II-175 Determination of Sulfur Containing Odorous Compounds in Night Soil Treatment Plant

Department of Urban Eng.,University of Tokyo
Student Member Yongwoo Hwang
Member Tomonori Matsuo
Member Keisuke Hanaki
Member Noriyuki Suzuki

1. Introduction

Odor-causing substances in Night Soil Treatment Plant(NSTP) may be broadly classified as either inorganic gases or organic vapors. The inorganic gases usually arise as a result of biological activity in the collection and treatment system. Likewise, the organic vapors often arise from biological activity but may result from direct additions of waste chemicals from industry. The principal odors of an organic nature arise from the anaerobic decomposition of compounds containing nitrogen and sulfur. These offenders include mercaptans, sulfides, indoles, skatoles, amines and various other nitrogen and sulfur-bearing organics.

However, this paper is presented only for sulfur containing compounds. The specific objectives of this study are to : identify chemically the characteristics and measure the concentration of the S-containing odorous compounds in NSTP, evaluate effectiveness of several practical odor control processes.

2. Samples and Methods

The samples of the night soil treatment process were taken at two different places. The first place was located in Urayasu with anaerobic digestion/activated sludge process. The second place had denitrification process(Denipac System) in Matsudo.

In order to analyze the high concentration samples, the Head Space Method was performed (ex. influent, effluent of 1st,2nd digestion tank). Otherwise, the Purge Trap Method and the Low Temperature Concentration Method with liquid Argon were performed for the analysis of low concentration samples.

3. Results

Figure 1 and 2 illustrate the basic scheme and sampling point of the two different types of NSTP ; anaerobic digestion/activated sludge process and denitrification process.

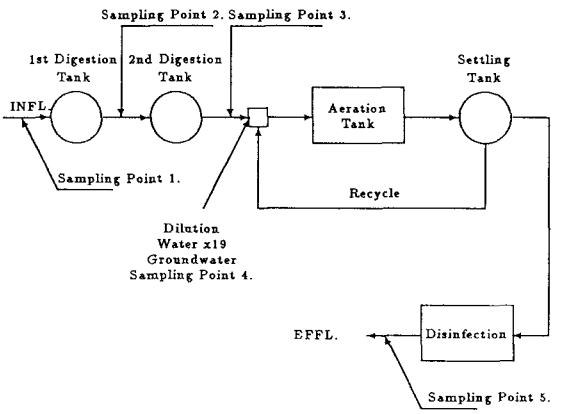

Fig.1 The Scheme of Anaerobic Digestion Process

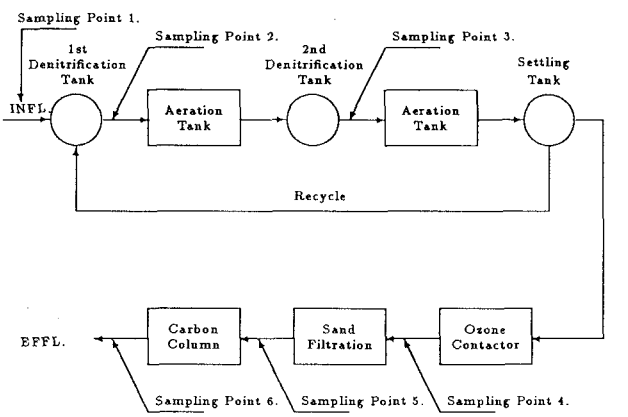

Fig.2 The Scheme of Denitrification Process

Table 1 and 2 show the detected odorous compounds in two types of NSTP. Figure 3 to 7 revealed the concentration change of the each item of the results of samples from Urayasu and Matsudo NSTP. In most of every case, Hydrogen Sulfide, Carbon Disulfide, Methyl Mercaptan(MM), Dimethyl Sulfide(DS), Propyl Mercaptane(PM) and Dimethyl Disulfide(DD) were detected in each process. However, it is very complex to evaluate which is more important odorous element or not. There are several odor evaluation index like a Odor Threshold Concentration(OTC), Odor Intensity(OI) except for concentration. For instance, in this case , the concentration of dimethyl disulfide was higher compared with that of methyl mercaptan. Otherwise, in the aspect of OTC, methyl mercatan is very lower than that of dimethyl disulfide. And, in the aspect of OI, methyl mercatan is very stronger than that of dimethyl disulfide, also. Thus, it is very dangerous assumption to regard methyl mercaptan as dimethyl disulfide as same level.

There were considerable differences between the results of two types of processes in methyl mercaptan and hydrogen slufide. The reason is that in denitrification process, bacteria will utilize following hydrogen acceptors preferentially in the order of oxygen, nitrate and sulfate. Thus, if nitrate is present, no sulfate reduction will occur until all of the nitrate has been reduced.

Finally, the research on relationship of OTC, Odor Intensity and Concentration of odorous compound will must be performed for establishing some reasonable guideline.

Table 1. The Odorous Compounds in the Anaerobic Digestion Process

Unit : μg/l (: mg/l, ** : ng/l)*

Compound	H_2S	CS_2	MM	DS	PM	DD
Influent	46.7	n.d	2.7*	1.1*	31.0	458.3
1st Digestion	72.2	n.d	42.6	37.5	43.7	188.8
2nd Digestion	30.8	1.8	22.0	1.3	3.2	213.6
Effluent	1.3**	82.6**	0.37	n.d	n.d	3.1
Groundwater	1.7**	12.9**	19.0**	n.d	n.d	14.4

n.d : *NotDetectable*

Table 2. The Odorous Compounds in the Denitrification Process

Unit : μg/l (: mg/l, ** : ng/l)*

Compound	H_2S	CS_2	MM	DS	PM	DD
Influent	47.8	n.d	4.8*	11.7*	313.5	613.6
1st Denitrification	0.15	0.29	26.3	50.0	2.3	104.6
2nd Denitrification	0.14	0.3	35.3	4.0	1.5	42.3
Ozone Contactor	3.5**	58.0**	0.55	17.7**	n.d	3.0
Sand Filtration	2.1**	21.8**	0.48	0.22	n.d	1.1
Activated Carbon	n.d	10.4**	n.d	n.d	n.d	n.d

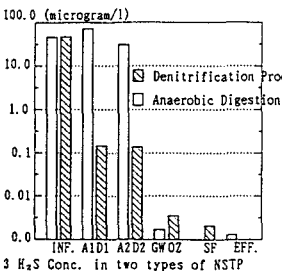

Fig. 3 H_2S Conc. in two types of NSTP

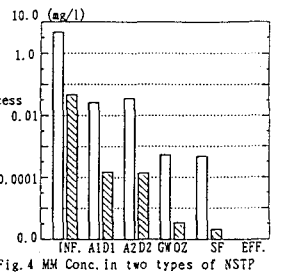

Fig. 4 MM Conc. in two types of NSTP

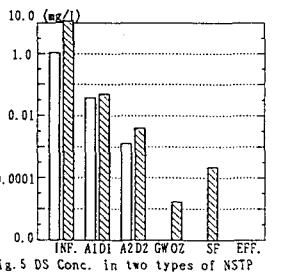

Fig. 5 DS Conc. in two types of NSTP

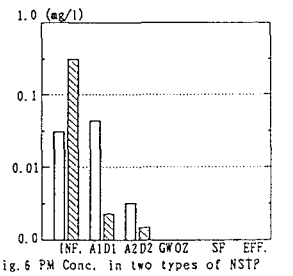

Fig. 6 PM Conc. in two types of NSTP

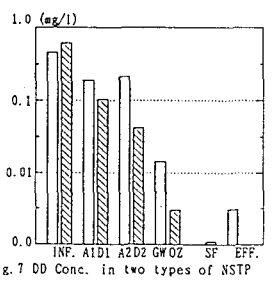

Fig. 7 DD Conc. in two types of NSTP

A1 : 1st Anaerobic Digestion Tank
A2 : 2nd Anaerobic Digestion Tank
GW : Groundwater
D1 : 1st Denitrification Tank
D2 : 2nd Denitrification Tank
OZ : Ozone Contactor
SF : Sand Filtration
EFF : In denitrification process, EFF is the effluent of activated carbon