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Application of Magnetic Separation in Water Pollution Control

Qingshan Yuan, Hanqing Zhao, Lihui Zheng

Department of Petroleum and Chemical Engineering, Northeast Petroleum University, Qinhuangdao, Hebei 066004, China

Abstract: **In recent years, magnetic separation technology in the industrial wastewater and sewage purification, seawater desalination, and other fields have a wide range of development and research, and made a lot of research results. Magnetic separation technology plays a more and more prominent role in application due to its advantages in waste water control and treatment. Several aspects of this technology in water pollution control are discussed in this paper.**

Keywords: Magnetic separation technology; Waste water control; Application; Membrane separation technology

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* Corresponding Author: Qingshan Yuan, ale_yuan@126.com

1. Introduction

Water pollution has already become an environmental problem to be addressed. People's living and production are greatly affected by industrial pollution and domestic sewage. The low cost and high efficiency of separation of components in water pollution is undoubtedly at the core of the water pollution control. The separation methods currently on the market cannot fulfill well the expectation due to some defects and problems. To this end, the waste water control is in bad need of technology featuring high efficiency, low cost and environmental protection.

2. Introduction of Magnetic Separation Technology

Magnetic separation technology, as one physical dressing method, separates the minerals by identifying the magnetic properties among different minerals. The magnetic technology is being applied widely in water pollution control since it is easy to operate, low in cost, high in efficiency and environmentally friendly. With the wide application and research of this technology in waste water control, there have already been some application examples and relevant research achievements, and good prospect of this technology in waste water treatment is further proved in the practice. The application of magnetic separation improves the water pollution while this technology continues to develop and innovate during waste water control. This mutual promotion no doubt brings forward favorable results for water pollution control and treatment.

The magnetic separation technology is mainly applied to separation of coal and ores in the early period while its application in waste water treatment emerged not many years ago. The superconducting separation technology produces strong magnetic field mainly through the strong current produced in the magnetic coil. The strong magnetic field and high gradient lead to the stronger separation ability of the superconducting separation technology. Besides, since the magnetic coil does not produce thermal effect of the current, some devices have shorter service life and less electric consumption, which reduces its operation cost.

3. Application of Magnetic Technology in Water Pollution Control

It is true that many achievements have been scored since the magnetic separation technology is applied to water pollution control. Currently speaking, this technology has already been widely applied to actual waste water treatment, among which the control effect is best shown in USA. China has also seen large quantity of research and exploration in this technology. Currently, our research mainly focuses on the treatment of ferromagnetic wastewater and the study on the non-ferromagnetic wastewater is developing gradually. Various treatment processes have also appeared. For example, high gradient magnetic separation of the sewage is the treatment method. The secondary magnetic separation technology processed industrial wastewater, etc. As shown in figure 1 and 2.

4. Application of Magnetic Separation Technology in Desalination of Weawater

Currently on the market the desalination of sea water is mainly realized by distillation and reverse osmosis while the magnetic technology realizes the desalination by acting on the salt ion and water content in the seawater. Judging from current situation, it can be said that the magnetic separation technology has wide prospect of seawater desalination. By acting on the charged ions in the seawater, the magnetic technology makes the salt ions in the seawater further moving or

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settling so as to realize the separation of salt irons from the water. Besides, the desalination by magnetic separation is able to change the original water structure to some extent so that the association water molecule group changes from big to small and even to single water molecule. This means that the physical property of the seawater after being treated by magnetic separation technology will also have some change, which undoubtedly has further beneficial effect on the seawater desalination.

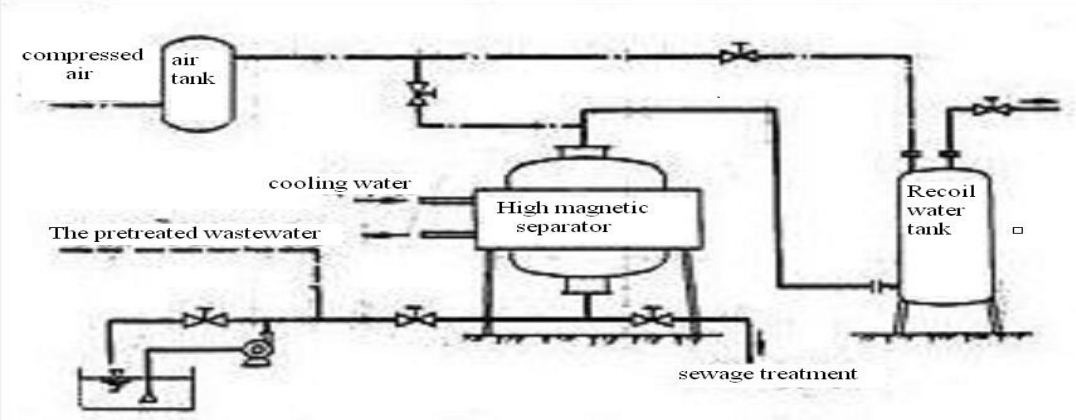

Figure 1. High gradient magnetic separation of the sewage treatment method.

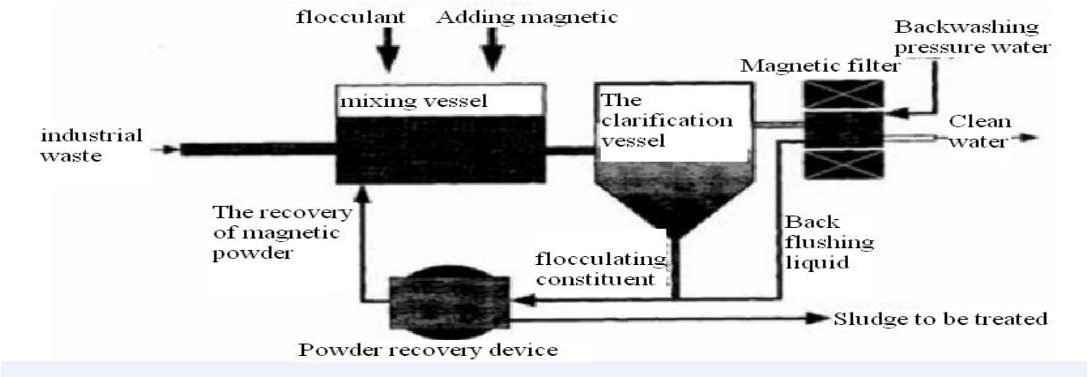

Figure 2. The secondary magnetic separation technology processing industrial wastewater.

There are already many invention patents for achievements of magnetic separation technology in desalination. However, the desalination is very limited in effect and there is certain distance from expected target and actual application. The basic principles of magnetic separation technology in seawater desalination vary, which mainly include; 1) building of highly magnetic field and further ion force in the seawater make the components in the seawater separate. Currently this method is not applicable since the desalination is unsatisfactory and the operation cost is high; 2) electromagnetic desalination technology mainly combines the magnetic field separation technology with electric filed technology. Firstly the electromagnetic separation technology separates the cation and anion in the seawater and then make them deflect in different directions when they pass the magnetic field by the action of force of charged particles in the electromagnetic field and finally realize the separation of water and salt in the seawater thus the desalination of seawater; 3) magnetic separation technology assisted with filter membrane desalinate the seawater mainly by investigation of force characteristics of the salt ions in the seawater and the building of filter membrane; 4) desalination technology with magnetic mirror mainly uses devices like the spiral water tube and magnetic tube. Since the spiral water tube is in the magnetic field, the sweater moves, with the drive of the water pump, gradually towards the direction of stronger magnetic field with the spiral water tube, and then separate the water content from salt ions with the characteristics that the gradient magnetic fields only reflects the salt ions before different kinds of water come out of different outlets.

5. Integrated Application of Magnetic Separation Technology and Membrane Separation Technology

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Membrane separation technology plays an important role in current technology of waste water control. Its specifically includes electro-osmosis and reverse osmosis. Both of the membrane separation technologies provide certain osmosis force through electric field and mechanical force so that the seawater components at both sides of the membrane pass the membrane selectively and thus realize the desalination. However in the application of membrane separation technology, the membrane pollution makes this technology further limited in application. Besides during the separation like reverse osmosis membrane, the inorganic pollution also decreases the membrane flux. In real production, the membrane pollution is mainly treated by chemical anti-scaling or cleaning, which not only complicates the operation, but increases the operation cost. Current research shows that the introduction of magnetic filed in the application of membrane separation technology can reduce the membrane pollution to certain degree and improve the operation of membrane separation technology.

With the force of magnetic field, some physical properties of the seawater like PH value, water osmotic pressure will change while they recover to the original level when the force disappears. The study further proves that with the force of magnetic field, the trans-missivity of reverse osmosis membrane of the membrane separation technology has certain decline, which means that the retention of the reverse osmosis membrane further increases and the outgoing water quality of the membrane separation technology further improves to some extent. Besides, the combination of magnetic separation technology and membrane separation technology is able to reduce effectively the pressure of the seawater across the membrane so as to improve the membrane pollution and enhance the operation of the membrane separation technology. Current study shows that the osmosis of the water molecules after the action of magnetic force is strengthened and those with high activity can destroy the crystal scaling of the scales and then make the scales break or fall off. However, in terms of current technology development, most of the experiments in which the magnetic field improves the membrane pollution are carried out in certain environment and conditions, which means the magnetic field is limited in improving the membrane separation technology. To this end, we have to continue to conduct research and discussion of magnetic separation technology and membrane separation technology in water pollution control.

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