AVOIDING EXPLOSIONS IN THE CHEMICAL INDUSTRY WITH NITROGEN

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CASE STUDY

HIGH-PURITY RAW MATERIALS FROM THE BY-PRODUCTS OF BIODIESEL PRODUCTION.

Producing diesel from plant-based raw materials creates unwanted by-products. Glaconchemie takes such by-products off of biodiesel manufacturers' hands and uses them to develop high-purity raw materials. Glaconchemie uses self-produced nitrogen to overlay the production steps during further processing.

In Germany, biodiesel is produced almost exclusively from rapeseed. The seeds of the oil-containing plant are ground and pressed to this end. Finally, the vegetable oil obtained – which is not yet suitable for use in diesel engines – is chemically converted during „transesterification". The rapeseed oil is stirred in an agitator tank with heat exchanger for a few hours at approx. 50 to 65 °C. Methanol is also added. The mixture ultimately cools down in a settling tank and separates into two phases at this point. The lighter crude biodiesel floats at the top of the tank, while glycerine accumulates at the bottom. The glycerine is produced during transesterification from the triacylglycerides contained in the rapeseed.

This is where Glaconchemie comes in. As specialists in processing the by-products of biodiesel production, Glaconchemie takes the accruing by-products off of biodiesel producers' hands – at standard market rates. One of these products is so-called substandard glycerine (SSG). This toxic and flammable substance can form sediments, clog fuel fil-

Numerous process steps at the Glaconchemie plant produce hazardous vapors in the handling of substandard glycerine as well as raw glycerine and its constituents, in particular methanol.© CLACONCHEMIE

MADE IN GERMANY

ters and damage diesel engines. It therefore needs to be removed from the fuel and be disposed of in the proper manner. Expensive additional systems are required in order to process the unwanted SSG component – systems that biodiesel manufacturers often do not possess. Once removed from the biodiesel, SSG can be converted into high-purity raw materials for many applications in the pharmaceutical, chemical, cosmetics and food industries. Substandard glycerine is processed in system D1 at Glaconchemie's Merseburg plant.

New reusable materials from biodiesel by-products

Following HGV collection of the SSG, it is transferred to the gas displacement system and pumped to two large production systems at Glaconchemie via pipelines. In the system, the substandard glycerine is initially separated into its components. Phase separation in the centrifuge is achieved as a result of acidification with sulphuric acid and the addition of potassium hydroxide. This separates methanol and free fatty acids, which are sent back to the biodiesel producers for further use in various biodiesel production processes. Separated potassium sulphate can subsequently be used as a component of potassium fertilisers in winegrowing, for example. Crude glycerine is also separated and is further processed to create high-purity glycerine in further process steps as part of neutralisation and filtering as well as rectification (distillation). Technical glycerine has a purity of 99.5% and can be used in many industrial areas. For example, this colourless and odourless liquid is used in the production of plastics (alkyd resins), polyurethane foams and antifreezes. Pharmaceutical glycerine with a purity of 99.7% is used as a moisturiser particularly in the pharmaceutical and cosmetics industry where it serves as a raw material in the production of creams, ointments and toothpaste. In the food industry, glycerine is used as a food additive (E 422) to keep food moist – as is the case with chewing gum. Another by-product also undergoes further processing in system D2 at the Merseburg plant. Crude glycerine, which is delivered and already free of methanol and fatty acids, is refined here with the addition of sodium hydroxide. Small residual amounts of methanol and water are also sepa-

Glaconchemie processes by-products from the biodiesel production to valuable basic and starting materials in Merseburg. Hazardous system components, agitators, centrifuges, storage tanks and pipe systems are overlaid with nitrogen for protection. © CLACONCHEMIE

Picture on the right: **Glaconchemie uses a nitrogen generator IMT PN 3000. The container solution is placed directly next to the system. All operating values are logged and can be conveniently read out via a large touch control panel. In addition, the generator can be remotely monitored and controlled. © CLACONCHEMIE**

rated and transferred to plant D1. The resulting sodium chloride is centrifuged out and can therefore be marketed to the mining industry. In addition, activated carbon bleaching of the crude glycerine produces valuable glycerine of highly pure (99.7%) quality as the end product. Glycerine is kosher, halal and certified as food-safe.

Critical processes are overlaid with nitrogen

In a number of process steps at Glaconchemie's plant, hazardous vapours are formed when handling substandard glycerine and crude glycerine and their components, particularly methanol. In combination with oxygen, the flammable substances create an explosive gas mixture which can result in explosions if combined with an ignition source. To prevent this from happening, hazardous system components, agitators, centrifuges, storage tanks and pipe systems are overlaid with nitrogen. The inert gas displaces the oxygen in the headspace above the liquid, efficiently preventing the danger of explosions. There are specific risks associated with unloading HGVs carrying tanks filled with SSG or crude glycerine. When filling storage tanks by means of gas displacement, the substance mixture is guided from the tanker into the tank via a hose. At the same time, a second hose feeds the vapours generated in the tank back into the HGV tank. Any potential differences can give rise to electrostatic discharges and, consequently, to the ignition of vapours. This is why the gas displacement system is also inerted with nitrogen. In addition, at Glaconchemie, the biological activity of microorganisms is prevented and corrosion in system components avoided thanks to the nitrogen overlay and the associated absence of oxygen.

Producing nitrogen on-site

An Inmatec nitrogen generator IMT PN 3000 is used to produce the requisite nitrogen quantity of 140 m^3/h for the various production steps in both systems. In addition to the generator, the container solution, which is located outside right next to system D2, comprises two compressors and a nitrogen buffer vessel with a volume of 10,000 litres. The main compressor is frequency-controlled and therefore energy-saving. The pressure generated is between 7.5 and 8.5 bar. The system with pressure swing adsorption (PSA) technology supplies nitrogen with a purity of 99.9%. Ambient air is pressed through an activated carbon filter and a dust filter to this end. The cleaned compressed air is then fed into a valve block via a pres-

„FOR THE QUANTITIES OF NITROGEN WE REQUIRE, ON-SITE PRODUCTION IS THE MOST COST-EFFECTIVE SOLUTION. IT ALSO PROTECTS US FROM SUPPLY SHORTAGES ASSOCIATED WITH LIQUID NITROGEN DELIVERY. IN ORDER TO KEEP THE SUSPENSION OF PRODUCTION PROCESSES AS BRIEF AS POSSIBLE, WE OPTED FOR A FINISHED COMPLETE SYSTEM FROM INMATEC. SETUP AND INSTALLATION TOOK PLACE VERY QUICKLY. ANOTHER GREAT ADVANTAGE IS THE RECORDING OF ALL OPERATIONAL DATA, WHICH WE CAN MONITOR AND CONTROL USING THE TOUCH CONTROL PANEL OR REMOTELY USING A PC. THE GENERATOR IS EQUIPPED WITH ROBUST TECHNOLOGY AND REQUIRES LITTLE MAINTENANCE – WHICH WE'RE ALSO PLEASED ABOUT."

Martin Drygala,
Production Manager at Glaconchemie GmbH

The system also comprises a nitrogen buffer vessel with a volume of 10,000 litres.
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sure regulator. This induces the air alternately in two adsorption vessels filled with a carbon molecular sieve. While one vessel adsorbs oxygen and carbon dioxide molecules from the ambient air in the sieve in filter mode, the other vessel regenerates and vice versa. The nitrogen obtained by pressure swing adsorption technology is transferred to a product vessel and can now be used in the various applications at Glaconchemie.

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