THE EFFECT OF ACTIVATED CARBON INJECTION RATE TO DIOXIN EMISSION LEVEL IN AN INCINERATOR SDA+B/F APC

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Introduction

Dioxins are one of the most toxic and persistent human-made organic chemicals and their density increase in the natural world by incineration of chlorinated carbons and other chemicals[1]. As Incineration rate of waste has increased, treatment of incineration emissions is becoming more important issue. Activated carbon injection has been identified as the Best Available Control Technology (BACT) for the removal of dioxins, mercury and other VOCs from municipal, industrial and other waste incinerators flue gas streams. Since 1991, activated carbon adsorption has been widely adopted for dioxin removal from municipal and other waste incinerators in Europe and Japan[2]. Research results showed that A/C injection has a significant effect on dioxin removal[3]. Particles like fly ash are known to have an effect on dioxin removal without activated carbon as well. There are a number of ways to use activated carbon in flue gas treatment. Powdered activated carbon (PAC) can be added alone or in conjunction with lime used for acid gas treatment. Due to the lack of experiences, there are still left some aspects to improve the operating parameters of incinerator and gas treatment facility. In this study, an effort has been given to determine optimal condition for the removal of dioxins at SDA (spray drying absorber)+B/F (bag filter) with activated carbon injection in terms of injection rate and system operational conditions.

Experimental methods and test procedure

Tests were done at a pilot plant which consists of a system to treat 2,000 m^3/h actual gas flow out of 40,000m^3/h exhaust gas from a real incinerator with capacity of 200 tons/day. The PCDD/F measurements were performed at SDA inlet and B/F outlet. PCDD/Fs sampling, clean up and quantification were conducted following the Korean standard testing method for Dioxins. As a part of this study, two important aspects were mainly investigated; 1) Dioxin removal effect without and with A/C injection, 2) Optimal A/C injection rate in the SDA+B/F system of a pilot plant connected to a real incinerator.

Results and Discussion

1 Dioxin removal effect without and with A/C injection

The purpose of the testing was to evaluate the levels of reduction achievable for both without and with activated carbon injection at SDA+B/F system. Test results of PCDD/Fs levels are summarized in Table 1 in TEQ values. The results with A/C injection make it clear that the emission limit value (0.1ng-TEQ/ Nm^3) is clearly satisfied, with an average of 0.05ng-TEQ/ Nm^3 corrected to 12% O_2 concentration. Without A/C injection, average removal efficiency from three test runs was 58.9%, indicating that particles (dust + lime slurry) themselves have some removal

effect of dioxins. Average removal efficiency from three test runs with A/C injection was, on the other hand in 96.3%, showing that the use of A/C injection is an effective way for reducing emissions of dioxins. Also, the similarity of PCDD/F isomer patterns found without and with A/C injection for SDA Inlet and B/F Outlet sample results.

Table 1. Dioxin removal efficiency without and with A/C

A/C	Test No.	Concentration (ng-TEQ/Nm^3)		Removal Efficiency (%)	
		SDA Inlet	B/F outlet		Average
Without A/C Injection	Run 1	1.64	0.62	62.2	58.90
	Run 2	1.57	0.56	64.3	
	Run 3	1.75	0.87	50.3	
With A/C Injection	Run 4	1.82	0.04	97.8	96.3
	Run 5	1.95	0.03	98.5	
	Run 6	1.06	0.08	92.5	

2 Determination of optimal A/C injection rate

To decide optimal A/C injection rate, dioxins concentration results are summarized in Table 2 and Figure 1 for all tests of injection rate change. As A/C injection rate increased, dioxin emission decreased sharply up to 100mg/Nm^3 A/C injection rate, but showed no significant change in dioxin level at higher A/C injection rate, indicating that optimal A/C injection rate is estimated around 100mg/Nm^3. The isomer pattern of dioxins as A/C injection rate was shown Figure 2. In the case of PCDFs, it decreased proportionally in flue gas as A/C injection rate increased, but it was different in the case of PCDDs. Therefore, dioxin removal by A/C injection seems more effective for PCDFs than PCDDs. For the behavior of dioxins with the change of bag pressure, dioxin emission in B/F flue gas and fly ash was measured at the same time. A/C was injected between SDA and B/F duct as same A/C type and about similar injection rate of 100 mg/Nm^3. The result was summarized in Figure 3. For the bag pressure change experiment, dioxin emission in B/F flue gas decreased and that in B/F fly ash increased as the bag pressure increased.

Table 2. Concentration of dioxins for A/C injection rate change

Test No.	A/C Type	A/C Inj. Method	A/C Inj. Rate (mg/Nm^3)	Bag Pressure (mmH_2O)	Concentration (ng-TEQ/Nm^3)	
					Flue Gas (B/F Outlet)	Fly Ash (B/F Hopper)
Run1	B	powder, duct injection	22	160-170	0.189	-
Run2	B	"	27	120-130	0.382	-
Run3	C	"	67	-	0.160	-
Run4	B	"	93	110-120	0.184	1.82(1.175)*
Run5	B	"	95	192-198	0.113	3.50(2.253)*
Run6	C	"	95	-	0.284	-
Run7	B	mixing with lime slurry	100	205-212	0.136	-
Run8	B	"	105	210-218	0.060	-
Run9	B	powder, duct injection	110	120-120	0.137	3.50(2.241)*
Run10	B	"	119	170-183	0.079	-
Run11	B	"	136	135-140	0.086	-
Run12	B	"	183	190-200	0.141	-

Run13	B	"	336	200-210	0.127	-
Run14	B	"	411	148-149	0.084	-
Run15	B	"	507	130-130	0.197	-
Run16	B	"	600	200-210	0.121	-

Remark] *: Dioxin concentration unit in( ) is ng-TEQ/g solid

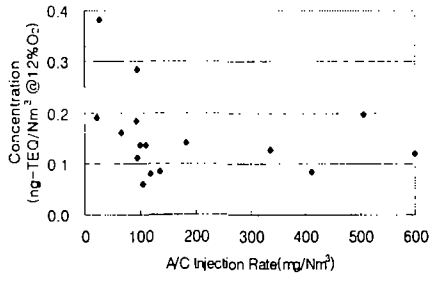


Fig. 1 Concentration of dioxins for A/C injection rate change

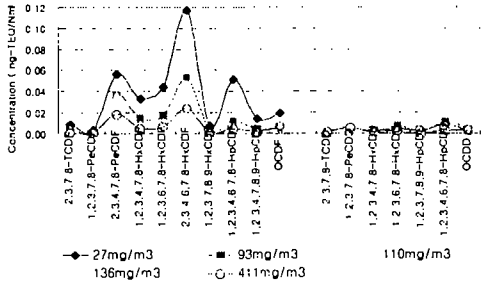


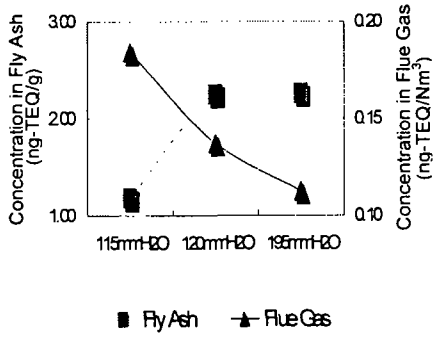
Fig. 2 The isomer pattern of dioxins in flue gas for A/C injection rate change

Conclusion

As A/C injection rate increased, dioxin emission decreased sharply up to 100 mg/Nm^3 A/C injection rate, however, showed no significant change in dioxin level at higher A/C injection rate, indicating that optimal A/C injection rate is estimated around 100 mg/Nm^3. As A/C injection rate increased, PCDFs level decreased proportionally in flue, however, PCDDs level was lowered at less efficient way, showing that dioxin removal by A/C injection seems more effective for PCDFs than PCDDs.

For bag pressure change experiments, dioxin emission in B/F flue gas and fly ash was measured at the same time. As the bag pressure increased, dioxin emission in B/F flue gas decreased and that in B/F fly ash increased, which is considered due to a possible collection mechanism at the bag filter surface like bridging effect with thicker dust cake.

Fig. 3. Concentration of Dioxins in flue gas and fly ash for bag pressure change



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