CASE STUDY

Green Retarder Program Helps Lotte Chemical Reduce NOx Emissions and Achieve Environmental, Social and Governance Goals

BACKGROUND

Styrene is an important petrochemical product used as a material for making various polymer products, especially polystyrene. As a highly reactive monomer, it polymerizes rapidly through free radical mechanisms at the high temperatures that typically occur in the styrene purification process. Unwanted polymerization can lead to lost production, operational issues, and even premature plant shutdown.

To control polymer formation, styrene manufacturers typically employ a fast-acting polymerization inhibitor paired with a slower-reacting retarder chemistry to protect against a runaway polymerization event. The industry standard retarder chemistry is DNBP, which is a highly hazardous chemical that poses a safety risk when handled by operators, is toxic, and produces NOx when incinerated. Based on these hazards, many regulatory bodies are heightening restrictions on the use of DNBP and on the discharge to the environment. The Ministry of Environment in Korea is one such governing body, requiring Lotte Chemical to develop a program to replace DNBP with a more environmentally friendly retarder chemistry. To solve this issue, they turned to Nalco Water.

SOLUTION

Nalco Water developed a Green Retarder (GR) to meet the limits on the use of toxic substances and NOx emissions. Lotte Chemical worked with Nalco Water to conduct testing known as Shutdown Polymer Risk Assessment (SPRA) to measure the efficacy of Green Retarder at controlling polymerization.

This testing showed that the Nalco Water Green Retarder performed commensurate with DNBP, as shown in Figure 1.

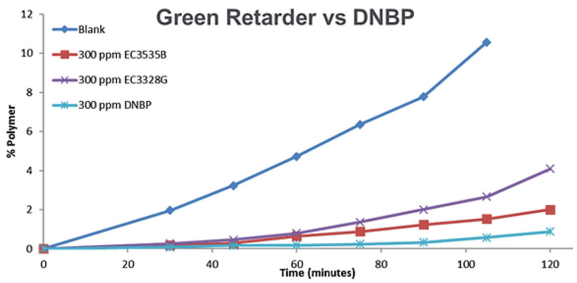

Figure 1: Green Retarder vs DNBP Shutdown Polymer Risk Assessment Test Result

ANNUAL SAVINGS

COSTS

DNBP disposal cost savings
$200,000

Reduced toxic facilities and safety management factors
$600,000

AIR

Reduction in fine dust (NOx) generation: **228 ton/yr** (40%↓)

ASSETS

No need to install SCR (selective catalyst reduction)
$2,500,000

ENVIRONMENTAL RESPONSIBILITY

ESG management – Urea reduction
$12,500,000

TOTAL VALUE DELIVERED

$15,800,000

NALCO Water
An Ecolab Company

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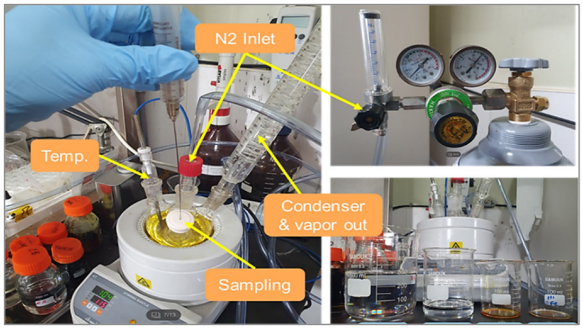

Figure 2: Shutdown Polymer Risk Assessment Test Equipment

Based on the positive test results and a rigorous technical evaluation, Lotte Chemical decided to proceed with a field trial using Nalco Water Green Retarder. During the trial, the Lotte Chemical technical team used a simulation program to optimize the amount of Green Retarder chemistry (Figure 3).

Items	Ecolab_Nalco water	Competitor
DNBP Mixing	Mix O	Precipitation
Stable supply of quantity	Stable supply possible	Insufficient presentation of alternatives
Reference	1.Domestic and overseas cases available 2. Customer in use since 2017	Inadequate
SPRA test	Excellent test results	Test results are similar or lower

Figure 3: Superiority in Technical Evaluation before preparing for Field Trial.

NOx reduction was also a goal of the trial. The NOx emissions were measured as Green Retarder usage was increased over a six-month period. As expected, those emissions were reduced from 130 ppm to 80 ppm (Figure 4).

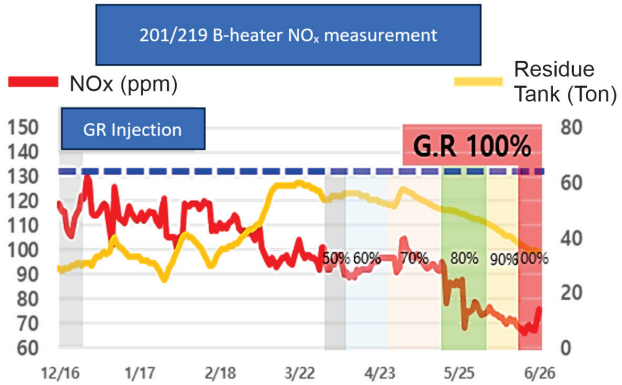

Figure 4: NOx reduction trend due to use of Green Retarder conversion residual fuel – 1.

RESULTS

The following points were considered when comparing technical and commercial aspects versus competitive chemistries:

1. Proven chemistry with reference
2. Product stability and smooth delivery through local production
3. Onsite technical service
4. Positive relationship with customers
5. No issues due to precipitation during DNBP and GR mixing test
6. Performance test and residual concentration report using GR
7. Presentation of simulation results for SPRA, Polymer Residue test, man-power service
8. Prompt, accessible, and experienced technical support and corporate sales support
9. Ability to supply both inhibitor and retarder
10. Optimization of chemistry usage

Based on these criteria and Lotte Chemical's Environmental, Social, Governance (ESG) goals and safety policies, they implemented the Nalco Water Inhibitor and Green Retarder program.

Based on the reduction in NOx emissions, Lotte Chemical was able to avoid a large capital cost that would have been required to meet the stronger emissions standards being set by the Korean Ministry of Environment with DNBP, as well as saving $12.5 million per year in urea usage. Overall, the Total Value Delivered for this project was over $15 million.

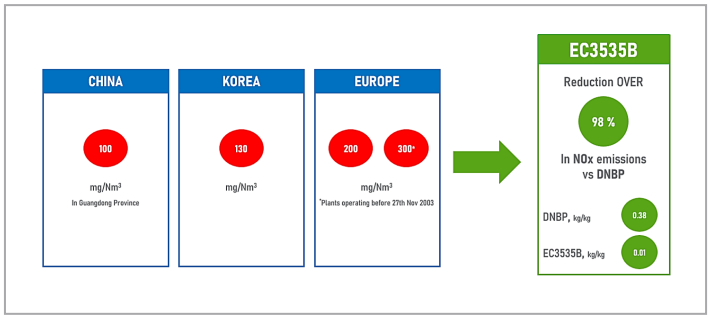

Figure 5: Reduce NOx emissions to improve air quality.

Nalco Water, an Ecolab Company

North America: 1601 West Diehl Road • Naperville, Illinois 60563 • USA
Europe: Richtistrasse 7 • 8304 Wallisellen • Switzerland
Asia Pacific: 52 Jurong Gateway Road, #16-01 Jem Office Tower, Singapore 608550
Greater China: 18G • Lane 168 • Da Du He Road • Shanghai China • 200062
Latin America: Av. Francisco Matarazzo • nº 1350 • Sao Paulo – SP Brazil • CEP: 05001-100
Middle East and Africa: Street 1010, Near Container Terminal 3, Jebel Ali Free Zone, PO BOX 262015, Dubai UAE

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