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Opinion

Innovative Strategies and Forward Thinking on the Development Trend of Urban Sludge Resource Utilization

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Opinion

With the widespread adoption of the activated sludge method for treating sewage wastewater around the world, the annual products production of urban sludge was very huge for the past few years in both developed and medium-income countries. The annual production of urban sludge in America and China was 7.2 and 6.2 million dry metric tons, respectively and it was significantly higher than that of most European countries. The urban sludge was rich in organics, heavy metals, phosphorus, and nitrogen, which was not only a great energy resources, but also generated the factors of environmental pollution. The European Green Deal issued by the European Union clearly proposed to decouple resource extraction from the economy and reached zero carbon emission by 2050, which meant that the wastes should be maximized to achieve the optimal use of energy resources.

The Change of Conception

Global energy demand was increased with the rapid development of social economy. Meanwhile, for the whole world, the urban sludge management was a challenge due to the high treatment cost and the increasingly stringent laws surrounding its agricultural use. Under the background of carbon neutral, we need to change our thinking and concept to form a system thinking, not only to talk about the optimal use of energy resources, but also to concern about the mitigation of environmental pollutants. It was necessary to increase clean production, such as the reduction of urban sludge sources. Besides, the promotion of resource recovery by taking advantage of the valuable nutrients and organics exist in urban sludge was also a useful technology. From the point of view of energy saving and resources development, source reduction, resource recycling and terminal treatment of urban sludge was the international consensus.

Carbon Reduction

Zero-carbon project was conducive to the efforts of overall waste minimization, which could greatly mitigate the contradiction between the resource depletion and the environmental pollution. Recently, the optimization of urban sludge reuse and recycle from physico-chemical processes for zero-waste discharge was essential for the optimal use of energy resources and mitigation of environmental pollutants. In the future, the quantitative assessment of carbon emission will definitely be a binding target and an important aspect of the research and development of urban sludge treatment.

Interdisciplinary Integration

Using new technologies would result in the intersection and integration of technical disciplines. Especially in life science study, the rapid development of molecular biology

technology and materials science was one of the research projects focuses currently, providing good support for the research on urban sludge waste. By effectively using new technologies, industries might minimize the need of original materials, thus contribute to reduce the consumption of energy and conserve the natural resource.

The Application of Models

Over the past years, a majority of physical models based on urban sludge treatment systems was presented in the laboratory. As most industries upgrade to the smart systems and processes, the optimal use of energy resources and mitigation of environmental pollutants will soon achieve the inevitable shift from a reactive operation mode to an active design concept. By combining the big data models and traditional models, the development of urban sludge treatment and resource utilization could greatly promote. The combining machine learning with response surface method approaches for predicting and optimizing urban sludge treatment some distinct advantages. Such a combination of method facilitated the wider field of vision to look at the complex management of urban sludge.

Industrial Synergy Model

Bearing in mind the properties of urban sludge, the industry must have scale and economic benefits. In this case, the collaborative treatment, such as urban sludge and other organic solid wastes could be operated to achieve complementarity and increase the efficiency of scale. The biogas generation and biogas residue utilization could also reach a certain scale, making a positive effect on new technologies extension and industrial development.

With the continuous advancement of scientific research and technology, the treatment and management of urban sludge will be solved in the future, realizing the optimal use of energy resources and the mitigation of environmental pollutants. In addition, the operating costs will be further reduced. Meanwhile, in view of the environmental and social value of urban sludge, the government will introduce more policies and regulations to support the reuse of urban sludge and promote the wide application of technologies. Although the technologies of urban sludge treatment still face challenges, the application prospect was optimistic. With the promotion of many factors such as economic and environmental protection policies, it is expected that urban sludge will be widely develop in the future, bringing double benefits on the economy and the environment.