

# Precipitation Behaviors of Palladium, Rhodium and Rhenium with Ascorbic Acid

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## 1. Introduction

Recovery of platinum group metals and transition element such as palladium, rhodium, ruthenium and technetium in SNF are becoming important issues around the world, due to their economic values of noble metals and also radio toxicity of technetium. Precipitation is reportedly one of the possible methods to recover platinum group metals [1]. Especially, an ascorbic acid is reviewed as a promising precipitant for palladium recovery. Also some successful results were reported with relation to the selective precipitation of palladium ion in the simulated fission product solution [2]. However, since most of them are qualitative results with limited data and considering that the purity of noble metal is crucial for its value, quantitative data depending on the various experimental variables are also required. In this study, precipitation behaviors for palladium by ascorbic acid were investigated to obtain the qualitative precipitation data depending on the coexisting ions and other operation variables.

## 2. Results and Discussion

### 2-1. Effect of Stirring Speed and Settling Time

The effect of stirring rate on the precipitation of palladium is shown in Fig.1. The stirring speeds were varied in the range of 800 and 1000 rpm. The stirring time was fixed at 5 min and then settling time was varied. The precipitation is shown to be increased proportional to the settling time and the stirring rates for the given experimental conditions. It shows about 98% of Pd is precipitated by 4mM ascorbic acid which is 10 in reactant mole ratio. Considering that valance of Pd is equivalent to that of ascorbic acid, the reactants are excessively consumed. Even though the 98% is not enough, from the qualitative point of view, the optimum conditions for stirring speed and settling time could be determined at 1000 rpm and 60 min, respectively.

### 2-2. Effect of Pd Initial Concentration and Reactant Mole Ratio on the Precipitation of Pd

Figure 2 represents precipitation behaviors according to the mole ratio of a precipitant to palladium for the different initial concentrations of palladium. It shows that the precipitation of palladium is greatly affected by the initial concentration. In the case of 200 ppm,

palladium is precipitated more than 99% with the mole

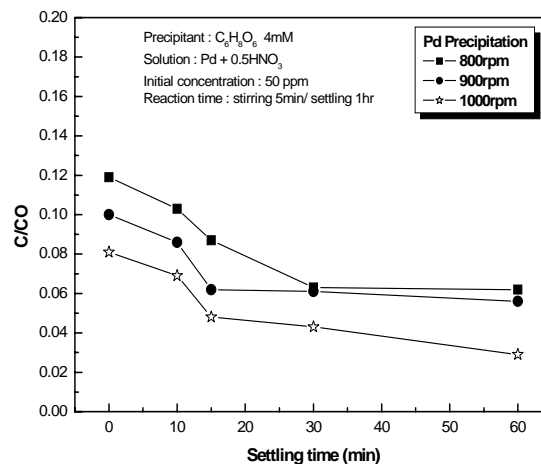


Figure 1. Effect of settling time and stirring speed on the precipitation of Pd

ratios of about 3.2 and 6.3 for 100 ppm. On the other hand, in the case of 50 ppm, it requires mole ratio of almost 20 for 99 % precipitation. From this result, we could see that the precipitation of Pd increase with the initial concentration, which might be due to the effect of co-precipitation with the pre-precipitated palladium metals.

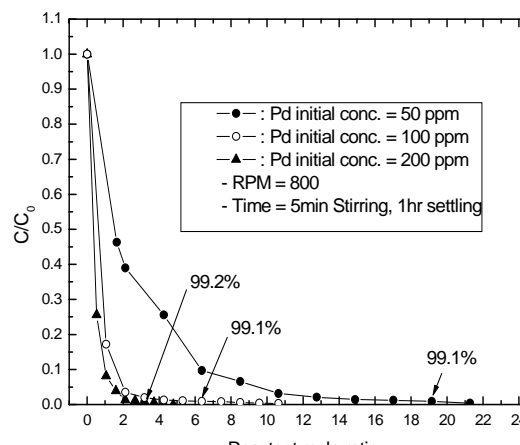


Figure 2. Effect of mole ratio on the precipitation of palladium for the different stirring speeds.

### 2-3. Effect of Nitric Acid Concentration

The precipitation of palladium is reportedly affected by the nitric acid concentration, obviously due to the dissolution reaction of palladium metal with the acid. Figure 3 shows the effect of nitric acid concentration on the precipitation behaviors. The nitric acid

concentrations were varied in the range between 0.5 M and 3M. It shows that the precipitation is decreased with the nitric acid concentration increase. If the nitric acid concentration is 3M, only 70% of the palladium is precipitated for the mole ratio of more than 20. It means that the dissolution reaction for palladium metals increase with the nitric acid concentration. It also means that for obtaining more than 99% recovery the concentration of nitric acid should be less than 0.5M.

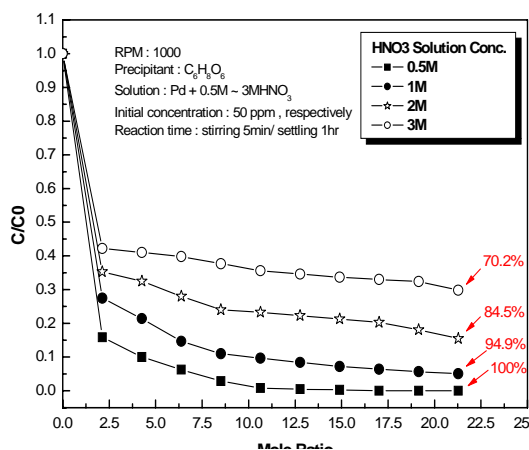


Figure 3. Effect of nitric acid concentration on the precipitation of palladium.

#### 2-4. Effect of Co-existing Ions on the Precipitation of Palladium

Originally palladium ions are generated together with other fission products and some transition metals. Here the precipitation behaviors of palladium were investigated for the mixed solutions of rhodium and rhenium which is substitute for technetium, and the result is represented in Fig. 4. .

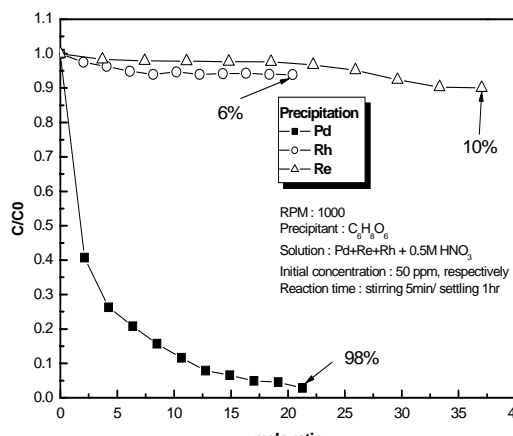


Figure 4. Effect of mole ratio on the precipitation of palladium for the mixed solution of rhodium and rhenium.

In this experiment, the initial concentrations of the three metal ions were 50 ppm, respectively. That is the reason that the mole ratios of the three components are

different from each other. The result shows that the palladium is precipitated selectively over the rhodium and rhenium ions. In the case of palladium, 98% of precipitation is obtained for the mole ratio of 20. While, in the case of rhodium and rhenium, only less than 10 percent is precipitated. However, taking into account the purities in palladium metals, the rhodium and rhenium metals which were contained in the palladium metal would be a great amount. Therefore it is necessary to improve the selectivity for palladium for getting a highly pure palladium.

### 3. Conclusion

Precipitation study was performed to recover a palladium in nuclear waste solution. Precipitation behaviors were found to be affected by the stirring speed, mole ratio, nitric acid, palladium initial concentration and co-existing cations. Also high recovery of palladium was possible by using ascorbic acid. However, for getting a high purity palladium, additional measures are also required.

### REFERENCES

- [1] Jung, et al., "Development of Radioactive Platinum Group Metal Catalysis", KAERI/RR-1884/98
- [2] You, et al., "Development of Long-Lived Radionuclide Partitioning Technology", KAERI/RR-1632/95.