Environment Conservation Journal 1 (1): 47-53, 2000

Quality Monitoring of The Effluent from Fertilizer Industry

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Key Words: Fertilizer, Effluent, Quality, Impact

Abstract

Importance of natural resources i.e. water and its requirement in a fertilizer industry have been described in the present paper. The effluent samples of a fertilizer plant situated in U.P. have been collected and analyzed for several physico-chemical characteristics to assess the pollution load of the effluent.

Introduction

Today, India is one of fastest growing industrialized country of the world. India has a good industrial infrastructure in core industries like chemicals, metals, fertilizers, petroleum, food products, etc. Each industry has its own water requirements. The water once it is used for industrial purpose cannot be used for any purpose without treatment. The quality of such water is characterized by their physical, chemical and biological properties.

In fertilizer production, water is an auxiliary input. Depending on the feedstock such as fuel oil, naphtha, coal and natural gas and process technology, consumption of water for a tone of urea varied from 9.0 m^3 to 40.0 m^3 with the plant operating at 90 % capacity. Most of the pollutants from a fertilizer plant emerge as a part of liquid effluent. This effluent generally has high pH, high ammonia, high acidity or alkalinity, organic matter, high nitrogen, potassium etc. On the direct disposal into water bodies, such untreated effluents, causes harmful diseases and have disastrous effects on the living organisms. (Sharma and Kaur 1994). Due to high level of toxicity, it is important to monitor the quality of such effluents on regular basis and maintain the standards prescribed by the Government agencies to keep environment healthy.

Keeping this in view present study was undertaken and the results are presented in this paper.

Materials and Methods

A fertilizer complex, Tata Chemicals Limited (TCL), selected for the study is situated at Babrala, in the district Badaun of Uttar Pradesh. This fertilizer complex is situated between the drainage basins of two small rivulets, Burdmar and Mahawa. Burdmar with its meandering course flows from NW to SE. It is very close to the complex. In this fertilizer complex the main plants are Urea and Ammonia.

During the manufacturing process of urea, the major potential liquid effluents emanating from various units are ammonia plant, urea plant, demineralization plant, cooling towers, and sanitary waste. The sampling from the following locations has been done for detailed investigation.

A. Effluent treated in the Individual Battery limit

- Ammonia plant process condensate
- Urea plant process condensate
- Demineralization plant regeneration effluent
- Cooling tower blow downs from ammonia and urea cooling towers

B. Effluent treated in effluent treatment plant (outside the main plant)

- Floor washings/ process drains from ammonia plant
- Floor washings/ process drains from urea plant
- Oil leakages/ spillages from ammonia and urea plants

C. Sanitary waste treated in sewage treatment plant

D. Guard pond where all the treated effluents collected for equalization

The standard parameters like - pH, ammonia, free ammonia, urea, total solids, total dissolved solids, total suspended solids, total Kjeldahl nitrogen, nitrate, phosphate, sulphate, dissolved oxygen, BOD, COD and oil & grease were selected for the study.

Standard methods described by Trivedy and Goel 1986 and Manivaskam 1996, were used for the analysis of above stated parameters.

Results and Discussion

Effluent flow and treatment scheme at the fertilizer complex, under investigation, is shown in Fig. 1. The values of various parameters are shown in Table 1 and Table 2. Detailed discussion of the findings is as under.

Ammonia plant process condensate discharged from ammonia plant is sent to steam stripper, which under high temperature and pressure removes all the impurities. The observed values for ammonia in untreated and treated effluent were 982 mg/L and 5 mg/L respectively. As per the findings of Melin *et al.* 1975, the concentration of ammonia varied from 100 to 1300 mg/L in untreated effluent and from 5 to 100 mg/L in treated effluent.

Table 1. The characteristics of treated and untreated effluent

Sl. No.	Parameters	Units	Values	
			Untreated effluent	Treated effluent
01	pH		9.36	9.22
02	Ammonia	mg/L	379	19
03	Free Ammonia	mg/L	209	8.5
04	Urea	mg/L	376	152

Table 2. Characteristics of effluent from guard pond

Sl. No.	Parameters	Units	Values
01	pH		7.8
02	Ammonia	mg/L	32.6
03	Free Ammonia	mg/L	1.14
04	Urea	mg/L	61.0
05	Total Solids	mg/L	2082
06	Total Dissolved Solids	mg/L	2010
07	Total Suspended Solids	mg/L	72
08	Total Kjeldahl Nitrogen	mg/L	51.4
09	Nitrate	mg/L	3.526
10	Phosphate	mg/L	690
11	Sulphate	mg/L	690
12	Dissolved Oxygen	mg/L	6.3
13	Biological Oxygen Demand	mg/L	18.4
14	Chemical Oxygen Demand	mg/L	80
15	Oil and Grease	mg/L	5.34

Urea plant process condensate discharged from urea plant is sent to hydrolyser-cum-stripper which under high temperature and pressure converts urea in to ammonia and carbon di oxide and removes all the impurities. Melin *et al.* 1975, on the investigation of various urea manufacturing plants, found the concentration of ammonia and urea 3000 mg/L and 4000 mg/L respectively for untreated effluent and 50 and 100 mg/L respectively for treated effluent. In the present investigation, values for ammonia and urea were recorded 6580 mg/L & 2880 mg/L for untreated and 2 mg/L & 2 mg/L respectively for treated effluent.

The treated effluent from both ammonia and urea plants containing ammonia and urea less than 5 mg/L is recycled as boiler feed water.

The demineralization plant consists of three numbers each of strong anion – cation exchanger I and II in series, weak base anion exchanger and strong base anion exchanger in series and mixed bed units. The weak acidic and alkaline effluents are generated from these units, which mixed proportionately and neutralized in neutralization pit. The values for pH and total solids were recorded 8.5 and 2060 mg/L respectively. This effluent is pumped to guard pond after proper neutralization.

Cooling water treatment is non-chromate based. Biocides and dispersants are added in cooling water blow down for the treatment of cooling water. These are non-toxic and biodegradable; therefore, the effluent generated from this part is non-toxic. The values for pH, total dissolved solids and dissolved oxygen were recorded 7.5, 2240 mg/L and 6.5 mg/L respectively in treated blow downs.

All the floor washings/ process drains are collected in floor washing pit in ammonia and urea plants. From where, these are sent to untreated effluent tank in effluent treatment plant. The run off water from compressor house, pump house, interstage separators of compressors are normally polluted with oily water along with oil spillage from refrigeration systems. These effluents are collected separately in a oil water pit and pumped to oil separator in effluent treatment plant. The clear effluent having less than 5 mg/L of oil and grease is also sent to untreated effluent tank. The combined effluent collected in untreated effluent tank had pH 9.4, ammonia 379 mg/L, free ammonia 209 mg/L and urea 376 mg/L. This effluent is then sent to steam stripper in effluent treatment plant. The treated effluent, having pH 9.2, ammonia 19 mg/L, free ammonia 8.5 mg/L and urea 152 mg/L, is pumped to guard pond via treated effluent tank.

In the investigated fertilizer complex, sanitary waste comes from the township as well as from the plant premises. Sanitary waste from plant is collected in soak pits/ septic tanks at various locations within the plant area whereas that from township goes to sewage treatment plant. In sewage treatment plant, main unit is oxidation ditch with aerators (to provide air for oxidation). The treated sanitary waste from this unit, after attaining the desirable BOD and total suspended solids, is used as irrigation water for horticulture. At the time of investigation BOD and total suspended solids were recorded

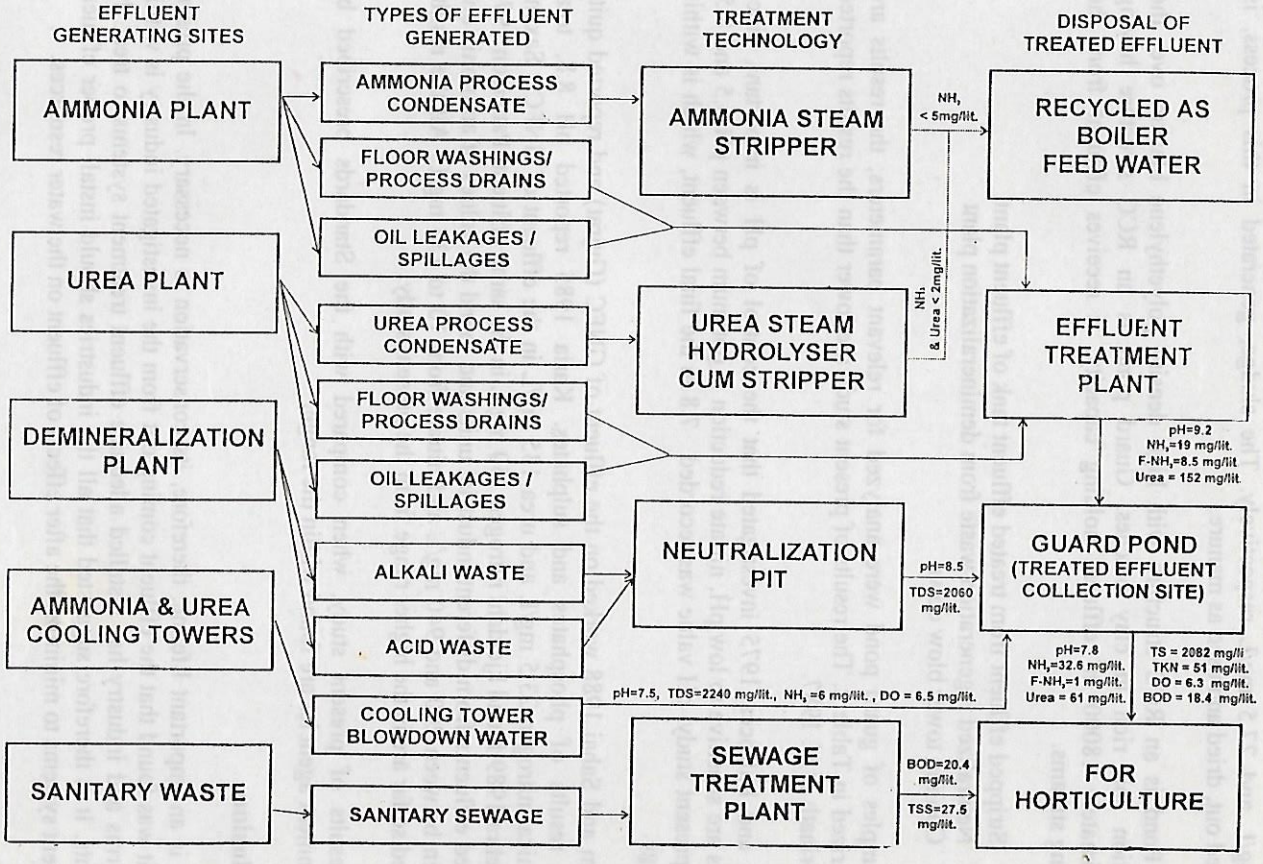

Fig. 1: Effluent flow and treatment scheme

20.4 mg/L and 27.5 mg/L respectively. The sludge, generated in this process, is separated out, dried and used as manure.

Guard Pond is an RCC structure with high density polyethylene blanket over the foundation soil rich in clay patches. Guard pond is an RCC structure having approximately 18000 m^3 effluent holding capacity. It receives effluent from the following streams.

1. Stripped effluent from treated effluent tank of effluent plant
2. Neutralized regeneration waste from demineralization plant
3. Cooling tower blow down

The samples of guard pond were analyzed for relevant parameters; the results are summarized in Table 2. The results of present study are lower than the results reported by Badrinath *et al.* 1987.

Hutton and LaRocca 1975 investigated that the control of pH is important, since nitrifers are sensitive to low pH, nitrate reduction is optimum between pH 6.5 and 8.5. In the present study, pH value was recorded 7.8 in the final effluent, which is within the range.

Neekam and Sahai 1988 worked on the effluent of GNFC (Gujrat) and reported quite higher results of phosphates and sulphates. Karia 1985 reported pH 8.8, total ammonical nitrogen 23.5 mg/L and urea 135 mg/L in the effluent of GNFC. Saxena and Mehra 1989 found kjeldahl nitrogen 150 mg/L in the same effluent. Patterson 1974 analysed effluents from different industrial units and found the values of ammonia and nitrogen between 200 and 940 mg/L and nitrate from 10 to 135 mg/L. All the results reported so far are in the higher range from the present study.

The results of present study, when compared with the Standards prescribed by Government agencies are found within the range.

Conclusion

Water is an important lifeline; therefore, its conservation is necessary. In the present study it was found that the effluent coming out from the investigated industry is within the norms and industry has installed adequate effluent treatment systems to treat the effluents. It is therefore suggested that all the industries should install proper effluent treatment systems to minimize the after effects of effluent on the water resources.

Acknowledgements

I would like to thank Mr. Deepak Chaturvedi, Mr. R. C. Saxena and Mr. Pathak of Tata Chemical Ltd., Babrala and Mrs. Namita Joshi, Department of Zoology and Environmental Sciences, Gurukul Kangri University, Hardwar for kind guidance.

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