Reuse of Flushed Water Using Electro-Oxidation Method

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Abstract **-** Billion gallons of water is used annually to flush the toilets across the world. To overcome the problem of wastewater generation in urinals, we have researched on the reuse and recycle of flushed water. This would minimise the water usage, as well as this study can be applied where water scarcity is a big concern. Aim of our study was to treat and reuse the flushed water. The electrochemical oxidation (EO) degradation process for flushed urine water were carried out with mix metal oxide plates. We have studied the effects of different current densities, different volume of flushed urine water and different amount of NaCl. By performing on laboratory scale, it was observed that, after treatment of flushed urine water for 4 hours at a current density of 2 A/cm^2 with 200mg/L amount of NaCl and keeping the space of 1.5 cm between the electrodes, the NH_3-N concentration was observed 6 mg/L at removal rate of 99.25%; COD concentration was 210mg/L at removal rate of 59.05%; and BOD concentration was 35mg/L at removal rate of 86.22%. The efficiency of the colour and odour removal was observed to be 100%. After treatment of the flushed water some free chlorine content was found in water as a by-product, which acts as a disinfectant and prevents the contamination of water.

I. INTRODUCTION

In public restrooms such as in bus depots, railway stations, highway urinals etc., due to the improper flushing of the toilet and maintenance, bad odor and unpleasant environment are common to be found in most public restrooms. This unhygienic environment creates discomfort to the users along with diseases. The recent studies reveal that 6 to 7 litres of water is wasted in a single flush. On the other hand, scarcity of water is also a major problem. Thus it is proposed to device a urinal flushing system that reuses the flushed water. This ensures proper flushing of toilet by minimizing the water usage by causing only limited amount of water to get flushed after every usage. Recycling and reusing are the best option for water scarcity. We worked on Electro Oxidation process (EO) method to solve these problems.

II. OBJECTIVES

The main objectives of this project are as follows:

1. To provide a clean and hygienic environment near the urinals at the public restrooms.
2. To use the less amount of water for flushing purpose.
3. To prevent the unnecessary wastage of water and save the water resource for our future generation.
4. To prevent the condition of bad odour resulting in various diseases due to unhygienic environment.
5. To provide a reliable and economical urinal flushing system.
6. To determine the removal efficiency of COD, BOD, pH, conductivity ammonical nitrogen, and free chlorine at lab scale plant.

III. NEED FOR THE STUDY

Urine water has high concentration of Chemical Oxygen Demand (COD), biological oxygen demand (BOD), and Nitrogen. That can effect on the health of human. In India major factors that affect the usage of toilet are lack of water availability, lack of proper plumbing, lack of drainage facilities and inadequate mechanisms to maintain sewage pipelines. Out of these factors, availability of water for toilet use can be overcome by recycling of urine water after proper treatment. Using reuse concept with proper technology, the availability of water for toilet use can be eliminated.

IV. ADVANTAGES

1. Water Savings: Toilets account for about half of a typical building's water consumption. In India, almost 5 billion gallons of water is used every day to flush toilets, according to the Environmental Protection Agency. Newer models of conventional flush-type urinals use about one gallon per flush. Older ones can use from three to five gallons. Since less-water urinals use less water, large amount of water is saved.
2. Hygiene: since water problem is solved by using this method so urinals can be kept clean and hygienic.
3. Odour control: odour is removed significantly.

4. Free chlorine remains in water after treatment due to which water does not contaminate.
5. This system is economical and reliable.

V. DISADVANTAGES

1. Large amount of heat is generated when water is treated for more than 4 hours.

2. Plates need to be changed after sometimes.

VI. SCOPE OF THE STUDY

1. Study was carried out to reuse and recycle flushed urine water using EO. Two mix metal oxide plates are dipped in the sample water and NaCl was added in the sample, which acts as a salt bridge. Which carried out electro oxidation process rapidly.
2. A sample was collected for a different time intervals to examine the removal of COD, BOD, AMMONICAL NITROGEN, ODOUR, COLOUR.
3. After treatment it was observed that pH was between the ranges of 7.5 -8.5and conductivity, DO were increasing with the time.

VII. SETUP

1. Electrodes

A Ti/RuO2-Pt anode with dimensions of 15.0 cm× 5.0 cm×1.5mm thickness was used in the experiments. RuO2 was used as electrode-coating material because of its relatively high oxidizability and long service life, and Pt because it has excellent electrical conductivity and electrical catalytic ability. A plate of the same size was used as the cathode.

2. Control panel

It was used to connect the electrodes and control the current passing through the sample.

3. Magnetic stirrer

It was used to stir the sample at a fixed rpm.

EO setup

VIII. METHODOLOGY

1. In the beginning, sample size of two liter was taken into a beaker.

2. NaCl was added in amounts of 100 mg/L, 200 mg/L, 300 mg/L, and 400 mg/L into that sample.

3. The current densities were 1 mA/cm2, 2 mA/cm2, and 3 mA/cm2, and could be adjusted.

4.Two plates were connected to control panel and were dipped in flushed water sample and current was allowed to pass through it.

5.Samples were collected at 15, 30, 60, 120, 180, 240, 300, 360 min in order to measure the rate of removal of ammonia content by the electrode.

6.After treatment, the treated sample was collected and tested for different parameters like COD, BOD, AMMONICAL NITROGEN, ODOUR, and COLOUR.

IX. RESULTS AND DISCUSSION

Optimum results were obtained at current density of 2 A/cm^2 for 2 litre of flushed water.

Following results were obtained:

1. COD

Reaction time(min)	Ampere(A)	Voltage	COD inlet(mg/L)	COD outlet(mg/L)
60	2	7.3	446	278
120	2	6.6	446	198
180	2	6	446	210
240	2	9.5	446	244
300	2	6.1	446	236

2. BOD

Reaction time(min)	Ampere(A)	Voltage	BOD inlet(mg/L)	BOD outlet(mg/L)
60	2	7.3	175	84
120	2	6.6	175	41
180	2	6	175	74
240	2	9.5	175	66
300	2	6.1	175	60

3. Ammonical nitrogen

Reaction time(min)	Ampere(A)	Voltage	NH_4-N inlet(mg/L)	NH_4-N outlet(mg/L)
60	2	7.3	279.2	11.2
120	2	6.6	279.2	10
180	2	6	279.2	8.4
240	2	9.5	279.2	6
300	2	6.1	279.2	2.1

4. PH

Reaction time(min)	Ampere(A)	Voltage	pH at inlet	pH at outlet

60	2	7.3	175	84
120	2	6.6	175	41
180	2	6	175	74
240	2	9.5	175	66
300	2	6.1	175	60

5. Conductivity

Reaction time(min)	Ampere(A)	Voltage	Conductivity inlet(before addition of NaCl) (ms/cm)	Conductivity inlet(After addition of NaCl) (ms/cm)
60	2	7.3	6.53	6.97
120	2	6.6	6.54	6.97
180	2	6	6.46	6.92
240	2	9.5	6.46	6.98
300	2	6.1	6.53	6.97

6. DO

Reaction time(min)	Ampere(A)	Voltage	DO inlet(mg/L)	DO outlet(mg/L)
60	2	7.3	0	2.5
120	2	6.6	0	2.8
180	2	6	0	2.9
240	2	9.5	0	2.5
300	2	6.1	0	2.6

7. Colour and odour were removed by 100%.

Comparison of inlet and outlet

VIII. CONCLUSION:

1. COD was removed by 55.6%.
2. BOD was removed by 76.57%
3. NH_3-N was removed by 99.5%.
4. Colour and odour was removed by 100%.
5. DO and conductivity were increased significantly.

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