Removal of odorous compounds from food industry wastewater by activated carbon

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1 Introduction

Unpleasant odours are a typical problem in many different kinds of wastewaters, which are usually the result of gases produced by the anaerobic decomposition of organic matter. Methane and hydrogen sulphide are examples of typical odour causing compounds found in wastewaters (Metcalf and Eddy 2003).

Various physical, chemical and biological treatment processes such as activated carbon adsorption, gas scrubbing towers, several chemical oxidants and biofilters are available for the removal of odorous gases from wastewaters. The majority of these processes have primarily focused on gaseous odour control and not on eliminating the problem by dissolving odours in wastewater. (Yongwoo et al. 1994, Metcalf and Eddy 2003)

2 Objectives of the investigation

In this study, two different activated carbon adsorbents have been used for the removal of odorous compounds from food industry wastewater.

3 Materials and methods

3.1 Pre-treatment and characterization of activated carbon

Activated carbon samples (labelled AC1 and AC2) were first washed with distilled water and then dried at 105°C. The dried samples were then ground and sieved to obtain particles with a size less than 150 µm. The specific surface areas (BET) of the AC1 and AC2 samples were characterized by using a Micromeritics ASAP 2020 device. Furthermore, untreated samples (labelled uAC1 and uAC2) were also characterized to observe the differences between the specific surface areas. The results are presented in Table 1.

Table 1 *Specific surface area of activated carbon samples.*

Sample	BET [m^2g^{-1}]
uAC1	102
AC1	99
uAC2	920
AC2	934

3.2 Adsorption experiments

Adsorption experiments were carried out with various adsorbent loads (5 to 20 g L^{-1}) on 500 mL of wastewater in a 1000 mL three-necked flask. The reaction mixtures were stirred for two hours with a magnetic stirrer at room temperature. Water samples were taken periodically during the adsorption

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reaction. Odour change, pH and DOC (Dissolved Organic Carbon) were followed as a function of time. The samples' odour were determined by a sensory method using a scale from 5 (initial odour level) to 1 (odourless sample). Both the samples' odour and pH were determined right after the sample was taken while the DOC was measured from filtrated (0.45 µm pore size filter membrane) water samples.

4 Results and discussion

4.1 Odour removal efficiency

The results of the odour removal efficiencies in wastewater samples during activated carbon adsorption are illustrated in Figures 1 (AC1) and 2 (AC2). As observed in Figure 1, AC1 adsorbent only slightly decreased the odour level while having no significant influence on the adsorbent concentration. On the contrary, the AC2 adsorbent (see Figure 2) was more effective as an odour removal agent. For a two hour experiment, all the tested AC2 adsorbent concentrations were successful in removing wastewater odour. For adsorbent dosages between 6 to 20 g L^{-1} the wastewater sample was already odourless after 60 minutes of reacting. Obviously, the higher specific surface area of the AC2 adsorbent, 934 m^2 g^{-1}, (Table 1) can explain the differences in the removal efficiency of odour from food industry wastewater.

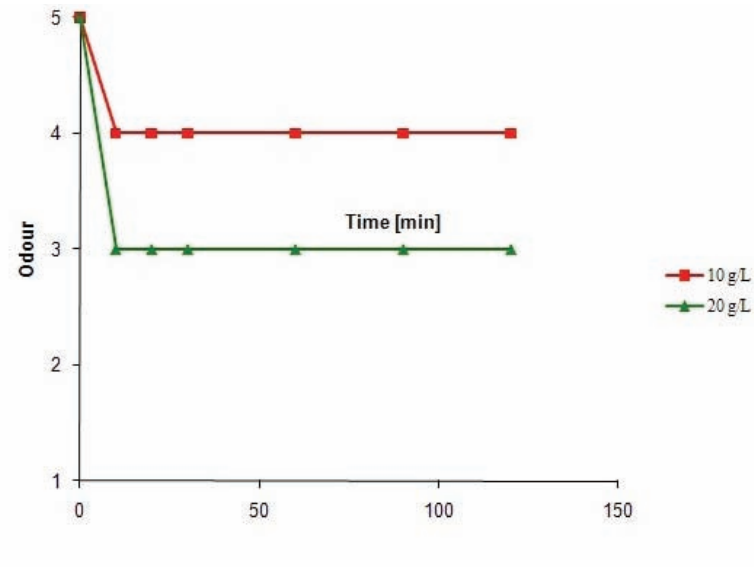

Figure 1 *Odour levels of food industry wastewater as a function of time with different AC1 adsorbent concentrations: 10 to 20 g L^{-1}.*

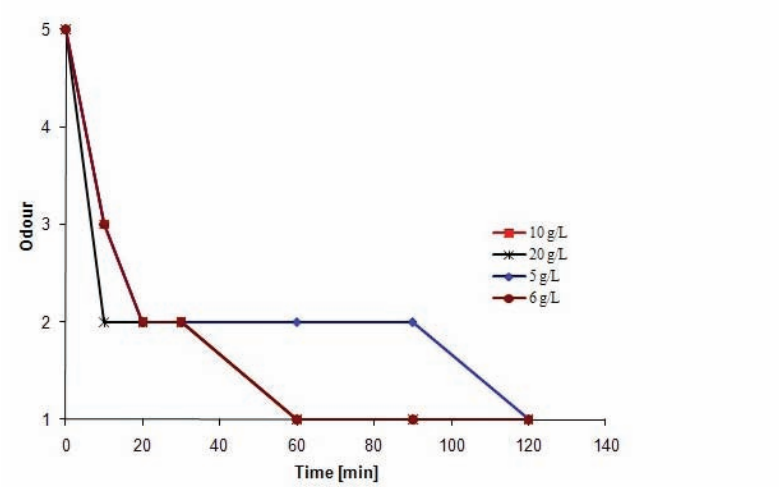

Figure 2 *Odour levels of food industry wastewater as a function of time with different AC2 adsorbent concentrations: 5 to 20 g L^{-1}.*

4.2 Removal of organic compounds

Observations made of the DOC measurements (Figure 3) also highlight that the AC2 adsorbent was more effective in the removal of organic compounds than AC1. Results show that the DOC removal efficiency for AC2 increases from 29% to 47% when the adsorbent concentration was increased from 5 to 20 g L^{-1}. Comparing this to the other adsorbent, the DOC removal efficiency of AC1 increased from 9% to approximately 20 % when its adsorbent concentration was increased from 10 to 20 g L^{-1}. As in the case for odour removal, the higher specific surface area of the AC2 adsorbent can adsorb more organic compounds from a wastewater sample.

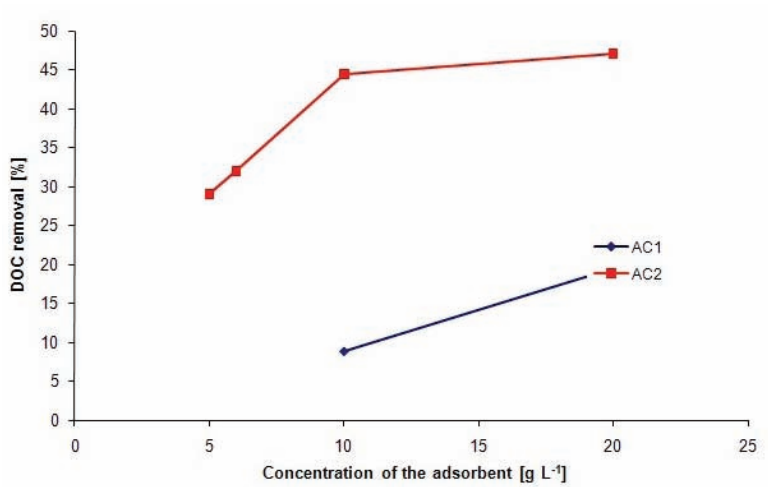

Figure 3 *DOC removal as a function of adsorbent concentration. Reaction time: two hours.*

5 Conclusions

The efficiency of odour removal from food industry wastewater was observed to increase with increasing adsorbent concentration. Activated carbon AC2 was notably more successful as an agent for the removal of odour compared to activated carbon AC1. The wastewater sample was already odourless within 60 minutes of starting the reaction when using AC2 adsorbent concentrations from 6 to 20 g L^{-1}. AC2 was also significantly more efficient for the removal of DOC when using a concentration of 20 g L^{-1}. A 47% DOC removal efficiency was measured under these conditions. Overall, according to the results, activated carbon AC2 has the potential to be used as a removal agent for odours and organic compounds in food industry wastewater. However, further investigations are required on the column operations to make the use of adsorbent more practical.

References

Metcalf and Eddy (2003) **Wastewater Engineering: treatment and reuse**. 4. ed, McGraw-Hill, Boston, 70-71.

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