

Setting

Country	Germany
Location	Krefeld-Uerdingen, North Rhine-Westphalia
Project start date	1.3.2009
Project end date	31.12.2012
Technology keywords	Industrial technologies
Host sector	Lanxess AG, chemical industry

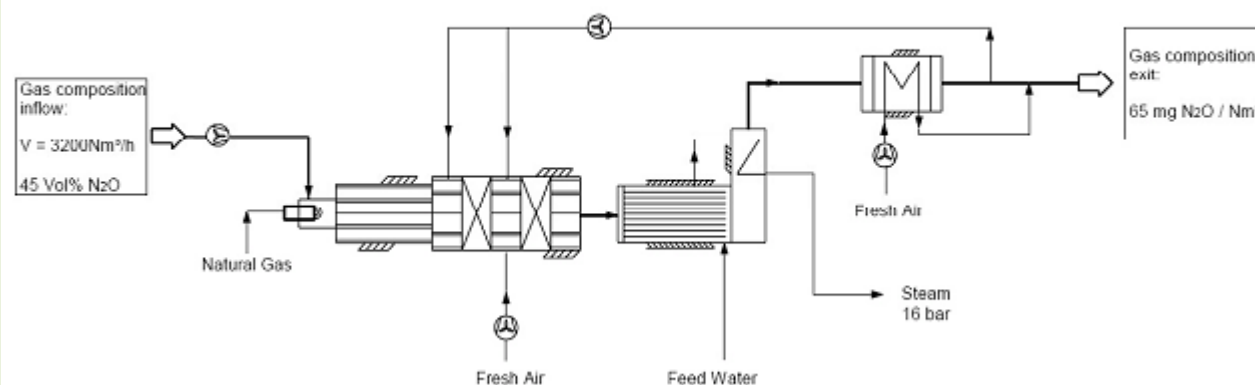
Technical summary of the project

Objective of the project	Redundant thermal decomposition of residual nitrous oxide (N ₂ O) from the LANXESS adipic acid production in Krefeld-Uerdingen
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Project description:



The following graph briefly shows the structure and flows of the thermal decomposition facility:



Source: Lanxess AG, PDD

LANXESS operates an adipic acid production plant at the industrial park in Krefeld-Uerdingen, Germany. Adipic acid production exists in Uerdingen since 1953 and the current installation is running since 1987. Adipic acid is used primarily as the main constituent for nylon production and is also used as carrier for fragrances, for the treatment of leather, in coatings, synthetic lubricants and fibres, photo chemicals, plastics and more.

As a by-product of the adipic acid production process, nitrous oxide (N₂O) is generated and is emitted in the waste gas stream. Besides N₂O, the waste gas also contains small amounts of NO_x, which has to be decomposed under a threshold value specified by German laws (BImSchG in connection with TA Luft), which the licensing notice for the plant refers to. Regarding N₂O emissions from adipic acid production, no national laws or rules exist to enforce its decomposition.

At the plant in Krefeld-Uerdingen, two types of decomposition facilities are installed:

- Selective Catalytic Reduction: The share of NO_x in the lowly charged waste gas stream, which does not contain N₂O, is decomposed in the selective catalytic reduction facility
- Thermal Decomposition of N₂O: The highly charged waste gas stream, containing NO_x and N₂O, runs through the thermal decomposition facility, where both fractions are almost completely decomposed.

Activity at the thermal decomposition facility must, on occasion, be interrupted for planned maintenance measures or unplanned failures. On these occasions where the thermal facility is at a shutdown, the waste gas from the adipic acid production entirely runs through the selective catalytic reduction to decompose the NO_x share. As the catalytic reduction is not able to decompose the N₂O fraction in the waste gas, the N₂O is released to the atmosphere.

Although not required to do so, LANXESS plans to install a further, redundant, thermal decomposition facility to decompose the residual N₂O amounts accruing during shutdown times of the existing thermal decomposition plant. With this measure, emissions of the potent greenhouse gas N₂O from the adipic acid production will be reduced to almost zero. As the current waste gas treatment meets all existing and currently discussed regulations and the installation of a further thermal decomposition plant does not generate any economical profit, the revenues from a JI project would enable the realisation of this emission reduction project.

Technology(ies) to be employed or measures, operations or actions to be implemented by the project:

The commercial manufacturing of adipic acid is achieved in two stages. In the first stage the oxidation of cyclohexane, or the hydrogenation of phenol, creates a cyclohexanone/cyclohexanol mixture (known as ketone alcohol). In the second stage, ketone alcohol is catalytically (copper, vanadium salts) oxidised with nitric acid. By-products are glutaric and succinic acid, nitric and nitrous oxides, especially N₂O. N₂O and NO_x are stripped with air, generating a waste gas stream. Water is removed from the reaction mixture by distillation generating a waste water stream. Adipic acid is isolated and purified in two-stages crystallisation/centrifugation and washing with water.

The highly charged waste gas stream, containing some 45 percent of nitrous oxide (N₂O) and 1,0 percent of nitric oxides (NO_x) (in volume), is routed from the flue gas scrubbing system to the thermal decomposition facility. Here both N₂O and NO_x are destroyed in a two-stage process, being decomposed into their elements at a very high temperature and then serving as an oxygen source for the combustion of methane. The off-gas leaving the furnace chamber contains minimal amounts of N₂O and NO_x. The hot off-gas is used to raise steam in a steam generator. The steam is fed into a steam network, supplying other plants at the industrial park.

Shutdown times of the thermal decomposition facility are caused by different technical reasons. Shutdowns at Lanxess are classified into two sections:

Unplanned shutdowns

- Shutdowns by MSR (malfunction of sensor and actor systems)
- Shutdowns due to malfunction of the process control system
- Shutdowns due to unplanned necessary repairing, e.g.
 - Repairs concerning valves, piping, instruments and machines
 - Repairs concerning the brick lining of the thermal decomposition facility

Planned shutdowns

- Cleaning of the steam system

Whenever possible, planned shutdown times for the inspection of the steam system and the thermal decomposition facility are carried out coevally.

- In case the firing chamber has to be repaired, the thermal decomposition facility has to be shut down which includes a long cooling down phase.

Therefore, because it is not possible to eliminate these shutdown times completely, the only option to destroy the whole N₂O generated is to install a redundant thermal decomposition plant.

[source: UNFCCC - CDM Executive Board: *PROJECT DESIGN DOCUMENT FORM (CDM PDD)*]

Environmental and social benefits

(Estimate of) Greenhouse Gases abated (in metric tons of CO ₂ -equivalent)	Annual average of estimated emission reductions over the crediting period: Up to and including 2012: 858,473 tCO ₂ -equivalents
Number of reduction units (EAU, CER, ERU, AAU)	During the whole crediting period, the amount of emissions reductions is estimated to rise up to 3,290,813 tCO ₂ -equivalents. So far roughly 500.000 ERUs could be realised within the project.
Socio-economic aspects What social and economic effects can be attributed to the project and which would not have occurred in a comparable situation without that project?	The project shows that industrial investments in emissions reductive technology can also be economically attractive for companies. Due to the huge amount of CO ₂ equivalents that can be prevented by a 100% decomposition of NO ₂ , the investment and operation costs are completely covered by selling the ERU to the market.

Methodology used (if applicable: approved baseline methodology or study done - refer to this; and monitoring organisation)

As the proposed project activity comprises the additional decomposition of N₂O from an existing adipic acid production plant, it fits into the coverage of the approved CDM methodology AM0021 "Baseline/Monitoring Methodology for decomposition of N₂O from existing adipic acid production plants". Relevant elements of this methodology shall be applied.

As the AM0021 methodology provides for an approach of decomposition of N₂O assuming no decomposition has taken place previous to the project activity, the baseline setting has to be adjusted for the project at hand. Considering the fact that the largest share of N₂O emissions from the adipic acid production is already decomposed by the existing thermal decomposition facility, the baseline scenario has to be capped at a level that reflects the average historical share of decomposed N₂O in the overall N₂O generation. The baseline scenario is the continuation of this situation. Thus the baseline emissions are the generated emissions representing the historic, state-of-the-art decomposition of N₂O at the adipic acid plant at Krefeld-Uerdingen. The possibility to use historical emissions for baseline scenario is provided in article 48 a of the Marrakech Accords.

The project design follows in principle AM0021 "Decomposition of N₂O from existing adipic acid production plants", whereas some elements of the methodology have to be adjusted due to project specific conditions:

Applicability:

Methodology AM0021 is applicable for installed capacity that exists by the end of the year 2004. For this JI project an adjustment is carried out. The project refers to the capacity as installed by the end of 2005.

Project boundary:

The project boundaries comprise the adipic acid production plant with its already existing N₂O/NO_x decomposition facilities and the planned redundant N₂O thermal decomposition facility. Within these boundaries, both, baseline and project emissions are measured and assessed. Therefore the project boundary has to be adjusted compared to AM0021.

Baseline:

Considering the fact that the largest share of N₂O emissions from the adipic acid production is already decomposed by the existing thermal decomposition facility, the baseline scenario has to be capped at a level that reflects the

average share of decomposed N₂O in the overall N₂O generation. The baseline scenario is the continuation of this situation.

Leakage:

Leakage emissions comprise the emissions associated with the energy sources used to generate steam and electricity to operate the thermal decomposition plant. In this project leakage is not considered because the installations that supply steam and electricity to the already existing and planned redundant thermal decomposition plant are covered by the EU Emission Trading Scheme. To avoid double counting these emissions are not treated within this JI project.

Economic data

Capital costs	The investment costs for the redundant thermal decomposition installation account for roughly 10 million Euro. By selling the considerable amount of ERUs to the market, the investment and operation costs of the installation can be refinanced.
Financing scheme	No information available
Financing organisation (if third party)	International financial services group

Project developer

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Host organisation

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Technology provider

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Additional Information

Printed or electronic reports or other literature available:

Title: JOINT IMPLEMENTATION PROJECT DESIGN DOCUMENT FORM Cost: none

Address for download of electronic document:

<http://ji.unfccc.int/UserManagement/FileStorage/8QPC7NZN8GH7NBB153UX0560HBNUVA>