

Press release

Virtual reality redefines plant engineering

- Exhibition highlight at Gastech in Tokyo: Linde unveils virtual reality application for training operators
- Simulation brings process module to life within one of the world's largest gas processing plants currently under construction
- Linde drives digitalisation across the company

Tokyo, Japan / Pullach, Germany, 5 April 2017 - Visitors to Gastech 2017 can explore the finer details of an industrial-scale plant first hand before it has even been constructed. The Engineering Division within The Linde Group is showcasing a new virtual reality application for the first time at the tradeshow in Tokyo. The technology was developed for training operators and can also be used to visualise design changes during the planning phase. It takes users on a realistic tour of a plant that Linde is currently building in the Amur region in Eastern Russia. Once it is complete, the facility will separate ethane, liquid gas components and nitrogen from natural gas. The unit will be part of one of the largest gas processing plants in the world.

Virtual reality (VR) refers to computer technologies that simulate a real environment for users. Until now, it has been mainly associated with video gaming. A VR headset with an integrated 3D display gives players the feeling that they are actually present in the virtual world. Linde has now adapted this technology for the field of industrial-scale plant engineering. Users can put on a VR headset and use a hand-held controller to explore all of the module's platforms and study its valves and compressors from every angle. They can even step inside process components such as heat exchangers and coldboxes – something that would not be possible in real life. In addition to making physical gestures, users can also use buttons on the controller to take small steps forward or even great leaps through the virtual world, enabling them, for example, to jump onto the 75-meter coldbox platform in just a split second. In a different mode, users can shrink the entire plant to the size of a human being. They can then view the plant from the outside or walk into it, bend down and look into all levels.

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The trainees who will later operate the real plant once it has been completed can use the VR application to prepare for their future tasks and get to know the process unit inside out. "The VR simulation is based on the extremely detailed CAD files that we created while designing the module," explains Julien Brunel, Head of Digitalisation at Linde Engineering. The company also wants its VR technology to be mobile. The hardware (primarily the VR headset and a very powerful laptop) fits into a specially modified hard shell case that Linde specialists will be able to take to customers in future. Any changes to the design of a plant can be immediately shown and verified in 3D using this technology.

The new virtual reality application was developed at the Digital Base Camp in Pullach, Germany. This department focuses on using data intelligently to drive digitalisation across the company. It aims, for instance, to further improve Group-internal processes and develop new services for customers. Predictive maintenance is a prime example here. In future, Linde wants to be able to predict when a component is likely to fail. To do this, it uses algorithms to evaluate data that sensors have been gathering in industrial plants for many years now. Past service incidents can be used to calculate the probability of future events. Technicians could then replace individual components in advance and minimise downtime for the entire plant. "Digitalisation will change our business and the way we work in the field of plant engineering for good," explains Dr Christian Bruch, Member of the Executive Board of Linde AG responsible for the Engineering Division and for the Technology & Innovation Group function. "By harnessing our data, we can offer our customers completely new services and opportunities."

Anyone who is interested is more than welcome to join Linde at stand 12-160 in hall 4 at Gastech 2017 in Tokyo from 4-7 April and try out Linde's new virtual reality application for themselves.

About The Linde Group

In the 2016 financial year, The Linde Group generated revenue of EUR 16.948 bn, making it one of the leading gases and engineering companies in the world, with approximately 60,000 employees working in more than 100 countries worldwide. The strategy of The Linde Group is geared towards long-term profitable growth and focuses on the expansion of its international business, with forward-looking products and services. Linde acts responsibly towards its shareholders, business partners, employees, society and the environment in every one of its business

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areas, regions and locations across the globe. The company is committed to technologies and products that unite the goals of customer value and sustainable development.

For more information, see The Linde Group online at www.linde.com

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