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聚四氟乙烯 / 聚苯硫醚复合滤料在火电厂燃煤锅炉袋式除尘应用研究

Investigations of Polytetrafluoroethylene / Polyphenylene Sulfide Composite Filter Materials Applied in Bag House Dust Removal for Coal Burning Boiler in Fired Power Station

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Investigations of Polytetrafluoroethylene / Polyphenylene Sulfide Composite Filter Materials Applied in Bag House Dust Removal for Coal Burning Boiler in Fired Power Station

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摘要

工业烟尘的大量排放给我国在大气质量造成了严重的影响，近年来引发了频繁的雾霾天气。为满足我国环境空气质量改善，达到污染物总量减排的目标，环境保护部会同国家质检总局在 2014 年 5 月 16 日发布了《锅炉大气污染物排放标准》（GB13271-2014），并于 2014 年 7 月 1 起实施，规定了新建锅炉自 2014 年 7 月 1 日起执行本标准，即燃煤锅炉颗粒物排放限值为 50 mg/m^3。新《火电厂大气染特排放标准》（GB13223-2011）也规定，烟尘排放浓度最高限值从原来的 50 mg/m^3 提升到 30 mg/m^3，重点地区提至 20 mg/m^3。

滤袋是火电厂燃煤锅炉袋式除尘器的核心部件，其性能决定着除尘器的除尘效率。滤袋材质的选择主要依据烟气特性、温度、粉尘性质及清灰方式。由于火电厂燃煤锅炉采用煤的种类不同，造成运行工况条件差异大。过去火电厂燃煤锅炉除尘滤料主要以聚苯硫醚（Polyphenylene Sulfide，PPS）滤料为主，因高温或酸腐蚀等原因，造成 PPS 滤料使用寿命短，个别项目滤袋使用时间不到一年就出现大规模破损。PPS 滤料破损的主要原因是受到烟气中酸性气体（如 SO_3、NO_2 等）影响，发生化学腐蚀，造成滤袋强力下降而使滤袋破损。

聚四氟乙烯 / 聚苯硫醚（PTFE / PPS）复合滤料就是针对此种恶劣的工况而设计研发的。本课题在现有资料的基础上，对不同混纺比例的 PTFE / PPS 复合滤料的耐氧化性能和过滤性能进行系统的测试与分析。结果表明，随着 PTFE / PPS 复合滤料中 PTFE 含量的增加，其耐氧化性能提高，但过滤性能有所下降。

在前期研究的基础上，本课题还在河南某 600MW 机组电袋除尘器进行挂袋实验，结合三次烟气检测，分析滤袋应用的实际工况条件。该项目运行温度波动大，酸露点温度在 119 ～ 145℃之间，而项目运行温度大多落在此区间，易导致滤袋表面结露，造成对滤料腐蚀。在挂袋实验中，四种材质滤料性能变化明显，含 50% PTFE 的 PTFE / PPS 复合滤料的耐化学腐蚀性能最优，其机械性能下降幅度最小，证明该滤料适合河南某 600MW 机组电袋除尘器工况的使用要求，在工况条件相对稳定的条件下，其使用寿命预计达 50 个月。

关键词：聚四氟乙烯；聚苯硫醚；复合滤料；过滤性能；袋式除尘

ABSTRACT

The release of a large amount of industrial smoke and dust has significantly lowered the air quality and polluted the environment in China. As a consequence, the atmospheric haze has frequently taken placed in recent years. In order to improve the air quality, to minimize the air pollution, and to meet the goal of the reduction in total pollutants being released, on May 16, 2014 the Ministry of Environmental Protection (MOEP) along with the General Administration of Quality Supervision, Inspection and Quarantine (AQSIQ) has issued the Emission Standard of Air Pollutants for Bill (GB13272-2014) which has been effective on July 1, 2014 and forced the newly established boilers to meet the standard that the maximal particulate emission should not exceed 50 mg/m^3 since July 1, 2014. Furthermore, the new Emission Standard of Air Pollutants for Thermal Power Plants (GB13223-2011) has also upgraded the limit for the maximum concentration of smoke and dust emission from 50 mg/m^3 to 30 mg/m^3, while to 20 mg/m^3 in some selected areas.

The filter bag is a core component of bag house dust removal for a coal burning boiler in a fired power station. The efficiency of bag house dust removal strongly depends on its performance. The bag materials are selected base on the characteristics of smoke and dust, the temperature and the cleaning way. Significant differences in operating conditions exist since the uses in different types of coals supplied to a burning boiler of fired power station. In the past, the major material of filter bag used in bag house dust removal for a coal burning boiler in a fired power station is polyphenylene sulfide (PPS). However, high temperature operation and/or acid corrosion have led to short service life of PPS filter bag. For instance, a filter bag may last less than a year and suffer severe damage. The main reason which causes the damage of PPS filter bag is chemical corrosion occurred on PPS due to the presences of acidic gases (such as SO_3, NO_2 etc.) in the smoke and dust. Accordingly, the strength of PPS filter bag weakens and the filter bag brakes.

To overcome these problems, the polytetrafluoroethylene / polyphenylene sulfide

(PTFE / PPS) composite has been specially designed and researched as filter materials. Based on a literature survey, a series of experimental measurements and analysis tests were carried out to investigate the oxidation tolerances and filtration performances of PTFE / PPS composite filter materials consisted of different proportions of PTFE and PPS. The results revealed that the oxidation tolerances of the PTFE / PPS composites were enhanced with the increases in the contents of PTFE, while the filtration performances were slightly declined.

On the basis of laboratory experimental results, the filter bags have been tested under the practical operation with the electrical bag composite precipitator of a 600 MW unit boiler in Henan Province. The actual working conditions of filter bags were evaluated by combing three sets of detection results of exhaust gas compositions. The temperatures were fluctuating during the testing period. The acid dew point temperatures changed from 119℃ to 145℃ which were the operating temperature ranges during the testing period. The surfaces of filter bags were readily dewed, causing the corrosion of filter bags. The performances among the four types of filter materials being tested had apparently been changed. The best chemical resistance performance with the least reduction in mechanical property was achieved with the PTFE / PPS composite filter material containing 50% PTFE. It proved that this composition of filter material could meet the requirement of electrical bag composite precipitator for a 600 MW unit boiler in Henan Province. The service life was estimated to reach 50 months under the relatively stable operating conditions.

Key Words: Polytetrafluoroethylene; Polyphenylene sulfide; Composite filter materials; Filtration performance; Bag house dust removal