

Application of Coal Gangue in Soil Remediation in Mining Areas in Northern Shaanxi

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Abstract: Coal is one of the important energy sources in many countries. Coal gangue is a kind of rock that accompanies and co-exists with coal in the process of coal formation. At present, my country's comprehensive development and utilization of coal gangue has achieved certain results and accumulated certain experience. There are relatively few domestic and foreign researches on the improvement of soil by coal gangue, and they are all in the stage of theoretical research and feasibility research. In northern Shaanxi, especially in coal mining areas, such as Yulin City, the soil type is mainly sandy soil. Sandy soil lacks organic matter and various beneficial elements required by the soil, and its mineral composition is dominated by primary minerals such as quartz and feldspar. Keywords: Coal Gangue; Soil Remediation; Northern Shaanxi.

1. INTRODUCTION

Coal is one of the important energy sources in many countries. In 2015, the total global coal consumption reached 5.5 billion tons, accounting for 19% of the world's primary energy [1]. From 2007 to 2017, coal consumption in Europe and North America declined, while coal consumption in Asia continued to grow [2]. In 2017, China accounted for 50.72% of the world's total coal consumption [2].

Coal gangue is a kind of rock that accompanies and co-exists with coal in the process of coal

formation. It is a waste discharged during coal mining and processing. It is a mixture of various rocks and accounts for about 10-15% of coal production [3]. These coal gangues are huge in quantity and piled up like mountains. The gangue hills have become a unique symbol of coal mines in our country [4]. At present, there are more than 1,500 coal gangue hills in my country, with a cumulative stockpile of more than 5 billion tons, covering an area of more than 13,000 hectares. And with the development of the coal industry, it is increasing at a rate of 300 to 350 million tons per year [5]. These coal gangues not only occupy a large amount of land and farmland, but also cause environmental pollution to varying degrees [6-11]. It is urgent to strengthen the research on the comprehensive utilization of coal gangue resources and convert their waste into usable resources.

2. POLICY

Since the end of the 1980s, my country has also begun to attach importance to the sustainable development of coal mining enterprises and the issue of ecological environment protection. A series of laws and regulations have been formulated successively, including the "Land Management Law of the People's Republic of China", "Regulations on Land Reclamation", "Technical Standards for Land Reclamation" and so on. At the same time, "Regarding Strengthening the Management of Land Reclamation for Production and Construction Projects", "Regulations on Mine Geological Environmental Protection", etc. [12]. On September 30, 2016, the Ministry of Finance, the Ministry of Land and Resources, and the Ministry of Environmental Protection jointly issued a document "Notice on Promoting the Ecological Protection and Restoration of Mountains, Waters, Forests, Lakes, and Lakes", which clearly requires the important concept of "Mountains, Lakes, and Forests are a community of life" Guide the work, adhere to the principles of respecting, conforming to and protecting nature, and actively carry out ecological restoration work [12]. The northern part of Shaanxi is located on the southern edge of the Mu Us Sandy Land and is my country's energy and heavy chemical industry base. Coal-based energy development is being carried out on a large scale. Coal mining has caused a series of ecological and environmental problems that are particularly serious.

3. RESEARCH STATUS

At present, my country's comprehensive development and utilization of coal gangue has achieved certain results and accumulated certain experience. At present, the comprehensive utilization of coal gangue in my country is mainly in the following aspects [13]:

- (1) Coal gangue power generation, heat supply, and production of fluidized furnace fuel.
- (2) Production of building material products: sintered bricks and tiles, non-fired bricks and tiles, hollow bricks, production of cement clinker, non-clinker and less clinker cement, special cement, ceramics, light aggregates, etc.
- (3) Fertilizer production for farmland: organic compound fertilizer, microbial fertilizer.
- (4) Production of chemical raw materials: synthesis of silicon carbide, preparation of molecular sieves, preparation of white carbon black, polyaluminum chloride, silicon-aluminum-iron alloy, etc.
- (5) Use coal gangue to build roads, fill mined-out areas, subsidence areas, and reclaim land.
- (6) Recovery of beneficial mineral products: kaolin, pyrite, extraction of rare earth elements, etc.

The comprehensive utilization of coal gangue is also a research topic of great concern to coal-producing countries in the world. There are at least 292 coal gangue hills in the United States, with reserves of 270 million tons. The U.S. Bureau of Mines has been sampling and analyzing all coal gangue hills since the 1970s, and made a comprehensive utilization plan for coal gangue. It is mainly used to produce cement or lightweight aggregate. The Trulayite Plant in West Virginia used coal washing gangue to produce porous lightweight aggregates before the 1950s. For coal gangue with greater coal content, hydrocyclones and heavy medium separation are generally used to recover coal. In addition, coal gangue is used to generate electricity and produce organic mineral fertilizers. For inconvenient coal gangue hills, the reclamation method is adopted to turn them into pastures or orchards. France currently has more than 500 coal gangue hills with a stockpile of 1 billion tons. According to coal gangue mineral composition, chemical composition and engineering characteristics, it is applied to different aspects. For 32 million tons of coal gangue with an ash content of 65% to 70%, it can be used for power generation; coal gangue can be used as a good building material, mainly for making bricks and producing cement; red coal gangue can be used to fill wet or even swamp water collapse pit. In recent years, red coal gangue can be used as road building materials. The British Coal Bureau administers 191 mines across the country. There are more than 800 coal gangue hills, and the amount of coal gangue has reached 1.6 billion tons. The goal emphasized by the Coal Management Bureau is to minimize the impact of surface coal gangue piles on the environment, and to carry out land restoration and renewal in a planned way. The main purpose of coal gangue is to produce building materials [14-18].

There are relatively few domestic and foreign researches on the improvement of soil by coal gangue, and they are all in the stage of theoretical research and feasibility research. In recent years, Tang Shengyin, Qian Zhaogan, and He Junyu have all succeeded in the feasibility study of using coal gangue as a soil amendment. However, the method of coal gangue activation and the method of adding proportion still need to be explored [19-21].

4. COAL GANGUE STATUS IN THE NORTHERN SHAANXI

In northern Shaanxi, especially in coal mining areas, such as Yulin City, the soil type is mainly sandy soil. Sandy soil lacks organic matter and various beneficial elements required by the soil, and its mineral composition is dominated by primary minerals such as quartz and feldspar. It has the characteristics of water leakage and fertilizer leakage [22]. Coal gangue is a kind of rock that contains a large amount of organic matter, trace elements and a small amount of calcium, phosphorus, and potassium compounds, and the mineral composition of coal gangue contains a large number of secondary clay minerals [3,4]. The characteristics of coal gangue happen to be lacking in sand. Therefore, coal gangue in northern Shaanxi has a theoretically optimal solution to land restoration in mining areas.

5. CONCLUSION

The study focus on the physical and chemical properties and types of coal gangue in northern Shaanxi, study on coal gangue activation and soil remediation effects, and clarify the impact of coal gangue addition on the physical and chemical properties of soil in the mining area and planting effects in

northern Shaanxi, and determine the remediation of coal gangue to soil in the mining area of northern Shaanxi. The best activation method and compounding ratio of the coal gangue reveal the mechanism of coal gangue remediation to the soil in the mining area in northern Shaanxi. This project can not only provide a new path for the recovery and utilization of coal gangue in northern Shaanxi, but also provide new materials for soil restoration and ecological environment management in mining areas.

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