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Technical Design of Water Pollution Prevention Project Based on Particle Swarm Optimization

Nicholson Julius*

Sharif University of Technology, Iran

**corresponding author*

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Abstract: In the water pollution prevention project, particle swarm optimization is a very practical method, which gathers multiple individuals into a group. It can effectively solve traditional problems. This paper mainly introduces the water pollution control technology and control theory and basic steps based on the characteristics of nuclear particle number and diversity, multi species clustering, etc. Then, it summarizes, analyzes and studies the existing literature on its application and shortcomings, and gives suggestions for improvement. It further explains from the design idea to the algorithm flow, and applies this method to practical projects to reduce costs while ensuring accuracy. Next, based on the research of particle swarm optimization algorithm, this paper designs the technical framework of water pollution prevention and control engineering, and conducts simulation tests on the performance of this algorithm. The test results show that in water pollution prevention and control engineering, through the comparative analysis of the performance of particle swarm optimization algorithm, it is found that the particle swarm optimization algorithm has a fast running time and high iteration efficiency, because it has good global optimization ability, And its performance is also very stable and reliable. Therefore, these factors should be fully considered and utilized in the design process to improve the technical level of water pollution treatment so as to achieve the goal of environmental protection in a real sense.

1. Introduction

Water pollution is a worldwide problem. With the continuous development and progress of industry, agriculture and transportation, people's living standards are increasing. How to improve the environmental quality in the case of water shortage has become an important topic [1-2]. In the

process of project construction, the heavy metal content in a large number of wastewater will also exceed the standard, which will have a serious impact on the ecological environment. At the same time, the water pollution problem is becoming more and more serious due to the imperfect water conservancy system and less advanced environmental protection facilities in China. Therefore, research on water treatment is the key to protect water resources, reduce pollutant emissions and effectively control water quality [3-4].

In the water pollution prevention project, the research and application of particle swarm optimization is a very promising topic. Due to the lack of knowledge and technology on water environment governance in China, a large number of experiments on environmental protection related issues have been carried out at home and abroad, and good results have been achieved. The most typical one is the Bird's Nest system, which can map individual particles in the bird swarm algorithm to the same space to analyze the similarity and difference between each object or group [5-6]. Some scholars have proposed particle swarm optimization algorithm to describe the relationship between things by simulating the law of the strength of the interaction force when there are a variety of different sizes and uncertain factors in the nature. In terms of water pollution prevention, you can choose the most suitable method according to the specific environmental conditions, and can effectively control the concentration and quantity of pollutants and deal with various influence factors [7-8]. Therefore, this paper integrates particle swarm optimization analysis to research and design water pollution prevention engineering technology.

Water is one of the most important resources on the earth, and it is also an indispensable material condition for our survival and development. However, in the ecological balance of the earth, water resources have been seriously polluted. Our country has studied the water pollution problem and found that the main reason is due to the eutrophication of surface water bodies and the overexploitation of groundwater. In this paper, by analyzing the new technologies and methods proposed by domestic and foreign scholars, and applying particle swarm optimization algorithm to solve this problem, combined with ant colony algorithm to optimize the utilization rate of water resources and reduce the emission of environmental pollutants, the new technologies and methods for better protection and sustainable development of water energy can be applied in projects.

2. Discussion on Water Pollution Prevention Engineering Technology by Integrating Particle Swarm Optimization Algorithm

2.1. Current Situation of Water Pollution

China is a country with a large population and few resources per capita. Therefore, many people in our country cannot reasonably use the limited natural resources for production and life. At the same time, due to the lack of scientific development and utilization of groundwater and other factors, a large number of underground water sources are wasted, surface water bodies are seriously deteriorated and land subsidence is a problem, which leads to a very serious situation of water pollution. Water pollution is an important problem in China, especially for water resource utilization and environmental protection [9-10]. The sewage discharged in the process of industrial production not only causes serious damage to the environment, but also causes some diseases. For example, domestic water, agricultural irrigation, etc. will lead to deterioration of water quality, and some industrial wastewater contains a large number of heavy metal ions, which may directly or indirectly enter the soil pollution to affect crop growth, ecological environment quality and safety risks, and a series of problems to produce water pollution. Due to the time difference of rainfall in the groundwater, a large number of scour materials are produced. This phenomenon will have a serious impact on the surrounding environment, even lead to the collapse of surrounding buildings or greatly reduce the service life. At the same time, it may also cause the loss of water and nutrients

in the growth of aquatic animals and plants, reduce the deterioration of groundwater quality and other problems. In addition, the content of toxic and harmful substances in industrial wastewater exceeds the standard. Some of the total water resources in China contain heavy metal ions, and many of these pollutants are also toxic, flammable, corrosive and other characteristics. At the same time, a large number of pollutants discharged into rivers and lakes will cause harm to human health and are difficult to degrade. Other pollutants, such as suspended solids and organic matter, will enter the groundwater through surface water to pollute the water quality and worsen the ecological balance of the water body and human health problems [11-12]. At present, the construction of urban sewage treatment plants in China is large in scale and widely distributed. However, due to the lack of unified planning and unsound management system, there is no way to effectively purify a large number of industrial wastewater, and the sludge accumulated in nature is used for re gardening. Secondly, some enterprises, in pursuit of economic benefits, ignore the pollution of water sources at the expense of water resources, Finally, the water quality is seriously affected and even the flow is cut off.

2.2. Water Pollution Prevention Works

Because of the harmfulness of water pollution, it is necessary to record the behaviors that affect the environment and human health during the engineering design. A large amount of sludge is generated in the sewage treatment plant. As China is short of water resources and water pollution has always occurred and is getting more and more serious, we need to effectively recycle or recycle some suspended solids in these industrial wastewater, and at the same time, we need to improve the water quality to reduce pollutant emissions to a certain extent, so as to reduce environmental damage and waste rate [13-14]. Water pollution prevention project mainly refers to the treatment of pollutants in water bodies and the discharge of pollutants into the natural environment, so as to purify the environment, protect the ecological environment and promote sustainable development. Figure 1 is the flow chart of water pollution prevention project.

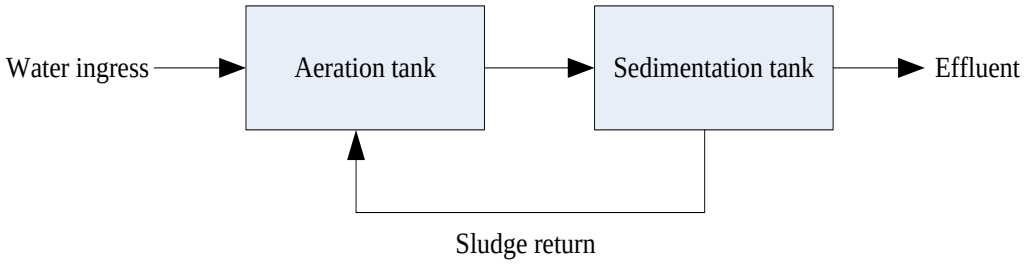

Figure 1. Water pollution prevention and control project process

Water pollution control projects can be divided into the following categories:

(1) Wastewater regeneration technology. Some new methods are used to remove harmful substances or microorganisms in water and recycle them to reduce chemical oxygen demand in water. In the process of sewage purification, it is necessary to separate the sewage containing a large number of toxic and harmful substances and the pollutants that are difficult to remove and easy to cause secondary hazards through certain methods. If it is found that the requirements of the standard or the discharge standard cannot be met, the production shall be stopped in time and the drainage system shall be replaced. At the same time, attention shall be paid to the fact that these harmful substances shall be discharged into the environment immediately when the content of pollutants in the wastewater is high and the refractory substances are high, which can effectively reduce the various components contained in the wastewater, thus causing the deterioration of the

water quality and causing accidents.

(2) Bioremediation technology mainly refers to the decomposition of pollutants in water, the adsorption and decomposition of pollutants in water by microorganisms to make water reach a stable state, and the purification of sewage, such as filtration and disinfection.. This method is one of the technical means to convert a large number of organic and inorganic substances in nature or human social environment into organic matter through biochemical reaction or to simply separate sludge without producing pollutants or reducing the oxygen content of sewage. This can effectively eliminate harmful substances in water. In this process, attention should be paid to the need to operate the equipment in strict accordance with the relevant national standards to avoid unnecessary or non-conformance to the requirements of national standards, which may cause water quality safety problems. The second is to take measures against those water bodies that cannot meet the national discharge standards and requirements and are polluted by corrosive water pollution sources [15-16].

2.3. Particle Swarm Optimization

Particle Swarm Optimization (PSO) is a random search method, which makes use of the cooperation among groups to process information. Each individual has its own meaning of independent existence. In the process of interaction between particles, the optimal solution can be obtained by using different types and properties, as well as characteristics such as strong or weak similarity or large degree of similarity in randomness, as a parameter library, so as to achieve operation, tracking and predictive control within the global value range of the solution function on the global optimization problem, At the same time, it can also improve the poor convergence performance when some local search ability is poor or complex data needs to be further studied through certain rules. It calculates the objective function by using the adjacent information at different locations during the optimization operation. When we need to find the optimal individual, we will find a global optimal solution as a set of all other point sets in the population, and then decide to reallocate the new sample to each particle according to each local best and most recent characteristics. Particle Swarm Optimization (PSO) is a search theory based on the space competition between random individuals and populations in nature, thus generating evolutionary search theory [17-18].

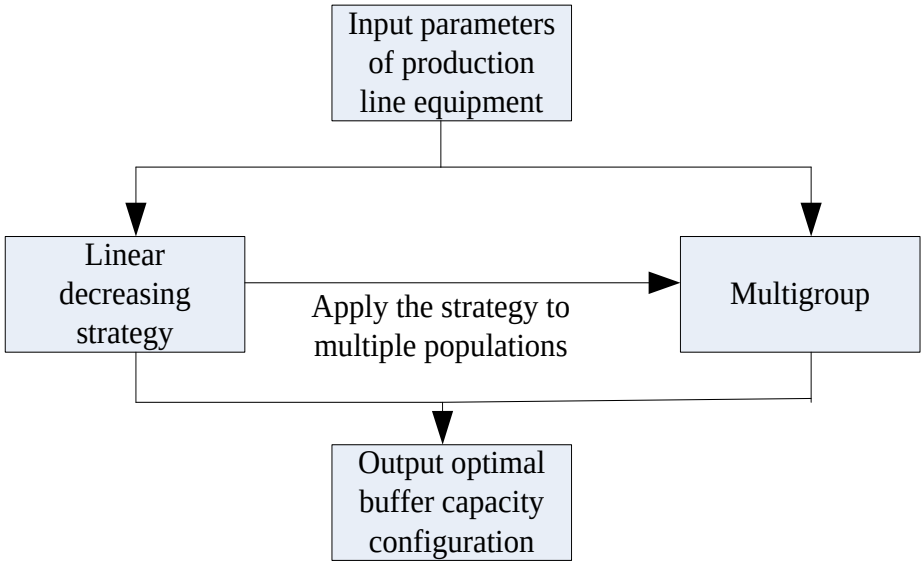

Figure 2. Particle swarm algorithm flow

Figure 2 shows the flow of particle swarm optimization algorithm. The basic idea is to use existing knowledge to determine whether to iterate by simulating or predicting environmental changes. When there is a local optimal solution. The particles will move to different degrees and form new combinations. At this time, the local optimal value may be adjusted to the global optimal value or the maximum energy point. In other cases, the global minimum optimal value will also be the final result of this algorithm. This search process is called "random". The algorithm parameters are initialized, including the size of the population, the dimension of the expected solution, and the maximum number of iterations of the algorithm;

2) Set the feasible region of the solution. Within the feasible region, set the motion range and velocity of each particle at the beginning of iteration;

3) Initialize the historical optimal function value and population optimal position of each particle;

4) At the beginning of iteration, update the speed and position of each particle in the algorithm according to equations (6) and (7);

$$v_{kd}^{t+1} = v_{kd}^{i} + c_1 r_1 \left(p_{id}^{t} - x_{id}^{t} \right) + c_2 r_2 \left(p_{gd} - x_{id}^{t} \right) \tag{1}$$

$$x_{id}^{i+1} = v_{id}^{i+1} + x_{id}^{i} \tag{2}$$

5) Continuously iterate to calculate the fitness value of each particle in real time. For this article, it is to find the objective function in equation (1);

6) Update the optimal position information of each particle and the whole population according to the function value of particles;

$$X_{\mathrm{id}}(\mathrm{k}+1) = X_{id}{}^{j}(k) + V_{id}{}^{j}(k+1) \tag{3}$$

7) If the current number of iterations is equal to the maximum number of iterations, the algorithm ends; otherwise, the algorithm turns to step (4) and continues to iterate.

3. Fusion of Water Pollution Prevention Engineering Technology by Integrating Particle Swarm Optimization Algorithm

3.1. Technical Framework Diagram of Water Pollution Prevention and Control Engineering Based on Particle Swarm Optimization

The technical framework of water pollution prevention and control project (as shown in Figure 3) refers to a system with a certain regularity, structure and expandability and general knowledge and skills, which is composed of several mutually restricted, interrelated and interacted systems. In this system, all factors need to be considered comprehensively. This method divides the entire ecosystem into different levels to study its influencing factors and their relationships. At the same time, the corresponding responsible party of each element can be determined by calculating the weight value of each element, so as to control problems, solve problems and reduce costs. In the water pollution prevention project, through the treatment and analysis of water, pollutants can be effectively prevented from entering the soil and affecting the ecological environment.

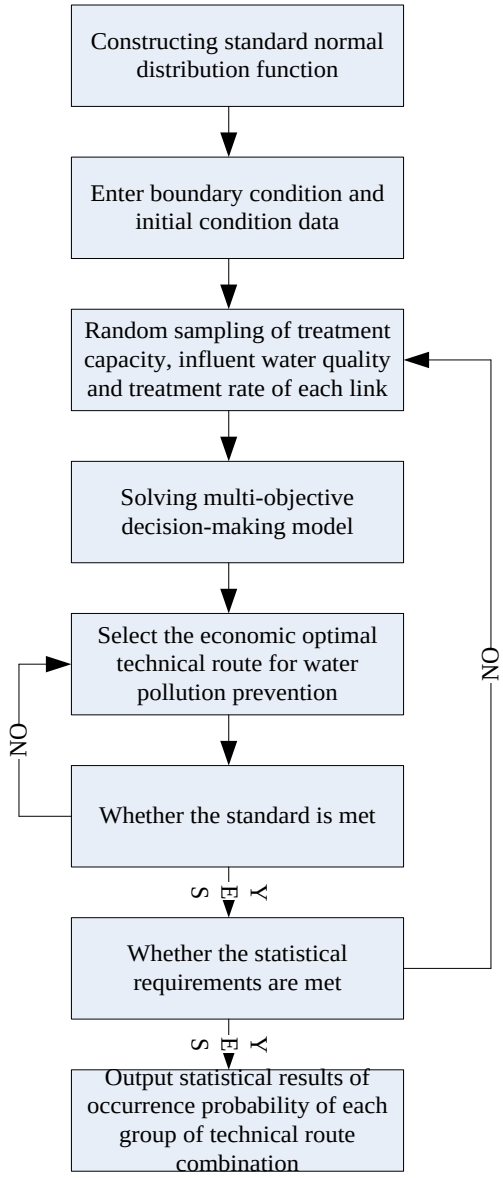

Figure 3. Water pollution control engineering technical framework map for analysis based on particle swarm algorithm

3.2. Technical Performance Test of Water Pollution Prevention Engineering Technology by Integrating Particle Swarm Optimization Algorithm

Water pollution prevention project is a comprehensive system, including environmental, economic and social aspects. In this comprehensive process, it is necessary to consider the interrelationship between various factors. Therefore, it is of great significance to analyze and study it. Harmfulness of water pollution. High concentration of pollutants in the water will worsen the water quality. When there are a large number of suspended solids in the water, it may also cause eutrophication of the water and cause water quality deterioration. Nitrogen compounds and phosphates are harmful to human health and other phenomena are disasters caused by force majeure events in the environmental damage sources. In the technical performance test of water pollution control engineering, the application of particle swarm optimization algorithm is a very meaningful and valuable research topic. It can process information of different types, sizes or similar features.

Among them, the particle swarm optimization algorithm randomly generates some individuals to compete and cooperate with each other, thus forming an orderly network behavior pattern to solve the problems in the water environment. The fusion population can use these parameters that are highly intelligent and not easy to change other types or have no correlation to improve its performance. The variation range of water quality is determined by analyzing water samples, pollutants and relevant indicators. According to the measured data, the corresponding parameter values are calculated, and then the two algorithms are used together. In addition, various methods can be used to optimize the process when the effect is not good when the difference between the amount of sludge and the amount of wastewater generated under different concentration standards is large, so that the pollution prevention project can achieve the best working state.

4. Experimental Analysis of Water Pollution Prevention Engineering Technology by Integrating Particle Swarm Optimization Algorithm

4.1. Analysis on Technical Performance Test of Water Pollution Prevention Engineering Technology by Integrating Particle Swarm Optimization Algorithm

Water pollution prevention engineering technology refers to the research and analysis of various possible sewage treatment methods and processes during the construction of the project. In this process, there will be many different types and different kinds of mixture. But from the technical point of view, the main purpose is to reduce the harm caused by pollutants. Therefore, it is difficult and uncertain for a new thing, so we need to constantly try to improve the technical scheme of water pollution prevention projects, so that the project construction can be more environmentally friendly, efficient, energy-saving and green development. Table 1 shows the technical performance test data of the water pollution prevention project.

Table 1. Technical performance test of water pollution prevention and control engineering

Test times	Maximum mutual information	Iterations	Operation time	Number of times trapped into a local optimal solution
1	635	432	5	324
2	524	345	4	255
3	576	443	6	326
4	563	542	4	346
5	557	312	5	267

For the water pollution prevention project, it is a very complex system, which needs to consider many aspects. In the design process, we should fully understand the extent and magnitude of the impact of various factors on the technical performance, as well as the hazards caused by the interference. From the analysis results in Figure 4, we can draw the following conclusions. In the water pollution prevention project, through the comparative analysis of the performance of the particle swarm optimization algorithm, it is found that the particle swarm optimization algorithm has fast running time and high iteration efficiency, because it has good global optimization ability, and its performance is also very stable and reliable. Therefore, these factors should be fully considered and utilized in the design process to improve the technical level of water pollution treatment so as to achieve the goal of environmental protection in a real sense.

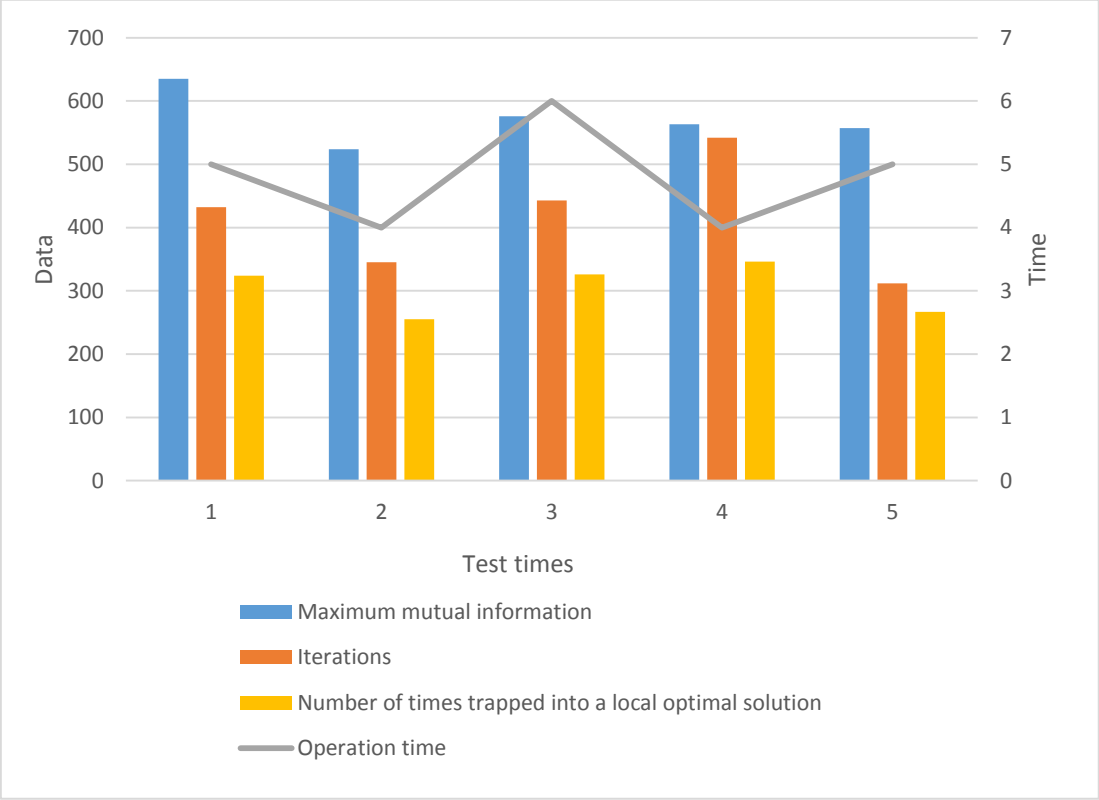

Figure 4. Technical performance of water pollution control engineering is analyzed by fusion particle swarm algorithm

5. Conclusion

Water is one of the most important resources on the earth, and it is also an indispensable material condition for our survival and development. However, in the ecological balance of the earth, water resources have been seriously polluted. Our country has studied the water pollution problem and found that the main reason is due to the eutrophication of surface water bodies and the overexploitation of groundwater. In this paper, by analyzing the new technologies and methods proposed by domestic and foreign scholars, and applying particle swarm optimization algorithm to solve this problem, combined with ant colony algorithm to optimize the utilization rate of water resources and reduce the emission of environmental pollutants, the new technologies and methods for better protection and sustainable development of water energy can be applied in projects.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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