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Analysis on the Application of Organic Polymer Flocculants in Sludge Dewatering

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Abstract: With the rapid development of China's economy, the components of sewage discharged from industrial manufacturing and daily life have gradually become diversified, resulting in a large amount of sludge generated during the sewage treatment process. Sludge contains a large amount of phosphorus, nitrogen, potassium and metal elements. For sludge dewatering, organic polymer flocculants have demonstrated more outstanding dewatering performance compared with previous inorganic flocculants. Therefore, this paper mainly analyzes and studies the application of organic polymer flocculants in sludge dewatering, objectively expounds the application effects of different types of organic polymer flocculants in sludge dewatering in recent years, and how to select organic polymer flocculants. By summarizing their treatment methods, it can be concluded that the addition of cationic inorganic flocculants and the proportioning of organic polymer flocculants with a relatively high molecular content have more outstanding performance in the actual application of sludge dewatering.

Keywords: Organic Polymer; Flocculant; Sludge Dewatering; Inorganic Flocculant

In order to pursue more long-term development, the world advocates green production and development. The wastewater generated from people's daily lives and industrial production contains a large number of components that pollute the environment. A large amount of sludge is produced during the treatment process. The components contained in the sludge are rather complex, mainly consisting of negatively charged particle groups with a relatively high water content. Therefore, in order to reduce the environmental pollution caused by sludge, dewatering treatment is an inevitable choice to separate the water content and reduce the overall mass of the sludge, laying a foundation for subsequent treatment [1]. During the sludge dewatering process, the main focus is to improve the dewatering performance of the sludge. Among all the current sludge dewatering treatment methods, flocculants are widely used due to their advantages of being cost-effective and having remarkable effects. However, with the progress and development of society, the organic components in sludge have gradually increased, which has had a serious impact on sludge dewatering treatment. The previous dewatering treatment methods have become difficult to effectively solve such problems, and the research on organic polymer flocculants has become an inevitable choice for improving the dewatering performance of sludge.

1. Factors Constraining the Dewatering Performance of Sludge

The traditional sludge dewatering method uses cationic flocculants and has achieved good results in practical applications. However, with the improvement of industry and people's living standards, the content of organic

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components in sludge has gradually increased. Traditional cationic flocculants often find it difficult to meet the needs of sludge dewatering and have had a profound impact on sludge dewatering treatment. Compared with traditional single cationic flocculants, organic polymer flocculants have a greater impact on the dewatering performance of sludge and have more significant effects. The dosage of flocculants, the molecular weight contained therein, the pH value, and the degree of anions and cations have a prominent influence on the dewatering performance of sludge. There are many research results on the application of flocculants in sludge dewatering. Most scholars believe that flocculants should be maintained at an appropriate level. If the amount of flocculant is too small, the dewatering effect will not be prominent enough. If it is too much, the sludge molecules will be too dispersed and it will be difficult to form a solid whole, failing to achieve the expected dewatering performance. At present, there are many studies on the advantages and disadvantages of sludge dewatering at home and abroad, but there are relatively few studies on the effects achieved by different sludge treatment methods. The types of flocculants, the molecular weight contained therein, the degree of anions and cations, and the pH value are the main considerations for the dewatering performance of flocculants.

2. Types of Organic Polymer Flocculants and Their Applications in Sludge Dewatering

2.1. Natural Polymer Flocculants

In the treatment of sludge dewatering, organic polymer flocculants are generally divided into natural polymer flocculants and synthetic polymer flocculants [2]. Natural polymer flocculants are not as effective as synthetic polymer flocculants in practical applications. The main components they contain include cellulose, plant gums, proteins, and various inorganic components. The research on organic polymer flocculants conforms to the global advocacy of green production and development, pursues more long-term benefits, and also lays a foundation for the research on non-toxic and side-effect-free natural flocculants. Cellulose graft copolymers and starch derivatives among natural polymer flocculants have become the mainstream research directions. Foreign countries have conducted a lot of theoretical research on non-toxic green flocculants. Most scholars believe that through the initiation effect of potassium permanganate, starch and similar components can be made to react with aminomethanol to form a natural polymer flocculant, which has high application efficiency for natural materials, low cost, simple processing technology, no need for a long production time, can adapt to the dewatering treatment of most sludges, and has broad application prospects.

2.2. Synthetic Polymer Flocculants

Synthetic polymer flocculants can be divided into different types due to their rich components, mainly including anionic, cationic, amphoteric, and non-ionic types, as well as composite types mixed with inorganic flocculants. Among them, the cationic type has better sludge dewatering performance, while the dewatering performance of other types such as the anionic type is relatively poor and it is difficult to achieve remarkable results. The cationic type contains a large number of negatively charged ions, which can neutralize other negative charges and flocculate and dewater the sludge. Due to its good dewatering performance, it is widely used in factory wastewater treatment. However, with the large amount of inorganic components contained in the wastewater discharged from people's daily lives and industrial production, the demand for sludge dewatering performance has gradually increased, changing from the previous single cationic flocculant to a composite cationic complex. For example, cationic cellulose derivatives have relatively prominent effects in the sludge dewatering treatment process. Their main advantage is that they can minimize the production cost and improve the resource utilization efficiency [3]. Different negative and positive ion gene structures have different attracting abilities to charges. Therefore, during the dewatering treatment process, they can effectively adsorb sludge particles. Traditional flocculant types mainly include powder and liquid forms. In recent years, water-in-water cationic emulsions have emerged. Such products are mainly emulsions extracted by acryloyloxyethyl in an aqueous medium. They have the advantage of fast dissolution speed in sludge dewatering, do not pollute the environment, and make up for the shortcoming of poor dissolution performance of powder flocculants, combining the high dissolution performance of emulsions.

Amphoteric flocculants have the advantages of both anions and cations at the same time, have a strong adsorption and

bridging effect on sludge particles, and the molecules are intertwined with each other, resulting in more prominent dewatering performance. They have good filtration and dewatering performance for different types of sludge and finally form sludge solids with a low water content, laying a foundation for subsequent treatment. Amphoteric flocculants are currently the main research direction at home and abroad. The components they contain mainly include imino groups and quaternary amino groups, anionic genes and hydrogen-containing metal ions, such as acrylate or methacrylate monomers containing amino groups and amphoteric complexes. Compared with cationic flocculants, amphoteric flocculants have better dewatering performance and more remarkable practical application effects. However, due to their large molecular weight and being restricted by the technical level in the manufacturing process, resulting in difficulties in product production, they are mainly applied in sludge dewatering treatment and have not been widely used in other fields.

3. Application Methods of Organic Polymer Flocculants in Sludge Dewatering

The internal structure of sludge is rather complex. Whether the addition sequence of flocculants in the application process is reasonable has a profound impact on the dewatering performance. Some developed countries abroad have achieved remarkable results in the research on flocculants, which are worthy of reference for our country. In order to improve the dewatering performance of flocculants in sludge treatment, foreign scholars believe that mixing cationic polymeric amines with polyacrylamide according to a certain ratio can significantly improve the sludge dewatering performance. After high-molecular flocculants are incorporated into the sludge, a dewatering machine is used for dewatering, and the dewatered sludge has less water content and takes on a solid shape. In the treatment of sludge dewatering, most factories use composite flocculants. Composite flocculants are generated on the basis of single flocculants. Since single flocculants are difficult to cope with different types of sludge components and it is difficult to achieve remarkable results in practical applications, composite flocculants came into being. The most prominent advantage of composite flocculants lies in integrating the advantages of most flocculants, being able to deal with a variety of sludge components and having a better dewatering effect. At present, there are many common methods for using flocculants to dewater sludge, such as mixing polymeric quaternary ammonium salts with polyacrylamide according to a certain ratio and adding them to the sludge; adding cationic substances and acrylamide to the sludge respectively. Adopting different dewatering treatment methods for different sludge components can effectively improve the dewatering efficiency.

4. Conclusion

In summary, organic polymer flocculants have remarkable effects in sludge dewatering treatment. They can effectively reduce the water content in sludge, improve the utilization efficiency of resources, reduce manufacturing costs, and enhance the dewatering performance. In recent years, scholars in related fields have achieved relatively remarkable results in the research on polymer flocculants, but there are still some deficiencies that need to be further improved. Meanwhile, the research on organic polymer flocculants has laid a foundation for green development and the production of flocculants that do not pollute the environment. Applying its advantages to other water treatment and sugar food processing fields will have a profound impact on solid-liquid separation. The development of organic polymer flocculants presents a good development prospect.

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