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PROGRESS REPORT ON SUPPRESSION IN JAPAN

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Abstract

Since last UJNR in 1992, many problems have been caused in the field of fire suppression in Japan, and there was remarkable progress in the employment of halon replacements.

Issues on fire suppression after 1992

There have been many important incidents on the fire suppression in Japan after 1992. The main problems of them are as follows:

(a) Ban on the halon production for the protection of the stratospheric ozone layer and employment of halon alternatives,
(b) Extinguishing difficulty of large fires caused by the grand Hanshin-Awaji earth quake on January 17, 1995,
(c) Accidental leakage and fire of coolant sodium metal in the fast breeder reactor, "Monju," in Tsuruga of Fukui Prefecture on December 7, 1995, and
(d) Accidental discharge of a carbon dioxide fire extinguishing equipment of a parking tower in Tokyo on December 1, 1995. There were two victims in the accidental discharge.

Progress in halon replacements

Since January 1, 1994, the production of halons is banned to prevent depletion of the stratospheric ozone layer. Potential candidates of halon replacements have been reported, and some of them are already employed in new fire extinguishing equipment as a total flooding system.

The study on development of halon alternative agents is continued in Japan. In National Industry Research Institute of Nagoya, Fukaya et al. [1] investigates the development of synthesis method and the fire extinguishing efficiency of perfluoroalkylamines as candidates of halon replacement. The perfluoroalkylamines show the efficiency enough for fire suppressants, but any methods for mass production of the chemicals have never succeeded. Recently, they tried to explain the fire suppression mechanism of CF_3 group of the perfluorocarbons by using *Ab initio* molecular orbital calculations [2].

In Sophia University, Takahashi et al. [3,4] studied the inhibition effect of perfluoroalkylamines and polyfluorocarbons using a shock tube, and Sekiuji et al. [5] reported the reaction mechanism of CF_3 radical with O atom and O_2 molecule to clear the combustion inhibition mechanism of polyfluorocarbons.

In Fire Research Institute, many investigations have been carried out on the fire suppression efficiency and its evaluation methods for the candidates of halon replacements to employing new fire extinguishing agents used in total flooding system. The cup burner scale-effect on flame extinguishing concentration was investigated and reported by Saso et al. [6]. Saito et al. [7] studied reproducibility of the flame extinguishing concentrations measured by glass cup burner systems under the fixed conditions, and they reported also the influence by operators on measurements of a fire extinguishing concentration in the report. Inoue et al. [8], Sakei et al. [9], and Saito et al. [10] reported the flame extinguishing concentrations of representative "new fire extinguishing agents" for several kinds of fuels, using the FRI cup burner system. The data contain the flame extinguishing concentrations of both HFC agents and inert gas agents.

Extinction phenomena of the cup burner flame are complex, so the burner scale and the experimental conditions affect flame extinguishing concentrations. A counterflow diffusion flame is formed in a stretch flow field and has relatively simple flame structure. Thus, it is expected that the physical conditions at extinction of the flame can be fixed easier than the case of cup burner flame. Saso et al. [11-13] tried to obtain the flame extinguishing concentrations of inert gases and halon replacements using a counterflow diffusion burner.

Inerting efficiencies of inert gases, halon replacements, and halon 1301 were measured by using a new technique, tubular flame burner method. Liao et al. [14] investigated appropriate measurement conditions of the flammability limits using the tubular flame burner, and reported the flammability limits of twenty-three kinds of fuel-air-additive ternary mixtures [15]. The fuels are methane, ethane, propane, butane, heptane, and ethanol. Nitrogen, carbon dioxide, argon, halon 1301, FC 3-1-10, HFC 227ea, and HFC 23 are used as the additives.

Saito et al. [16] reported that the flammability peak concentrations of halon 1301 and three kinds of halon replacements measured by the tubular flame burner agree well with the inerting data listed in NFPA 2001. Saito et al. [17] studied also the relation between the suppression efficiency of an inert gas mixture and those of the component of the mixture. They found that the fire suppression efficiency on the mixture is represented by simple relation of harmonic mean weighted by the component mole fractions in both cases of flammability limit and flame extinguishing concentration.

In the relation of halon recycling, Otsu et al. [18] investigated the flame extinguishing efficiency of halon 1301 containing nitrogen, and reported that halon 1301 containing within 7 mole % of nitrogen does not change the flame extinguishing concentration over 0.1 %.

Progress in water system

There are many activities on the water system, especially water mist technology for the fire extinguishing systems, but a few reports on the system have been appeared in the period.

Tokyo Fire Department [19] carried out extinguishing tests of a high tension transformer station using water fire extinguishing systems as halon alternative, and made a guide line on use of the water mist and sprinkler systems for protection of transformer station.

In Fire Research Institute, Takahashi [20] studied the extinguishing of plastic fires with wet water. He found out that the wet water shows excellent fire extinguishing effect for plastic fires, and use of the wet water can reduce water application rate relative to normal water.

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