Higher Degree Decomposition of Harmful Organic Compounds containing Chlorine by using Molten Salts

Yuzuru Sato, Daisuke Aoki, Yojiro Yamauchi, and Tsutomu Yamamura

Department of Metallurgy, Tohoku University, Sendai 980-8579, Japan.

Introduction

As some organic compounds combined with halogen elements such as PCB, dioxin etc. are harmful and have caused severer environmental problems, it is desired to establish the safe, low cost and highly efficient process for destroying the compounds. Asakura[(1)] proposed the process using molten salts and successfully tried to decompose the refrigerant gas prohibited for use, for example, R-143a. Therefore, the authors have planned to develop the advanced process with the basic molten salts based on the reactions between the compounds and the molten salts such as hydroxides and carbonates.

In this process, It is expected that the halogens contained in the compounds are removed by strong electrophilic property of basic molten salts and that the compounds are decomposed to H_2O and CO_2 completely by oxidative property.

Although the goal of the project is to decompose strongly harmful PCB or dioxin, It was tried to decompose mono-chlorobenzene that has similar structure to PCB as a first step of this work

Experimental

Reaction system of the apparatus used is shown in Fig.1. Molten salt mixtures of KOH-K_2CO_3 or NaOH-Na_2CO_3 are contained in 99.5% alumina crucible. Sample compound as a liquid is supplied by syringe pump slowly through thin stainless steel tube whose end contains a bundle of thin Pt-13%Rh wires to avoid the droplet formation. The carrier gas, imitation air of N_2-21%O_2 mixture, is also supplied through coaxial outer stainless steel tube. They are injected together into the molten salt bath through a 99.5% alumina tube. A small amount of the exhaust was sampled and analyzed by the gas chromatograph mass spectrometer (Shimadzu GCMS-QP2010) to determine the products species contained in the exhaust and the decomposition efficiency.

Results and Discussion

The compositions of the molten salts were KOH-30mol%K_2CO_3, KOH-9.3mol%K_2CO_3 and NaOH-8.3mol%Na_2CO_3. The experiments were carried out at the temperature range between 300^0C and 700^0C. When the ratio of air to mono-chlorobenzene exceeds the stoichiometry for complete reaction to produce H_2O, CO_2 and alkali chloride under slow rate of gas flow, almost no other compound was found and the decomposition efficiency was typically achieved higher than 99.999% as shown in Fig.2.

In the case of N_2 flow instead of air, various compounds were found in the exhaust. However, they were excluding chlorine such as benzene. This indicates the excellent advantage of this process.

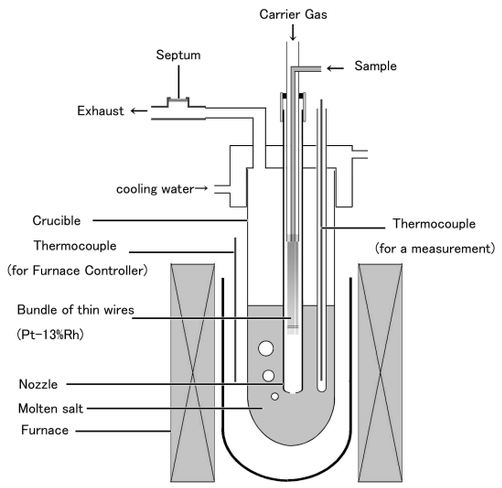

Fig.1 Schematic view of the injection system.

On the other hand, in the case of too much flow rate of injection, some amount of undecomposed mono-chlorobenzene was found. The reason was considered to be due to the lack of contact between the sample gas and molten salt interface. Therefore, appropriate injection rate should be studied. These results suggest that the process will be adaptable to decompose PCB.

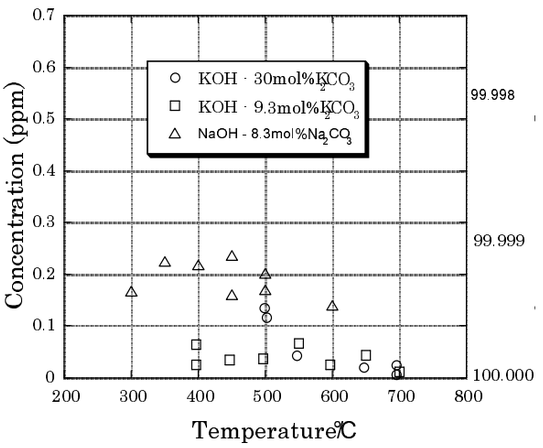

Fig.2 Decomposition efficiency at various temperatures and molten salts for the excess air condition.

Conclusion

The decomposition of mono-chlorobenzene was tried in basic molten salt mixtures. Excellent decomposition efficiency was obtained under the condition of excess air in wide temperature range. Furthermore, the effect for extracting chlorine even by using N_2 instead of air was confirmed.

Acknowledgement

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Reference

1) S.Asakura：Kinzoku, **70**(2000),349