Transactions of the Korean Nuclear Society Autumn Meeting
Gyeongju, Korea, October 25-26, 2012

Dispersion Characteristics of PAA(Polyacrylic acid) for Tube Fouling Control of Secondary System in Nuclear Power Plant

H. C. Kwon[a], K. B. Sung[a], H. Y. Yang[a] , W. Y. Maeng[b*],
[a]*Korea Hydro & Nuclear Power Co., LTD, 1312, Yuseong-daero, Yuseong-gu, Daejeon,305-343, Korea*
[b]*Korea Atomic Energy Research Institute, DukJin-Dong 150, Yuseong, Daejeon, Korea*
[*]Corresponding author*:* *wymaeng@kaeri.re.kr*

1. Introduction

Corrosion products induce the material degradation in the secondary system and depress the thermal performance of the power plants. Dispersant injection was applied to reduce the accumulation of the corrosion products in some foreign PWRs [1]. Polyacrylic acid (PAA) is considered as a dispersant in a domestic power plant. This study is to evaluate the settling behavior of magnetite power and the dispersion efficiency of PAA dispersants in various conditions.

2. Methods and Results

2.1 Settling tests

Dispersion efficiency is tested using a settling test procedure. A colloidal suspension of the corrosion product oxide (30, 50 ppm magnetite), containing the dispersant (PAA) at the desired concentration was prepared. 10 ppb, 100 ppb, 1000 ppb PAA in the water solution (>17 MΩ) were tested to compare the settling behavior at room temperature. The particle size of the magnetite (Fe_3O_4, SIGMA-ALDRICH, USA) is about 20~30 nm. The pH was controlled at 9.7~9.8 by using ETA.

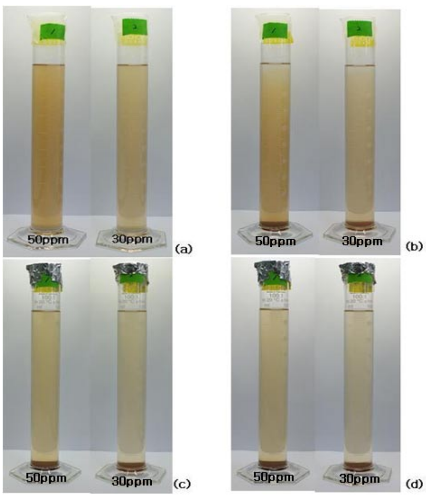

Fig. 1. Settling test results for different magnetite concentration in 100 ppb PAA solution. (a)just after dispersion, b)24h, c) 7 days, d)14 days suspension.)

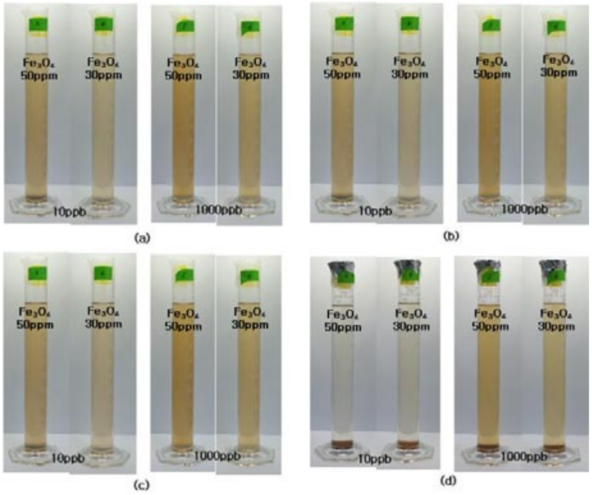

Fig. 2. Settling test results for different PAA concentration (10 & 1000 ppb). (a)just after dispersion, b)3h, c)24h, d)7 days suspension.)

Fig. 3. Settling test results as a function of PAA concentration (PAA: 10, 100, 1000 ppb, 50 ppm magnetite, 7 days suspension)

In fig. 1, almost magnetite suspension was settled after 14 days, though more powders seem to be remain suspended for the 50 ppm magnetite solution. To compare the effect of dispersant concentration, settling tests were conducted for the solution of different PAA concentration of 10 ppb~1000 ppb. It is clear that the higher PAA concentration solution have the higher capacity of suspension of magnetite powders in water solution if we observe the trend in fig. 2 and in fig. 3. The dispersion efficiency increases as the PAA concentration increases. The amount of the suspended magnetite in 10 ppb PAA solution is much less than in 1000 ppb PAA solution after 7 day suspension tests.

2.2 Dispersion stability tests

Dispersion stability tests were conducted with turbi-scan apparatus. The effect of PAA molecular weight on the dispersion stability is shown in fig. 4. It is considered that PAA 1800 is the most stable dispersant based on the light transmittance data in fig.4.

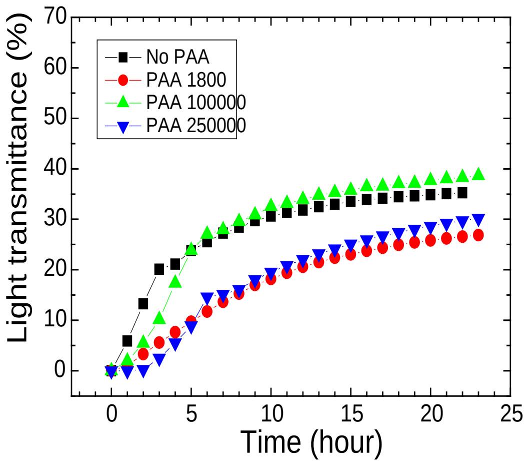

Fig. 4. Dispersion stability of various PAA (molecular weight: 1800~250,000, 1 ppm PAA, 0.05wt% magnetite, pH 9 solution)

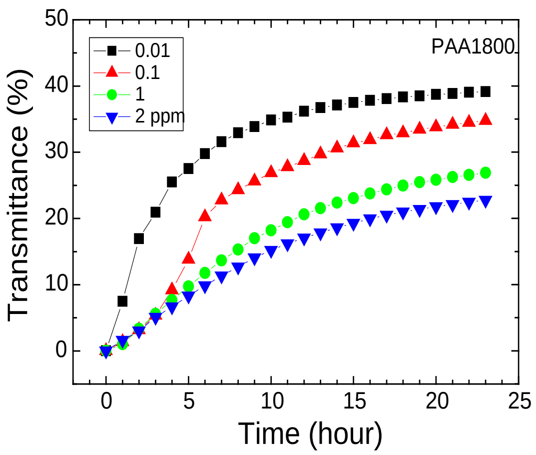

Fig. 5. Dispersion stability of PAA 1800 for various concentration of dispersants (PAA: 0.01 ~ 2 ppm, 0.05wt% magnetite, pH 9 solution)

Dispersion stability of PAA 1800 for various PAA concentrations is shown in fig. 5. Transmittance increases as the PAA concentration decreases. Based on the results in fig. 5, PAA influences the dispersion stability of magnetite power and (it seems) PAA can be applied to control fouling of secondary system of power plants.

2.3 Thermal decomposition of PAA

PAA dispersant decomposes into organic acid in high temperature. The thermal decomposition behavior is showed in Table 2. Main decomposed organic acid is acetic acid, but the effect of PAA injection in not clear.

Table 2. Thermal decomposition of PAA

Species	Without PAA (ppm)				With PAA			
	25℃ 0h	300℃ 72h	300℃ 120h	300℃ 168h	25℃ 0h	300℃ 72h	300℃ 120h	300℃ 168h
Acetate	<0.1	2.62	2.11	5.24	<0.1	0.68	1.43	1.44
Formate	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Glycolate	<0.1	0.31	<0.1	<0.1	<0.1	0.72	<0.1	1.31

3. Summary

The PAA addition increases the dispersion efficiency of magnetite. As PAA concentration increases, the amount of the suspended magnetite increases.

Dispersion stability increases as the PAA concentration increases. Based on the test results, PAA influences the dispersion stability of magnetite power and (it seems) PAA can be applied to control fouling of secondary system of power plants.

REFERENCES

[1] EPRI 1015020, Dispersants for Tube Fouling Control, Volume 5: PWR Application sourcebook, 2007