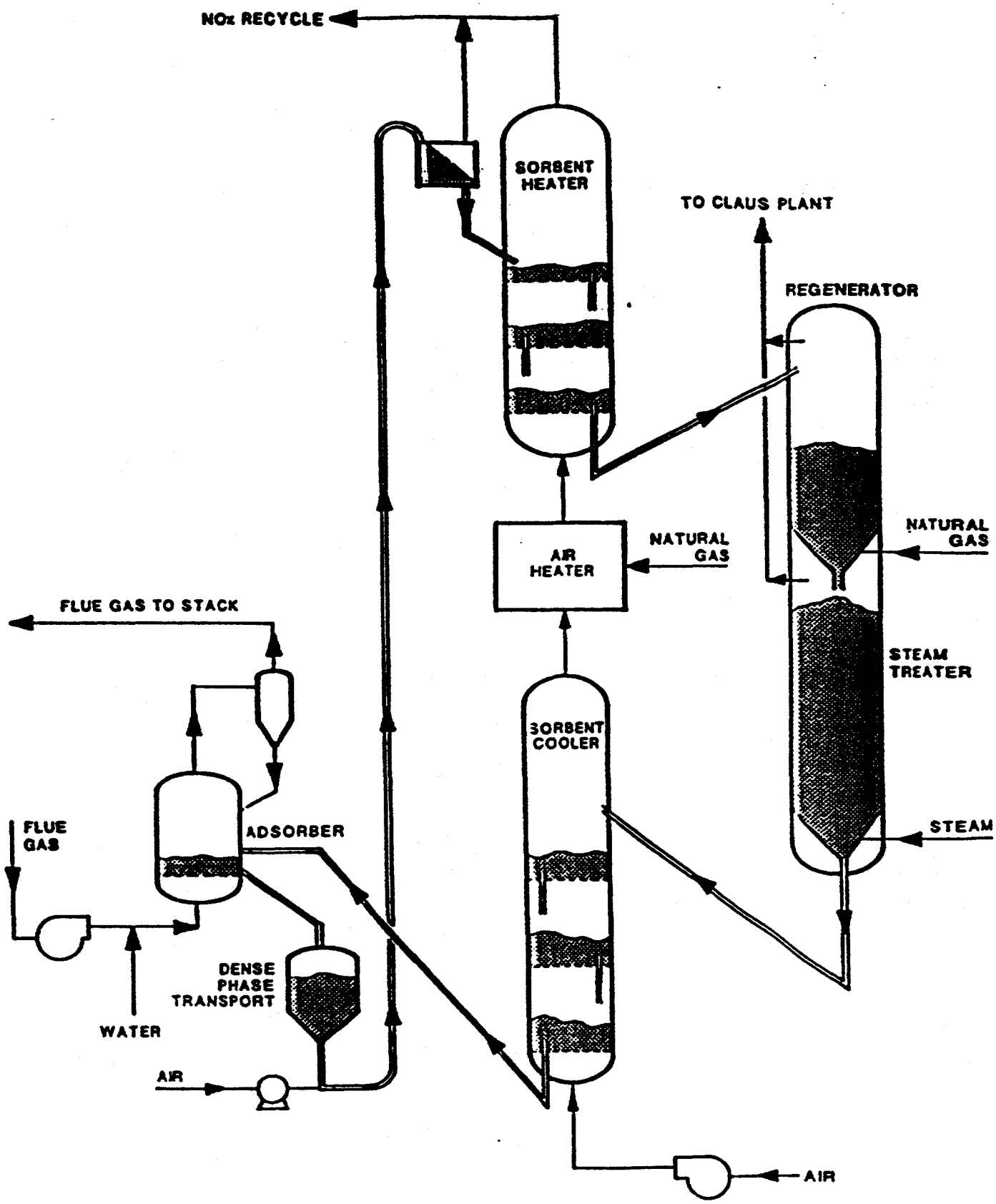
Spent sorbent from the adsorber flows into a dense-phase conveying system which lifts the sorbent to a disengaging vessel. From the disengaging vessel the sorbent flows by gravity to the top bed of the sorbent heater. The sorbent flows through the multi-stage fluidized bed sorbent heater counter to the heating gas which heats the sorbent to the regeneration temperature of approximately 1200°F.

In the process of heating the sorbent, the NO_x is driven from the sorbent and carried to the power plant boiler in the NO_x recycle stream. The NO_x recycle replaces a portion of the combustion air. The presence of NO_x in the combustion air reduces the formation of NO_x in the boiler resulting in a net destruction of NO_x.

The heated sorbent enters the regenerator where it is contacted with a methane reducing gas. Through a series of chemical reactions, the sulfur on the sorbent combines with the methane and forms SO_2 and H_2S. Additional regeneration occurs in the steam treater when the sorbent is contacted with steam converting the remaining sulfur on the sorbent to H_2S.

The regenerator and steam treater off-gas streams are combined and directed to a Claus plant where the H_2S and SO_2 are converted to liquid elemental sulfur. Tail gas from the sulfur plant will be incinerated and recycled back through the adsorbers to remove any sulfur compounds.

High temperature sorbent exiting the steam treater passes to the multi-stage fluidized bed sorbent cooler. The sorbent flows counter to the ambient air which cools the sorbent. Regenerated sorbent exits the cooler at 250°F. It is directed to the adsorber completing the sorbent cycle.



NOXSO PROCESS FLOW DIAGRAM

FIGURE 1

Ambient air which is forced through the sorbent cooler by the heater-cooler fan exits the sorbent cooler at approximately 800°F. This preheated air then enters the air heater where it is heated to approximately 1350°F so it is capable of heating the sorbent exiting the sorbent heater to 1200°F.

2.0 PROJECT DESCRIPTION

The objective of the NOXSO Demonstration Project is to design, construct, and operate a flue gas treatment system utilizing the NOXSO Process at Ohio Edison's Niles Plant Unit #1. The effectiveness of the process will be demonstrated by achieving significant reductions in emissions of sulfur and nitrogen oxides. In addition, sufficient operating data will be obtained to confirm the process economics and provide a basis to guarantee performance on a commercial scale. Ohio Edison's Niles Plant Unit #1 generates 115 MW of electricity and 275,000 scfm of flue gas while burning 3.5% sulfur coal.

3.0 PROJECT STATUS

No NEPA compliance activities were conducted this re

NEPA Compliance

No NEPA compliance activities were conducted this reporting period.

Preliminary Engineering

No preliminary engineering activities were conducted during this reporting period.

Nitrogen Oxide Studies

Contract DE-AC22-91PC91337, "An Experimental Study of NO_x Recycle in the NOXSO Flue Gas Cleanup Process" was issued by the DOE to NOXSO on 9-18-91. The objective of the project is to perform a series of tests involving the injection of a simulated recycle stream into the combustion air supply of the small boiler simulator (SBS) at Babcock and Wilcox's Alliance Research Center. The SBS is a single cyclone boiler having a configuration appropriate for modelling the utility boiler at Niles.

Process Studies

No process studies specifically associated with the demonstration plant design were conducted during this reporting period. Construction of the NOXSO Proof-of-Concept (POC) plant was completed on 9-6-91.

Cold flow and hot inert flow tests were conducted to verify proper operation of the equipment. Modifications to the system were required to attain the required sorbent circulation rates. Specifically, this required modifications to the downcomer flapper valve design between fluid bed stages. Modifications were also required in the J-valve downcomer which transports sorbent from the sorbent cooler to the adsorber.

Testing began with flue gas to the adsorber on 11-23-91.

Plant Characterization

No effort was made to obtain power plant characterization information during this period.

Site Survey/Geotechnical Investigation

No site survey was conducted or geotechnical investigation obtained during this period.

Permitting

No permitting activities were conducted during this reporting period.

4.0 SUMMARY

Activity on this project has been minimal while awaiting results from the NOXSO pilot plant. Staffing and expenditures reflect this low level of effort.