Discussion on the Scheme of Preparing Ammonia Gas by Hydrolysis of Urea

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Abstract. The process of ammonia hydrolysis to prepare ammonia gas is often used in the denitrification of coal-fired power stations. Because of its safe and stable operation and low investment price, it has been widely studied and used. This paper analyses the equipment used in the process of preparing ammonia gas by conventional urea hydrolysis, and the layout of the site. Or rebuild the power plant to give professional advice.

1. Introduction
The urea hydrolysis system ammonia system includes a urea storage room, a bucket elevator, a urea dissolution tank, a urea solution feed pump, a urea solution storage tank, a urea solution conveying device, a urea hydrolysis reactor, and a control device. The urea is stored in the storage room, and is transported to the dissolution tank by the bucket lifter. The dry urea is dissolved into a urea solution of about 50% by mass with demineralized water, and is sent to the urea solution storage tank through the urea solution feed pump. The urea solution enters the hydrolysis reactor via the transfer pump, and the ammonia-containing gas stream generated in the hydrolysis reactor is sent to the reaction zone, and after being diluted by the hot air, ammonia gas having a concentration of less than 5% is generated and enters the ammonia-smoke gas mixing system, and is ammonia. The injection system is injected into the denitration system. The steam condensate produced by the system is recycled to the drain tank for system flushing and solution configuration. The waste ammonia gas discharged from the system is collected by the pipeline and then enters from the bottom of the wastewater tank. The ammonia gas is dispersed into the wastewater tank through the dispersion pipe, and the ammonia gas absorbed by the safety valve is absorbed by the water [1, 2].

The designed urea hydrolysis ammonia process should meet the following conditions: the supply of reducing agent can meet the requirements of different load and denitrification efficiency of the boiler, and the adjustment is convenient, flexible and reliable. The urea storage area should have a certain safety fire distance with other equipment and workshops, and an outdoor fireproof plug should be installed at an appropriate position, and a lightning protection and anti-static grounding device should be provided. The urea ammonia process should be equipped with a good control system. The urea dissolution tank, the urea solution storage tank, the urea solution conveying device, the urea hydrolysis reactor, and the like are common to the SCR systems of the two units[3, 4].
2. Main equipment

2.1. Urea storage room
A urea storage room is arranged in the scheme, and the capacity of the urea granule storage room is designed according to the amount of urea required for continuous operation for 5 days (24h per day) under the design conditions of the two units of the denitration system.

2.2. Urea dissolving tank
A stainless steel urea dissolution tank is provided, and each urea dissolution tank is equipped with a bucket lifter. The urea is delivered to the dissolving tank. In the dissolution tank, about 50% of the urea solution was made with demineralized water. When the urea solution temperature is too low, the steam heating system is activated to bring the temperature of the solution above 80 °C (to ensure no crystallization). The material is SS304 stainless steel. The effective volume is designed for one day under the conditions of two boilers BMCR. The urea solution feeding pump is a stainless steel body, a centrifugal pump with a silicon carbide mechanical seal, and two pumps are provided one by one and arranged side by side. In addition, the solution feed pump circulates the urea solution using a circulation line configured in the dissolution tank for better mixing.

2.3. Urea solution storage tank
The urea solution enters the urea solution storage tank via the urea solution feed pump. Set two urea solution storage tanks to meet the requirements of system dosage (40~60% urea solution) for 5 days. The tank is made of SS304 stainless steel. The tank is a vertical flat bottom structure, equipped with a liquid surface, a temperature display instrument, a manhole, a ladder, a ventilating hole and a steam heating device (to ensure that the solution temperature is higher than the crystallization temperature corresponding to the concentration of 5 °C). The foundation of the storage tank is a concrete structure. When the storage tank is placed in the open air, an isolation fence is added around the tank, and other variables on the site including seismic zone, wind load, snow load and temperature change should be considered. Insulation is carried out outside the can. Set up a urea solution heating pipe system. The urea solution pipeline is hydrophobically heated by the urea dissolution tank and the heating steam of the storage tank. The steam pipe will be connected from the auxiliary steam main pipe of the plant.

2.4. Urea solution transfer pump
A urea solution supply device is provided to supply a urea solution to the denitration device of the hydrolysis reactor. The urea solution transfer pump is a stainless steel body, a centrifugal pump with a silicon carbide mechanical seal, and two pumps are provided one by one and arranged side by side.

2.5. Urea hydrolysis system
The urea hydrolysis system includes a urea hydrolysis reactor module, a metering module, and the like. The urea solution with a concentration of about 40-60% is sent to the urea hydrolysis reactor, and the saturated steam enters the hydrolysis reactor through the coil. The saturated steam is not mixed with the urea solution, and is recirculated through the coil, and the condensed water is drained by the drain tank. Pump recovery. The concentration of the urea solution in the hydrolysis reactor can reach 40-60%, the pressure of the gas-liquid two-phase equilibrium system is about 0.48-0.6 MPa, and the temperature is about 136-160 °C. The ammonia-containing gas stream produced in the hydrolysis reactor first enters the metering module, is then diluted with the unit to generate a primary air at the ammonia-air mixer, and finally enters the ammonia-smoke gas mixing system. The hydrolyzer is made of 316L. Two furnaces are equipped with two hydrolysis reactors, one for each, the hydrolysis reactor is arranged in the urea workshop, and the single hydrolysis reactor equipment output meets the maximum ammonia consumption when designing the inlet NOx concentration under the two furnaces BMCR load.

The specific requirements of the hydrolysis reactor for the core equipment of the system are as follows:
The hydrolysis reactor is provided with multiple sets of safety measures such as gas pressure relief and liquid phase pressure relief.

The urea solution supply and the ammonia production capacity of the urea hydrolysis reactor have a margin of 10%.

The hydrolysis reactor has a service life of not less than 30 years. The urea hydrolysis reactor is arranged in the urea zone. Ensure that the urea hydrolysis reactor can meet the denitration reaction under any working conditions and does not affect the denitration efficiency.

The hydrolysis reactor is made of 316L stainless steel, which does not require additional anti-corrosion measures such as compressed air to meet the needs of use. Available in armored modular form, the armored module requires integration of all valves, piping, instrumentation and electric heat tracing control systems connected to the hydrolyzer body. All urea solution and ammonia gas pipeline on the hydrolyzer module need to be equipped with an electric heat tracing system, and the electric tracing system needs to be displayed in a centralized display on the electric heat tracing control cabinet. The hydrolysis reactor module shall be provided with four levels of safety protection measures, including but not limited to shutting off steam input, venting the gas phase pressure in the hydrolyzer, liquid phase solution in the bleeder, safety valve take-off, rupture disc blasting, etc. The ammonia gas pipeline automatic cleaning and purging device is integrated on the hydrolyzer armor module, and the integrated hydrolyzer pressure and liquid level measuring point need to be redundant.

2.6. **Heat tracing system**
For the urea solution delivery pipeline, a heat tracing system should be configured. The gas ammonia pipeline after the hydrolysis reactor is reasonably insulated to ensure that the temperature before the ammonia air mixer is not lower than 120 °C.

2.7. **Pumps, pipes, valves**
Pumps, pipes, valves, and other materials that come into contact with urea are made of stainless steel. Pipes and valves for the outlet of the hydrolysis reactor to the AIG inlet should be made of 316L stainless steel.

When the urea solution is transported, when the nominal diameter of the pipeline is less than DN50, the flow rate of the urea solution in the pipeline is not more than 1 m/s; when the nominal diameter of the pipeline is greater than DN50, the flow rate of the urea solution in the pipeline is not more than 2 m/s.

2.8. **Water washing system**
The urea solution pipeline should have insulation measures to avoid crystallization of the urea solution. A complete desalinated water flushing system should be set up on the urea solution pipeline to eliminate the influence of the urea solution crystallization. The rinse water eventually returns to the urea dissolution tank.

2.9. **Heating steam and hydrophobic recovery system**
The urea dissolution tank and the solution storage tank adopt a steam heating system, and the urea solution pipeline adopts a steam hydrophobic heat tracing system. Steam is taken from the interface of the designated main plant steam mother pipe or boiler auxiliary steam pipe, and the hydrophobic system is reused.

2.10. **Ammonia absorption, wastewater dilution facility**
Set up an ammonia absorption and wastewater dilution facility. The ammonia gas is absorbed into a certain volume of pit. The liquid level of the pit is controlled by the interlocking of the pit pump, the inlet pipe and the level gauge. The ammonia absorption facility is designed as the top spray water and the inlet water. The waste ammonia gas discharged from the system is collected by the pipeline and then enters from the bottom of the absorption facility. The ammonia gas is dispersed into the absorption
facility water through the dispersion pipe, and the ammonia gas absorbed by the safety valve is absorbed by the water. Set up 2 waste liquid pumps, one for each.

3. Conclusion
The size of the urea workshop is 29m*15m, which covers 435 m3 of ground. The location of the urea plant should be close to the SCR unit. The size of the hydrolysis reactor is 12m*18m and the area is 216 m3. It can be arranged side by side with the urea workshop or separated by a distance. Arrangement. Various pipelines and channels, including overhead pipelines, direct buried pipelines, and when connected to the outer island channel, the location, elevation, pipe diameter or channel section size, slope, aspect, and trench should be indicated at the design boundary. Name, where to lead, and so on. The overhead clearance of an overhead pipe passing through a car is 5 meters, and the clearance height at the bottom channel of the indoor pipe support beam is 2.2 meters. The process pipeline (ammonia gas pipeline) from the urea zone to the SCR zone uses the integrated pipe rack and the boiler zone steel frame in the original plant as much as possible, and is not in the new stand. The regional environmental noise of the denitration urea system meets the Class II standard of GB12350 “Industrial Enterprise Boundary Noise Standard”; the equipment running noise is less than 85 decibels (measured 1 meter away from the equipment); if the equipment noise level or multiple operating equipment noise superimposition exceeds the standard, Soundproofing measures are available.

References
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