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연립 주택 화재시 유독가스 방출 특성과 Rats를 이용한 독성평가에 관한 실험적 연구

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Toxicity Evaluation of Effluent Gases from a Residental Fire by Rats

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INTRODUCTION

It has long been recognized that exposure to the fire-induced toxic gases is one of the hazards confronting people in fires. In this study, the toxicity of the effluent gases released from a residential fire is evaluated by testing the blood of lab rats exposed to the gases.

METHODOLOGY

Figure 1 shows the reconstructed residential building located in ansan city of Korea, where the experiment of exposing rats to the fire-induced gases was performed.

The fuels of the residential fire included furniture, paper, wood, clothes, and interior upholsteries such as sofa, chair, curtain, floor cover, etc. The lab rats used in the experiment are Sprague Dawley (age 7 weeks, male, 215±15g). The rats were exposed to the gases in two chambers connected to the residential building with an induction pipe (Figure 2). The pipes were suspended in the living room and child room at the height of 1.5m where the respiration of human normally takes place.

Then, several types of blood tests were given to the rats, which includes glucose (enzyme method, reagent ; sinyang, Korea, Hitachi 7600 110), AST(GOT, UV method, reagent; sinyang, Korea, Hitachi 7600 110), ALT (GPT, UV method, reagent ; sinyang, Korea, Hitachi 7600 110), CBC Count (complete blood cell count method, reagent ; RBC/Plt, HGB, Baso, EZ Kleen, Defoamer, Sheath Rinse, Perox 1,2,3 Ret., ADVIA TM 120 Hematology System, Bayer, USA) and CO

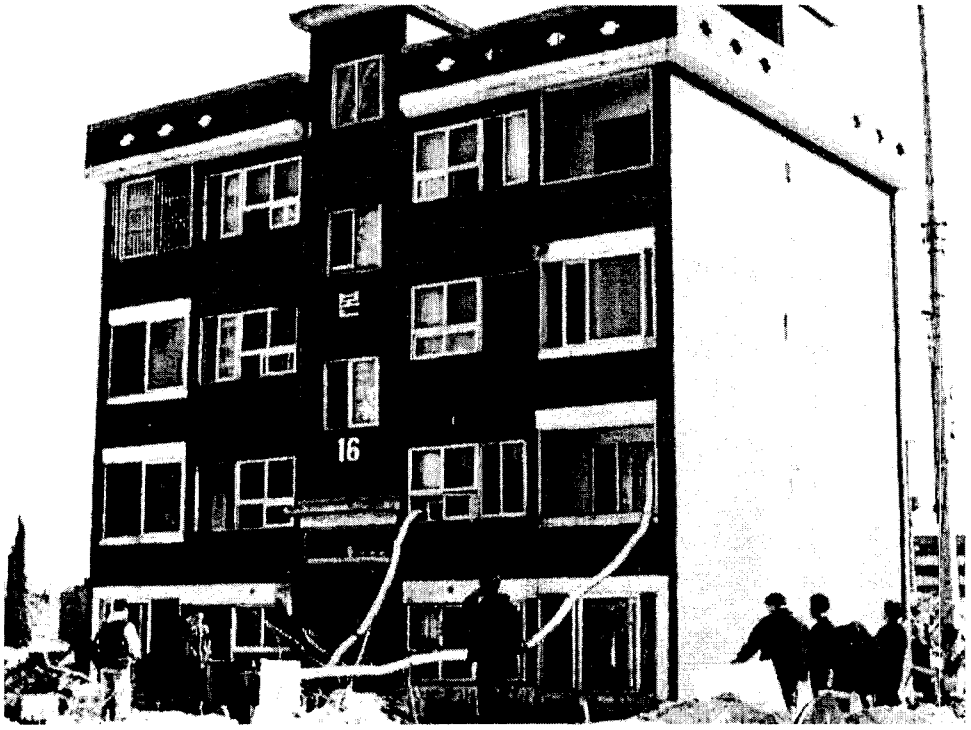

Fig. 1. The view of the reconstructed residential building.

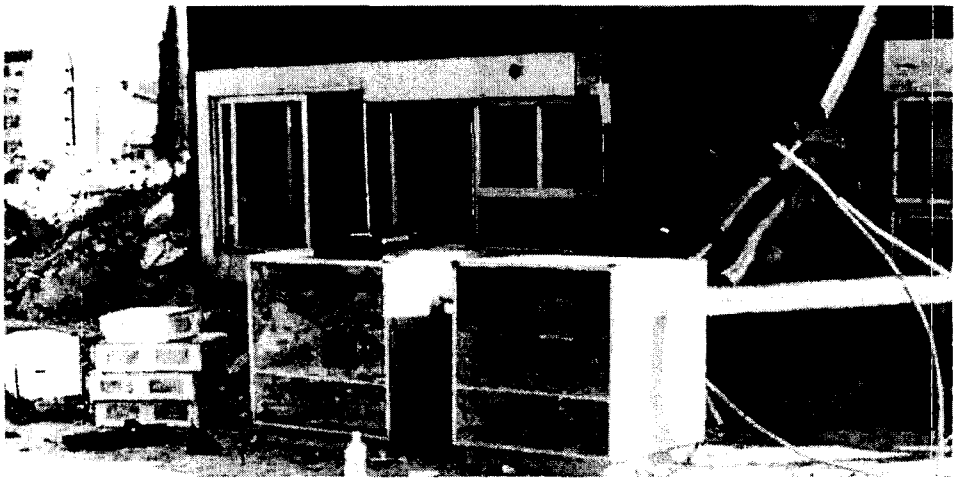

Fig. 2. The chambers where the rats were exposed to the fire-induced gases.

(carboxy)- Hb (method : alkali hematin, UV spectrometer, Hewlett Packard).

The compositions of effluent gases were measured by a gas analyzer (ENERAC 2000(USA) and ECOM-A(COM America LTD., USA), which includes CO (carbon monoxide), CO_2 (carbon dioxide), O_2 (oxygen), SO_2 (sulfur dioxide), NO and NO_2.

Fig. 3. The location of induction pipe suspended in living room and child room.

Toxicity of effluent gases released from the residential fire is evaluated according to CO-Hb curve, CBC curve measured from the blood and serum of rats, and glucose, AST, ALT curve obtained from the serum of rats. These blood tests were conducted in Seoul Clinical Laboratory.

RESULTS AND DISCUSSIONS

The gases released from the experimental fire were measured within 30 minutes. The results are shown in Figure 4 and 5.

The concentration of CO increased sharply when 2 minutes elapsed since the fire ignition, and climbed to the peak when 9 minutes elapsed. The concentration of NO and CO2 respectively climbed to the peak when 5 minutes and 12 minutes elapsed. In chamber 2, 6

minutes after the NO concentration climbed to the peak, most rats were asphyxiated to death.

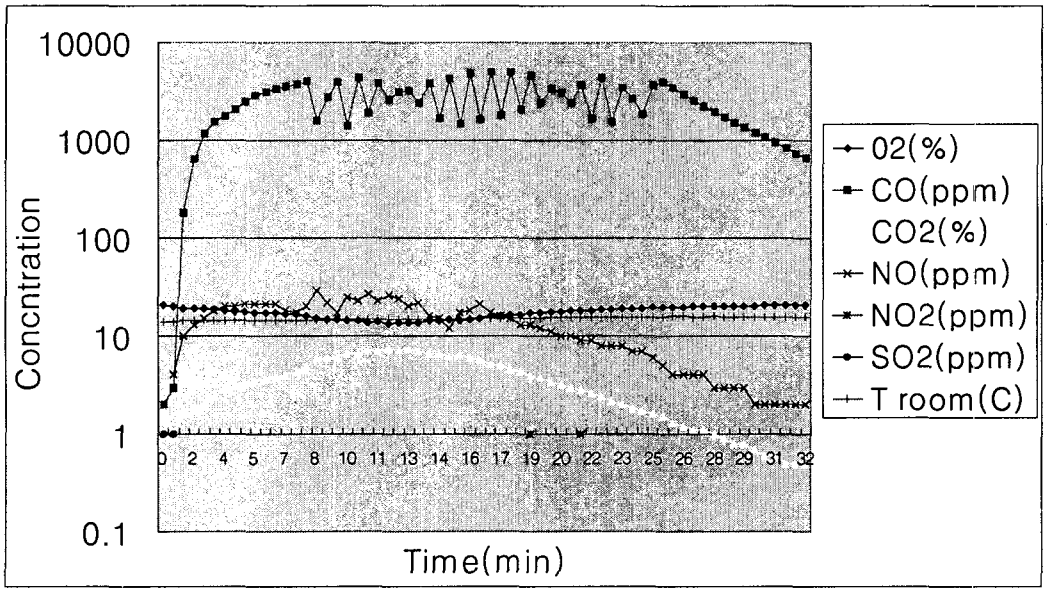

Fig. 4. Time dependent gas concentrations released from the residential fire.

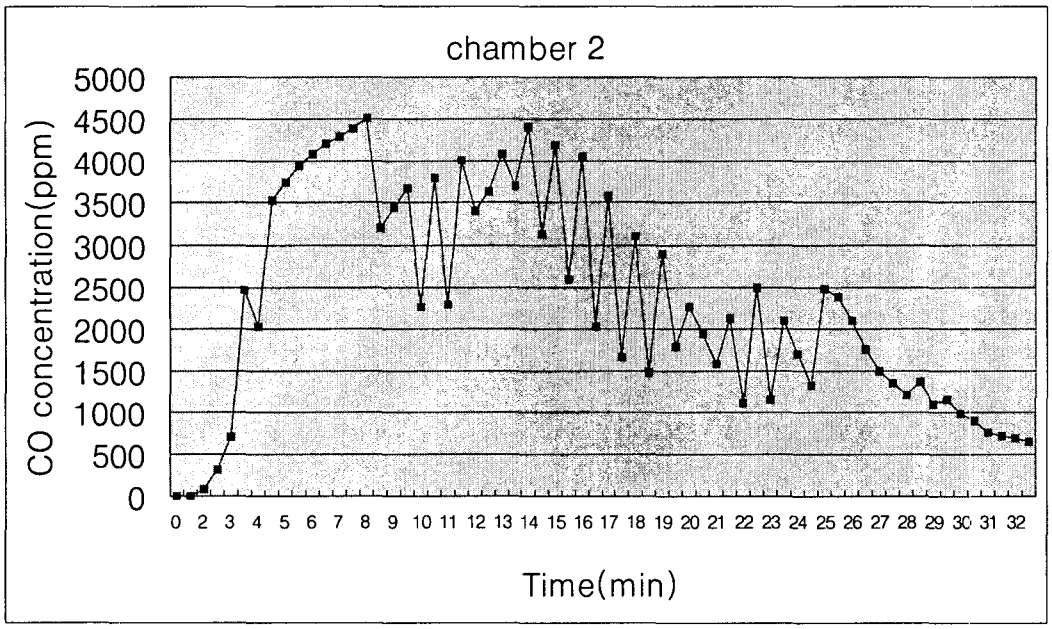

Fig. 5. Time dependent concentration of CO in chamber 2 (child room).

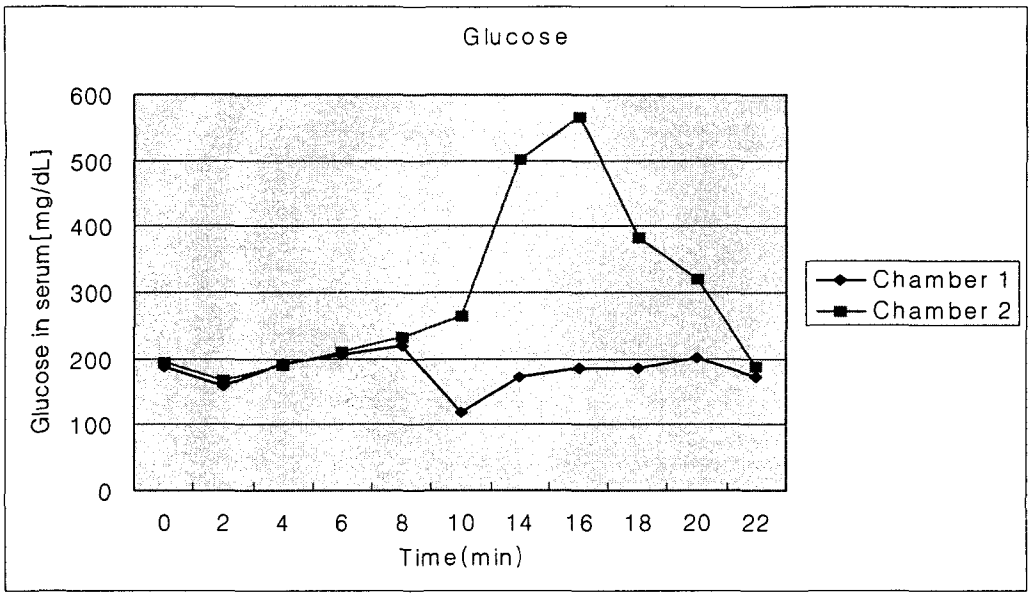

Fig. 6. Time-dependent glucose concentrations in serum of rats.

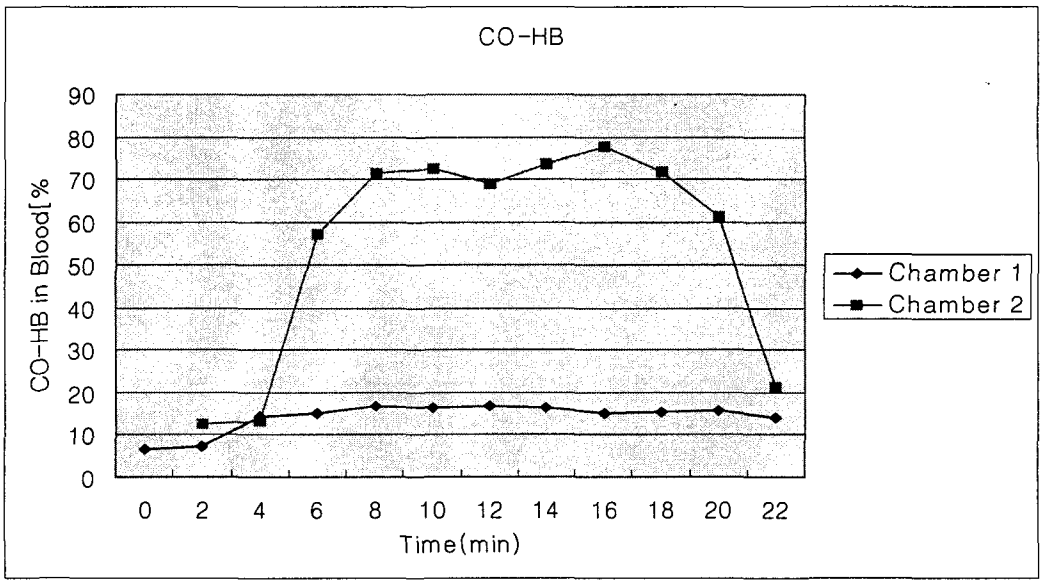

Fig. 7. Time-dependent CO-Hb concentrations in Blood of rats.

According to the Figure 6, the gases inducted to chamber 1 had greater influence on the glucose concentrations in serum of rats than those in chamber 2. Also, glucose concentrations increased sharply after 10 minutes elapsed. It's believed that toxic gases with higher concen-

trations flowed into chamber 2.

According to the Figure 7, chamber 1 had greater influence on the CO-Hb concentrations in blood than those the chamber 2. Along with the sharp increase of CO concentration after 2 minutes of elapse since the fire ignition, CO-Hb concentrations increased sharply 4 minutes later, which demonstrates the dose-response relationship between CO concentration and CO-Hb concentration. There were no signifiant changes with the concentration of GOT, GPT and CBC according to the results of blood tests.

CONCLUSION

1. The concentration of CO increased sharply when 2 minutes elapsed from the fire ignition, and climbed to the peak when 9 minutes elapse. The concentration of NO and CO2 respectively climbed to the peak when 5 minutes and 12 minutes elapse. In chamber 2, 6 minutes after the NO concentration climbed to the peak.

2. The gases inducted to chamber 1 had greater influence on the glucose concentrations in serum of rats than those in chamber 2. Also, glucose concentrations increased sharply after 10 minutes elapsed. It's believed that toxic gases with higher concentrations flowed into chamber 2.

3. Chamber 1 had greater influence on the CO-Hb concentrations in blood than those the chamber 2. Along with the sharp increase of CO concentration after 2 minutes of elapse since the fire ignition, CO-Hb concentrations increased sharply 4 minutes later, which demonstrates the dose-response relationship between CO concentration and CO-Hb concentration. There were no signifiant changes with the concentration of GOT, GPT and CBC according to the results of blood tests.

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