The First Application of CPP Amine-form Operation in OPR Plant

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1. Introduction

Hanul Unit 6 has recently experienced a slight decrease in power output possibly due to the FW venturi fouling phenomenon. It is highly considered that an increase of iron oxides in the secondary system has an impact on this issue. Therefore, it is extremely important to minimize iron concentration in the FW system. To do so, it is desirable to maintain as high pH as possible in the secondary system by increasing the injection amount of amine used as pH adjusting agents(such as mono-ethanolamine(ETA), ammonia(NH_3)[1]. But this may lead to shortened period of CPP demineralizer use. In order to solve this problem, the amine form operation of CPP is applied in Hanul Unit 6, which is the first case to be operated in KHNP OPR NPP to perform a better water quality management in a more stable and efficient way under high pH operation conditions in the secondary system.

2. Methods and Results

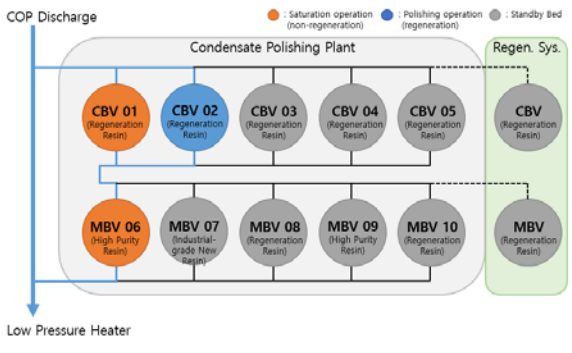
2.1 Ion Exchange Resin

The general industrial grade of cation exchange resin(H form) was used as the Cation Bed Vessel(CBV). And the high-purity grade of ion change resin was used as the Mixed Bed Vessel(MBV).

2.2 Operation Method

Two CBVs and one MBV were in-serviced during application period. One of the CBV was operated with saturated by amines(ETA/NH_3) at a flow rate of 500m^3/hr for about 2 months and another CBV was 50m^3/hr for water purification, and then brought up to a flow rate of 550m^3/hr for CPP amine form operation.

Figure I: CPP amine saturation operation diagram



2.3 Water Chemistry

The water quality conditions were set as target values that satisfies the FSAR reference values and the WANO Chemistry Performance Indicator(CPI) values. Six representative points were selected for water quality analysis in consideration of various environmental conditions in the secondary system during the CPP amine-form operation, and behaviors of chemical parameters such as iron(Fe) concentration, pH, total conductivity and chemical additives (ETA, NH_3, N_2H_4) were evaluated.

2.4 Result

The FW pH has risen to 9.85 and has been stably maintained, while the iron concentration has decreased to 1~1.5 ppb and has been well maintained.

3. Conclusions

CPP amine form operation procedure was developed and a trial operation was carried out in Hanul Unit 6 for the first time in KHNP OPR NPP. As a result, the pH value in FW system was maintained at the range of 9.8~9.9 and the impurities concentration (sodium, chloride, sulfate, etc) in the steam generator was also kept stable within the target value. As seen in table I, the usage of Regenerative Chemicals(sulfuric acid, sodium hydroxide) has significantly dropped by 85% due to a decrease in the count of resin regeneration and the used pH Agent, ETA, has also been reduced by 79%. These results show the CPP amine form operation highly effective as intended.

Table I: Comparing amine form operation (for 4 months)

		Before	After	Rate
Cation resin regeneration (m^3)	Times	15	2	87% ▽
	Wastewater	4408	678	85% ▽
	Sulfuric acid	25.1	3.5	86% ▽
	Sodium hydroxide	27.6	3.8	86% ▽
Chemical additive Feed (m^3)	Mono-ethanolamine	19.9	4.1	79% ▽
	Hydrazine Hydrate	7.9	3.5	56% ▽

REFERENCES

[1] EPRI, Palo Alto, CA: 2017. 3002010645, Pressurized Water Reactor Secondary Water Chemistry Guidelines, Revision 8