SNCR (Selective Non Catalytic Reduction)

The modern society needs a lot of energy. The energy needed by society is mostly heat energy and is mostly gained through oxidization of organic materials. Due to the oxides of organic materials, many types of atmospheric pollutants occur.
Of these, the characteristics of nitrogen oxide (NOX), unlike other pollutants such as SOX and CO, are produced by combustion air even if there is no nitrogen component in the raw material. Of these, nitrogen oxide produces secondary pollutants due to photochemical reactions and is one of the main materials of the city's atmospheric pollution.

The nitrogen oxides due to combustion are usually emitted in the form of NO and NO changes to rufous NO2 in the atmosphere. Although NO toxicity is comparatively weak, NO2 has 5-10 times more toxicity than NO. It damages respiratory organ cell at high concentration and by integrating with hemoglobin in the blood, creates breathing difficulty. To add, it is also the cause of acid rain and as the main cause of photochemical reaction, increasing the ozone concentration of the atmosphere. It also produces secondary pollutants such as PAN and aldehyde and induces photochemistry smog.

As reduction methods of nitrogen oxide of emission source, fuel improvement and combustion control technology exist, but fuel improvement is not economically feasible and as high temperature combustion for complete combustion is essential for combustion control, control of more than a certain concentration is difficult.

The nitrogen oxide emitted in the emission source can be classified into Thermal Nox, which occurs by nitrogen oxidizing in the combustion air, Prompt Nox, which occurs during combustion of hydrocarbon fuel and Fuel Nox, which occurs due to oxidization of fuel's nitrogen substance being oxidized by oxygen. Of these, Thermal Nox becomes the main emission cause.
The NO emission concentration of power plant is about 250~500ppm and the temperature of exhaust gas coming out from the combustion chamber is about 1130~1230 degrees. SNCR makes the reductant and nitrogen oxide reacts in such high temperature area. This refers to reducing to nitrogen and moisture.

Reaction of Removing Nitrogen Oxide Being Emitted from the Emission Source

Wet Technique	Dry technique
- There is wet cleaning method, oxide absorption method, liquid reduction method - Nox and Sox can be removed at the same time - It has advantage of not being influenced by particle material of flue gas - A lot of investment and operation costs are needed - There is a problem of having to dispose of waste water	- Catalytic reduction method (SCR), non-catalytic reduction method (SNCR), absorption method, electron beam investigation method - Investment and maintenance costs are lower compared to wet technique - It has the advantage of simple process and high NOX removal rate - Also, it is appropriate for large capacity Nox removal process - It has the advantage of not needing waste water disposal - It is greatly influenced by dust included in the exhaust has - It has disadvantage of having a high possibility of emitting by products such as ammonium sulfate ((NH4) 2S04) or ammonium bisulfate (NH4HS04)

About SNCR

- By injecting ammonia (NH3), Urea (Urea-NH2CONH2) or other reduction materials at 800~1100 degrees, high temperature is needed to reduce Nox.
- Therefore, it is directly inserted to the back of the boiler. The nitrogen oxide of combustion gas is reduced to non-harmful nitrogen in non-catalytic state. It is done selectively at high temperature and at reductant being injected through the nozzle of the SNCR.
- A constant temperature control is possible. Ammonia does not react at low temperature and it flows out. The ammonia is oxidized to nitrogen monoxide and efficiency is reduced.
- Without the use of catalyst, nitrogen oxide in the high temperature combustion gas reacts selectively with urea that contains amino group (NH2). It decomposes it to N2 and H2O and uses the principle of removing it.
- Nox reduction of about 50%
- If too much reductant is used, non-reactive ammonia reacts with hydrogen chloride of flue gas. If white lead of ammonium chloride occurs, one must be careful.
- As problems, the temperature is too low and non-reactive ammonia is made. If temperature is too high, nitrogen monoxide is produced.

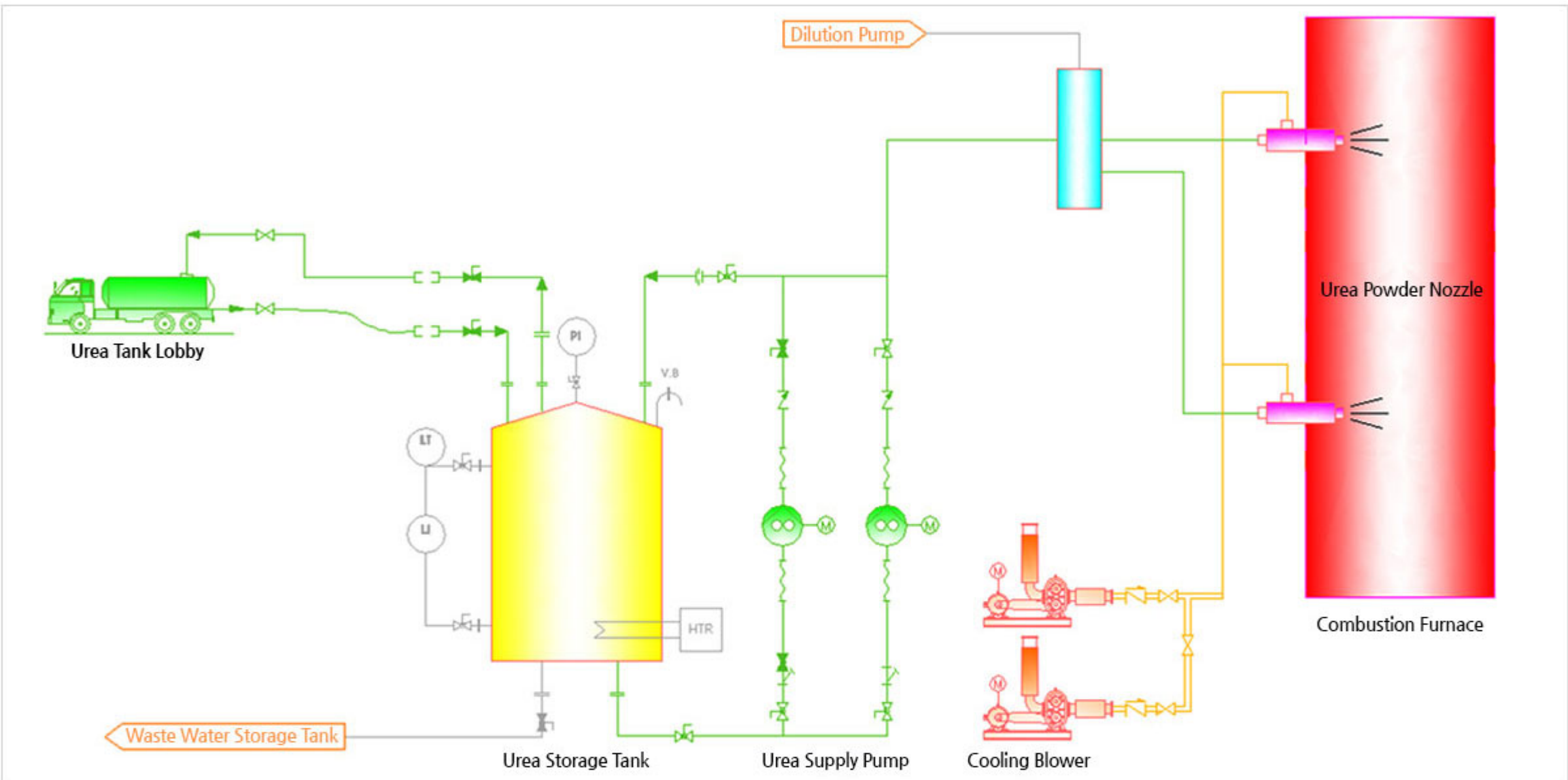
Ammonia : $4NO + 4NH_3 + O_2 \rightarrow 4N_2 + 6H_2O$
Urea : $2No + (NH_2)_2CO + 1/2O_2 + 2N_2 + 2H_2O + CO_2$

Advantages and Disadvantages of SNCR

Advantages	- Cheap installation costs - Only small site needed - Catalyst not needed
Disadvantages	- -A lot of difficulties in operation such as injection of appropriate amount of NH3 and maintenance of appropriate reaction temperature - As high temperature is needed for reaction, the applied scope is narrower than SCR - As catalyst is not used, high temperature (900 degrees or more) is needed. Thus, usually, reactants are scattered near the flames of the incinerator to increase the possibility of corrosion in the economizer at the back. - There are 2~3 times more reactants compared to SCR - The efficiency is comparatively low - The non-reactive ammonia reacts with hydrogen chloride and leads to while lead of ammonium chloride - If temperature I too low, non-reactive ammonia is produced and if the temperature is too low, nitrogen monoxide is produced.

SNCR Process Flow Chart

Urea Water Supply Equipment System Diagram



Combustion Gas Processing Facility System Diagram