Removal efficiency of the water pollutants by activated carbon treated with potassium

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1. Introduction

The use of activated carbon (AC) as a catalyst support material has been fueled by its unique properties like stability in both acidic and basic media, easy recovery of precious metals when supported on AC, very high thermal resistance and the possibility of changes in its textural and surface chemical properties. In general granular activated carbon processes have attracted interest for wastewater treatment with most of the academic research into this field concentrating on the removal of small concentrations of law molecular weight contaminants [1]. Due to the high organic matter concentration of the piggery wastes, special design has been recommended as a primary step of treatment by many authors [2,3]. In this further studies [3,4], authors presented in the advantage of multilayered metal-treated activated carbon bed system for treatment of piggery wastewater in overall processes. In this research, which is the first part of a study on the K-activated carbon system, the aim is to investigate the effects of physical and textural change of activated carbon, and chemical treatment sequence, and on the properties and catalytic activities for the removal of chemical and biological polluted factors from piggery urine effluent.

2. Experimental

Self-made activated carbon used as a starting material was prepared from coconut shell based granular type. The 0.1 M diluted nitric acid at boiling temperature was used in the oxidation treatment to increase the formation of functional groups without the damage of the carbon surface. For potassium treatment, 500 g of activated carbons

were dipped into 1 liter of 0.01M potassium salt-dissolved aqueous solutions and stirred for 12 h at room temperature. The trial examples of K-activated carbons and nomenclature are listed in Table 1. Full characterization of K-activated carbon system and removal of pollutants were presented by nitrogen adsorption properties (ASAP 2010, Micrometrics), SEM (JSM-5200 JOEL, Japan) and chemical and biological factors (COD, BOD, T-N and T-P). The wastewater samples of under 1500 mg/L leveled were used for characterization for the catalytic activities of K-activated carbons (Table 2).

3. Results and discussion

The S_{BET}s and porous structure of the K-activated carbons are summarized in Table 3. The activated carbons treated with potassium salts were also characterized by SEM. The average COD values of the waste after filtration through K-activated carbon bed filter were distributed between 250~280 mg/L. But, these values were dropped to under 160 mg/L after air blowing for 72 h. The results of catalytic effect using activated carbons treated with potassium are shown Fig. 1. Almost all samples are present to significant COD removal efficiency ranging from 60 to 160 mg/L after air blowing for 72 h. The result obtained from sample K3, especially, show the high removal efficiency that contributed to reduce the COD. The results for T-P removal by using K-activated carbon bed are shown in Fig. 2. The average concentration of T-P in the raw waste was over 150 mg/L, while final water purified with K-activated carbon filter was ranging from 3 to 11 mg/L before air blowing. But, these values for T-P were dropped into ranging from 1.5 to 7.5 mg/L after air blowing for 72 h. The average concentration of T-N in the raw waste was over 500mg/L (Table 2), while the values of final purified water by filtration with K-activated carbon bed was 22.8 mg/L ranging from 18 to 32 mg/L before air blowing. But, these values for T-N were significantly dropped into ranging from 3.2 to 9.5 mg/L after air blowing for 72 h. The results of T-N removal effect by K-activated carbon for the piggery waste are shown in Fig. 3. These values are acceptable for the final disposal of the treated effluent.

4. Conclusion

Various different types of K-activated carbon bed have been used in this study to investigate the catalytic removal COD, BOD, T-N and T-P from piggery wastewater. The results obtained from K-activated carbon samples show the high removal efficiencies accepted for the final disposal of the treated effluent for COD, T-N and T-P before and after air blowing for 72 h.

References

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Table 1. Nomenclatures of activated carbon treated with potassium salts

Sample	Nomenclature
0.01 M KCl + Activated Carbon	K1
0.01 M KNO_3 + Activated Carbon	K2
0.01 M $KMnO_4$ + Activated Carbon	K3
0.01 M $K_2S_2O_8$ + Activated Carbon	K4
0.01 M K_2CO_3 + Activated Carbon	K5
0.01 M KOH + Activated Carbon	K6

Table 2. The Analytical Results for the Primitive Piggery Waste

Step	CDO(mg/L)	BOD(mg/L)	T-N(mg/L)	T-P(mg/L)
Original Waste	Over 50,000	Over 50,000	Over 500	Over 150
After primary treatment (coagulation)	1,000	1,500	200	50
Ultimate*	Under 50	Under 350	Under 20	Under 5

* Permitted values of Ministry of Environment of Korea

Table 3. Comparison of physical parameters of activated carbon treated with potassium

Sample	Parameter			
	$S_{BET}(m^2/g)$	Micropore Volume (cm^3/g)	External Surface Area (m^2/g)	Average Pore Diameter (Å)
K1	1295	0.566	24.03	17.48
K2	1299	0.518	26.13	17.41
K3	1214	0.517	27.73	17.03

K4	1148	0.452	19.35	16.95
K5	1195	0.467	23.71	17.02
K6	1349	0.537	24.21	17.26

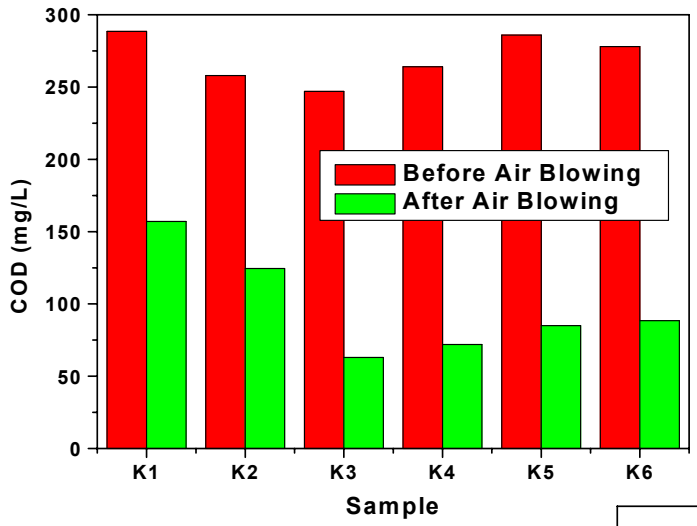

Fig. 1. Results of COD removal efficiencies by K-activated carbons for the piggery waste.

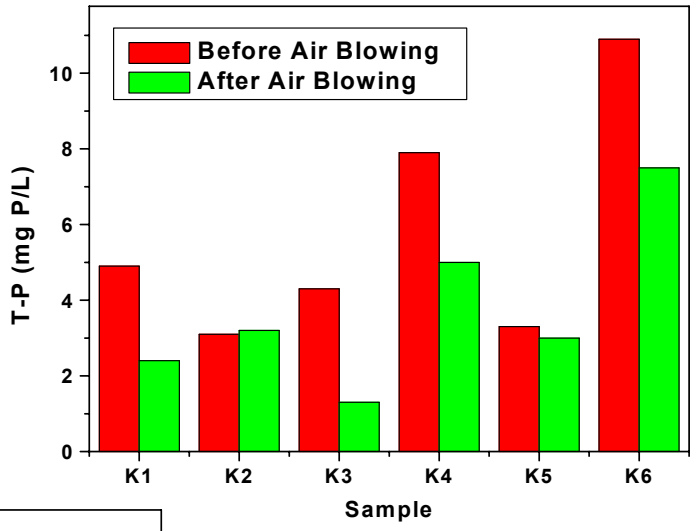

Fig. 2. T-P removal efficiencies by K-activated carbons from the piggery waste.

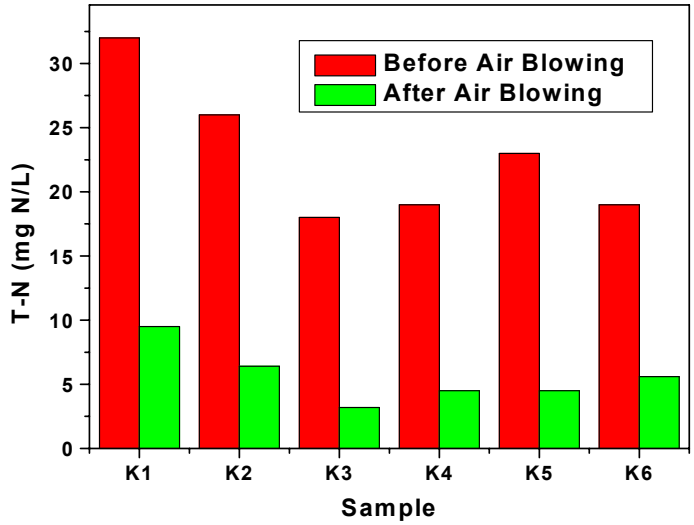

Fig. 3. Results of T-N removal effect by K-activated carbon for the piggery waste.