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Studies on Inflammability of Hydrogen. II.
Influence of Organic Bromine and Iodine Compounds
on the Upper Limit of Inflammability of
Hydrogen-Air Mixtures.

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Abstract.

On continuing the previous work, the effects of the organic bromine and iodine compounds other than ethyl bromide on the upper limit of inflammability of hydrogen in air have been investigated. It was found that ethyl and methyl iodides had an effect of lowering markedly the upper limit of inflammability of hydrogen by nearly the same degree as ethyl bromide, and so the flame temperature necessary to activate the molecules of methyl and ethyl iodides to burn will be equal to that obtained for ethyl bromide. The effects of ethylene bromide, bromoform and methylene bromide were much less significant. It was therefore suggested that the extinctive effects of the bromine compounds on hydrogen flame do not depend on the number of the bromine atoms in the molecules, but on the chemical nature of the compounds.

In the previous paper⁽¹⁾ the authors investigated the influence of ethyl bromide on the limits of inflammability of hydrogen. The present paper is concerned with the study of the influence of other organic bromine and iodine compounds on the upper limit of inflammability of hydrogen in air. The halogen compounds used in the present investigation were carefully purified by drying over calcium chloride and fractionating with a Hempel still-head, fractions collected boiling within 0.1°C . of the boiling points of the pure compounds. The apparatus and the procedure of experiments are the same as in the previous investigation.⁽¹⁾

The results obtained are given in the following table:

Halogen compounds added.	Mole per cent. of halogen compounds in the upper limit mixtures.	Mole per cent. of hydrogen in the upper limit mixtures.
	0	71.2
Ethyl bromide ($\text{C}_2\text{H}_5\text{Br}$)	1.00	49
" " (")	0.50	56
Ethyl iodide ($\text{C}_2\text{H}_5\text{I}$)	0.79	50
" " (")	3.43	<35
Methyl iodide (CH_3I)	0.95	$\left\{ \begin{array}{l} >50 \\ <55 \end{array} \right.$
Ethylene bromide ($\text{C}_2\text{H}_4\text{Br}_2$)	0.50	$\left\{ \begin{array}{l} >56 \\ <60 \end{array} \right.$
Bromoform (CHBr_3)	0.525	>60
Methylene bromide (CH_2Br_2)	0.50	>60

It can be seen that ethyl iodide lowers the upper limit of hydrogen by nearly the same amount as ethyl bromide, and consequently the temperature necessary to activate the molecules of ethyl iodide to burn will be equal to that given for ethyl bromide,

(1) Y. Tanaka and Y. Nagai, this report, 22, 249, 1927.

which is 1550°C. The flame temperature for the activation of the molecules of methyl iodide will also be equal to that for ethyl bromide. That the amount of lowering of the upper limit of inflammability of hydrogen by the addition of one per cent. of methyl iodide is smaller than that effected by the addition of the same amount of ethyl bromide may be ascribed to the smaller number of carbon and hydrogen atoms in the molecule of methyl iodide.

The above table shows also that the extinctive effect of the bromine compounds on the hydrogen flames is independent of the number of the bromine atoms in the compounds but depends on the chemical nature of the compounds.

Summary.

(1) Influence of organic bromine and iodine compounds on the upper limit of inflammability of hydrogen in air was investigated.

(2) By the addition of a small amount of ethyl bromide, methyl iodide or ethyl iodide, the upper limit of inflammability of hydrogen is lowered markedly, the amount of lowering being nearly equal in each case.

(3) The extinctive effects of ethylene bromide, bromoform and methylene bromide are less significant than that of ethyl bromide.

(4) It was suggested that the temperature necessary to activate the molecules of methyl and ethyl iodides to burn will be equal to that obtained for ethyl bromide.

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抄 録

水素の燃焼に関する研究 (第二報)

水素の燃焼高極限に對する有機性臭素及び沃素化合物の作用

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臭化エチルが水素の燃焼範圍を著しく縮小し、殊に其の高極限を著しく低下せしむる實驗結果、並に理論に關しては第一報に記載したのであるが、臭化エチルと類似、又は同族の有機性臭素化合物及び沃素化合物が、水素の燃焼範圍、殊に其の高極限に對して如何なる作用を有するものなるかを研究するは學術上興味あるのみならず、最も有効なる水素爆發防止劑を探索する上に必要なる知識を與ふるものである。斯の如き考慮から沃化エチル、沃化メチル、臭化エチレン、プロモホルム、臭化メチレン等に就て前報臭化エチルの作用研究と同一裝置及び方法に依り研究を續行した。其の結果に依ると沃化エチル及び沃化メチルは臭化エチルと殆ど同じ程度に水素燃焼の高極限を著しく低下するものである。從て沃化エチル及び沃化メチルの分子を活性化するに必要な火焰温度も亦臭化エチルの場合と同様であることを推定し得るのである。而して臭化エチレン、プロモホルム及び臭化メチレンは臭化エチルに比し水素燃焼の高極限を低下せしむる程度が弱いことを認めた。此のことから斯の如き臭素化合物が水素の燃焼に對して抑制作用を有する影響の大小は其の分子中に於ける臭素原子の數に關係するものでは無く、該化合物の化學的性質に關係するものであることを知り得るのである。