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Chemical Characteristics of Coal Gangue as Filter Material in Simulated Coal Mine Goaf

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In this research, coal gangue was used as the main filler to deal with mine water in the simulated coal mine goaf, its filtering effect and mechanism were analyzed, and the filling characteristics were also analyzed and tested. The results showed that the gangue exhibited good removal characteristics for turbidity, iron and manganese of the mine water. In addition, the pollutants in the water in simulated goaf were removed by filtration, precipitation, adsorption and biochemical effects.

Key Words: Coal gangue, Goaf, Mine water, Filter mechanics.

The gangue is caught in the coal seam and coal-bearing strata within a variety of rock mixture¹⁻³. Different geological conditions of the mine, the coal gangue component changed greatly for the rational and efficient use of coal gangue response to mine coal gangue analysis laboratory. In addition, the comprehensive utilization of coal gangue lot of research and technological development, utilization is summarized in the following aspects: as a source of energy, building materials, extraction of chemical products, direct separation and direct use and for wastewater treatment⁴⁻⁷. Gangue pollutants in sewage removal mechanism is more complex, adsorption, precipitation and filtering role, but play a leading role in the good adsorption performance. Because the gangue has a certain specific surface area, it having both physical adsorption and chemical adsorption properties⁸.

The goaf useful minerals of underground mining after the formation of a complex underground rock shaft engineering and stope space, it is cut after several blasting, stress redistribution tends to temporarily stabilize the underground space. Coal mining coal after the formation of the underground mined

area also contains a large number of coal mining dropped the gangue and rock collapse down the sand, natural mine water treatment filter media⁹. This test simulates goaf characteristics of the gangue filled in analog devices, the filtering effect of the visits the gangue of mine water to reach by waste purposes.

Graininess characteristic of gangue: The test samples were taken from ASM200 type Shandong mining goaf gangue in China. In order to understand the characteristics of the particle size of the filler goaf vibration screening instrument to measure the analog goaf filler particle size characteristics. Collected good the goaf gangue is divided into 3 parts, were detected particle size distribution. Test data were shown in Table-1.

As is shown in Table-1, the goaf the gangue filler level with better, only 37.67 % of the particles of diameter were greater than 10 mm, accounting for 62.34 % of particles with diameter were less than 10 mm, as well as 13.09 % of the particles were restricted to the smaller particle size, particle size and uniform distribution of the filter. The coal seam was easily mudded filling particles vacuity, filling the gap between

TABLE-1
GRANULARITY CHARACTERISTIC OF COAL GANGUE

Number	Distribution of particle size (%)					Restriction of particle size	
	> 10 mm	>10-2 mm	2-0.5 mm	0.5-0.25 mm	< 0.25 mm	d ₆₀ (mm)	d ₃₀ (mm)
1	20	47	22	7	4	5.4	1.142
2	47	19	18	10	6	14.3	1.52
3	46	31	12	5	6	13.5	3.4
Average	37.67	32.33	17.33	7.33	5.33	11.07	2.02

the smaller of mine water, suspended solids and Fe^{3+} filter. Seam roof and floor containing a certain amount of clay minerals, bacteria also produce filtered role.

Experimental system: The test device is 1.7 m long, 0.3 m wide and 0.3 m high with the plexiglass seepage slot, the side of the water to the other side of the water. From the front lower part of the water side 0.5 m, 1 m at set two sampling holes outlet at 1.5 m, taking the third kind. Seepage trough inlet side and the water side of the bulkhead has a diameter of 0.15 mm small hole test device into the inlet area, treatment area and catchment diagram was shown in Fig. 1.

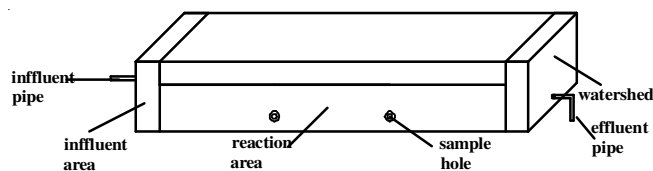


Fig. 1. Schematic diagram of experimental facility

Relationship between the adsorption and desorption:

As are shown in Figs. 2 and 3, heavy metals in the goaf filling material desorption process and adsorption behaviour are closely related, for the quantitative understanding of goaf Fe^{2+} (or Mn^{2+}) before desorption amount and desorption Fe^{2+} (or Mn^{2+}) adsorption amount of relationship, its desorption quantity of Fe^{2+} (or Mn^{2+}) with before desorption of Fe^{2+} (or Mn^{2+}) changes in the amount of adsorbed optimal simulation is found basically in line with the linear relationship. Goaf filling total adsorption amount of iron, manganese can be divided into two forms, one for non-fixed state of iron, manganese content, this part can be desorbed; another fixed state of iron, manganese content, this part of the material would not be desorbed. Fixed iron and manganese content reflects the goaf filling of iron, manganese self-purification capacity and itself the capacity. Goaf filling with a certain degree of self-purification capacity and the capacity that the adsorption fixed amount, plus over adsorption fixed amount of iron, manganese, non-fixed state increased, easy on the environment caused by pollution.

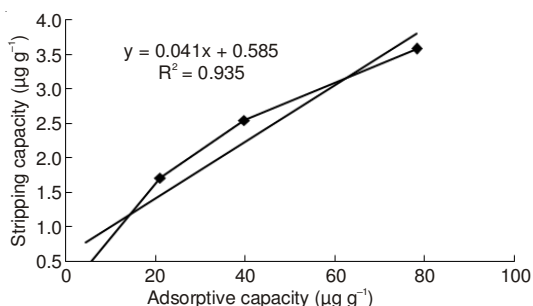


Fig. 2. Relation between iron adsorption capacity and iron desorption capacity

Analysis of mechanics: There were a certain amount of sandstone, siltstone and other substances in the goaf filler gangue. According to the characteristics of these substances, we can speculate that the goaf filler plays filtration of pollutants in the water, precipitation, adsorption and biochemical effects. Goaf filling graded better seam roof and floor easy mud filling particles vacuity, filling the gap between the smaller of mine

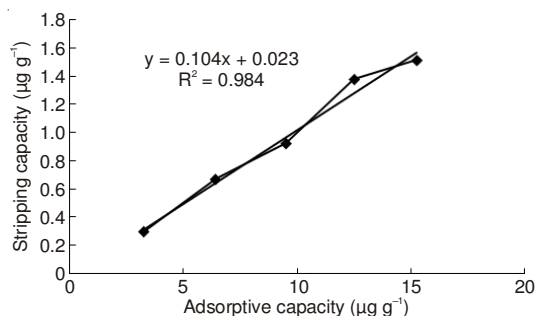


Fig. 3. Relation between manganese adsorption capacity and manganese desorption capacity

suspended solids in the water and Fe^{3+} from the filtering role. Containing a certain amount of clay mineral due to the coal seam for bacteria also produce functional filtration; mine water influent water is small, the seam floor inclination was small (typically less than 4°), coupled with the small voids between the filler and therefore mine the movement of the water in the filling for seepage action, sedimentation and filtration role simultaneously, so enter the catchment area of the suspended solids and Fe^{3+} much less. Catchment area of the water basically in a stationary state, therefore occur in the catchment precipitation and also the removal of suspended solids and Fe^{3+} in the final stages; adsorption occurs mainly in the mine water flow in the filling process, The main way to clear the mine water harmful ion. Due to the filling of the mined-out area in the sandstone, siltstone porosity of between 5-13 % of these substances harmful ions mine water will produce a certain adsorption; the goaf such a large area, inevitably contains a lot of different types of microorganisms, for the removal of iron, manganese and will play a role.

Conclusion

The test of gangue as the goaf main filler treatment, mine water filter effect and mechanism was analyzed and the formation of the mined-out area and filling characteristics would be analyzed and determined. Meanwhile, gangue mined-out area of the mine water turbidity, iron and manganese treatment effect is obvious.

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