Reduction of Hydrogen Concentration by Particulate Catalysts Installed into Radioactive Waste Storage Containers
(2) Evaluation of Reaction Rates of Particulate Catalysts

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The reaction rate of hydrogen and oxygen of a newly developed particulate hydrogen recombination catalyst for reducing hydrogen concentration in a fuel debris storage container was clarified experimentally.

Keywords: Fuel debris, reaction rate, activation energy, passive autocatalytic recombiner (PAR)

1. Introduction

It was confirmed by our former study [1] that the hydrogen concentration in the radioactive waste storage container can be effectively reduced using the newly developed particulate PAR. Moreover, the effect of various parameters on the reduction of hydrogen concentration was quantitatively investigated. Here, the reaction rate and activation energy of the present PAR were evaluated when that contributes the hydrogen-oxygen recombination reaction.

2. Experimental results

Figure 1 shows the effect of the quantity of catalyst on the measured hydrogen concentration (α) and the estimated reaction rate (ν), which is calculated by Eq. (1).

$$\nu = k \cdot [H_2]^x [O_2]^y \qquad (1)$$

Here, k is the reaction rate constant, H_2 and O_2 is the molecular weight of hydrogen and oxygen, and x and y are the reaction exponents of hydrogen and oxygen [2]. In cases of 6 and 9 PAR, each reaction rate increases rapidly to 2.1 ml/s and then shows a constant value of 1.7 ml/s. In case of 3 PAR, the reaction rate increases gradually in proportion to α until 2500s.

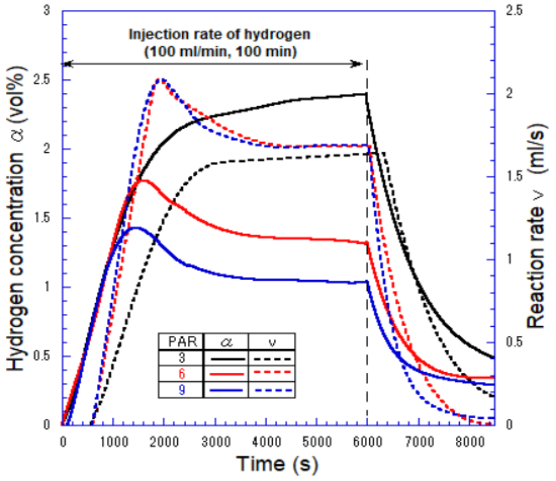

Fig.1 Effect of the quantity of PAR on α and ν

Figure 2 shows time variations of α and ν depending on the initial temperature in the container. The ν shows a maximum value and then reaches equilibrium. When the initial temperature increases, the maximum value of ν also increases. In addition, the activation energy of the present particulate catalyst was estimated quantitatively.

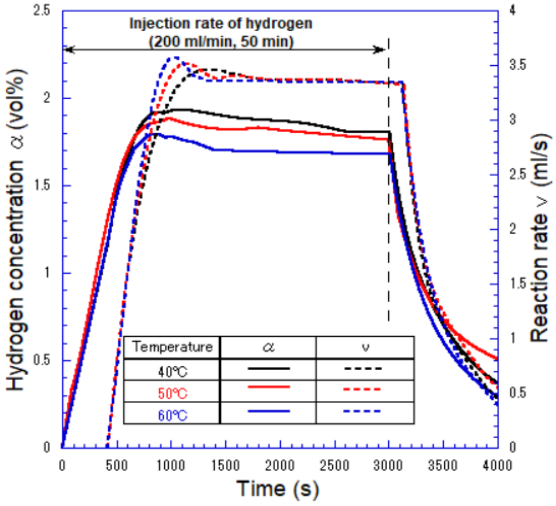

Fig.2 Effect of initial Temperature on α and ν

3. Conclusion

In this study, the reaction rate and activation energy of the particulate PAR were clarified experimentally in order to reduce the hydrogen concentration in the storage container.

References

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