

Feasibility analysis of simultaneous de-sulfization, denitrification and dephosphorization of mine waste comprehensive treatment

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Abstract: In order to dispose sulfate mine waster and make it reclaimable, it bring forward pioneerly the new thought that under the condition of anaerobic, make use of sulphate-reducing bacteria,thiobacillus denitrifican, make municipal waste which is undischarged directly as carbon source. In anaerobic reactor sulfate mine waster get disposed, gain the perpose of de-sulfide denitrification and dephosphorization in mine waste in-phase and reclaim simple substance sulfur. The article analyze its feasibility.At last ,the perpose of mine waste in-phase synchronization and treat waste with waste come true.

Key words: mine waste; Sulphate-Reducing Bacteria;Thiobacillus denitrifican; municipal waste ;carbon source;continuable

0 Foreword

Mine waste is one important pollutant sources of mine environment,among them mine waste with sulfate whose hazard is the most serious^[1].The great majority of mineral resources are coal mine、pyrites and metallic sulfate minerals in our country.There are different forms of sulphide in mineral resources.Under the use of oxidation and animalcule's particion in air,the sulphide is oxidated into sulfate.With the increase ages of mine,sulfate accumulate ceaselessly

which cause sulfate's concentration get increase. High concentration sulfate mine waste will pollute ground environment seriously, foul up river and lake, destroy ground sight, restrain growth and multiply of aquatic life, make soil harden or salinize. It exerts an influence on development of industrial and agricultural and makes bad effect on mine products and environment. Mine waste with sulfate has become one of the most serious environment pollution which mining should be confronted with^[2]. Because the high content of sulfate, pollution caused by mine waste with sulfate has become one of global problem, around the world, many cities's surface water and ground water have already been subjected to different degree sulfate pollution. So the disposal of sulfate mine waste has attracted academicians's attention widely at home and abroad.

Reclamation of mine waste is the best choice to settle mine area water depletion and mine waste environment pollution, it is the only way of solving water depletion for mine. It has important social, environmental and economic meanings.

1 Sulfate mine waste manages technology present condition at home and abroad

At present, there are some manage measures (1) Control the creation of the sulfate mine waste: Water covering (Use the way of mantling to prevent oxygen from mineral with water); Restrain growth of iron oxidation bacteria (Use bactericide); Passivation (Under the reaction of Physics and chemistry make the surface of sulphide mineral granule form one layer indiscernible and inert velum) and electrochemistry technique (2) Dispose mine waste: neutralisation (throw lime into mine waste in order to remove procreant acid); Everglade disposing (Utilize bacteria catalyse sulfate which is deoxidized into sulphide then secondary deposit metal sulphide and increase PH). With the development of technology, disposal technology of mine waste gets incessant new development, for instance, solvent extraction biomembrane adsorption (Blenkinsop, 1991) and so on. In recent years, some new disposal technologies get developed, for example, Chocklongam and Subramanian^[3] combine bioanalysis with adsorption, pretreat acid mine waste with poppy shell then dispose it with chemical and biological way. They found that the efficiency of follow-up biological treatment had obvious elevation. It can remove 90% iron and 89% zinc. It is said that poppy shell has two important

functions, one is adsorpt partly contamination, another is make some nutrient substance dissolve into waste, this will afford enough carbon source to follow-up biological treatment. Yet, by all accounts, we are lack of researches on sulfate in mine waste dispoement.

2 A new way of sulfate mine waste comprehensive treatment

In order to make dream of reclaiming mine waste come true, the key is **disposing** sulfate mine waste appropriatly. Now bioanalysis is prevalent, under the condition of anaerobic, use Sulphate-Reducing Bacteria (SRB) make sulfate change into sulphide or sulfur and then removed at last^[4].

When use SRB deoxidize sulfate, it need to supply organic carbon source, but the mine waste with sulfate has a small quantity of organics, so it need to supply organic carbon source from nonego^[5]. SRB can make use of many carbon sources, for instance, sirup、ethanol、carbamide、haulm and domestic garbage whose acid leavening and so on. It is said that caseate is the best carbon source which suit to growth of SRB, but its price is very high, when dispose mine waste need supply a great deal of carbon source, so economic is very important. At present, some pursuer use poppy shell and corncob as carbon source, but these ways all will enhance cost. However, the way of using mine municipal waste as carbon source hasn't been seen.

Because a mess of mine municipal waste which disposed by primary treatment or secondary treatment always has residual nitrogen, phosphor and organics. In these substance nitrogen and phosphor are the biggest pollutant source, discharge them into natural water, especially the lake and bay which flow slowly, will cause alga and other animalcule in water greatly propagate easily, engender eutrophication pollution, increase consumption of oxygen, dissolved oxygen get reduce, affect zoology seriously, so staring denitrification and dephosphorization from municipal waste in the face. And that, mine municipal waste has a mess of organics, they can be used as organic carbon source of anaerobe.

So we can import primary treatment mine municipal waste into sulfate mine waste, organics in waste can be used as SRB's organic carbon, and that phosphor in municipal waste combine with mental ion Fe and Mn which contained in mine waste comform

indissoluble phosphate then wiped off. In addition, under the condition of anaerobic, nitrogen and phosphorus in municipal waste can be removed in-phase.

In conclusion, mine municipal waste can be considered to be the SRB's organic carbon of mine waste biological treatment. And try best to create condition of removing N and P in-phase, achieve the effect of removing S, N and P in-phase, shorten the time of process flow, depress the running cost, achieve the aim of managing waste with waste and comprehensive treatment.

3 Technology, current situation and prospect of simultaneous de-sulfization, denitrification and dephosphorization at home and abroad

Technologies of de-sulfide, denitrification in -phase are infrequent, now we have known one method, it is that making use of Thiobacillus denitrificans, Nitrobacteria and Sulphate-Reducing Bacteria effect on waste apartly, remove ammonia nitrogen and sulfate split phase.

Simultaneous de-sulfization and denitrification is one of metabolic pathway which exist in partial thalli, principle is making low valence state as electron donor of split metabolic pathway at the condition of anaerobic, nitrate nitrogen is electron acceptor, oxidate sulphide to be sulfur, at the same time, transmit electronic and deoxidize nitrate to be free ammonia, then get growth needed energy of itself^[6]. Thiobacillus denitrificans can use sulphide as electron donor, NO_3^- is electron acceptor go along with redox reaction. In the process, sulphide and nitrate are removed effectively and reclaim simple sulfur^[7]. So $\text{NH}_3\text{-N}$ in waste should be oxidated to be NO_3^-N by nitrifying bacteria firstly and then removed.

At present, there are some grown-up processes of biology simultaneous denitrification and dephosphorization: A²/O series, SBR series and oxidation ditch series^[8]. But they all have some disadvantages. Recent years, simultaneous nitrification and denitrification process, denitrification dephosphorization process, short-range nitrification and denitrification process, anaerobic ammonia oxidation and some other processes are found and researched, they supply effective approaches for solving processes insufficiency. For instance, Y Watanabe, Fdez-polanco^[9] achieve simultaneous nitrification and denitrification, it is also good for releasing phosphorus in anaerobic segment; Delft Technical University in Holland has

empoldered SHARON process by short-range nitrification and denitrification, which has been circulated in sewage plant in Rotterdam of Holland^[10]. At the same time, the University also has researched ANAMMOX process, under the condition of anaerobic, NO_2^- 、 NO_3^- are electron acceptor, change ammonia into nitrogen^[11].

However, the research of simultaneous de-sulfization, denitrification and dephosphorization has't been reported till now.

4 Theoretics and mechanism analysis of simultaneous de-sulfization, denitrification and dephosphorization

On the basis of characteristics of sulfate mine waste, principle of disposing sulfate mine waste, research survey at home and abroad, analysis of level and trend in development, principle of simultaneous denitrification and dephosphorization and combine mechanism of simultaneous de-sulfization and denitrification, then analyze feasibility of simultaneous de-sulfization, denitrification and dephosphorization.

Mechanism of SRB de-sulfization: under the condition of anaerobic, SRB make use of organic carbon source, electrons are transmitted to oxidation state sulphide (SO_4^{2-}) by decomposing, electron transferring and oxidating the three moments, and then deoxidize SO_4^{2-} into S^{2-} with consuming ATP. At the same time, S^{2-} combine with mental iron which in mine waste and then deposition to be formed and holded up.

Mechanism of denitrification and dephosphorization: denitrification bacteria use $\text{NO}_3\text{-N}$ and $\text{NO}_2\text{-N}$ as electron acceptor, organics are electron donor, deoxidize $\text{NO}_3\text{-N}$ and $\text{NO}_2\text{-N}$ to be N_2 and discharged. It is also good for releasing phosphor in anaerobic segment, released phosphor combine with mental iron and then deposition to be formed and holded up.

Mechanism of de-sulfization, denitrification: make low valence state as electron donor of split metabolic pathway at the condition of anaerobic by Thiobacillus denitrificans, nitrate nitrogen is electron acceptor, by way of redox, oxidate sulphide to be sulfur, at the same time, transmit electronic and deoxidize nitrate to be free ammonia. In the process, sulphide and nitrate are removed effectively and reclaim simple sulfur.

By analyzing feasibility, de-sulfization, denitrification and dephosphorization all should

proceed under the condition of anaerobic, it laid the foundation of simultaneous reaction. And try best to find a way of removing sulfate, nitrogen and phosphor by experimental research. Resolve difficulties when disposing sulfate mine waste radically. Achieve the unification of managing waste with waste and reclamation.

5 Conclusion

Import primary treatment mine municipal waste into sulfate mine waste, part of phosphor in waste react with metal iron (Fe, Mn and so on) to form indissoluble phosphate then wiped off; organics in municipal waste can supply organic carbon source for SRB, under the condition of anaerobic, SRB make use of organic carbon source and deoxidize SO_4^{2-} into S^{2-} , part of S^{2-} combine with metal iron which in mine waste and then deposition to be formed and holded up^[12]. Try best to create anaerobic condition remove nitrogen and phosphor from waste; use *Thiobacillus denitrificans* to remove sulfur and nitrogen simultaneously, reclaim simple sulfur at last. Get the effect of removing S, N and P in-phase, shorten the time of process flow, depress the running cost, achieve the aim of managing waste with waste and comprehensive treatment. And it also helps to develop a new process of simultaneous de-sulfization, denitrification and dephosphorization, which has independent intellectual property rights, supply a gap of technology.

6 Analysis of social and economic benefits

Empowering and extending comprehensive treatment and reclamation of sulfate mine waste with mine municipal waste is promising. Not only reduce waste discharge, reduce charges for disposing pollutants, but also economize a great deal of tap water, save charge for water resource and energy change cost, create economic benefits for mine obviously. Reclamation of mine waste pioneers a new water resource, reduce the produced quantity of fresh water resource; fundamental of high quality used excellently and poor quality used poorly are become true; alleviate and abstain the problem of long-distance water transmission. Reclamation of sulfate mine waste will reduce pollution of surface water which caused by mine waste, plug up pollutant source, beautify mine environment, protect surface water source, the reclamation of

simple sulfur pioneer a new approach for mine export earnings. Accelerate harmonious of mine resource and environment, stabilize balanced development, realize the unification of social, environmental and economic benefits.

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