NITROGEN IN-HOUSE PRODUCTION

USE OF N_2 GENERATORS IN THE OIL & GAS INDUSTRY

ANYONE WHO PRODUCES OR PROCESSES OIL AND GAS REQUIRES NITROGEN – BE IT FOR AVOIDING EXPLOSIONS OR FOR TREATING AND DE-OILING FORMATION WATER.

To ensure an uninterrupted supply, it can be worthwhile to produce such gas on-site using nitrogen generators. Two examples from Russia and Austria attest to this. The oil refinery in Orsk, Russia, is located almost 2,000 km further east of Moscow – a considerable distance from the usual transport routes. In addition to gasoline, diesel fuel, heating oil and kerosene, the plant also produces liquid gases such as propane and butane. To this end, the crude oil supplied via pipelines and the subsequent intermediate products undergo a series of processes for purification, distillation and conversion. Many of these processes require inerting with nitrogen to prevent any combination of oxygen, an ignition source and an ignition gas from causing a high risk of explosion. The nitrogen displaces the oxygen thereby effectively preventing the formation of any explosions.

Image: This nitrogen generator is used in the oil refinery in Orsk. Service personnel can easily carry out maintenance work via the maintenance platform

Up until a few years ago, the nitrogen required for this was supplied to the oil refinery by truck as liquid nitrogen. Particularly in remote areas on the border with Kazakhstan, however, a delivery of this nature was not always reliable and was also associated with significant costs. The risk of a production stoppage due to nitrogen supply shortages was an enormous risk for the refinery operator. The refinery's management therefore pursued the goal of reducing costs by producing nitrogen on-site.

PSA technology ensures high-purity nitrogen on-site

Inmatec, the plant manufacturer, then planned a nitrogen plant for the oil refinery in Orsk based on the required quantities. The system can generate up to 2,500 Nm3/h of nitrogen with a purity of 99.95% and an outlet pressure of

MADE IN GERMANY

THE RISK OF A PRODUCTION STOPPAGE DUE TO NITROGEN SUPPLY SHORTAGES IS A MAJOR RISK FOR OPERATORS.

8.1 bar. The PN PAN 48.000 plant has been certified in accordance with the regulations of the Eurasian Customs Union TRCU 032 for products working with positive pressure and meets the requirements of the EU Atex directives for explosion protection. Measuring 8.5 m in length x 7.8 m in height x 5 m in width, it is housed in a separate hall in the refinery. It is equipped with twelve adsorption vessels for separating the oxygen molecules from the nitrogen molecules based on pressure swing adsorption technology (PSA). In this context, the ambient air is compressed to 9.1 bar by two turbo compressors and then cleaned of oil, dust and water by means of compressed air treatment.

The clean and dry air is then passed through specially designed valves, each connected to two activated carbon tanks. The valves automatically regulate the alternating filling of the adsorption vessels filled with a carbon molecular strainer. The vessels switch alternately from production to regeneration mode. In this way, oxygen and carbon dioxide molecules are adsorbed from the ambient air in one vessel, while the second vessel regenerates under compressed air relief.

The continuous nitrogen stream produced in this way is then buffered in various product vessels with a volume of several thousand cubic metres. In order to be able to bridge power outages in the refinery itself, a high-pressure compressor with 500 m3 under 40 bar pressure is also filled. In addition, up to 20,000 m3 of nitrogen is available as a reserve to safely shut down the refinery's oil refining processes in an emergency.

Use of nitrogen in various areas of the refinery

The nitrogen produced on-site in the refinery is used in various areas. Not only is the headspace of the oil tanks filled with nitrogen in order to prevent the formation of an explosive mixture during storage. Nitrogen also plays an important role in tank cleaning: In oil storage tanks in particular, slag settles on the bottom, causing the tank to lose storage capacity. The operator therefore needs to clean the oil tanks at regular intervals. In order to avoid inflammatory reactions between

Image: Nitrogen generator in the water treatment plant of an oil producer in Schönkirchen. The fully redundant design ensures high reliability.

MADE IN GERMANY

Image: The plant in Schönkirchen produces nitrogen for the treatment and deoiling of formation water.

oil residues and cleaning agents, the tanks are emptied with nitrogen and blown out.

In addition, the nitrogen serves as a sealing gas in the turbo compressor. This increases the pressure of the gases produced in the refinery to 55 bar when they are fed into the pipelines. Here, the nitrogen overlays the mechanical seal, which seals the rotating shafts against the machine housing. This prevents the process gas from entering the engine and igniting.

The unused pipelines of the refinery pipeline network are also inerted with nitrogen meaning that gas residues do not form an explosive atmosphere. Furthermore, nitrogen is used to check the pipelines for leaks with nitrogen in order to prevent damage and production losses in advance.

Treatment and deoiling of formation water

A further application of nitrogen in oil and gas production can be seen in the example of an Austrian oil producer, who produces up to 700,000 t/a of oil in the Vienna Basin. This also reveals a large amount of water that has formed in the oil deposits at depths of between 500 and 4,000 m over millions of years. The proportion of this water, which we refer to as formation water, amounts to up to 93% of the flow rate. In the production stations of the oil company in Matzen, the formation water, which contains an oil content of 300 ppm, is separated and transported via pipelines to the water treatment plant in Schönkirchen. On the one hand, the aim is to purify the formation water, return it to the storage sites thereby closing the natural cycle. On the other hand, the extracted oil is returned to the extraction stations for further processing.

Nitrogen plays an important role in the treatment of formation water in various processes.

It not only serves as an inert gas to prevent explosions, but also aids various processes for purifying the formation water as a process gas. The formation water treatment plant in Schönkirchen purifies the water in a three-stage process. The nitrogen overlay excludes oxygen and, consequently, prevents the biological activity of microorganisms as well as corrosion in plant components. This increases the reliability of the plant, which is intended to achieve an availability of 99.9%. In the flotation cell of the plant, mixed nitrogen bubbles also lift artificially generated flakes of oil particles and polymers to the surface. The resulting flotation sludge can then be easily skimmed off and processed further. The oil separated in the various process steps in Schönkirchen is then piped back to the extraction stations. In this regard, the pipeline systems are also pressurised with nitrogen. From here, the oil is transported to a large tank storage facility in Auersthal and onwards to the refinery in Schwechat.
Two Inmatec IMT PN 2150 generators are used to produce the requisite quantities of nitrogen for these processes. In addition, the nitrogen plant, which is housed in a separate hall, includes two air compressors and redundant valve blocks to ensure high reliability. The plant supplies 50 m3/h nitrogen with a purity of 99.9%. In order to buffer the gas, two product vessels with 1,500 l each, two product vessels with 4,000 l each as well as a 10,000 l buffer storage for production peaks are available.

published in CHEMIE TECHNIK June 2019
Further information about oil production and nitrogen production can be found at www.chemietechnik.de/1906ct604

Author: Markus Berniger
Inmatec, Marketing

Images: Inmatec

MADE IN GERMANY