Research on Enterprise sewage treatment based on infiltration Technology

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Abstract. As circulating water resources in iron and steel enterprises, reclaimed water reuse has been paid more and more attention by major iron and steel enterprises. The double membrane desalination process of ultrafiltration and reverse osmosis has been gradually applied to the advanced treatment of industrial wastewater in iron and steel enterprises. From the actual operation effect of the enterprise, there are some phenomena in varying degrees, such as fast pollution plugging of reverse osmosis system, frequent cleaning and the decline of reverse osmosis desalination rate caused by frequent cleaning. This paper makes a preliminary analysis of the common problems occurred in the application of the reverse osmosis process in the treatment of industrial sewage in the whole plant.

Key words: Iron and steel enterprises; Industrial sewage; Reverse osmosis.

1. Introduction
As a non-traditional water resource, industrial sewage from iron and steel enterprises has been paid more and more attention by major iron and steel enterprises. Making industrial sewage into recycled water is a common treatment method for industrial sewage in major iron and steel enterprises at present. The recycled water made from industrial sewage treated by conventional water treatment processes (coagulation, precipitation, filtration, etc.) has the characteristics of high salt content, generally, it can only be used for DC slag spraying or pouring floor of process units such as sintering, ironmaking, steelmaking, steel rolling, etc., but the water consumption of DC slag spraying or spraying floor is very limited. With the more stringent requirements for the discharge of industrial sewage from existing iron and steel enterprises and the trend of the shortage of new industrial water year by year, based on the existing conventional treatment process, the industrial sewage of the whole plant is further desalted into desalted water for production, which has become an effective measure to improve the effective utilization rate of new water in iron and steel industry and the water-saving level of enterprises. As a rapidly developed and mature new water treatment technology, reverse osmosis desalination technology has opened up a new way for enterprises to reduce new water consumption. At present, the desalination process of ultrafiltration and reverse osmosis has been gradually applied to the advanced treatment of industrial wastewater in iron and steel enterprises. This paper makes a preliminary analysis and discussion on the problems of ultrafiltration and reverse osmosis desalination of industrial sewage in this enterprise. [1,2]
2. Analysis of the main sources and characteristics of industrial sewage in iron and steel enterprises

2.1. Main sources of industrial sewage in iron and steel enterprises

For iron and steel enterprises, the proportion of circulating water consumption to the total water consumption is often more than 95%, and the industrial sewage of the whole plant mainly comes from the sewage discharge of the circulating water system. Besides, industrial sewage may also contain a small amount of domestic sewage.

2.2. Analysis of main pollutants in industrial sewage from iron and steel enterprises

Industrial sewage from iron and steel enterprises generally has the following main pollutants: turbidity, COD, hardness and alkalinity, oil, salts and so on.

1) turbidity: turbidity is mainly caused by suspended solids and colloidal substances in water. In the industrial circulating water, there are suspended matter composed of insoluble substances such as soil, sand, dust, corrosion products, scale, microbial slime, an inorganic colloid of iron, aluminum, and silicon, as well as some organic colloidal substances. These suspended and colloidal substances are either entered from the air, or brought in by supplementary water, or maybe formed in the operation of the circulating water system. These suspended solids are discharged into the industrial sewage through the circulating water system. Besides, there are suspended solids composed of iron oxide scale and metal dust in industrial sewage, which mainly enter the circulating water system in the production process of gas cleaning, slag flushing, flame-cutting, spray cooling, quenching cooling, refining, and dedusting. These suspended solids also enter the industrial sewage through the sewage discharge system. [3]

2) COD: COD is an indicator of the number of reducing substances in water. The reducing substances in water include all kinds of organic matter, nitrate, sulfide, ferrous salt and so on, mainly organic matter. The COD material is mainly replenished water into the industrial circulating water system, and in the process of operation, the COD material in the raw water is continuously concentrated.

3) hardness and alkalinity: for the circulating water system, as the circulating cooling water is concentrated, the hardness and alkalinity of the cooling water will increase. The circulating water system discharges sewage into the industrial sewage system. As a result, the hardness and alkalinity of the industrial sewage system are also greatly increased compared with the raw water. 4) Oil: the oil in industrial sewage is mainly due to the leakage of hydraulic oil from main process equipment such as continuous casting and hot rolling into the turbid circulating water system, thus into the industrial sewage system. 5) salts: salts enter the circulating water system with the replenishment of water and are continuously concentrated and with the discharge of sewage from the industrial circulating water system into the industrial sewage system.

Water quantity and water quality characteristics of industrial sewage in iron and steel enterprises as the industrial sewage of the whole plant mainly comes from the discharge of circulating water system, so the quantity fluctuates greatly and the water quality fluctuates greatly. The quantity and quality of sewage discharge vary with the production cycle and season. Generally speaking, in the peak of production and summer, the circulating water system consumes a lot of water and its evaporation is also large, which leads to a large amount of sewage discharge from the system. As a result, it also causes a lot of pressure on follow-up water treatment.

2.3. Characteristics of quantity and quality of industrial sewage in iron and steel enterprises

As the industrial sewage of the whole plant mainly comes from the discharge of the circulating water system, the water quantity fluctuates greatly and the water quality fluctuates greatly. The quantity and quality of sewage discharge vary with the production cycle and season. Generally speaking, in the peak of production and summer, the circulating water system consumes a lot of water and its evaporation is also large, which leads to a large amount of sewage discharge from the system. As a result, it also causes a lot of pressure on follow-up water treatment.
Analysis of effluent quality after conventional treatment process Industrial sewage is made into recycled water after conventional water treatment processes such as coagulation, sedimentation, and filtration. After treatment, although the turbidity and impurities in the treated water have been effectively removed, the hardness and alkalinity can be effectively controlled, and the content of pollutants such as COD and oil has also been reduced, but its salt content (including electrical conductivity, hardness, and other ion concentration, etc.) has not decreased. [4]

3. Ultrafiltration-reverse osmosis process

The whole system includes ultrafiltration device and reverse osmosis desalination device, ultrafiltration and reverse osmosis equipment and the whole water treatment equipment adopts a set of a programmable logic controller control device, which has a communication interface speaking, in the peak of production and summer, the circulating water system consumes a lot of water and its evaporation is also large, which leads to a large amount of sewage discharge from the system. As a result, it also causes a lot of pressure on follow-up water treatment.

With the water control point of the whole plant. Compared with the traditional water treatment method, the process design using ultrafiltration as reverse osmosis pretreatment system has its characteristics: stable effluent quality and low SDI value, which improves the water flux of reverse osmosis membrane and prolongs the service life of reverse osmosis membrane. [5]

4. The main problems of industrial sewage desalination treatment in our enterprise

4.1. Water treatment facilities for desalination treatment by ultrafiltration and reverse osmosis are adopted in this enterprise.

From the actual operation effect, there are some phenomena in different degrees, such as fast pollution plugging of reverse osmosis system, frequent cleaning, a decrease of reverse osmosis desalination rate caused by frequent cleaning, frequent replacement of security filter element and so on. According to the actual situation of the project, the raw water entering the desalination advanced treatment system is caused by oil and a certain amount of COD. According to statistics, reverse osmosis system failures caused by these organic compounds account for 60% and 80% of all system failures.

4.2. Cause analysis

1) Analysis of conventional pretreatment facilities: after conventional coagulation, precipitation and filtration treatment, the COD content of the effluent is generally dozens of mg/L, and the oil content is generally 1~5mg/L. The COD in industrial sewage is mainly insoluble substances, and the oil in industrial sewage is mainly engine oil leaked by the equipment. It is difficult to further reduce COD and oil content, whether air flotation or biochemical treatment, the effect is not good. [6]

2) Ultrafiltration system analysis: as a pretreatment of reverse osmosis, ultrafiltration can separate suspended macromolecular colloids, slime, microorganisms, organic matter and other impurities that can cause fouling to the reverse osmosis membrane, and can completely remove insoluble substances. reducing the pollution risk of particles has been an important guarantee of reverse osmosis for a long time. The ultrafiltration system is not the reason for the frequent operation problems of the whole deep desalination system. At the same time, it is proved that the ultrafiltration in the current water treatment process can not effectively intercept the COD and oil in the industrial sewage after conventional treatment.

3) reverse osmosis system analysis: at present, reverse osmosis membranes are all organic membranes. Even if fouling resistant membranes are used, organic membranes are still easily fooled by oil in water, resulting in membrane blockage and difficult backwashing. The general reverse osmosis membrane requires that the influent oil content should be less than 0.5mg less than 0.5 mg / L COD is not greater than 20mg/L (using low pollution membrane). Because the quality of industrial sewage treated by the conventional process can not meet the requirements of influent water quality of reverse osmosis process, and ultrafiltration is of little help to improve this water quality, this is the real reason
for the abnormal operation of industrial sewage ultrafiltration plus reverse osmosis desalination system in iron and steel enterprises.

5. Problems needing attention in the design of ultrafiltration and reverse osmosis desalination
From the above analysis, we can see that the key to solving the current problems of the reverse osmosis desalination system does not lie in the reverse osmosis membrane itself, of course, it is necessary for the reverse osmosis membrane to continuously optimize the performance of the membrane itself. But the key problem should be the front pretreatment section and ultrafiltration stage of the double membrane desalination system.

6. Existing problems
In recent years, with China's attention to the environment and increasing investment in sewage treatment, some large domestic iron and steel enterprises have built new treatment measures, that is, to build water treatment facilities based on the original industrial sewage treatment facilities. The additional treatment facilities are the use of double-membrane desalination reuse technology, the main purpose is to treat industrial sewage in depth. From the actual operation effect of increasing the treatment facilities, there are some bad phenomena in varying degrees, such as the system is vulnerable to fouling, frequent cleaning and the decline of reverse osmosis desalination rate. The main reason for this situation is that the raw water entering the desalting advanced treatment system contains oil or is accompanied by a certain amount of COD, resulting in a small amount of oil in the raw water is due to continuous casting and hot rolling turbidity cycle sewage discharge. According to the relevant data, statistics show that the causes of reverse osmosis system failures caused by organic matter account for 60% and 80% of all system failures. Generally speaking, the requirement of influent oil content of reverse osmosis membrane should be below 0.5mg/L, while COD is not greater than 20mg/L. [4]

After routine treatment of industrial sewage from iron and steel enterprises, although the content of COD and oil in the discharged wastewater is still difficult to meet the requirements of reverse osmosis, it has been at a low value. On this basis, it is very difficult to further use biochemical treatment or air flotation to meet the requirements of conventional reverse osmosis. Given the above situation, this requires iron and steel enterprises in the existing industrial sewage conventional treatment, and then use activated carbon filtration and other methods to further treat the sewage. The final treatment method adopted by some large-scale iron and steel enterprises in China is to put aside the turbid circulating water system such as continuous casting and hot rolling to prevent it from entering the industrial sewage deep desalination treatment system.

7. Conclusion
As the supplementary water of circulating water in iron and steel enterprises, the advanced treatment of industrial sewage can effectively solve the current problem of shortage of water resources, improve the utilization rate of water resources, reduce the problem of water environment pollution, and reach the national standard of energy-saving and emission reduction. Therefore, desalination and reuse of industrial sewage will be the development direction of heavy industry enterprises. However, there will be many problems in the process of implementation, which need to be constantly optimized and solved.

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