Research on Flocculation and Sedimentation Characteristics of Extremely Fine Coal Slime Based on Computer PID Algorithm

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Abstract. Coal slime water treatment is a very important process in coal preparation plant, its treatment effect directly affects the reuse of washing water and closed-circuit circulation index, and on the other links of coal preparation plant such as separation efficiency, the number of product quality index has a great impact, and even restricts the economic and social benefits of an important system. Based on improved grey prediction fuzzy control principle, an improved slurry flocculating settling process of feed forward and feedback control strategy, the improvement is: using fuzzy algorithm to replace the current use of conventional fuzzy control algorithm, namely according to the online setting parameters of fuzzy rules, both to overcome the difficult to eliminate the steady-state error and fuzzy control to realize accurate control weaknesses, and overcome the difficulty of parameter setting, make them form a complementary advantages. Therefore, it is of great significance to study advanced control method and improve control effect in coal preparation plant.

Keywords: Slime Water Treatment, Flocculation Sedimentation, Automatic Dosing, Grey Prediction, Fuzzy Control

1. Introduction

Flocculation sedimentation is an important part of coal slime water treatment. Flocculent is a kind of organic chemicals, polymer molecular chain structure, its lively group has a strong adsorption in water, after the flocculants fully soluble in water, difficult to settlement of those tiny coal slime coal slime water particles will be adsorbed by active groups on the molecular chain, make its aggregate and gradually formed a large floccules and rapid settlement[1-4]. Flocculation sedimentation process, however, is a complex, with large inertia, large lagging, time-varying and uncertainty of nonlinear process, and the settlement of slime water features, the nature of the coal slime water, such as the
properties of flocculants have relations, so sufficient study of flocculating sedimentation process is influenced by various factors relations and regularity, and the flocculants adding system control strategy and implementation method, improve the control precision of the thickener overflow water, oil and stability, this is an important part of coal preparation automation and the development direction, has important strategic significance and research value.

2. Problems in the process of coal slime water treatment

2.1. Introductions of coal slime water treatment technology and mechanism

At present, most coal preparation plants, especially large and medium-sized coking coal preparation plants, deal with the process of slime water including the following aspects: slime separation, tailings concentration, pressure and filtration, slime flotation using direct flotation process, flotation tailings slime water into the thickening machine (that is, large sedimentation tank), first concentration, then pressure and filtration. Control technique of computer PID algorithm is shown as figure 1.

![Figure 1. Control technique of computer PID algorithm](image)

The slime water into the concentrator is a mixture composed of suspension, electrolyte and colloid. It is mainly characterized by high ash content, fine particle size and negative charge on the particle surface. Due to the same repulsive force, these particles remain dispersed in the water. Computer PID algorithm is combined in the flocculation of coal slime water is shown as figure 2.

![Figure 2. Computer PID algorithm is combined in the flocculation of coal slime water](image)

Therefore, it is necessary to take some purification measures to promote the settlement and clarification of coal slime water. In the practice of coal preparation plant, polymer flocculants is used to accelerate the sedimentation of particles in coal slime water.

2.2. Existing problems in coal slime water treatment
The traditional coal slime water treatment always adopts the method of manual adjustment and constant drug delivery by the operator. There is no real-time online detection instrument in the system, and the workers can only estimate the dosage by visual detection of the color of the overflow water. Due to the fact that the coal slime water property, concentration, flow rate and other parameters entering the thickening machine are constantly changing, the constant value dosing method cannot make the drug dose tracking the change of the coal slime water property, concentration and flow rate, so the phenomenon of overdose or underdoes often occurs. If the dosage is not enough, it will cause incomplete drop, make the circulating water concentration is too high, in addition to the pollution of products also lead to serious system disorders; On the contrary, if the dosage is too much, not only waste a lot of agents, but also because the chemical molecules mutually repel each other will make the precipitation effect of coal slime water worse. Therefore, this kind of dosing method causes the concentration of circulating water to be high and low, which has a certain adverse effect on coal preparation. At the same time, the unreasonable dosage will also increase the burden of dehydration and filtration, restrict the normal and orderly production, and cause economic losses to the coal preparation plant.

3. **Study on sedimentation characteristics of coal slime water**

A considerable part of raw coal in China is of high ash and mud quality, which is easy to mud when exposed to water. It is difficult to deal with the slime water produced in the washing and dressing of this kind of raw coal. For many years, the research work in this field has never stopped, but it is difficult to have a general treatment method. Time response of various simulated PID regulators to step change of deviation is shown as figure 3.

![Figure 3. Time response of various simulated PID regulators to step change of deviation](image)

Although some coal preparation plants in China began to try to use coagulation-precipitation secondary treatment process, due to the improper choice of coagulant or treatment process and process parameters, there are still problems such as unsatisfactory effect or high treatment cost in slime water treatment. In order to solve this kind of coal slime water treatment problem, we must study its nature and characteristics, find the reason of difficult treatment, and put forward a reasonable solution.

3.1. **Study on the influence of water quality of coal slime on settling characteristics**

Slime water is a complex system composed of slime and water. Its properties are not only related to the amount of slime contained in slime water, the size of particle size, density and mineral composition, but also related to the PH value, viscosity, conductivity and viscosity of slime water, and
are affected by the relationship between them. These properties directly affect the sedimentation property, flocculation property, filtration effect and dehydrated product moisture of coal slime water. Therefore, in order to solve the settlement clarification problem of coal slime water, we must first make clear the property of coal slime water.

3.2. Chemical properties of coal slime water and its influence

Usually it is not comprehensive to describe the characteristics of slime water with slime content and slime size composition. Firstly, in many cases, it is difficult to obtain the true content of coal slime due to the large circulation and accumulation of fine slime, so the slime degree and slime content cannot be accurately expressed[6]. Secondly, it does not reflect the rock characteristics and mineral composition of coal slime and it does not reflect the content of soft clay minerals that particularly affect the characteristics of coal slime water. Clay mineral mud properties, making them in slime water system in microns particles exist, thus make the effect of clay mineral in coal slime performance not only in small size, light weight, difficult to settlement, but also because of the clay mineral and water phase has a certain interface chemistry, in turn worsen their fine particle sedimentation environment. At the macro level, a large number of muddy materials are difficult to settle and accumulate in the system in a vicious cycle. Among them, the viscosity of coal slime water has a great influence on the sedimentation effect.

3.3. Basic principle of fuzzy control algorithm PID

Fuzzy control is a control method that adopts linguistic control rules. According to the actual control experience of field operators or the theoretical knowledge of relevant experts, it is not necessary to establish an accurate mathematical model of the controlled object in the design, so that the control mechanism and strategy are easy to understand, the design is simple, and the application is easy. Fuzzy control is especially suitable for those objects which are difficult to acquire mathematical model and dynamic characteristics.

4. Conclusion

At present, the important process of coal preparation plant is still very low degree of automation, the use of advanced technology and equipment of coal preparation plant less than 40%, most of the coal preparation technology level backward, thereby causing loss to the plant, product problem of high ash content and poor sorting results, in many important process in coal preparation plant automation and far distance and the huge task, such as flotation process automation, automatic control and so on, the density only finished part of this study. It is very difficult to measure the concentration of slime water in coal preparation plant. At present, only the detection accuracy of isotope concentration meter can meet the requirements. In order to achieve better control effect, the fuzzy control rules should be perfected step by step in the process of industrial application[7].

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The project of this paper is Study on flocculation and sedimentation technology of coal slime water in jixi area.

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