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# Fate of selected odorous compounds in sewage treatment plant

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## Introduction

For the promotion of the motive for the reuse of treated waste water (TWW), the quality of TWW must be acceptable for public. Even some of the advanced waste water treatment processes can not meet the odor removal target unlike other water quality indices, because human nose is very sensitive. To find out appropriate treatment process for achieving odor removal target, knowledge of the fate of odorous compounds in every single type of unit process is essential.

Most of the odor causing compounds in waste water are nitrogen or sulfur containing. In this study, eight S-containing and eight N-containing compounds are chosen as they are the most frequently occurring compounds which are shown in table 1. They usually result from decomposition of organic materials like human excreta and others.

## Objective

The objective of the study is to survey the actual concentration of target compounds at every step in existing waste water treatment plant to explore the internal dynamic mechanism of the odor production and reduction in biological waste water treatment process.

## Materials and methods

As the Odor Threshold Concentration (OTC) values are extremely low (Table 1), laboratory method was newly developed to examine compounds with very low concentration, in the range of μg/l or ng/l level. In conjugation with this study, improved analytic technique was proposed to detect these compounds in low concentration dissolved in aqueous solutions. To determine S-containing compounds, a methodology was adopted which was proposed by Islam et.al. (ref.1) employing purge & trap as the concentration tool and GC FPD as the detector. For N-containing compounds four different analytical procedures were adopted for different compounds. NH was measured by spectrophotometry at 630 nm wave length. IN & SK were measured by direct injection into HPLC with 210 nm UV detector. All amines except TA were lyophilized (freeze-dried) for two times as a concentration technique. After that they were derivatized with SNPA in presence of THF. HPLC was used to detect amines after the third step concentration during THF removal. TA was measured by GC MS employing SIM technique utilizing head space concentration. Detection limits are given in Table 1.

TABLE 1: Recovery, lowest detection and OTC

*S-containing compounds*

| NAME | | Detection (μg/l) | Recovery (%) | OTC (μg/l) |
|---|---|---|---|---|
| Hydrogen Sulfide | (HS) | 0.040 | 43 | 0.4 |
| Di Methyl Sulfide | (MS) | 0.066 | 74 | 9.0 |
| Di Ethyl Sulfide | (ES) | 0.070 | 91 | 0.25 |
| Di Methyl Di Sulfide | (DD) | 0.086 | 75 | 1.0 |
| Carbon Di Sulfide | (CS) | 0.092 | 87 | 2.6 |
| Methyl Mercaptan | (MM) | 0.080 | 69 | 1.1 |
| Ethyl Mercaptan | (EM) | 0.068 | 66 | 0.19 |
| Propyl Mercaptan | (PM) | 0.066 | 88 | 0.5 |
| OTC : Odor Threshold Concentration (ref. 2, 3, 4, 5) | | | | |

*N-containing compounds*

| NAME | | Detection(μg/l) | OTC (μg/l) |
|---|---|---|---|
| Ammonia | (NH) | 10 | 37.0 |
| Indole | (IN) | 1 | 370.0 |
| Skatole | (SK) | 1 | 1.2 |
| Methyl Amine | (MA) | 100 | 20.0 |
| Ethyl Amine | (EA) | 100 | 39.0 |
| Propyl Amine | (PA) | 100 | 7.0 |
| Di Methyl Amine | (DA) | 100 | 47.0 |
| Tri Methyl Amine | (TA) | 120 | 0.2 |
| OTC : Odor Threshold Concentration (ref. 2, 3, 4, 5) | | | |

## Field survey

Utilizing the analytical method setup by the current study, samples were taken and analyzed from a sewage treatment plant's each single unit process. This plant uses conventional activated sludge process as secondary treatment, sand filtration as tertiary treatment and has sludge treatment facilities involving thickener, centrifuge and belt press dewatering for raw sludge. Concentrations of odorous compounds

in each unit process are shown in Table 2.

Table 2 Concentrations of odorous compounds in each unit process

| Parameter | Influent | P.S.T. | A.T. | S.S.T. | S.F. | Cl | R.S. | E.S. | Thickener | Centrifuge | Dewater |
|---|---|---|---|---|---|---|---|---|---|---|---|
| NH* | 35.40 | 20.78 | 18.60 | 16.27 | 13.18 | 16.88 | 16.56 | 20.95 | 38.12 | 22.48 | 65.10 |
| IN | 10.42 | -- | -- | -- | -- | -- | -- | -- | 25.14 | 3.19 | 22.74 |
| SK | -- | -- | -- | -- | -- | -- | -- | -- | 71.24 | -- | 209.5 |
| MA | -- | -- | -- | -- | -- | -- | -- | -- | 810.7 | -- | 1722. |
| EA | -- | -- | -- | -- | -- | -- | 63.32 | 92.50 | 404.8 | 276.4 | 1215. |
| DA | -- | -- | -- | -- | -- | -- | -- | 38.93 | 112.7 | -- | 711.3 |
| PA | -- | -- | -- | -- | -- | -- | 38.02 | 136.3 | 218.1 | -- | 374.0 |
| TA | 408.0 | 214.8 | 91.2 | 69.6 | 75.6 | -- | 182.4 | 255.6 | 382.3 | 312.8 | 765.6 |
| | | | | | | | | | | | |
| HS | 0.832 | 4.175 | 0.355 | 0.202 | 0.189 | 0.149 | 0.167 | 0.479 | 1.393 | 0.590 | 2.899 |
| MM | 0.602 | 3.416 | 0.222 | 0.107 | 0.136 | -- | 0.942 | 2.397 | 24.81 | 9.774 | 66.41 |
| EM | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| MS | 0.776 | 1.294 | 0.137 | 0.211 | 0.182 | -- | 1.706 | 2.469 | 14.98 | 6.865 | 33.77 |
| CS | 0.111 | 0.044 | -- | -- | -- | -- | 0.414 | 0.325 | 1.063 | 0.309 | 0.632 |
| PM | -- | -- | -- | -- | -- | -- | -- | -- | 0.094 | 0.039 | 0.300 |
| ES | -- | 0.050 | 0.125 | -- | -- | -- | 0.866 | 0.142 | 0.608 | 2.450 | 1.219 |
| DD | 0.503 | 1.867 | -- | -- | -- | -- | 0.345 | 0.296 | 10.74 | 2.951 | 18.68 |

Notes: 1. All units are in μg/l except NH, which is in mg/l.
2. P.S.T = primary sedimentation tank; A.T. = aeration tank; S.S.T = secondary sedimentation tank; S.F. = after sand filtration; Cl = after chlorination; R.S. = return sludge; E.S. = sludge from PST;
3. Thickener receives sludge from SST, others receive from PST.

## Discussion

The main observations are listed as follows :

1. Odorous compounds in the influent were degraded in the treatment process as a whole (Fig. 1).
2. Under aerobic condition, odorous compounds were decomposed or at least not produced.
3. Under anaerobic condition, odorous compounds were produced. However, no degradation was observed.
4. It seems that sand filtration is not completely effective in odor removal.
5. Sludge treatment processes produced water containing high concentration of odorous substances.
6. Considering their OTC, amines seem to be major sources of odor in sludge treatment process.

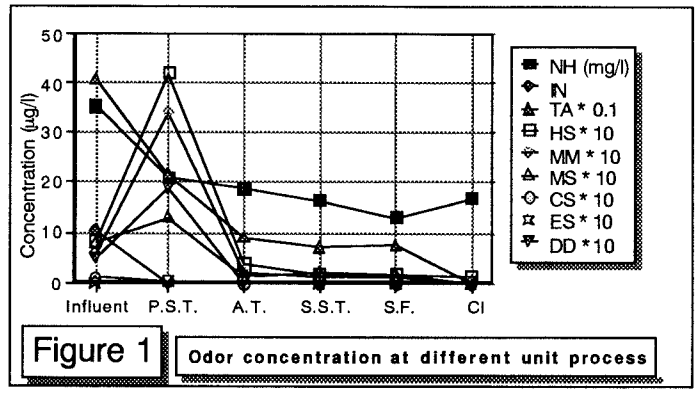


Figure 1 Odor concentration at different unit process

It may be noted here that similar trends were also observed in other two treatment plants investigated.

## References

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