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Research on Step-Type Chemical Liquid Deodorizer using Liquid Catalyst*

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Abstract

The purpose of this study was to research and develop a step-type chemical liquid deodorizer including a liquid catalyst that can prevent civil complaints due to odor due to its excellent deodorizing performance. The main composition of chemical liquid deodorizer including liquid catalyst is cleaning deodorization, catalyst deodorization, chemical deodorization, water film plate, deodorization water circulation device, deodorization water injection device, catalyst management system, gas-liquid separation device, chemical supply device, deodorizer control panel, etc. It consists of a device. The air flow of the step-type liquid catalyst chemical liquid deodorizer is a technology that firstly removes basic odor substances, and the liquid catalyst installed in the subsequent process stably removes sulfur compounds, which are acidic odor substances, to discharge clean air. The efficiency of treating the complex odor of the prototype was 98.5% for the first and 99.6% for the second, achieving the target of 95%. The hydrogen sulfide treatment efficiency of the prototype was 100% for the first and 99.9% for the second, which achieved 95%, which was the target of the project. As a result, ammonia was removed by the reaction of ammonia and hydrogen sulfide.

Keywords: Quality of Life, Odor, Chemical Liquid Deodorizer, Step-Type Structure, Liquid Catalyst

Major classifications: Health Science

1. Introduction

The quality of life improved as the income of the people increased. However, the perception of the odor problem has changed, and a comfortable living environment is required, but the concentration of odor generated in environmental facilities is

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increasing due to an increase in population or a change in the social environment. Civil complaints due to odor are increasing day by day. In order to solve such odor complaints, a highly efficient deodorizing device is required.

Stage-type chemical liquid deodorizer including liquid catalyst removes more than 98% of sulfur compounds including hydrogen sulfide, which is the main cause of odor in environmental facilities, and removes low-concentration odors from which sulfides have removed. It does not violate the "Hazardous Chemicals Maintenance Act" by removing it with caustic soda (less than 5%) and sodium hypochlorite.

The chemical liquid deodorizer is a highly efficient deodorizer capable of removing more than 98% of complex odors and more than 99% of hydrogen sulfide by removing odor substances such as VOCs using an adsorption facility using activated carbon. In this study, contaminated air containing odors or volatile organic compounds (VOCs) generated from sewage treatment plants, wastewater treatment plants, excreta treatment plants, waste incineration plants, and painting facilities, etc., is cleaned using chemical solution and catalyst technology, which is the strict emission standard air. This study aimed to discharge within 300 times the dilution factor. The purpose of this study is convenient maintenance by the use of a water film plate and a collision type nozzle that do not need a nozzle, and it is economical because there is no need to change the packing material due to deposits.

2. Research Methodology

2.1. Device and technology features

The main composition of the chemical liquid deodorizer including the liquid catalyst shows in Figure 1. The deodorizer consists of cleaning deodorization, catalyst deodorization, chemical deodorization, water film plate, deodorization water and injection device, catalyst management system, gas-liquid separation device, chemical supply device, deodorizer control panel, and other devices.

The air flow of the step-type liquid catalyst chemical liquid deodorizer is shown in Figure 2, as shown in Figure 2, cleaning and deodorizing primarily removes basic odor substances, and the liquid catalyst installed in the subsequent process stably removes sulfur compounds, which are acidic odor substances, to remove clean air. It is a technology to discharge.

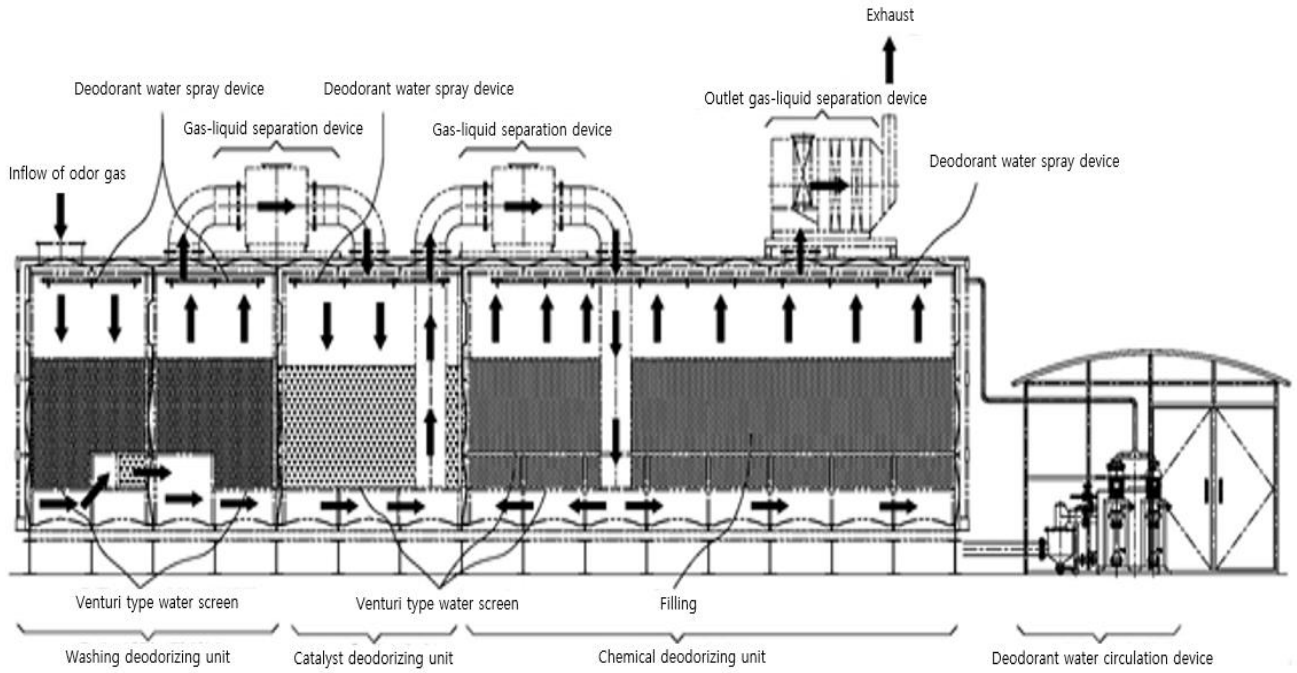

Figure 1: Step-type liquid catalyst chemical liquid deodorizer configuration device

Figure 2 shows the air flow of the stepwise liquid catalyst chemical liquid deodorizer. Cleaning and deodorization is a technology that firstly removes basic odor substances, and the liquid catalyst installed in the subsequent process stably removes sulfur compounds, which are acidic odor substances, to discharge clean air.

Figure 2: Chemical liquid deodorizer air flow by liquid catalyst

Water and chemicals (acid, alkali) used for the deodorization water used in this study according to the odor substances contained in the odor gas. In order to remove the sediment contained in the deodorized water, a cyclone type filter installed in the deodorized water circulation pipe, and the sediment precipitated in the lower portion of the filter configured to discharge by automatic control. The water curtain plate installed inside the deodorizer used as a support for dissolving and reducing odor substances by finely ejecting the mixed fluid using the Bernoulli principle as shown in Figure 3 and for installing other fillers.

Figure 3: The Shape and Structure of the Water Curtain Plate

The deodorizing water sprayed device shows in Figure 4. To prevent clogging of the nozzle due to foreign substances attached to the inside of the nozzle, the circular hole made in a straight line. In order to maximize the scattering efficiency, the water inside the nozzle maintains a high pressure state and collides with the collision plate installed in front of the nozzle.

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Figure 4: Deodorant Water Spray Nozzle

The catalyst management system of the step-type chemical liquid deodorizer is shown in Figure 5. It consists of a filter, a transfer pump, a control valve, and a pipe. It is a technology that divides the inner space of the filter up and down, and blocks the passage above the barrier plate and the barrier plate with passages inside, and passes the solid sulfur contained in the liquid catalyst through the sieve through a sieve. It is operated by a control valve that controls the flow of liquid catalyst and wash water.

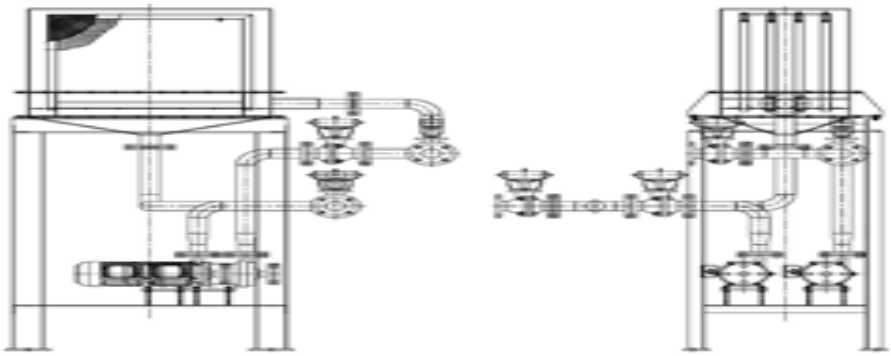


Figure 5: Catalyst Management System

The gas-liquid separation device is shown in Figure 6. This is composed of a main body and a filler, and the deodorization water used in the short process is included in the air and passed to the subsequent process to prevent mutual reaction, thereby increasing the deodorization efficiency and preventing scattering to the outside.

Figure 6: Gas-liquid Separation Device and Filler

2.2. Characteristics of treatment technology

The liquid catalyst is a sulfur compound containing high concentration hydrogen sulfide contained in the incoming malodorous gas. This allows the liquid catalyst to absorb odor substances such as low concentration ammonia and amines, and then removes the odor using the reaction of the liquid catalyst. Equation 1 below is to remove basic odor substances. This reaction equation is a technique for removing sulfur compounds by using a liquid catalyst (iron-chelate) reaction. In order to have excellent stability against oxidation reactions, a technique is required to maintain EDTA and NTA concentrations more than twice the iron concentration.

‣ Reduction reaction: $H2S + 2Fe3+(OH)EDTA4- \rightarrow 2Fe2 + EDTA4- + 2H2O + S0\downarrow$

‣ Oxidation reaction: $2Fe2+EDTA4- + 1/2O2 + H2O \rightarrow 2Fe3 + (OH)EDTA4-$

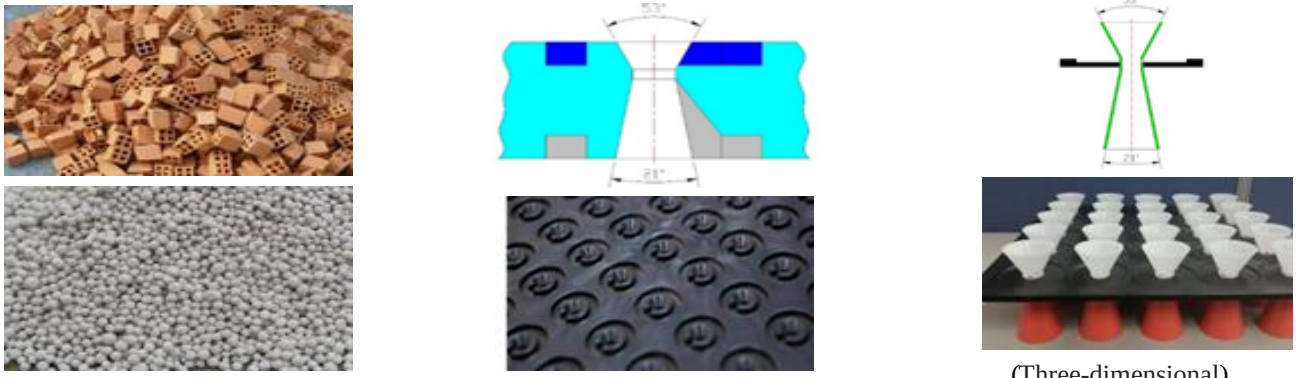
Formula 1: Liquid catalyst (iron-chelate) oxidation/reduction reaction

Hydrogen sulfide and sulfur compounds contained in the odor gas flow to the circulation tank through the flow path along with the liquid catalyst after the solid sulfur furnace is removed by the reduction reaction and oxidation reaction of the liquid catalyst.The solid sulfur contained in the liquid catalyst in the circulation tank is removed by the special filtration filter of the catalyst management system. Activated carbon, zeolite, ceramic, etc. are installed at the rear end, so it is possible to remove deodorant water and deodorize at the same time.

2.3. Differentiation plan and detailed research content

2.3.1. Water screen

The water curtain plate is a technology for fine ejection of the mixed fluid by increasing the pressure by reducing the velocity of the mixed fluid at the enlarged cross-sectional area using the Venturi effect by Bernoulli. This water curtain plate prevents aerodynamic deflection flow, which makes the deodorizing effect constant.



(Flat plate) (Three-dimensional)

(1) Conventional ceramic products (2) Developed water screen product

Figure 10: Ceramic products from other companies and water film products developed in this research

2.3.2. Chemical supply device and catalyst management system

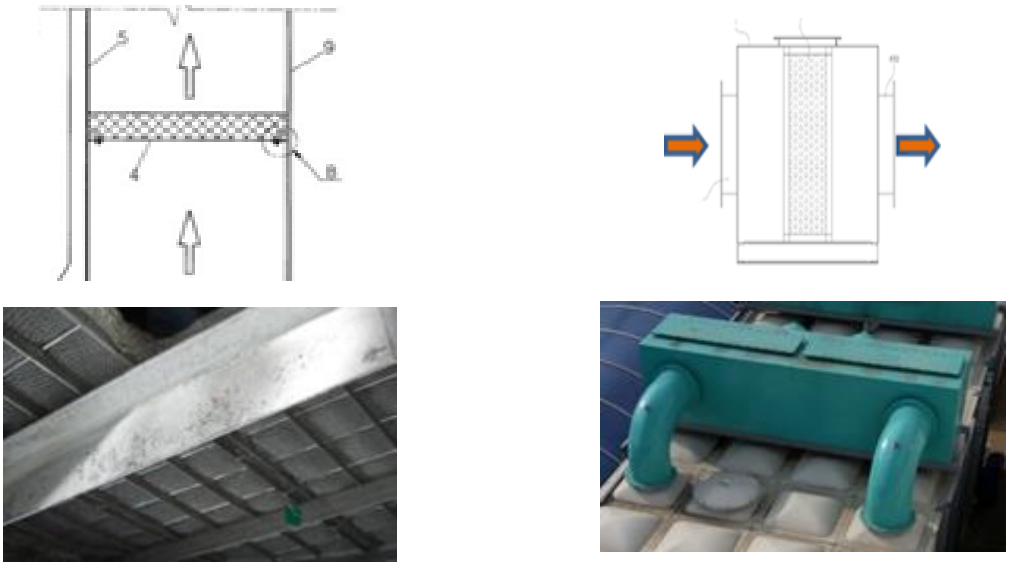
We researched to maintain proper chemical concentration by linking the drug supply device and catalyst management system with ICT, to shorten idle time of circulation motor, to reduce energy loss due to pressure loss and easy maintenance by using a foreign substance removal device and collision type nozzle. .

(1) Catalyst management system (2) Foreign matter removal device (3) Collision type nozzle

Figure 11: Catalyst management system and maintenance device

2.3.3. Gas-liquid separation device

The front-end process by the gas-liquid separation device prevents the reaction by passing the used deodorized water (water, chemicals, catalyst) to the subsequent process with air and mixing. At this stage, it is possible to prevent secondary pollution by preventing the deodorant water from scattering to the outside.



(1) Existing product (2) Gas-liquid separation device of this study

Figure 12: Existing product and gas-liquid separation device of this study

3. Research Results

The composite odor treatment effect of the prototype was 98.5% for the first and 99.6% for the second, achieving the target of 95%. The hydrogen sulfide treatment efficiency of the prototype was 100% for the first and 99.9% for the second, achieving the target of 95%. In the ammonia treatment efficiency test of the prototype, the odor gas of the acid fermentation tank generating high concentration of hydrogen sulfide was used as the inlet air of the prototype.

Table 1: R&D product performance

		Unit	1st inlet	1st outlet	2nd inlet	2nd outlet	3rd inlet	3rd outlet	Average removal efficiency(%)
			Efficiency(%)		Efficiency(%)		Efficiency(%)		
Compound malodor	Oxidation fermentation tank	Dilution Factor	30,000	448	30,000	208	44,814	208	98%
			98.5		99.3		99.5		
	Thickening tank		3,000	249	4,481	144	44,814	144	
			91.7		96.8		99.7		
Ammonia	Oxidation ermentation tank	μ mol /mol	0.2	0	0.1	0	0.1	0	100%
			100		100		100		
	Thickening tank		0.3	0	0.4	0	0.4	0	
			100		100		100		
	Oxidation		35,400	95.5	61,440	52.2	44,000	0	

Hydrogen sulfide	ermentation tank	n mol /mol	99.7		99.9		100		99.9
	Thickening tank		13,860	0	10,480	2.2	11,808	0	
			100		99.9		100		

4. Conclusion

The result of acquiring and analyzing the data obtained while manufacturing, producing, and testing the prototype is that even if the standard of the prototype is reduced, sufficient odor gas treatment efficiency can be obtained if it is not in an area where ultra-high concentration odor gas is generated such as an acid fermentation tank. The biggest obstacle to miniaturization of the deodorizer is the polling to increase the air contact time and the filling that is filled inside the deodorizer such as a carrier for microbial treatment.

Miniaturization was possible through a study in the form that sufficient deodorizing performance can be guaranteed even in a small area by using the physical collision between deodorized water and contaminated air except for the filling. As the deodorizer has been miniaturized and processing efficiency has been improved, the amount of by-products generated after the treatment of malodorous gas increases, while the capacity of the miniaturized deodorizer to store by-products has gradually decreased.

When by-products adhere to the inside of the deodorizer, the deodorization performance of the deodorizer decreases over time and the possibility of failure of the deodorizer itself increases. Therefore, there is a need for a technology to prevent by-products from sticking to the deodorizer by periodically filtering by-products.

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