



A Study on Application of the Technology for Activated Sludge Reducing

Yang Zhan

School of Municipal and Environmental Engineering, Harbin Institute of Technology, Harbin 150090, China

Abstract: Activated sludge process is the most widely used technology in sewage bioremediation up to now. However, there is also a serious problem with this technology, that is, a great amount of sludge will be left over. In view of this situation, a study has been carried out through the domestic activated technology for sludge treatment and also research on the effective sludge treatment. They made use of the microbial decomposition to decompose the oxide by using the means of physical, chemical, biological, etc. to minimize the effluent from the sewage treatment plant and thus, reduced the amount of sludge produced.

Key Words: Activated; reduction optimization; dewatering; sewage treatment

1.0 Overview of Sludge Issues

1.1 Sludge Production

Urbanisation development is accompanied with the pollution. During the process of sewage treatment, the sludge is contained parasite eggs, bacteria and various of organics pollutants which are highly contaminous have increased the difficulty of the treatment process. Besides, city development and intensification of industrial activities have lead to severe pollution which has also resulted a reduction in water resources. The treatment for the pollution is now become a knotty problem of the citizen. .

1.2 Development of sludge production

Copyright © 2017 Yang Zhan

doi: <http://dx.doi.org/10.18686/wc.v6i3.112>

This is an open-access article distributed under the terms of the Creative Commons Attribution Unported License

(<http://creativecommons.org/licenses/by-nc/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

At the end of the 1990s, domestic sludge production was more than 10 million tons but the amount of treated sludge was not even more than one-tenth of the total amount of sludge produced. The increment of population and the rapid urbanization have caused rampant pollution. Not only this, there are many industrial factories have also begun to develop up which has also increase the domestic sludge treatment facilities. In accordance with country's treatment standards, China has constructed up to 500 sewage treatment plants and therefore, our country capability in sludge treatment is about 6 times higher than previous. It showed a trend of growth in sludge production from this situation. Besides, higher standards of the country's sewage treatment will also lead to an increment of sludge production. The reagent in denitrogenation and phosphorous removal treatment of sewage will increase the amount of sludge produced about 40% extra than the original basis.

Countries	Sludge production (Dry weight, kiloton/ day)	Landfill	Incineration	Land application	Others
United State	6800	3750	670	2330	350
Germany	2750	1787	275	688	/
Japan	1365	403	896	148	18
United Kingdom	1075	172	54	548	301
France	900	477	180	243	/
Sweden	180	72	/	63	45
Switzerland	170	/	50	120	/
Denmark	130	43	36	48	3

Figure 1 Sludge production and treatment methods in some countries

2.0 Sludge Reduction Technology

Unprompted treatment for the harmful substances and heavy metal in the sludge poses a tremendous threat to the environment as it will result in a severe pollution. In order to facilitate the transportation, preliminary treatment is required for the sludge in the sewage treatment plant before it is processed. There is a regulation on the disposal to landfill of treated sewage sludge, that is, sludge from sewage treatment plant can be landfilled only if its dry matter content is above 35% and its shear force shall not less than 25KN/m². Due to the high content of organic matter in sludge and the sludge corruption issue also has been taken into account, sludge stabilization will be carried out before the disposal of sludge. The general sludge treatment procedure are: sludge concentration - sludge stabilization - sludge dewatering. First of all, it is necessary to reduce the interstitial water in the sludge during the sludge concentration. Anaerobic digestion method or aerobic digestion method can be adopted for sludge stabilization and dehydrate the sludge subsequently. Sludge dehydration can be achieved by using the integrated sewage treatment equipment. Figure 2 below shows the endogenous process of the biological sewage treatment system

Although the water content in sludge can up to 80% and above, there are also contain of refractory organic matter, heavy metals and salts. In China, sludge treatment in those industrially advanced area is considerably difficult. Hence, sludge reduction technology has garnered a great deal of attention.

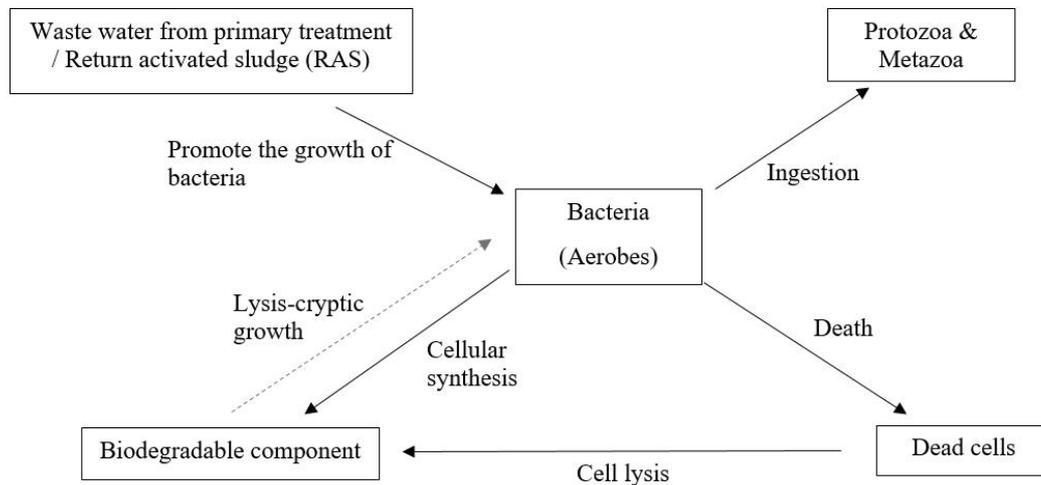


Figure 2 Endogenous process of the biological sewage treatment system

2.1 Domestic and International Research

From the domestic and international research situation, the three basic principles is effective on sludge reducing treatment. The biological cell lysis in the sludge is the most effective method. In order to reduce the sludge production, mechanical disintegration has been used for an accelerated and improved anaerobic digestion of sludge during the sludge treatment process. Besides, the microbial predation cycle used to reduce the sludge production by increasing the quantity of predator. Lastly, chemical treatment or biological treatment is being applied on the uncoupling of metabolism result in energy spilling and biological degradation as well.

2.2 Aim of Study

As people has more concern on the environmental issues, our researchers have begun to research on the sludge treatment methods at the beginning of the twentieth century. Sludge treatment will affect the region's economic benefit and also the development of cityscape directly and thus, sludge reducing treatment has become particularly important. China is a developing country which has been practicing the principle of sustainable development. In order to adhere to this principle, we need to take into account the strategic optimization of the design principles so that we are able to cherish the environmental resources and also protect the existing resources. Therefore, it is extremely essential to put the treatment of pollution in an important position as it is beneficial to our country's development in other socialist countries.

3.0 Application of Activated Sludge Reducing Treatment

Activated sludge refer to the flocculation of bacteria. The interior cell contains up to 70% of cytoplasm. It is surrounded by a rigid cell wall, made of sugar polymer. Its structural characteristic able to protect its shape from damage. In addition, the surface of sludge also contains refractory contaminants which are harmful to the environment. There is a trend of growth on factory effluent due to the development of industry and our country has also improved in sewage treatment efficiency in the meantime. Thus, a great amount of sludge has been produced. The higher the water content in the activated sludge, the more difficult for it to be treated. Therefore, it is necessary for us to probe the application of activated sludge reducing treatment in daily life.

3.1 Chemical treatment

According to the chemical methodology, chemical treatment used to destroy the outer cell membrane of the microbial in the sludge to destroy its inner structure. Then, chemical agent added in have demonstrated effectively good results in floc disintegration, better filterability and solubility. The chemical agent will disintegrate the sludge, consequently weaken their structure, disconnected the electrostatic interaction between the inner cell component and hence, sludge hydrolysis can be facilitated.

3.2 Mechanical disintegration

In the course of the study, the researchers have even applied ozonation, electro-osmotic methods to dispose dewater sludge due to the low efficiency of chemical treatment. The major purpose is to destroy the inner structure of activated sludge with external factors in order to facilitate the floc disintegration & solubilisation and thus, result in sludge dehydration

3.2.1 Ozonation

Ozone is the most effective oxidant as it will destroy the cell membrane of bacteria and caused floc disintegration, cell lysis, organic matter solubilisation and also reduce the sludge pollution area. As the ozone generator output voltage is high, the recommended ozone dosage during ultrasonic operation is 0.05g/015/g SS, while the filtered water content in the going through the settler should not be more than 30%. When there is a fix value of ozone, both of the microbial in the sludge as well as the sludge production have been reduced significantly. Sludge ozonation is relative ease of operation and able to minimize the pollution.

3.2.2 Electroosmotic dewatering method

All sludges consist of a combination of a solid phase with a certain quantity of water. Most sludge materials have a slight electric charge relative to water. To balance this charge, a row of cations from the solution line up along the sludge particle surface. The combined system of the surface charge on the particle and the corresponding counter ion charge in the solution is known as a double layer. Electroosmotic is a novel technique to dewater sludge. Under the optimum conditions, 2 hours of electroosmotic dewatering able to increase the sludge dewater rate up to 40% higher than the original basis, which more efficient than 11 hours of mechanical compression but only can increase 22%. Based on the study of Yang , (23), etc. on electroosmotic dewatering of sludge with 5% of solid rate, undergo 45mins of electro osmosis with current 1A and 2 A respectively, the dewatering rate are 35.0% and 46.8%. By using titanium mesh as electrodes for dewatering treatment, with current density of 80A/m², adding calcium oxide 0.3 g / L, constant pressure 5×10^5 Pa, the solid rate of mud cake has exceeded 67% which has better dehydration effect.

A study on the dewatering effect of freezing / dissolving conditions condition and existence of polyelectrolyte by using titanium plate as anode and stainless steel as cathode. The result show that polyelectrolyte and the temperature condition are able to facilitate sludge dehydration. At temperature of -20 ° C, 15 kg of polymer electrolyte been added into every kilo tonnes of dry sludge , the maximum dewatering rate is up to 48.7% under the condition of 3.6kg per square meter of electrode sludge and voltage is 20V. Although electro-osmotic unable to dehydrate all the water content in sludge, the EPS (extracellular polymer) in the sludge will be affected and destroyed its inner structure as well under high voltage. Electroosmotic dewatering treatment is cost efficiency and high stabilization. Therefore, this technique is adopted widely in most of the sewage treatment plants for sludge reducing treatment.

3.3 Microbial Predation

Activated sludge treatment seem to be a small-scale ecosystem. During the treatment process, one organism eats another

the total amount of biomass decreases and the transfer to a higher trophic level of the food chain occurs. The organic matters in the sewage are a food source for those higher organisms to promote the growth of organism. In this way part of the biomass and the potential energy is lost as heat and excretory products, which causes a reduced growth of biomass and lower sludge production. Hence, auxiliary liquid has to be used in the reduction treatment in order to shorten the predation process and obtain higher potential energy ingestion.

4 Land Application of Treated Sludge

Nitrogen and phosphorus are found in large quantities in treated sludge. According to the statistics, the nitrogen and phosphorus content in sludge is generally higher than the farm manure and it also contained a certain quantities of micro-element which is important in increasing the crop agricultural yield. Therefore, it is also a kind of high-quality organic fertilizer and have better mineralization rate than farm manure. They are easily decomposed by the soil microorganisms and also stimulated the metabolism of those microorganisms. Landfarming has been widely adopted in local and foreign countries as it is nutrient supplement for crop agriculture, soil fertilization and sludge disposal as well. Britain had disposed 55% of the 1mil. Tonnes of sludge to landfarming in 1998 and 61% of the 1.5 mil. Tonnes of sludge been disposed by 2002.

5.0 Conclusion and Outlook

The earth resources that we rely on for life sustenance have been severely tested. Surrounding environment is the place where we need most protection. We realised that anti-pollution measure can be practised by making full use of the biological or physical knowledge through the study on the application on the activated sludge reducing treatment in this paper. We need to adhere to the principle of sustainable development and also developed the economy with green concept instead of sacrifice the environment as a price

References

- [1] Chen Lu, Luo Da-fang, Wen Bin. Study on Persistent Organic Pollutants in Municipal Sludge [M] .2016 (52)
- [2] Li Juan, Lan Fang, Song Yi, Wang Cuiping. Construction Status and Policy Requirement Analysis of Urban Sludge Cement Kiln [G] .2015 (46)
- [3] Wang Li, Liu Jun-jian, Qiang Liang-sheng, Zhang Hong-yuan. Journal of Harbin Institute of Technology. Electrochemical oxidation of activated sludge reduction efficiency [J] .2009 (96)
- [4] Jones P W. In: Processing and Using of Sewage Sludge [M]. In: P. L'Hermite and H. Ott, eds D. Reidel Publishing Company, 2009, 178-185
- [5] Angelidis M. Chemistry of metals in anaerobically treated sludge. Water Res, 2015, 56 (2): 23-33