



Oxygen enrichment for the intensification of air oxidation processes in the liquid phase.

In the production of basic chemicals and fine chemicals, oxidations are often carried out in the gas/liquid phase. The most frequently used oxidant is molecular O₂, predominantly in the form of process air. Increasing the O₂ content can enhance the efficiency of the oxidative process step in many cases.

Benefits

The additional use of O₂ (process air often has an O₂ content of 23–26 vol.-%) can have the following effects:

- Increase in conversion
- Improved selectivity
- Increased yield
- Reduced level of exhaust gas

Requiring only minor capital investment, O₂ enrichment can provide considerable improvement and intensification for the production plant:

- Enhanced capacity, e.g. by increased in throughput
- Increased yield from source products
- Support of the process air supply, e.g. for capacity preservation
- Less effort for waste gas treatment

Fields of application

- For example, O₂ enrichment can be used in the production of:
- Terephthalic acid (PTA)¹ or its dimethyl ester (DMT) from p-xylene
 - Phenol/acetone from cumene
 - Benzoic acid from toluene
 - Cyclohexanone/cyclohexanol (KA oil)¹ from cyclohexane
 - Acetaldehyde¹ from ethylene
 - Hydrogen peroxide¹ (anthraquinone process)

Experiments and calculations

The technical application of O₂ enrichment is usually preceded by experimental analyses in order to ensure a reliable prognosis of the effects to be expected. Linde has the experience and equipment to carry out such testing, which have been successfully put to the test during the investigation of several reaction systems. The equipment comprises a mobile stirred reactor test plant* (see picture above) with a modular design and a software for the

- Evaluation of kinetic data
- Scale-up for technically applied oxidation reactors, i.e. stirred vessels or bubble columns
- Simulation of technical reactors

It is also possible to involve Linde Engineering in the evaluation of the tests.

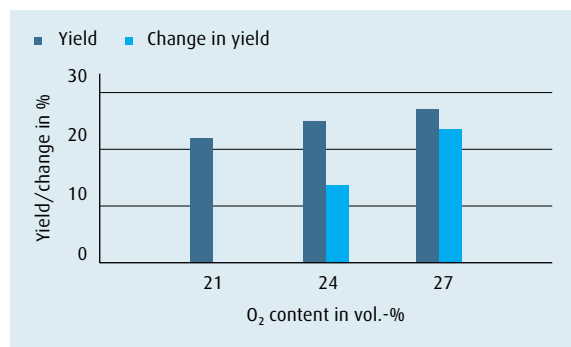


Stirred reactor test plant

¹⁾ O₂ enrichment has already become the state of the art for the above-named production processes.

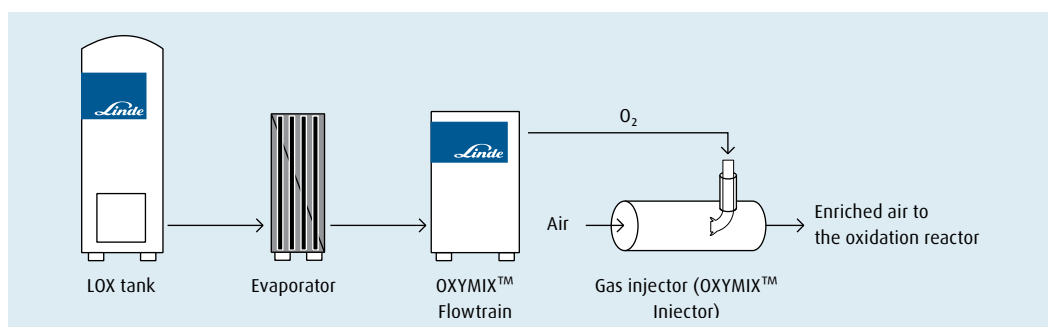
Example In the production of DMT, which is a preliminary product of polyester, the air oxidation of a mixture of p-xylene and p-toluic acid methyl ester plays a decisive role. The bar chart shows the dependence of the para-toluic acid (p-TA) yield, which is one of the two main oxidation products, on the O₂ contents of the process air.

P-xylene oxidation, p-tulic acid (p-TA) yield



Implementation

In order to integrate an O₂ supply into a plant, an O₂ source – often an O₂ production plant (on site) – is necessary in addition to a gas measuring and control unit (OXYMIX™ Flowtrain*) and equipment for gas injection into the process air. For the realisation of O₂ tests on a technical scale in particular, the following O₂ supply system is used primarily. It is based on liquid oxygen (LOX): The above-named hardware is in compliance with the highest safety standards and is customised in order to suit each plant.



Service range

When it comes to considering an O₂ enrichment system for air oxidation processes and its implementation, Linde offers a comprehensive service package:

- Experimental analyses, e. g. for gas/liquid oxidations in the stirred reactor test plant*
- Support in the evaluation of customer data
- Calculation of the effects on the large-scale plant
- Design of a technical solution
- Assistance in the evaluation of safety aspects
- Cooperation in technical-scale trials
- Supply, installation and start-up of the O₂ supply and injection equipment including specific measuring and control systems
- Design of an optimised O₂ supply concept as well as O₂ delivery

Service and know-how

With indepth knowledge and experience in gases for procedural issues enables us to provide efficient project handling support. Using approved process simulation programs and substance databases ensure optimum design, safe plant operation and economic use of technical oxygen.

*Datasheets on the marked products are also available, e. g. from our sales offices.