

Rich Reagent Injection

Up to 80% NO_x reduction for Cyclone furnaces utilizing layered technology.

What is Rich Reagent Injection?

The concept of Rich Reagent Injection (RRI) is to inject NO_x reducing reagents in a staged lower furnace to increase the NO_x reduction rate. Numerical investigations and full-scale field demonstrations have shown that significant NO_x reductions can be obtained in cyclone fired furnaces utilizing RRI with little to no ammonia slip. RRI in combination with SNCR and Overfire Air (OFA) is found to yield up to 78% NO_x reduction under full load conditions.

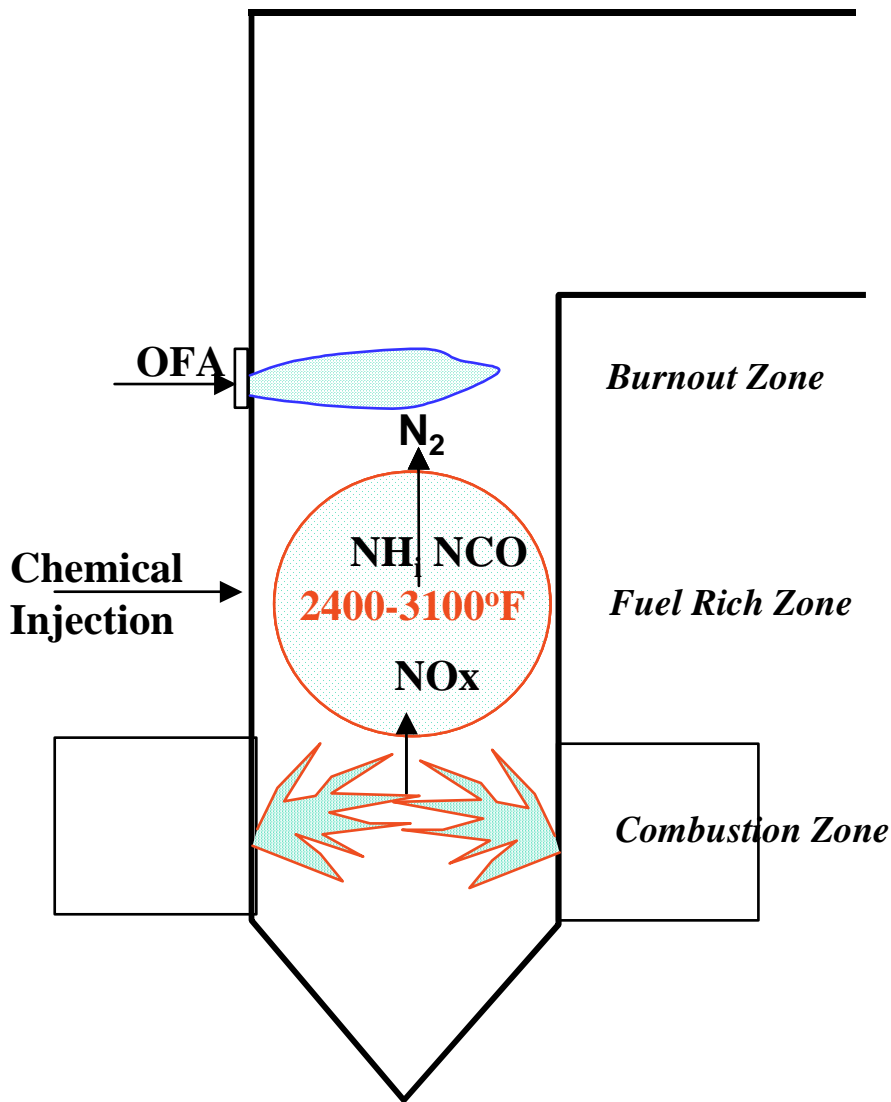
How Does RRI Work?

Model research and pilot scale testing demonstrated that under ideal conditions the injection of NH₃ or urea into the high temperature reducing atmosphere, NO_x-containing flue gases, using normalized stoichiometric ratios (NSR) of 1 to 4, can produce noncatalytic NO_x reductions of up to 80%.

The RRI process, applied to staged cyclone fired furnaces, uses a nitrogen-containing additive to increase the NO_x reduction rate in the lower furnace. The reducing conditions in the lower furnace of a staged cyclone furnace make RRI ideal for NO_x reduction. Previous studies indicate that staging the cyclone barrels to operate the lower furnace fuel rich reduces NO_x that is formed in the barrel. When the barrel is operated fuel rich, NO_x reduction rates are high near the barrel outlet but are much lower in the lower furnace volume. RRI technology accelerates the rate of NO_x reduction using this phenomenon. A schematic diagram illustrating the application of RRI in an air-staged furnace explains this process.

Benefits of RRI

- Up to 78 % NO_x Reduction from baseline using layered technology
- Negligible Ammonia Slip
- Capital Cost Similar to SNCR
- Urea – Non Toxic Reagent
- NO_x Reduction of RRI & SNCR is Additive
- No SO₂ → SO₃ Conversion Problems
- Ideal for Ozone Season Control Technologies



Schematic diagram illustrating the application of RRI in an air-staged furnace

How is RRI Different From SNCR?

Selective Non Catalytic Reduction (SNCR) involves the injection of amine reagents (urea or ammonia) into fuel lean combustion products at temperatures between 1700°F and 2100°F. In the RRI process, reagent injection occurs at significantly higher gas temperatures within the combustion zone of the lower furnaces. The RRI process results in little to no ammonia slip in comparison to SNCR.

RRI Process for Cyclone Fired Furnace

- Stage the furnace using overfire air
- Inject reagent into high temperature, fuel rich zones

How is RRI Different from SNCR?

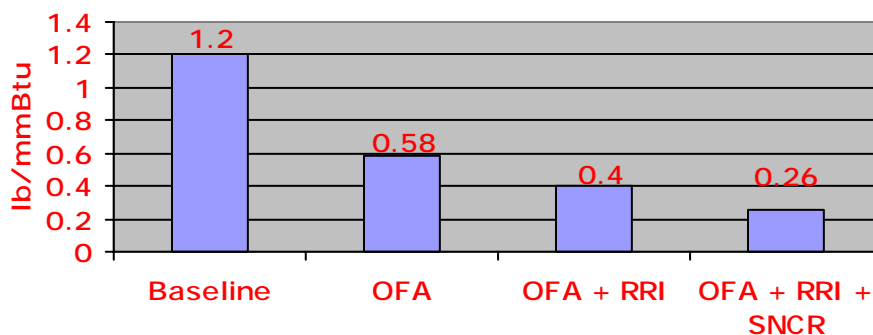
- Flue gas stoichiometry
 - SNCR: Fuel Lean (SR > 1)
 - RRI: Fuel Rich (SR < 1)
- Flue gas temperature
 - SNCR: 1700 - 2100°F
 - RRI: 2400 - 3100°F
- NSR
 - SNCR: ~ 1
 - RRI: ~ 2
- No NH₃ or N₂O emissions expected with RRI

RRI Demonstration Results

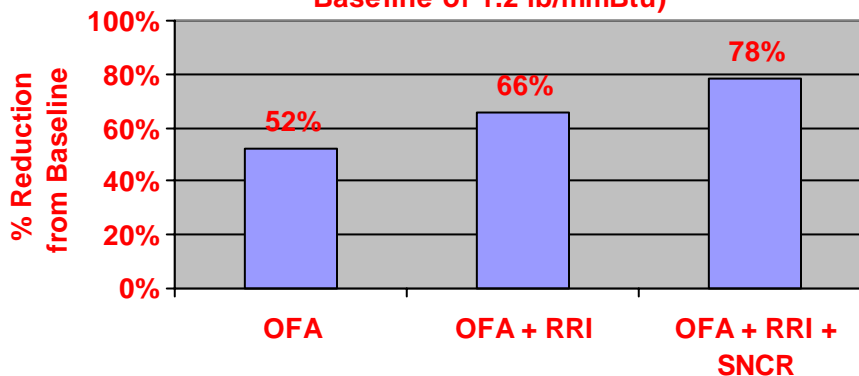
The process design for RRI, sponsored by EPRI, DOE and CNCIG began with Conectiv's B.L. England Unit 1, a 130 MW cyclone fired furnace, firing an eastern bituminous coal. This design used the existing SNCR equipment in units 1 and 2. RJM Corporation installed eight RRI injection ports in B.L. England's Unit 1 and utilized the existing SNCR system from Unit 2 in order to make the temporary RRI system functional. The installation allowed testing of the new RRI system in combination with the 3 existing SNCR zones.

RRI with OFA was able to reduce NOx emissions up to 66% with less than 1 ppm ammonia slip. RRI and OFA in combination with SNCR yielded NOx reductions of up to 78% with less than 5 ppm ammonia slip.

RRI Test Results

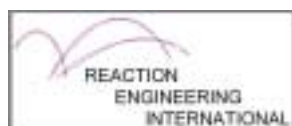


RRI Test Results at B.L. England Unit 1 (Percent Reduction Achieved from Baseline of 1.2 lb/mmBtu)



Contact RJM today for more information on RRI

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RJM's Layered Approach to NOx Reduction

- Layering the OFA, SNCR and RRI process can achieve up to 80% NOx reduction

Reaction Engineering International and Electric Power Research Institute developed the Rich Reagent Injection Technology for cyclone firing. This technology was jointly demonstrated with RJM Corporation at the B.L. England Station.