Growth and electrochemical reactions of Fe(Ⅲ) colloidal species adsorbing harmful organic compounds in wastewater

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Introduction

A new effective method has been developed in order to purify wastewater containing harmful organic compounds, such as landfill leachate[1]. The method with iron electrode electrolysis does not need any chemical additives. In this system, organic compounds in wastewater are adsorbed by colloidal particles of Fe(Ⅲ) colloidal species formed in an iron electrode electrolysis process, and then the colloids adsorbing organic compounds are removed in a strong magnetic separation process.

To scavenge the organic compounds effectively, we have researched the electrochemical behavior of F(Ⅲ)colloidal species[2], and the relations between growing rate of the colloid sizes adsorbing organic compounds and their chemical structures. In this work, the following four organic compounds were used as test adsorbate; bisphenol A (4,4'-iso-propylidenediphenol) and diethylphthalate, which are suspected to be endocrine disruptors, and m-, p-cresols (Fig.1). The aim of this work is to study the relation between the growing colloid sizes and organic compound adsorption mechanism by electrochemistry and their chemical structures.

Experimental

Fe(Ⅲ)colloidal species, ferric hydroxide sol solution was prepared mainly by means of the usual hydrolysis method[3]. The mixtures of Fe(Ⅲ) colloidal species and the organic compounds were prepared not to leave free organic compounds; that is, the concentration of the organic compounds were 1×10^{-5}~2×10^{-4} mol/dm^3 against 1×10^{-2} ~ 5×10^{-2}mol/dm^3 of concentration as Fe atom. The colloidal particle sizes were measured with light scattering method. Cyclic voltammetry or other electrochemical experiments were performed using Pt or Fe working electrode at room temperature under N_2 atmosphere.

Results and Discussion

In the results of cyclic voltammetry using the Fe(Ⅲ) colloidal species solution at pH 1.7 with Pt electrode, only the first reduction wave, which corresponded to $Fe^{3+}+e^{-}\rightarrow Fe^{2+}$, was observed at more negative potential than in $FeCl_3$ solution (-200mV shifted).

As shown in Fig. 2, the growing rate of the colloids adsorbing bisphenol A was the fastest among the test organic compounds. For all of the test adsorbates, the colloid sizes became finally about 70 times as large as those before adsorbing.

These results and the kinetic analysis of the oxidation of bisphenol A on Fe(Ⅲ)colloidal species which was reported in previous paper[2] suggest that the first CV wave may represent electrochemically the bonding state of the reactant on the surface of colloid particles. The growing rates of the colloid sizes adsorbing the organic compounds were not simply explained with only the partial charges calculated by MO. Therefore, it is considered that the adsorption and growth may not be driven by only electrostatic force of attraction, and then further work is under way.

Acknowledgement

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References

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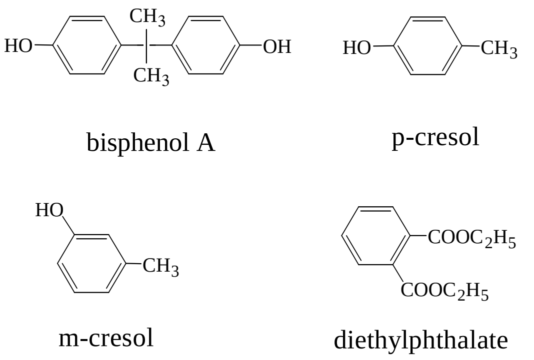

Fig.1 The structures of the organic compounds used as adsorbate.

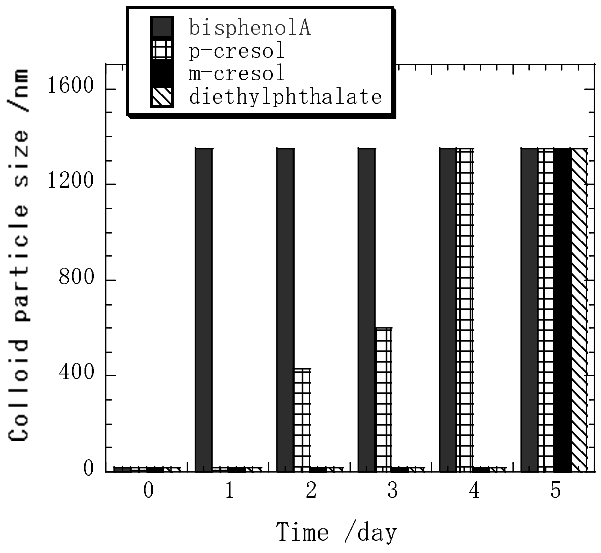

Fig. 2 Growth of colloidal particles adsorbing the organic compounds at pH 1.7.