

NEW USE OF REACTION BETWEEN SOLID AMMONIUM SULFATE AND SOLID CALCIUM CARBONATE IN AMMONIA-NITROGEN TREATMENT OF WATER BODY

TECHNICAL FIELD

The present invention belongs to the technical field of water ecological restoration, and more particularly relates to a new use of a reaction between solid ammonium sulfate and solid calcium carbonate in ammonia-nitrogen treatment of a water body.

BACKGROUND

In general chemistry, especially in chemistry teaching in middle school, it is believed that ammonium sulfate solution can react with calcium carbonate because the ammonium sulfate is a salt derived from a strong acid and a weak base and the solution is acidic due to the hydrolysis of ammonium ions therein. In other words, the reaction is actually a reaction between the calcium carbonate and an acidic substance. However, the reaction may cease soon over time for the reason that the formed calcium sulfate may adhere to the surface of the calcium carbonate, thereby preventing the reaction from continuing. Therefore, the solid-liquid reaction between the ammonium sulfate and the calcium carbonate cannot proceed very well.

In recent years, chemical methods have played an increasingly significant role in the treatment of water pollution. Wastewater treatment by chemical methods refers to removing dissolved or colloidal pollutants in wastewater by methods such as chemical reactions. With the development of China's economy, municipal domestic wastewater, various kinds of industrial wastewater, and chemical fertilizers and farmyard manure have lead to excessive ammonia nitrogen content in a water body, which may cause not only the deterioration of water environment quality, but also serious harm to human beings, animals and plants. In addition, ammonia nitrogen may account for 60% of total nitrogen in the water body. Therefore, the removal of nitrogen, especially ammonia nitrogen, in wastewater needs to be paid great attention to.

At present, chemical treatment methods for ammonia nitrogen in a water body mainly include air stripping, chemical precipitation, ion exchange, break point chlorination, etc. The air stripping method may be seriously affected by temperature and thus have low air stripping efficiency at a low temperature. The chemical precipitation method may require that a cheap precipitant with high performance be used to solve the problem of high cost. The ion exchange method may be difficult to handle during the treatment of high concentration ammonia nitrogen

wastewater with a high consumption of ion exchange agent. The break point chlorination method may be high in treatment cost with high requirements for safe use and storage of liquid chlorine, and thus not suitable for treating high concentration ammonia nitrogen wastewater.

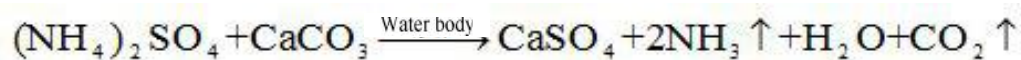
SUMMARY

The present invention provides a new use of a reaction between solid ammonium sulfate and solid calcium carbonate in ammonia-nitrogen treatment of a water body for the purpose of solving the problems of high costs and poor effects in existing chemical ammonia-nitrogen treatment methods for water bodies.

The present invention is implemented by employing a technical solution as follows: a new use of a reaction between solid ammonium sulfate and solid calcium carbonate in ammonia-nitrogen treatment of a water body is characterized in that the solid ammonium sulfate and the solid calcium carbonate are subjected to a surface contact double decomposition reaction under the conditions of a proper stirring strength and a proper temperature. Specifically, river revetments are built with calcium carbonate stones, and during a long period of water flowing, ammonia ions and sulfate ions in the water react with the calcium carbonate stones under alternate drying and wetting conditions to release ammonia gas, thus achieving the purpose of purifying water.

The calcium carbonate stones are selected from solid and new blocky stones containing calcium carbonate as the main component and having no weathered exfoliation with a center thickness of no less than 15 cm, and other stones with a center thickness of less than 15 cm are used for stuffing up gaps, but accounts for not more than 10% of the total stone consumption.

Thermodynamically, the reaction between solid ammonium sulfate and solid calcium carbonate, which is an exchange reaction with a ΔG_m value of greater than zero, cannot happen spontaneously. However, experimental results show that the reaction may happen under particular conditions. This reaction is a complex heterogeneous chemical reaction process including the steps of liquid film diffusion, solid film diffusion, and chemical reaction. With the liquid film diffusion resistance being excluded under the conditions of a proper stirring strength and a proper temperature, it may be deemed to be a solid film diffusion controlled reaction. The reaction equation is shown below:



Thus, the reaction can be applied to ammonia-nitrogen treatment of water bodies. With the conditions for the surface contact double decomposition reaction between solid ammonium

sulfate and solid calcium carbonate created in the water flowing environment, the ammonia nitrogen in the water can be released in the form of ammonia gas.

The present invention has the following advantages: according to the invention, the surface contact double decomposition reaction between solid ammonium sulfate and solid calcium carbonate with strict reaction conditions is applied to ammonia-nitrogen treatment of water bodies, thereby achieving the treatment of ammonia nitrogen in water bodies. The revetments built with calcium carbonate stones can not only cause a reduction in corrosion of concrete resulted from some acidic ions in river water, but also react with the ammonium sulfate in the water to release ammonia gas, thus reducing the ammonia-nitrogen content in the water. This method is applicable to aquatic ecosystems characterized by changeable water levels and great stormy waves and has the advantages of mild conditions, low cost, ease of handling, etc.

DETAILED DESCRIPTION OF EMBODIMENTS

A new use of a reaction between solid ammonium sulfate and solid calcium carbonate in ammonia-nitrogen treatment of a water body is characterized in that solid ammonium sulfate and solid calcium carbonate are subjected to a surface contact double decomposition reaction under the conditions of a proper stirring strength and a proper temperature. Specifically, river revetments are built with calcium carbonate stones, and during a long period of water flowing, ammonia ions and sulfate ions in the water react with the calcium carbonate stones under alternate drying and wetting conditions to release ammonia gas, thus achieving the purpose of purifying water.

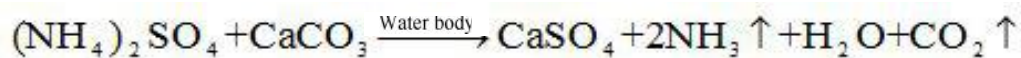
The calcium carbonate stones are selected from solid and new blocky stones containing calcium carbonate as the main component and having no weathered exfoliation with a center thickness of no less than 15 cm, and other stones with a center thickness of less than 15 cm are used for stuffing up gaps, but accounts for not more than 10% of the total stone consumption.

The following treatment steps are required during specific implementation. Firstly, slope surface finishing is carried out. Before paving, a dam slope design line is drawn through setting-out by a surveyor, and slope cutting finishing is carried out along the line by using a backacting shovel. Secondly, paving is carried out layer by layer from bottom to top by constructors carry out according to surveying setting-out. A broken stone cushion having a uniform thickness of 100-200 mm is laid before paving. Thirdly, revetment building is carried out. Mortared stone masonry is built by a mortar laying method with a mortar thickness of 30-50 mm (which may be adjusted appropriately when the temperature changes). Large stones are used at the bottom layer, while stones having relatively appropriate shape and size are selected and fit on the surface. The stones are required to be laid horizontally layer by layer with staggered joints

up and down, and lapped inside and outside. Next, river bottom paving is carried out, i.e., calcium carbonate-containing stones such as cobblestones are laid disorderly on the river bottom. Finally, pointing maintenance is carried out, where pointing mortar is prepared separately by using fine sand with a small water-cement ratio and a cement-sand ratio between 1:1 and 1:2. After pointing is completed, the surface of the masonry is cleaned using a brush, covered with straw bags and cured by watering, keeping the masonry wet.

Example 1

Calcium carbonate (50 g) and ammonium sulfate (15 g) were weighed accurately and mixed in a 250 ml three-necked flask which was connected to a 50 mL separating funnel two-thirds filled with water at the first neck thereof and to an electric constant-temperature stirrer at the second neck thereof. Water was dripped while stirring, allowing a complete reaction of the materials at room temperature. A delivery tube was connected to the third neck of the three-necked flask to deliver reaction gas. The gas was delivered into clear limewater and the limewater became turbid, manifesting the production of carbon dioxide gas. A piece of litmus red test paper was placed at the orifice of the delivery tube and turned blue, manifesting the production of ammonia gas. The reaction equation is shown below:



Example 2

Calcium carbonate (50 g) and ammonium sulfate (15 g) were weighed accurately and mixed in a 200 mL beaker. A constant-temperature stirrer was used for stirring, and meanwhile, water was sprayed, where the stirring rate was guaranteed to be 350 r/min and the temperature was guaranteed to be 45°C. The quantity of gas released from the reaction in 5 hours was recorded. The reaction analysis data in different periods of time are as shown in table 1.

Table 1 Analysis data in different periods of time

Time (h)	1	2	3	4	5
Released gas (g)	1.04	1.86	2.50	3.21	3.98

The solid-liquid reaction between ammonia sulfate and calcium carbonate would cease soon due to covering with the calcium carbonate. The above reaction data indicates that the reaction could continue in case of friction between solids and the extent of reaction was increased with the reaction time extending.

What is claimed is:

1. A new use of a reaction between solid ammonium sulfate and solid calcium carbonate in ammonia-nitrogen treatment of a water body, wherein the solid ammonium sulfate and the solid calcium carbonate are subjected to a surface contact double decomposition reaction under the conditions of a proper stirring strength and a proper temperature; specifically, river revetments are built with calcium carbonate stones, and during a long period of water flowing, ammonia ions and sulfate ions in the water react with the calcium carbonate stones under alternate drying and wetting conditions to release ammonia gas, thus achieving the purpose of purifying water.

2. The new use of a reaction between solid ammonium sulfate and solid calcium carbonate in ammonia-nitrogen treatment of a water body according to claim 1, wherein the calcium carbonate stones are selected from solid and new blocky stones containing calcium carbonate as the main component and having no weathered exfoliation with a center thickness of no less than 15 cm, and other stones with a center thickness of less than 15 cm are used for stuffing up gaps, but accounts for not more than 10% of the total stone consumption.