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Volume Reduction of Decommissioning Burnable Waste with Oxygen Enrich Incinerator

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1. Introduction

The incineration technology is an effective treatment method that contains hazardous chemicals as well as radioactive contamination [1]. Incinerator burns waste at high temperature. The volume reduction of the combustible wastes through the incineration technologies has merits from the view point of a decrease in the amount of waste to be disposed of resulting in a reduction of the disposal cost. Incineration is generally accepted as a method of reducing the volume of radioactive waste. The incineration technology is an effective treatment method that contains hazardous chemicals as well as radioactive contamination. This paper covers the general facility operation of an oxygen-enriched incinerator for the treatment of decommissioning wastes generated from a decommissioning project. The combustible wastes have been treated by the utilization of incinerator the capacity of the average 20 kg/hr.

2. Facility Description

2.1 Incineration facility

Fig. 1 shows a process diagram of Oxygen-Enriched Incineration (OEI). The system consists of a waste preparation system, an incineration system, an off-gas cooling system, and an off-gas treatment system. The off-gas treatment method is generally divided into wet and dry methods. Off-gas system was adapted to a dry system with air dilution and filtration. Special considerations have been incorporated into the design of the system for the treatment of problematic wastes. These problematic wastes can generally be described as heterogeneous wastes of varying physical descriptions, densities, and compositions, including all kinds of combustible, organic wastes and high chlorine content materials. Before the incineration, all wastes were classified by local worker. The off-gas measuring and monitoring system (TMS) and radionuclide measuring system (i-CAM) are installed in a stack. A small amount of materials generated from the burning waste, however, will be released as undesirable air emissions. Regulations limit the allowable emissions that can be discharged from a stack into the atmosphere. Where the emissions leaving an incinerator exceed the allowable stack emissions limit, control equipment for the air emissions must be provided to clean the exhaust gas before discharge into the atmosphere. TMS was designed to measure the total suspended particulate (TSP), CO, HCl, O_2, NOx, and SOx contents after passing through the air pollution control system.

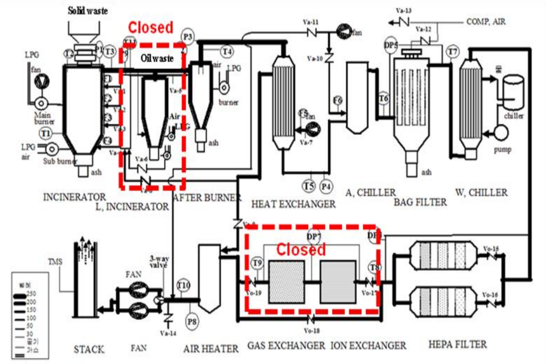

Fig. 1. A schematic diagram of an incineration facility

2.1 Waste material

The main materials of incineration radioactive waste consist of contaminated lumber, paper, cotton, cloth, gloves, vinyl, and PVC. A summary of incineration material is shown in **Table 1**.

Table 1. Incineration material

Materials	Amount (kg)	Ratio (%)
Lumber, paper	45.0	90
Cotton, Cloth, Glove	3.5	7
Vinyl	0.25	0.5
PVC	1.25	2.5
Total	50	100

The wastes are processed through the upper position of the incinerator using two sliding gates (**Fig. 2**). The combustible waste was packed using a paper bag. The weight of the single packages of lumber, cotton, vinyl, PVC, and mixed waste were around 1.5 kg. After incinerating the radioactive waste, bottom and fly ash collected at different units was used to estimate the volume and weight reduction ratio.

Fig. 2. Waste classification and feeding

3. Results and Discussion

3.1 Temperature

Fig. 3 shows the incinerator temperature. The incinerator has a sub burner for preheating and a main burner for incineration. The normal operating condition of OEI is 800℃−1000℃. The thermal destruction of most organic compounds occurs between 590℃ to 650℃.

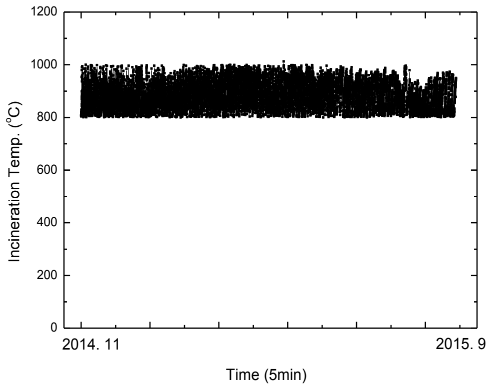

Fig. 3. Normal operation temperature of incinerator

3.2 Offgas

Fig. 4 shows the sulfur oxide (SOx) concentration. SOx concentration remained below about 5 ppm range during facility operation. According to notice of nuclear safety and security commission, Regulatory limit in Korea of SOx is 300 ppm (corrected to 12% oxygen). The nitrogen oxide (NOx) concentration remained below 10 ppm (**Fig. 5).**

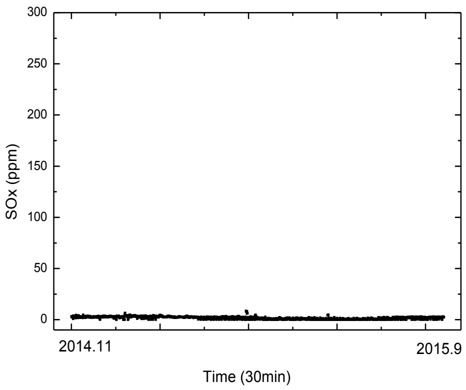

Fig. 4. Sulfur oxides concentration in stack

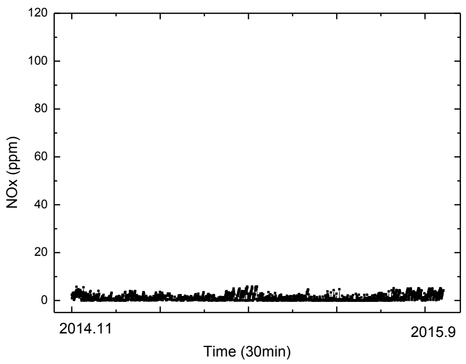

Fig. 5 Nitrogen oxide concentration

3.3 Emission concentration of radionuclides

The emission concentration of alpha (α) and beta (β) radionuclide in stack by iCAM is shown in **Fig. 6** and **Fig. 7**. An α and β radionuclide measurement line shows the current dose rate as measured by the external detector, and the current unit of measurement. The measured α and β radionuclide activities are less than 0.04 Bq/m^3 and 0.8 Bq/m^3 during facility operation. The regulatory limit is 0.1 Bq/m^3 and 0.4 Bq/m^3 for α-nuclide and β-nuclide, respectively. The concentration of radionuclide was well controlled to below the regulatory limit.

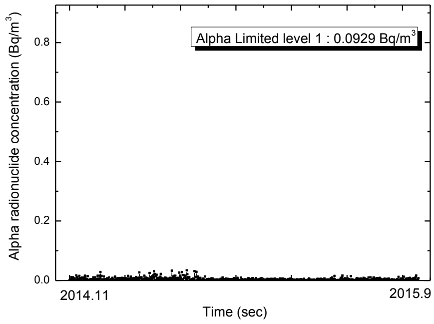

Fig. 6. Alpha radionuclides concentration.

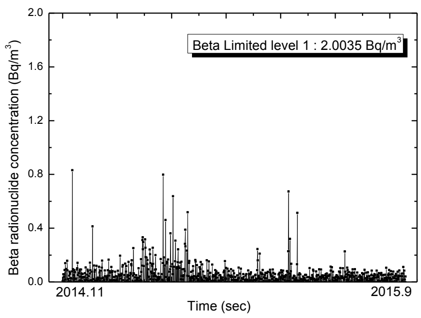

Fig. 7. Beta radionuclides concentration.

4. Conclusions

The decommissioning combustible waste of about 31 tons has been treated using Oxygen Enriched incinerator by at the end of 2016. The off-gas flow and temperature were maintained constant or within the desired range. The measured gases and particulate materials in the stack were considerably below the regulatory limits. The incineration facility was verified as one of the most effective technologies for a volume reduction. Hazardous and decommissioning combustible wastes were treated safely during the incineration facility operation.

REFERENCES

[1] C. R. Brunner, and P.E., Dee, Incinerator System Air Emissions Control, POHengineer.com, Course No. EN-3007, 2012