MECHANISM OF POOL FIRE EXTINCTION
BY CARBON DIOXIDE HYDRATE

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ABSTRACT
The extinction of the laminar flame formed over a methanol pool in 27.2 mm diameter and 15 mm depth fuel container by the carbon dioxide hydrate is experimentally investigated. The powder of carbon dioxide is dropped into the methanol pool 100 mm high from the methanol surface. Two distinct influence are expected. One is the cooling of the methanol and the other is the ejection of the carbon dioxide. Temperature variations in the methanol and the air region above the methanol surface are measured by K type thermocouples to discuss the cooling effect. Ice and dry-ice are used to compare with carbon dioxide hydrate. Ice does not have the effect of carbon dioxide ejection, while dry ice does not have water. The result shows that the spreading of carbon dioxide to the flame base plays an important role on the flame extinction as well as the methanol cooling. The extinction needs much longer time than the time to reach the carbon dioxide from the center to the flame base. It indicates that this extinction is not the “blowoff” but the “extinction due to weakening the flame”.

Keywords: Carbon dioxide hydrate, Flame extinction, Pool fire

INTRODUCTION
Fire always threatens our life, especially, the large scale fire at oil tanks or chemical plant is serious for our life. There are many extinguishing agents, e.g, water, bubble, nonflammable gas, and Halon etc. The water is widely used for fire extinction because it is easily supplied from river, pond, city water supply lines. Bubble is used for chemical materials. Non flammable gas, such as carbon dioxide, is used where the water is not used. Halon gas is one of the conventional fire extinguishing agents, typically used for the fire for which the water spraying cannot be applied, e.g, the fire in a subway station. But this extinguishing agent has often considered the worse effect of the environment. The carbon dioxide hydrate is supposed to be a novel extinguishing agent. The carbon dioxide hydrate consists of two extinguishing materials, one is the nonflammable gas, carbon dioxide, and the other is water. As hydrates are ice-like crystalline solids, the heat of dissociation of carbon dioxide hydrates is typically 300-500 kJ/kg [1]. This values is comparable to or even larger than the heat of fusion of ice, 333 kJ/kg. 160 m³ carbon dioxide at STP is ejected from 1m³carbon dioxide hydrate. If the carbon dioxide hydrate is dissociated in a combustion field, the temperature is expected to be decreased due to the heat of hydrate dissociation. At the same time the dissociation of the hydrate in the combustion field would prevent the supply of the fuel and oxygen due to the ejection of the carbon dioxide from the dissociating hydrate and the mixture is diluted. We also note the advantage of the dense, solid hydrate compared to the fluid fire extinguishing agents. An industrial scale method to form carbon