



## ArmaSound Industrial Systems in one of Europe's largest cavern storage facilities

**Thermal-acoustic insulation of installations at the new gas processing plant in Etzel (Germany); reliable protection against corrosion under insulation (CUI)**

The Etzel salt dome in Lower Saxony (North Germany) is one of the largest gas storage sites in Europe. Over a period of three years, the company Etzel-Kavernenbetriebsgesellschaft mbH & Co. KG (EKB) constructed gas processing facilities on the IVG site in Etzel, which went into service at the end of 2012. The complex consists of various facilities for gas storage and withdrawal. To provide thermal-acoustic insulation on the pipework and other installations, employees of Kaefer Industrie GmbH (Bremen, Germany) installed ArmaSound Industrial Systems made by Armacell. The insulation system not only protects the plant against heat losses, but also minimizes corrosion under the insulation (CUI) and noise pollution at the site.

### **Underground gas storage facilities ensure security of supply**

The oil crises of the 1970s showed how important it is to stockpile energy reserves. The Russian-Ukrainian gas conflict put the issue of security of supply back on the agenda and in the current discussion regarding the energy revolution and increased use of renewable energies the topic has taken on a new dimension.

Underground caverns are an important element in the energy supply. They ensure that the required amount of oil and gas can be provided continuously and flexibly. On the one hand, the energy provision is safeguarded if there are disruptions to supply. On the other hand, the storage facilities allow daily and seasonal fluctuations in supply and

demand on the commodities markets to be absorbed. Germany committed itself early on to stockpiling a minimum level of energy reserves. Today the country has the largest storage capacities in the European Union and is in fourth place in the world behind the USA, Russia and the Ukraine.

### **The Etzel salt dome is one of Europe's largest gas storage facilities**

In the Etzel salt dome in North Germany, underground caverns have been used to store petroleum since the 1970s. This is where the majority of the German strategic crude oil reserves are stored. Since 2007, the IVG Caverns have evolved from storage facilities for crude oil into one of Europe's largest gas storage sites and former petroleum caverns have been converted into natural gas caverns. Etzel is connected to international oil and gas pipelines and is an important energy hub in North-West Europe. The cavern site is owned by IVG Immobilien AG and its subsidiary IVG Caverns GmbH is responsible for constructing (leaching), operating and marketing the caverns in Etzel. These are rented by renowned companies in the energy sector and national petroleum stockpiling agencies. The site currently consists of 59 completed caverns (36 for petroleum, 23 for crude oil; as of July 2012) with a capacity of around 35 million cubic metres.

### **Construction of a new gas processing plant**

All in all there are four operators at the Etzel site that have rented caverns from IVG and built surface facilities. One of these operators is Hamburg-based Etzel-Kavernenbetriebsgesellschaft mbH & Co. KG (EKB), which was founded in 2007 as a joint venture between BP, DONG Energy and Gazprom Germania. The company spent three years constructing gas processing facilities on the IVG site in Etzel, which were taken into service in December 2012.

### **Effective noise control for a safe working environment**

The highly sophisticated complex consists of various facilities for gas storage and withdrawal. The natural gas is compressed prior to storage in order to reduce the volume. The compressors, pumps, control and relief valves generate significant noise levels, which are transmitted through the pipework. In pipes in which gases, vapours or liquids flow under high pressure, the noise is often increased when turbulence occurs in the vicinity of obstacles such as valves or orifice plates, or as a result of changes in flow direction. The high noise levels that can arise through unprotected or inadequately insulated installations are not just an annoyance for the employees; they are also a health risk. Noise-induced hearing loss is one of the most common occupational illnesses and results in high costs for national economies. The risk of accidents in the workplace also rises due to noise, for example when warning shouts or signals are not heard. Furthermore, concentration and individual performance drop in noisy environments. As a consequence, not only the number of mistakes rises, but also the risk of injury.

Apart from reducing noise development and re-radiation effects, one of the key measures required to minimize noise is sound absorption. Therefore, when selecting the insulation material for the installations of the gas processing plant in Etzel, not only thermal insulation, but also the requirements of effective noise control played a crucial role.

### **Risk of corrosion under insulation (CUI)**

Traditionally, mineral wool with a cladding made of aluminium, stainless steel or galvanized metal sheeting is used in this area of application. The acoustic performance of the systems depends on the thickness and density of the mineral wool and the cladding. However, in a damp environment, for example, if installations are located outdoors as is the case in Etzel, mineral fibre insulation with a metal cladding can cause problems. If the cladding system is not sealed – and it is never possible to ensure that it is completely sealed – water can penetrate the insulation. Moisture not only leads to a drastic reduction in the acoustic and thermal properties of the insulation material, there can also be considerable corrosion damage under the insulation, resulting in time-consuming renovation work and a considerable increase in costs.

As the term corrosion under insulation (CUI) indicates, the processes take place beneath the insulation and therefore often remain undiscovered over a longer period. This phenomenon is particularly widespread in the oil and gas industry because the corrosion processes are accelerated in the salty air of offshore facilities at high sea. When water containing chlorides or sulphates penetrates the insulation, corrosion damage is likely to occur.

### **Suitable insulation systems reduce the risk of corrosion**

Insulation alone cannot safeguard installations against corrosion, but suitable insulation systems can effectively support corrosion protection. On pipes where the line temperature is higher than the ambient temperature, there is a particularly high risk of water gathering in open-cell insulation materials in outdoor applications. If on clear nights the temperature of the cladding falls below the dew-point temperature of the enclosed air due to heat radiation into space, moisture condenses on the inside of the cladding and can drip into the insulation material completely soaking it at some point. In contrast, closed-cell insulation materials have a high resistance to moisture absorption from the surrounding air.

On installations where the line temperature is lower than the ambient temperature, the surface temperature falls below the dew point and condensation can occur. Closed-cell insulation materials ensure that the surface temperature remains above the dew point even after many years of operation and thus prevent condensation processes. Due to the difference in temperature between the cold medium and the warm ambient air, a difference in vapour pressure arises which acts on the insulation from the outside. The water vapour contained in the air can penetrate the insulation and gather in it. How much moisture is able to penetrate the insulation as a result of vapour transmission depends on the resistance to water vapour transmission ( $\mu$ -value) of the insulation material. The lower the  $\mu$ -value of an insulation material, the more sharply the moisture content increases over time. This must be taken into account when selecting the insulation material.

The risk of corrosion can be further reduced with the use of a suitable cladding. When traditional metal jackets are installed, there is a danger of water penetrating the insulation through seams or damage to the jacket. Moreover, moisture can diffuse into the insulation in form of water vapour if there is a difference in vapour pressure. Metal jackets only work as a weather barrier, to achieve a vapour barrier a double jacket would have to be installed. Rubber jacketing systems have proved themselves for outdoor installations and established themselves as an alternative to metal jackets in recent years. These elastomeric claddings based on EPDM rubber (ethylene-propylene polymer) provide excellent protection against mechanical impact and weathering. The tough, flexible, 1 to 2 mm-thick mats are usually installed directly from the roll on the building site. They can be cut to the required shape and size quickly using a standard sharp knife, insulator's scissors or a cutter knife – no machines are needed. Securing the seams additionally with suitable sealants ensures that the system functions well in the long term.

### **Thermal-acoustic insulation with ArmaSound Industrial Systems**

To provide thermal-acoustic insulation on the pipework and other installations of the gas processing facilities in Etzel, ArmaSound Industrial Systems manufactured by Armacell were used. When Armacell presented these innovative insulation systems in 2009, it was the first manufacturer to supply insulation materials that offer both thermal and acoustic insulation as well as minimizing the risk of corrosion under the insulation. In Etzel, ArmaSound Industrial System C was installed. The sandwich product

is a multilayer insulation system: the closed-cell, high-temperature insulation material HT/Armaflex reliably protects the insulated installations against moisture ingress and energy losses. In addition, Armaflex has good isolation properties and the material also reduces the transmission of structure-borne noise. The acoustic foam ArmaSound RD 240 has excellent sound absorption properties and greatly reduces noise. Noise control is further enhanced by a 4 mm-thick layer of ArmaSound Barrier E, a vinyl sound barrier mat. The rubber-based cladding system Arma-Chek R gives the installations effective protection against moisture penetration and mechanical impact. Arma-Chek R is resistant against UV rays, saltwater washover and chemicals. The product has a resistance to water vapour transmission of  $\mu > 50\ 000$  and is therefore technically vapour tight. The visco-elastic properties of the materials also dampen resonance effects and thus reduce re-radiation effects typically associated with metal cladding systems. An additional benefit of the flexible material is that, unlike rigid metal jackets, it regains its shape after impact and the underlying insulation system is not damaged.

### **Simple and reliable installation after comprehensive training**

In comparison to traditional insulation constructions, ArmaSound Industrial Systems meet the noise-control requirements with reduced insulation thickness and weight. Furthermore, the fibre-free systems offer benefits during installation and are easier to maintain. All ArmaSound Industrial Systems fulfil the requirements of ISO 15665 "Acoustics. Acoustic insulation for pipes, valves and flanges".

The thermal-acoustic insulation system was installed by Kaefer Industrie GmbH (Bremen, Germany). As the employees were using the new insulation system for the first time, they received comprehensive application training from Armacell prior to beginning work. After the first workshop at the Kaefer Training Centre in Bremen, Vance Brownhill, Armacell Installation & Project Support Manager, carried out a second training session on the building site before the employees began to install the product.

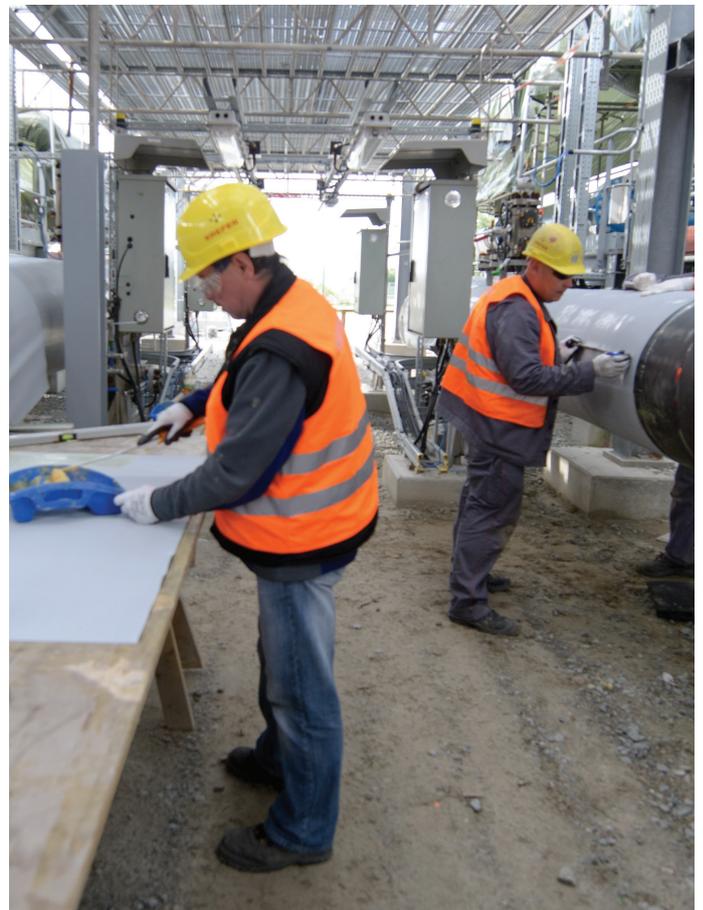
All in all, around 2 500 m<sup>2</sup> of ArmaSound Industrial Systems were used, which were supplied by VTI-Hamburg, a branch of the German insulation wholesaler WeGo Systembaustoffe.

From March to mid August 2012, EKB carried out the first fill of the caverns. At the end of the year the commissioning phase was successfully completed. The EKB facilities can store crude oil in six salt caverns up to a working gas volume of 500 to 600 million Nm<sup>3</sup>. The injection and withdrawal capacities are 600 000 Nm<sup>3</sup>/h and 900 000 Nm<sup>3</sup>/h respectively.

*More information on this project can be found in a video at [www.armacell.com/ArmaSoundEKB](http://www.armacell.com/ArmaSoundEKB)*



Construction site in Etzel (North Germany): building the EKB gas processing facilities



The butt joints of the ArmaSound material are glued securely using Armaflex adhesive



For bends Armaflex, ArmaSound RD, the ArmaSound Barrier and Arma-Chek R are cut to the required shape and then installed one on top of the other



ArmaSound Industrial Systems consist of a multilayer insulation construction for thermal and acoustic insulation