Recycling Study of PRS Filter Bag

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I. Research background and purpose：

Linkou Power Plant and Talin Power Plant use particle removable system (PRS) to remove particulate pollutants in the flue gas. The most significant advantage is that the dust removal efficiency can reach over 99.9%, and the emission concentration of particulate pollutants can reach below 10 mg/m^3. It also has a good collection efficiency for fine particles below 2.5 μm. However, a large number of waste filter bags are produced at the same time. In addition, most of them are made of synthetic chemical fibers with poor biodegradability and are difficult to degrade in nature. Therefore, waste filter bags have become a new source of pollution. How to effectively dispose of waste filter bags has become an urgent problem to be solved at present.(Fig. 1)

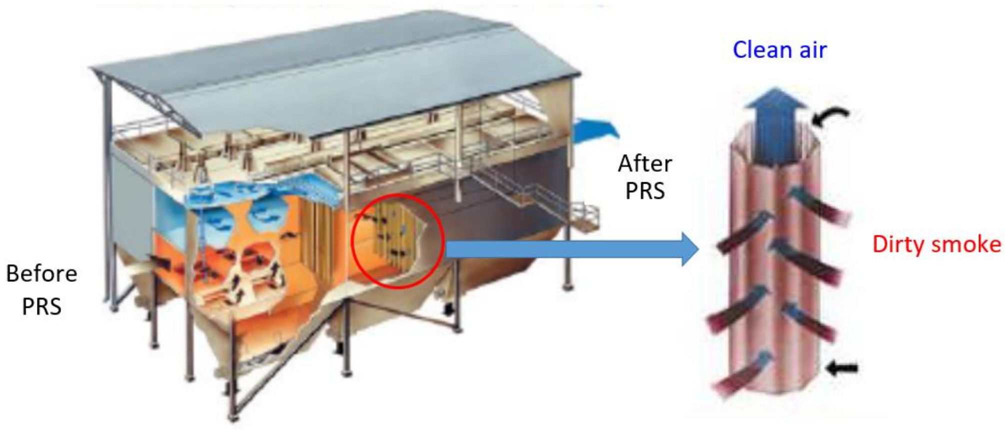

Fig. 1 The schematic diagram of particle removable system

The main material of the filter bags used by our company is polyphenylene sulfide (PPS). Polyphenylene sulfide has high thermal stability and can be used continuously at 220 °C. With chemical resistance, it can also resist a variety of solvents and corrosive chemicals at high temperatures. At the same time, it has high strength and high rigidity. It is a high-performance thermoplastic engineering plastic applied to industrial products. It can be processed by various molding methods. It is widely used in various fields at present.

The purpose of this case study is to focus on how to recycle and reuse waste filter bags as the main raw materials.

II. Research methods：

In this study, physical recycling technology and chemical depolymerization technology are applied to reuse waste filter bags. Physical recycling is the easiest method to implement and can be applied in large-scale waste plastic recycling. Its recycled material is functionally equivalent to virgin plastic, with the immediate advantage of reducing raw material waste. After the waste filter bags are crushed, glass fiber and other filling materials are added, and high-strength composite materials are developed by using a twin-screw extruder (TSE). They can be used as electronic product casings, materials for outdoor public art or walking trails, humanistic gardening containers, cultural and creative products, etc.

After cleaning the filter bag fragments, most of the fly ash particles on the filter bags can be removed. The filter bag fragments are mixed with an unchaining agent through a twin-screw extruder, and the melt can be smoothly extruded. Pellets can be obtained after cooling and cutting. If we add 40% glass fiber to the pellets, we can obtain composite material granules. The properties of the composite material granules (tensile strength, flexural strength and modulus, impact resistance, etc.) are about the same as the commercially available Solvay Ryton R-4-02 composite rubber particles.(Fig. 2)

Fig. 2 After the filter bag fragments are unchained, 40% glass fiber is added to the pellets, and the composite material colloids are obtained by twin-screw extrusion.

Chemical depolymerization technology is to oxidize the depolymerization product of waste filter bags whose main component is polyphenylene sulfide and sodium sulfide in the presence of a weak base to obtain dithiol oligomers. The methylation reaction is done by adding methyl trifluoromethanesulfonate, a highly reactive methylation reagent, to form a cationic polymer product. At the same time, the solubility and stability of the product in different organic solvents are tested to evaluate the feasibility of being used as an anti-corrosion coating.

III. Research results：

We used the composite material granules to produce navigation machine shell products by an injection molding process. The surface texture of this product is fine and hard, and there is a metallic sound when knocked. After comparing with the 3C product casing made of Toray PPS/GF composite products, there is no significant difference in performance. It has also passed the verification of no heavy metal residue.(Fig. 3,4)

Fig. 3. Composite material granules are manufactured by injection molding machine (left) to manufacture navigation machine shell products (right).

The dithiol products obtained after chemical depolymerization of waste filter bags are used to replace the anti-corrosion resin part in the existing anti-corrosion coating formula (its main components are anti-corrosion resin, hardener and solvent), and the coating containing dithiol products can be obtained whose have a very good anti-corrosion effect. At the same time, the waste filter bag is methylated (with methanesulfonic acid as the reaction solvent) to obtain a water-soluble methylated product, which can be compounded with water-based epoxy resin to form an anti-corrosion water-based coating.

Waste filter bags are disposed of in a reusable manner, which has the advantage of a lower carbon footprint compared with common waste disposal methods (burying and burning, etc.). Reducing greenhouse gas emissions during the disposal process is more environmentally friendly and can protect the environment for a better future.

IV. Future Outlook：

This project is a pilot study to find ways to reuse waste filter bags. This study found that the performance of waste filter bags is still perfect after cleaning. Therefore, we plan to reuse the cleaned waste filter bags in the particle removal system. In addition, verification of maintenance performance, filter bag recycling model, and promotion of more applications of recycled products will be further studied.