TAKING GAS TREATMENT TO THE NEXT LEVEL

Klaus Jopp, freelance journalist on behalf of BASF, Germany, presents a new digital platform designed to help optimise gas treating technology and processes in both new and existing plants.

According to the forecasts of numerous market research companies, the treatment of natural gas, essential to the practical and safe use of natural gas resources, remains a growing market. With a volume of approximately US$3.76 billion in 2018, the market is set to rise to almost US$5 billion in 2023, with an annual growth rate of 5.7%. This development is being driven by the increasing global demand for natural gas, as well as ever more stringent regulatory provisions on air pollution and climate protection. In addition, the discovery of new gas fields in many countries is expected to boost the market further. Market researchers predict that the amine scrubbing sector will take the lead in terms of both value and volume in the period between 2018 and 2023. This is primarily due to the fact that the removal of acidic gases, such as hydrogen sulfide (H_2S) and carbon dioxide (CO_2), from natural gas is an essential prerequisite when it comes to meeting statutory environmental, health, and safety standards in industrial and commercial applications.

A brief history of gas treatment

The treatment of gases began with the development of the Haber-Bosch process for producing ammonia. The process required a CO_2 removal unit, in order to protect the downstream catalyst from CO_2 poisoning. This CO_2 removal

process has now become even more important for LNG, since natural gas often contains unwanted acidic components, in particular CO_2 and H_2S, but also mercaptans and other sulfur compounds. All of these compounds need to be removed prior to use, especially CO_2. Indeed, CO_2 can significantly hinder the liquefaction of natural gas, as it tends to transition directly from its gaseous to its solid state (i.e. it freezes). This is a highly undesirable outcome in a liquefaction process, since a build-up of frozen CO_2 will cause the capacity of a liquefaction plant to fall dramatically within a very short period of time, thereby making liquefaction uneconomical. This is precisely why gas treatment is indispensable.

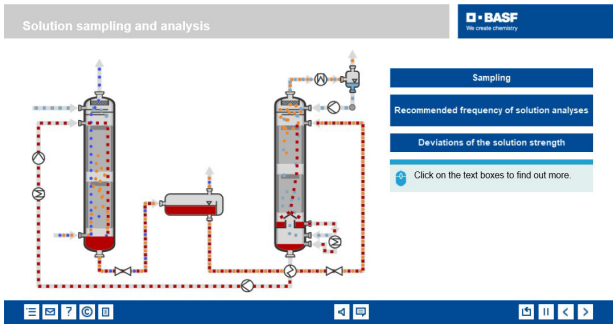

Figure 1. A screenshot from the e-learning section of the software. The comprehensive e-learning package helps customers and business partners to expand their knowledge regarding the design and operation of gas scrubbing processes.

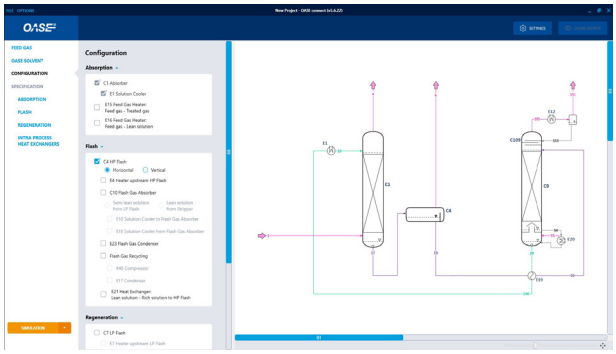

Figure 2. The new tool can be used to both configure new projects and optimise existing plants.

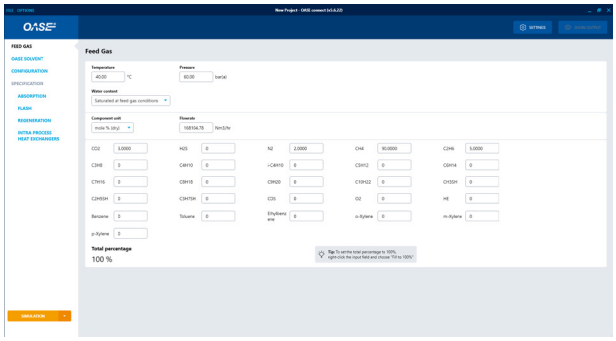

Figure 3. For process planning and revision, the extracted gas must be analysed with regard to its temperature, pressure, and composition.

A digital platform for planning and optimising plants

Building on its nearly 50 years of experience in the gas treatment technology market, BASF has created an innovative digital platform, the OASE® connect. The platform aims to unlock entirely new opportunities for utilising BASF's expertise in gas treatment, enabling customers to either optimise their gas treatment processes for new plants, or to improve them in existing plants (e.g. in terms of energy and OASE solution consumption and emissions).

The OASE connect was developed by OASE specialists in collaboration with their BASF colleagues from engineering and technical expertise, and digitalisation and information services. According to Torsten Katz, Global Technology Manager at BASF Gas Treatment Solutions, an initial step in the platform's development involved updating and repurposing BASF's old software that was originally developed for ammonia processing, but which was not a perfect fit for dealing with natural gas. The resulting server-client solution serves to protect BASF's intellectual property, while also allowing its customers to access the information they need. Users install the platform client on their computers, which then connects to the BASF cloud.

The project started in early 2016 and was completed in mid-2017, after only 16 months. One highly important goal was to establish a secure authentication process to manage access to the software for all users. After developing the first prototypes, feedback was collected from customers and engineering companies. This played a key role in making the platform easier to use, enhancing its functionality. It now also includes a knowledge centre with manuals and videos for the design, simulation, and operation of plants, as well as e-learning courses (Figure 1).

Several users were especially keen on integrating the OASE connect platform into their own process modelling software. The development team has recently succeeded in integrating the corresponding CAPE-OPEN interface in OASE connect, saving customers time and money. While data transmission in the past involved numerous error-prone manual steps, now all changes in upstream and downstream plant processes are automatically applied in OASE connect.

The simulation tool is the heart of OASE connect and is designed in a simple and clear manner. With just a few entries, even engineers with little experience are able to design a functioning plant. One major advantage of this is that design works in both directions: plant engineers can configure and plan their future plant based on desired values, even when the dimensions are still unknown; and, conversely, plant operators can get the best out of their process in an existing plant by configuring optimised parameters (Figure 2).

Iterative improvement of the scrubbing process

Process analysis and optimisation is always based on the collection of all key data, in particular the temperature and pressure of the conveyed gas (Figure 3). It is also essential to know the exact composition of the gas. The most important parameters are methane, ethane, nitrogen, CO_2, and H_2S contents, but longer-chain hydrocarbons, aromatic hydrocarbons, oxygen, and noble gases are also recorded (Figure 4). Furthermore, the configuration of the plant with its individual equipment items and their connections is also

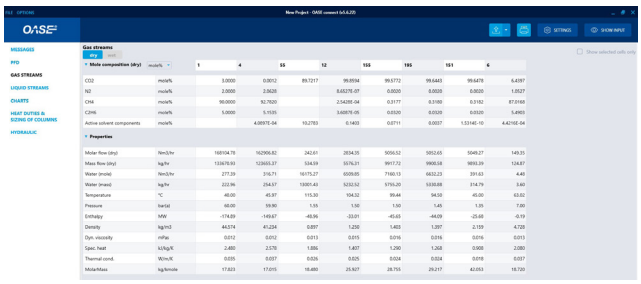

Figure 4. The simulation tool can be used to calculate the exact composition and physical properties (density, viscosity, specific thermal conductivity, etc.) of gases and liquids at every point in the process. This figure shows the result for the gas streams.

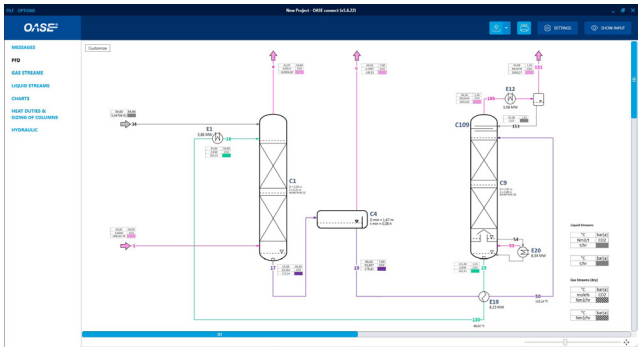

Figure 5. At the end of the new planning or plant revision, the customer receives a process flow chart of his plant, which contains all relevant design data.

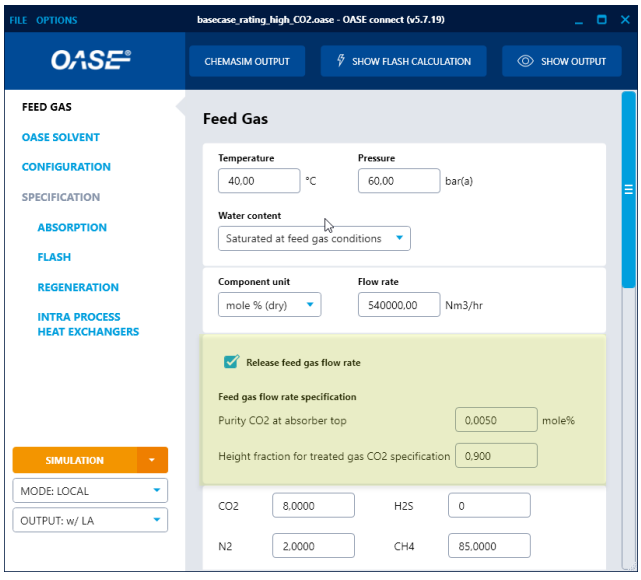

Figure 6. Input mask with release of feed gas flow and specification of CO_2 purity at absorber top (Case 2).

of fundamental importance for both existing and new plants. The plant design and target values are approximated in an iterative process by means of simulations. The simulation result is displayed in the form of a process flow diagram containing all major relevant process data (Figure 5).

The platform interface is supported by a database, meaning that all plants can be displayed with just a few clicks of the mouse. According to Andreas Northemann, Vice President Gas Treatment Solutions, customers benefit from a process flow diagram reflecting the basic plant data, enabling them to monitor and optimise the process in operation.

The newly established platform serves to make collaboration between BASF and its customers considerably more efficient and contributes to reducing the number of feedback loops. Moreover, it can be used to improve the environmental footprint and sustainability of virtually all plants. Indeed, BASF's customers have already conducted thousands of plant simulations using the tool, with the results almost always leading to capacity maximisation, long-term trouble free operating conditions, energy savings, and lower CO_2 emissions.

Case study: LNG plant switching to a new well with higher CO_2 content

An LNG plant in Asia is currently producing LNG from a feed gas containing 6 vol% CO_2 (Case 1). Due to the depletion of the field, a new well with a higher CO_2 content will be brought onstream. As a consequence, the feed gas CO_2 content is expected to increase to 8 vol% (Case 2). The operator wants to know which capacity the plant can handle by keeping the operability and the margins similar to the original conditions. Table 1 summarises the situation.

With the simulation tool of OASE connect, BASF empowers its partners to resimulate the existing operating conditions (Case 1) and to predict the maximum capacity of the plant under the new, expected conditions (Case 2).

In order to determine the target capacity for the new feed gas with the increased CO_2 content, the software offers the option to release the feed gas flowrate from the first simulation and to specify instead the CO_2 slip at a certain height fraction for the new feed gas composition (Figure 6).

With this input, the OASE connect tool simulates a capacity for Case 2 of 436 226 Nm^3/hr, for which stable operations can be expected.

Conclusion

As discussed, BASF's development of its OASE connect platform has unlocked new ways for its customers to utilise its expertise in gas treatment. The platform's design and simulation tools, in particular, provide significant opportunities for the optimisation and customisation of plant processes. Increasing efficiency, lowering operational costs, and attaining sustainability goals, are a priority for all plant operators across both the LNG and broader natural gas industries. Looking to the future, there is little doubt that new technologies and digital platforms will continue to play a vital role in assisting with the attainment of these goals. LNG

Table 1. Comparison of the operational conditions for Case 1 and Case 2

	Case 1: Operational conditions	Case 2: New conditions
Feed gas flowrate	540 000 Nm^3/hr	?
CO_2 content in feed gas	6 vol%	8 vol%
Solution flowrate [t/hr]	844 t/hr	844 t/hr
Reboiler duty [MW]	48.5 MW	48.5 MW