THE REDUCTION OF GAS PHASE AIR TOXICS FROM COMBUSTION AND INCINERATION SOURCES USING THE GE-MITSUI-BF ACTIVATED COKE PROCESS

Co-Author: David G. Olson
General Electric Environmental Services, Inc.
200 North Seventh Street
Lebanon, Pennsylvania 17046 USA

Co-Author: K. Tsuji
Mitsui Mining Company, Limited
2-1-1 Nihonbashi Muramachi
Chuoh Ward, Tokyo, Japan 103

Co-Author: I. Shiraishi
Mitsui Mining Company, Limited
1-3 Hibikimachi, Wakamatsu Ward
Kitakyushu City, Kukuoka, Japan 808

Introduction

This paper provides information on the GE-Mitsui-BF dry DeSOx/DeNOx/Air Toxics removal process which can be utilized by utility, chemical, oil refineries and other industries. This process, originally researched and developed during the 1960's by Bergbau-Forschung (BF), now called Deutsche Montan Technologies, was licensed to Mitsui Mining Company (MMC) in 1982 to investigate, test and adapt the system to Japanese regulations which are more stringent than those in the United States. General Electric Environmental Services, Inc. (GEESI) has licensed the Mitsui-BF process for flue gas cleaning applications in North America. The process is installed on four coal-fired boilers and fluidized catalytic cracker (FCC) units. These units were constructed by MMC in Japan and Uhde Gmbh in Germany. MMC has also developed a technology to produce the Activated Coke (AC) used in the removal process based on their own metallurgical coke manufacturing technology.

Research & Development of AC

AC is a formed, carbonaceous material designed for a dry DeSOx/DeNOx/Air Toxics process used for flue gas cleaning. AC has a high mechanical strength against attrition and crushing during the circulation and handling process.

Laboratory tests of the AC have been conducted by MMC since 1980, including selection of raw materials, methods of producing high mechanical strength pellets, procedures for carbonization, activation and chemical treatment methods to enhance adsorptive effectiveness.

In October 1996, a 3,000 ton/year capacity plant for AC production began operation in MMCs Kitakyushu works.

Characteristics of MMC's activated coke vs. activated carbon are shown below.

Items	MMC's Activated Coke	Activated Carbon
BET Surface Area (m^2/g)	150-250	850
Mechanical Strength (%)	95	85
SO_2Adsorption Capacity (Mg-SO_2/g)	60-120	220*/70**
NOx Removal Efficiency (%)	80-85	60-70
Price Ratio (-)	1/4 - 1/3	1

* with fresh material
** with used material

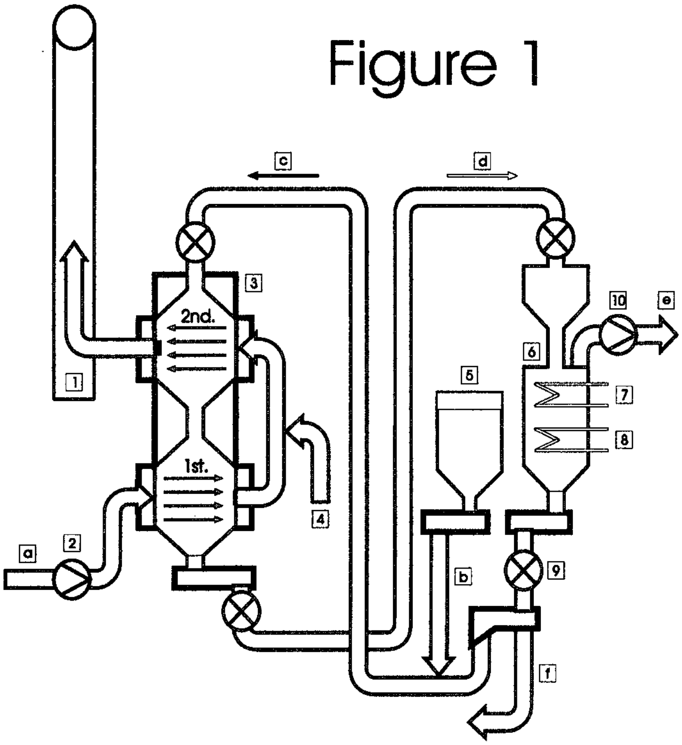
GE-Mitsui-BF Dry Simultaneous DeSOx/DeNOx/Air Toxics Removal Process

MMC's activated coke is utilized in a process which accomplishes desulfurization, denitrification and air toxics removal simultaneously in a single system consisting of three sections: adsorption, AC regeneration and byproduct recovery. A schematic of the process is provided in Figure 1.

ADSORPTION: The adsorption section consists of two stages. AC moves continuously from top to bottom through the adsorber. First AC enters in the top of the second stage, where NOx reduction with the addition of NH3 occurs. The discharged AC from the bottom of the second stage enters the top of the first stage, where the majority of the SOx and Air Toxics adsoprtion occurs. The SOx/Air Toxics-filled AC is discharged from the bottom of the first stage and sent to the regeneration stage. If only DeSOx or DeNOx along with Air Toxics removal separately is required, a single stage process can be designed.

AC REGENERATION: AC discharged from the bottom of the first stage is sent to a two-stage regeneration vessel where sulfuric acid, its ammonia salts and air toxics are thermally decomposed into an SO_2 concentrated gas.

Figure 1



1. **Stack**
2. **Flue Gas Booster Fan**
3. **Adsorber**
4. **NH_3 Injection**
5. **Activated Coke Bin**
6. **Desorber**
7. **Regeneration Heater**
8. **Regeneration Cooler**
9. **Vibrating Screen**
10. **Blower**

a. **Flue Gas**
b. **Activated Coke (granular)**
c. **Activated Coke (regenerated)**
d. **Activated Coke (saturated)**
e. **SO_2-rich Gas**
f. **Fines (return to boiler)**

During the first stage, the AC is indirectly heated by an external furnace's combustion air. This SO_2-rich gas (SRG) is sent to the byproduct section. During the second stage, the cooled, regenerated AC is filtered to remove fine dusts, then recycled back to the adsorber. The AC fines can be recycled and disposed of by burning as fuel.

BYPRODUCT RECOVERY: SRG generated in the AC regeneration section contains approximately 20-25% SO_2. It can be converted into either salable elemental sulfur (purity >99%) either liquid or solid, sulfuric acid (purity > 98%) or liquid SO_2.

Process Applications

In 1987, a commercial plant started operation at Idemitsu Kosan, Aichi Oil Refinery which treats flue gas from the catalyst regeneration section of a Residue Fluid Catalytic Cracking Unit (RFCC) (236,000 Nm^3/hr design).. Performance of this DeSOx/DeNOx plant has been very successful. A removal efficiency of 100% for SOx and over 80% for NOx has been constantly achieved at operating temperature of 180 C.

Additional applications include two power plants in Germany, one burning lignite and one burning hard coal.

Conclusion

The GE-Mitsui-BF dry, low temperature DeSOx/DeNOx/ Air Toxics removal system has been proven capable of removing over 99% of the SOx, including SO3, up to 99% of selected air toxics and over 80% of the NOx in coal-fired and fluidized bed boilers and RFCC units. In addition, the process is effective in reducing vaporous, elemental mercury by 99%+ and dioxins/furans by 70% to 98% from combusion flue gases.

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