Intelligent complex control technology for nitrogen oxide in combustor

Hybrid Intelligent Nox Control in Combustion System

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Patent title Combustion gas processing system and method using multi-stage combustion gas recirculation

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Authority status Registered

Technicality

Technology overview

A combustion gas treatment system is a denitration technology which complexly controls and removes harmful substances such as nitrogen oxides, sulfur oxides, and nitrous oxides generated in a process of combusting fossil fuels or wastes for the production of electricity or renewable energy, and is a technology which dramatically reduces the concentration and total amount of combustion gases emitted into the atmosphere.

Development background and problem to be solved

- A selective non-catalytic reduction (SNCR) system and a selective catalytic reduction (SCR) system, which are representative methods for reducing nitrogen oxides, require a large space and a long residence time for the reaction of a combustion gas with a reducing agent to stably remove nitrogen oxides. However, there are disadvantages such as damage to a spray nozzle or clogging of the inside of the nozzle.
- Therefore, a suitable space and a reaction time for the denitrification treatment are required, and a technology capable of protecting a spray device and free from problems such as clogging of a nozzle is required.

Excellence and discrimination of technology

▶ Excellence of technology

- A part of a discharge combustion gas is recirculated and injected into a combustion chamber or a selective catalytic reduction (SCR) device.
- A recirculation technology individually mixes combustion gases with different temperatures through multiple paths.
- Simultaneous injection of a nitrogen oxide removal reducing agent and a sulfur oxide removal desulfurization agent enables simultaneous desulfurization and denitrification.
- Nitrogen oxide removal efficiency is improved by spraying a thermally decomposed gaseous reducing agent together with a recirculated combustion gas into a combustion chamber.
- A post-processing process for simultaneous removal of nitrogen oxide and nitrous oxide is minimized.

▶ Discrimination of technology

- Air discharge concentrations and total amounts are reduced.
- A drug usage amount is minimized.
- Operational variability is reduced, and an energy collection function is strengthened.
- A zero emission system of nitrogen oxide (NOx), which is a core material that causes ultrafine dust, is implemented.
- There is a capability to apply various facilities by complex control/removal functions.

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Implementation method

According to the present invention,

- a combustion system comprises a combustion chamber, a selective catalytic reduction (SCR) device disposed at the rear end of the combustion chamber, and a cleaning unit.
- A combustion gas recirculation system extracts a part of a combustion gas discharged from the combustion chamber and supplies the same back to the combustion chamber.
- A combustion gas discharged from an SCR device is partially extracted from multiple paths passing through the cleaning unit, and a reducing agent for removing nitrogen oxides and the extracted combustion gas are sprayed into the combustion chamber to perform denitrification.

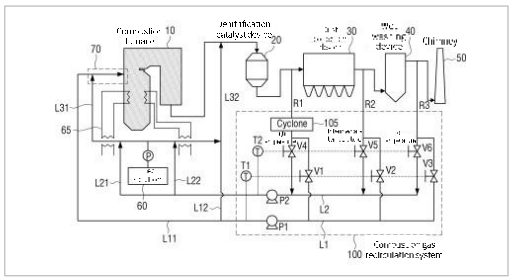

Figure 1 Combustion gas processing system using multi-stage combustion gas recirculation

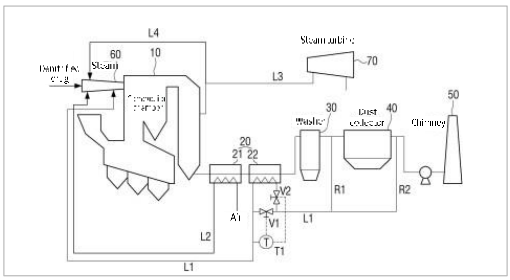

Figure 2 Nitrogen oxide removal system

Degree of technology completion (TRL)

Degree of technology completion: TRL7 (quasi-commercial product development stage)

TRL1	TRL2	TRL3	TRL4	TRL5	TRL6	TRL7	TRL8	TRL9
Technical principle presentation	Technology concept setting	Technology concept verification	Lab Scale prototype development	Implementation environment application experiment	Full Scale prototype development	Quasi-commercial product development	Commercial product development	Commercial product implementation

Utilization

Utilization field and applied product

Utilization field

- Renewable energy environment facility (waste incinerator)
- Thermal power plant denitrification facility
- Chemical facility

Figure 1 Thermal power plant denitrification facility

Applied product

- Selective non-catalytic reduction system (SNCR)
- Selective catalytic reduction system (SCR)
- Flue gas recirculation (FGR)
- Air staging

Figure 2 Waste incinerator

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Technology trend

- As interests in an air environment, such as fine dust issues and severe smog in the city, increases, a process technology for realizing a clean air environment has become very important. Substances such as nitrogen oxides (NOx) and sulfur oxides (SOx) are discharged into the atmosphere from industrial facilities such as incinerators, thermal power plants, combustion processes of fossil fuels, and chemical plants.
- Selective non-catalytic reduction (SNCR) and selective catalytic reduction (SCR) methods are most often applied as denitrification technologies for removing nitrogen oxides.
- In the case of exhaust gas desulfurization and denitrification technologies, Japanese companies such as Mitsubishi Heavy Industries, Hitachi Heavy Industries, Kawasaki Heavy Industries, and Chiyoda Engineering had high technological competitiveness in the world.
- In Korea, large corporations such as Hyundai Heavy Industries, Doosan Heavy Industries & Construction, Samsung Heavy Industries, POSCO ICT, and KCT Cottrell are taking the lead in building large-scale air pollutant treatment facilities such as thermal power plants and steel mills.

Family patent status

Application nation	Application No. (Application date) / Registration No.	Title of the invention
KOR	KR 10-2017-0054144(2017.04.27) / 10-1957450(2019.03.06)	Combustion gas processing system and method using multi-stage combustion gas recirculation
KOR	KR 10-2018-0132921(2018.11.01) / 10-2068334(2020.01.14)	Nitrogen oxide processing system using pyrolysis method of reducing agent
KOR	KR 10-2019-0142034(2019.11.07) / 10-2116352(2020.05.22)	System and method for simultaneous removal of nitrogen oxide (NO_x) and nitrous oxide (N_2O) using reducing agent

Market prospect

Target market size and prospect

The size of the global market related to air pollution prevention facilities is expected to grow from USD 67,420 million in 2016 to USD 86,883 million in 2021 at a CAGR of 5.2%. In the market, denitrification facilities account for 20%. In the domestic air industry market, the manufacturing and construction industry of facilities for controlling air pollutants is very large, accounting for 89% of the total market and reaching about 5 trillion won.

(Unit: million dollars,%)

Division		2016	2017	2018	2019	2020	2021	CAGR
Air pollution prevention facility	Desulfurization facility	18,613	19,562	20,560	21,608	22,710	23,868	5.1
	Denitrification facility	13,769	14,443	15,151	15,893	16,672	17,489	4.9
		14,168	15,060	16,009	17,018	18,090	19,230	6.3
	Bag filter	12,957	13,644	14,367	15,128	15,930	16,774	5.3
	Scrubber	4,619	4,817	5,024	5,240	5,466	5,701	4.3
	Other	3,295	3,394	3,496	3,601	3,709	3,820	3.0
Total		67,420	70,921	74,607	78,489	82,577	86,883	5.2

Table World market size by type of air pollutant prevention equipment

<Data: SME Technology Roadmap (2018-2020)_Energy >

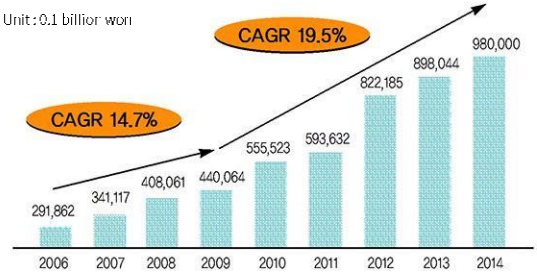

Figure Domestic environmental market growth status

<Data: Today Energy>

Technology transfer query

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Technology transfer process

Explore promising technologies → Contract consultation → Apply for technology transfer → Negotiate and sign contracts → Follow-up support