Green Environmental Protection Technology Applied in Sewage Treatment System Upgrading Modern Management

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Abstract. The sewage treatment system is upgraded from the original UNITANK process to A2O+MBR process and pharmaceutical sewage treatment process. The automatic control system involves the problem of combining with the original automatic control system. The design is based on advanced nature, flexibility, reliability, and ease of use. The principle of scalability, the control project covers all technological processes, can realize the centralized monitoring of the central control room of the whole plant equipment, and effectively improve the automation of sewage treatment. Through the project budget, the total cost of different processes and different scales of treatment schemes is obtained, and the functional relationship between the cost and scale of different processes is obtained through curve fitting. According to the principles of technical economics, the cost of the sewage treatment project is related to the quantity of reduced pollutants, and the cost flow of the project and the reduced pollutant load flow are discounted.

Keywords: Green environmental protection, modern enterprise, management, sewage treatment.

1. Introduction

China is rich in resources, but scarce per capita. The finiteness of resources and environmental capacity determines that a sustainable scientific development concept must be firmly established, and cleaner production provides an effective way of resource and environmental management. By using clean energy and raw materials, adopting advanced technology and equipment, improving management, implementing comprehensive utilization, etc., not only can the generation and emissions of pollution be greatly reduced from the source, but also the efficiency of resource utilization can be effectively improved. Sewage treatment is an industry that eliminates pollution, turns harm into profit, and benefits the people. The volume of production and management data in sewage treatment plants is large, and the relationship between the data is complicated [1]. If information management is not adopted according to the actual sewage treatment situation, it will be difficult to ensure the reasonable operation of production, and it will not be possible to improve the labour productivity of sewage treatment and reduce the cost of sewage treatment. To meet the needs of China's rapid economic development. The design scheme of the comprehensive sewage treatment information management
system makes full use of the advantages of the computer network, closely links management and production processing, analyses and organizes production and management data, and improves overall work efficiency.

2. Estimation of economic cost of sewage treatment

2.1. Investment estimation

(1) Estimated scope: Sewage treatment works of sewage treatment plants, sludge treatment works, other ancillary construction works, other public works, etc. (2) The preparation of the plan is based on the Ministry of Construction "National Municipal Engineering Investment Estimation Index" (2006 edition), the Ministry of Construction "Municipal Engineering Feasibility Study Investment Estimation Method" (2006), "Water Supply and Drainage Design Manual Technical Economy" (No. 10 Volume) (Second Edition) and similar engineering economic indicators and equipment quotations of related manufacturers [2]. The construction unit management fee is calculated at 1% of the part 1 project cost; the survey and design fee are calculated at 3% of the first part project cost; the project construction supervision fee is calculated at 1.2% of the first part project cost. (3) The construction period is calculated as 1 year. See Table 1 and Figure 1 for the investment analysis of sewage treatment process.

| Project scale/(ten thousand t·d⁻¹) | Project investment/ten thousand yuan |
|-----------------------------------|-------------------------------------|
|                                  | SBR process | Oxidation ditch process | A / A / O craft | Biological contact oxidation ditch process |
| 0.25                             | 1131.64     | 1129.84                  | 1028.78         | 892.59                                      |
| 0.5                              | 1312.96     | 1430.9                   | 1319.84         | 1456.29                                     |
| 1                                | 1726.36     | 2027.9                   | 1793.61         | 1856.28                                     |
| 2                                | 2508.88     | 3016.59                  | 2598.37         | 3109.69                                     |

According to the curve fitting, the functional relationship of the project investment of the sewage treatment plant of different processes with the scale change is as follows: oxidation ditch process:
\[ y_1 = 2091x^{0.4753} \]; SBR process: \[ y_1 = 1917.5x^{0.3841} \]; biological contact oxidation ditch process: \[ y_1 = 2020x^{0.5721} \]; A/A/O process: \[ y_1 = 1850x^{0.4453} \]. In the formula, \( y \) is the project investment, ten thousand yuan; \( x \) is the project scale, ten thousand t/d.

2.2. Estimation of operating expenses
Depreciation of fixed assets: 20-year straight-line depreciation, with a residual value rate of 5.0%, and a comprehensive maintenance rate of 1%. Sewage treatment plant labour quota: 40 people (scale of 20,000 t/d), 27 people (scale of 10,000 t/d), 20 people (scale of 50,000 t/d), 18 people (scale of 20,000 t/d) t/d). The unit price of electricity is 0.60 yuan/(Kwahu); the unit price of water is 1.8 yuan/t; the salary and welfare standard are 12,000 yuan/(persona); the unit price of polymer polyacrylamide is 50,000 yuan/t; ferrous sulphate The unit price is 1,000 yuan/t. Maintenance and overhaul rate: the overhaul commission rate is 1.8%, the comprehensive maintenance rate is 1%; the depreciation of fixed assets: 20-year straight-line depreciation, the residual value rate is 4.8%. According to the above estimation, the results are shown in Table 2.

| Project scale/ (10,000 t·d⁻¹) | 0.25 | 0.5 | 1 | 2 |
|-------------------------------|------|-----|---|---|
| Unit processing cost/ (yuan·t⁻¹) | SBR process 1.482 0.873 0.682 0.521 | Oxidation ditch process 1.524 1.102 0.78 0.62 | A/A/O process 1.48 0.95 0.73 0.58 | Biological Contact Oxidation Ditch Process 1.41 1.121 0.78 0.69 |

Oxidation ditch process: \[ y_2 = 0.8153x^{-0.4391} \]; SBR process: \[ y_2 = 0.6953x^{-0.4881} \]; biological contact oxidation ditch process: \[ y_2 = 0.8472x^{-0.3616} \]; A/A/O process: \[ y_2 = 0.7532x^{-0.4434} \].

![Figure 2. Unit processing cost analysis](image)

2.3. Economic analysis
According to the cost model obtained above, the total cost of the operation of the sewage treatment plant can be estimated, considering the time value of funds and the social willingness to improve the
environment, to provide the same comparison basis for different projects [3]. If the project is adopted to reduce the average economic cost of unit pollutants, the total cost of the sewage treatment plant during the operation period is:

$$F = y_1 \left( 1 + i \right)^{n+m} + 365 y_2 \left[ \frac{\left( 1 + i \right)^n - 1}{i} \right] (1+i)$$  \hspace{1cm} (1)

In the formula, I is the social discount rate; n is the operation time of the sewage plant; m is the construction period of the sewage plant.

3. **Sewage economic treatment system based on environmental protection concept**

3.1. **System goals**

The system objectives include: (1) Establish a network structure of workstations in various departments of the enterprise to form an enterprise network information system. (2) Establish information management of sewage treatment plants, realize the rational application of corporate resources, establish corporate annual plans, balance material plans and capacity plans, and dynamically track monthly production plans; supervise and control process operation and establish corporate financial computerization, Comprehensive and balanced management of the four basic elements of the company's manpower, equipment, materials, and production methods, to provide an accurate basis for the company's production and business decision-making. (3) Provide a comprehensive information query system to provide analysis and resolution basis for the decision-making level. (4) Establish a technical archive database for the sewage treatment industry. (5) Realize water quality monitoring and analysis. (6) Realize factory information management. (7) Realize the sharing of enterprise information resources and equipment resources. (8) Establish an enterprise office automation system. (9) Establish an information communication platform with external companies to gradually meet their e-commerce needs. Figure 3 shows the sewage treatment system architecture.

![Figure 3. Sewage treatment system architecture](image)
3.2. System network structure
The network communication structure of this system is concise, efficient, and open. The previous five-layer communication structure is simplified into a three-layer network with excellent communication functions such as the management layer, the control layer, and the device layer. The management layer adopts Ethernet network to realize data communication between PLC and host computer, and between PLC and third-party equipment. The control layer adopts Profibus-DP network and is responsible for the communication between each controller and IO module [4]. The equipment layer can adopt many kinds such as serial bus network, Ethernet network or Profibus-DP network. The device layer network is used to realize the communication between field devices such as switches, meters, and man-machine interfaces and PLC. Local control has the highest control authority. When the automatic control system cannot operate normally due to some force majeure, the continuity of the sewage treatment process can be ensured through on-site control. Switch the "local/remote" knob on the field control box to the "local" position, and realize local manual control through the "start/stop" button on the box.

3.3. System structure and configuration
According to the control requirements of the sewage treatment process, the sewage treatment engineering automation control system is divided into three levels of management, including production management level (central control room), field control level (PLC control station) and local control level. Various field data are collected through the PLC system and transmitted to the monitoring computer in the central control room through the backbone communication network to achieve centralized monitoring and management [5]. The data communication between the central control room and the PLC control station adopts high-speed real-time industrial Ethernet, the network structure is ring, the transmission medium is optical fibre, and the communication rate is 100Mbps. Similarly, the control commands of the monitoring computer in the central control room are also transmitted to the PLC through the above-mentioned network to implement distributed control of each unit. The topological structure and functional configuration of the sewage treatment plant automation control system are shown in Figure 4.

![Figure 4. Topology configuration of sewage plant automation control system](image-url)
3.4. System software

(1) Operating system Windows NT Server. The system provides a complete solution for the computing environment of various organizations. From file printing operations to Intranet and Internet services, mission-critical application support, all services are embedded in the operating system. Starting from the basic point, Windows NT Server is designed to be the most integrated, complete, and convenient server operating system, and provides the necessary evaluation, reliability, and manageability for mission-critical applications. (2) The database system SQL Server 2000. SQL Server 2000 is a comprehensive distributed management framework that centrally manages all database servers in an organization [6]. Through enhanced Windows-based management tools and powerful server-based job schedules, multiple servers can be intuitively controlled, and the automatic execution of remote operations composed of distributed environment commands can be realized. Considering the integration with the Internet, SQL Server also provides a high-performance Web page information access mechanism. Its new component, Web Assistant, can use SQL data to promote Web services in a variety of ways, allowing distribution of company data on a private Intranet network or on the Web of the World Wide Web (Internet). (3) Client system software. The client operating system can use Windows NT Workstation 10.0 or Windows 10 Chinese version.

4. Economic analysis

According to the limited space available for municipal land, the project covers an area of only 15m² and the total investment is about 600,000 yuan. The electricity fee is 0.77 yuan/ m³, the sewage treatment chemical fee is mainly the hollow fibre membrane backwashing medicine, etc., which is 0.10 yuan/m³, the labour cost is 0.83 yuan/ m³, the maintenance and depreciation cost is 0.76 yuan/ m³, and the total operating cost is 2.46 yuan / m³. The current industrial water fee is 7.50 yuan/ m³, and the operating time is 300d/a, and the investment payback period is 3.31a.

5. Conclusion

In view of the sewage discharge situation and water quality characteristics, the treatment process of high temperature cooling tower + two-stage walnut shell filter pre-treatment + hollow fibre membrane microfiltration system is adopted for some sewage. The operation results show that the process technology is reliable and stable. It can not only save water resources, realize clean production of the enterprise, but also reduce the operating load of the original sewage treatment station, and achieve the stable and up-to-standard treatment of effluent.

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