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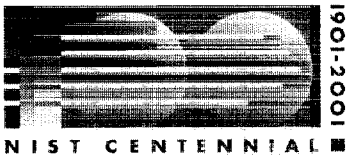

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OVERVIEW ON PROGRESS OF FIRE EXTINGUISHING RESEARCH AND TECHNOLOGY IN JAPAN

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Introduction

In 2000, Japanese fire extinguishing science and technology face the following issues:

(1) Protection of the global environment,

(2) Decreasing water damage in fire fighting of residence fires,

(3) Promotion of the fire safety for old people in the aged society,

(4) Reduction of victims by urban fire after a large earthquake, and

(5) Fire protection in high technology industries by developing new method.

Here, the recent researches and development on the fire extinguishing in Japan are introduced according to these subjects.

1. Global environment and fire extinguishing

One of the most important subjects in the fire extinguishing science and technology is the prevention of the stratospheric ozone layer. Japan employs the two halon phase-out policies as follows:

1.1 Halon recycling

In Japan, there are about 55,000 halon fire extinguishing systems, and about 17,000 tons of halons are stored in the systems. "Halon Recycling and Banking Support Committee, Japan" is responsible for the recycling, banking, and preventing illegal discharge of the halons. The recycling halons are used mainly new fire extinguishing systems for very important facilities, like a telecommunication facility, a museum, etc., and to replenish the exiting halon extinguishing systems. Large tanks with floating roof in refineries and stockpiling bases of oil are equipped with the halon 2402 system for protecting against a weather seal fire of the floating roof. There has not yet been an appropriate replacement for the fire extinguishing system. For the recycling of Halon 2402, Nakada et al. [1] researched the quality and fire extinguishing capability of Halon 2402 stored for form 16 years to 27 years in the systems. They did not find any problems to use the Halon 2402 without further purification.

1.2 Employment of halon replacements

(a) Gaseous fire suppressants

Since 1995, about 600 fire extinguishing systems of halon replacements have been employed in Japan. Inert gas agents of IG541, IG100, and IG55 were employed by 75 % of the systems, and the rest 25 % used HFC suppressants. NRIFD researches the fire extinguishing capability of the agents under the various application conditions. Saito et al. [2] studied the effect of combustible vapors mixed in air on flame extinguishing concentrations to install the equipment in the facilities where hazardous materials are handled. Sakurai et al. [3, 4] studied flame extinguishing concentration of inert gas agents for methane and propane flames, and discussed the meaning of such data for the gaseous combustibles.

There are basic researches to prepare the development of high performance agents. Saso et al. [5, 6] reported the simulation results of burning velocity of trifluoromethane-methane mixtures, and tried to explain the difference of temperature effect between CF_3Br and CHF_3 agents.

Since the efficiency of almost all halon replacements are not better than halon 1301, the safety factor of design concentrations has to be smaller than that of halon 1301. This fact requires the more spatial uniformity of the agent concentration in the compartment. For verifying the system design, there is a joint research between NRIFD and University of Tokyo to develop a computer cord for simulating the flow and mixing process of discharged fire suppressant [7-9]. On this subject, Makarov et al. [10] simulated the mixing process of discharged IG541 in a full-scale model of a mechanical car parking system. Tsuruda et al. [11] report the above simulation results in this meeting.

Japanese users are very interested in the information of a toxic hazard of the products generated in fire extinguishing form the gaseous fire extinguishing agents. Saso et al. [12] studied CO formation in the flames inhibited by halon replacements. Recently, FDMA (Fire and Disaster Management Agency, Ministry of Home Affairs) also started a research project on the overall safety of fire extinguishing by the halon replacements under the direction of "Committee for Safety Assessment of Halon Replacements."

(b) Water mist

Water mist is expected as a total flooding agent of halon replacements, because water mist extinguishes the fire very effectively if it passes through a reaction zone in a flame and takes the heat away from the flame by the heat of evaporation. However, there are many difficulties to use the water mist as a total flooding agent.

There are a few researches on the basic fire extinguishing effect of water vapor since the last UJNR meeting. Ogawa [13] studied the effect of low concentration of water vapor on the

flammable limit of methane. Ogawa [14] also reported the suppression effect of higher concentration of water vapor in the meeting. Danbara et al. [15] studied the effect of water vapor on flame spread rate over the filter paper surface. They concluded that the extinguishing effect of low concentration water vapor is essentially thermal.

For the water mist, Morita [16] introduced "Extinguishing Compartment Fires by Water Mist" in this meeting. Yashima [17] studied the quenching effect of water spray on propagating flames in premixed gases. Asami [18] measured actually delivery density of water spray for propane diffusion flame.

The application research of a micro-fog system was conducted by Kikkawa et al. [19] for a full-scale dwelling house used in South Pole. Irie et al. [20] and Takemoto et al. [21] carried out compartment fire extinguishing tests by a pressurized water mist system. FDMA studies the fire extinguishing method by water mist systems to prepare a standard.

2. Decreasing water damage in fire fighting

According to Japanese Fire Service Law, the fire extinguishing by water is a basic concept of the fire fighting. Therefore, the systems of fire hydrant, "drencher", and sprinkler have to be intrinsically desirable for the fire protection. However, the water system is not liked residents because of the water damage. Many local fire departments try to decrease the amount of water to extinguish residential fires. Noguchi et al. [22] reported a development of a pneumatic atomizing gun for fire fighting by the joint research with Yokohama Fire Department. Shimoju [23] tried to develop a sprinkler system minimizing water damage using a shape-memory alloy. Tsuji [24] studied "efficient fire extinguish sprinkler method." Kashiki [25] proposed a new fire fighting method by solutions of special polymers which suddenly change to viscous gels at the higher temperature form 310 to 340 K.

3. Fire safety for old people in the aged society

There are no fire extinguishing approaches on the subject since the previous meeting.

4. Reduction of victims by urban fire after a large earthquake

The study of fire fighting by helicopters is continued in NRIFD in cooperation with the fire departments of local governments. There are several experimental reports on the effect of this fire fighting method by Yamashita et al. [26, 27] and Takemoto et al. [28]. Hiraga et al. [29] studied the impulsive force of falling water in the aerial fire fighting.

5. Fire protection in high technology industries

A study of sodium fire is an old subject of alkali metal fires. After the fire accident of the fast

breeder reactor "Monju," many experimental studies have been conducted on the combustion phenomena and extinguishing of sodium fire by Saito et al. [30, 31]. They found combustion between sodium and sodium combustion products on a pool fire, and they think that the extinguishing by the inert gases as argon and nitrogen may be impossible [32].

Another important alkali metal fire is a fire of lithium ion battery cell factory. The battery cells are widely used in recent electronic instruments. Tsuruda [33] began to study this battery fire to find useful fire fighting method.

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