



COOLSORPTION

THE VAPOUR RECOVERY SPECIALIST™



In control of emissions



Vapour Recovery pioneer

Cool Sorption A/S is a well-known Danish company, founded in 1982 and a pioneer in the VRU industry. Cool Sorption has been a dedicated supplier of Vapour Recovery solutions for over 35 years and a track record of more than 320 units installed worldwide.

The Company was acquired gradually by the AKER Group from 1997 and today it is part of the oil-service investment company Akastor, owned by the AKER Group. With hundreds of VRUs in operation around the world, Cool Sorption is an industry leader.

We follow our products through their entire lifecycle ensuring the best possible value for our customers. Cool Sorption has a strong focus on Quality, Health, Safety, Environment, and Business Integrity. The mindset is an integral part of our operational excellence and is imbedded in our DNA. Our QHSE and project organization is continuously inspired and developed through close cooperation with major players in Oil & Gas industry.



The Cool Sorption name

“Cool Sorption” refers to the original cold absorption process on which the company was based. From 1982 until today, there was a short period during which the name Cool Sorption was put in the background. However in 2014, being a strong brand, the Cool Sorption name was reintroduced.

 **Cool Sorption A/S**

 **Cool Sorption A/S**
An Aker Kvaerner Company

 **AkerSolutions**

 **COOL SORPTION**

 **COOL SORPTION**
THE VAPOUR RECOVERY SPECIALIST™

Your quality partner

Commercial processes, engineering, project management, purchasing and correct handling of suppliers & sub-contractors are all an active part of our approach. This ensures a flawless execution of projects, having resulted in an immaculate track record of in-time and on-budget delivery & start-up of VRU systems, extreme low near-incident level and zero incident level.

Cool Sorption VRU systems are well known for their safe and reliable operation. Being part of

the Norwegian AKER group ensures long term stability, engineering capacity and technical back-up when required.

Cool Sorption has over 320 units installed worldwide, most of which are receiving a preventive periodical maintenance service from our knowledgeable and experienced service team. This is strong evidence to the long-term reliability of our systems and the trust of our customers of Cool Sorption.

Your clean air partner

Stakeholders such as oil & gas companies, tank terminal owners and operators, engineering companies, specialized consultants, environmental agencies and related organizations rely on our expertise and sound solutions.

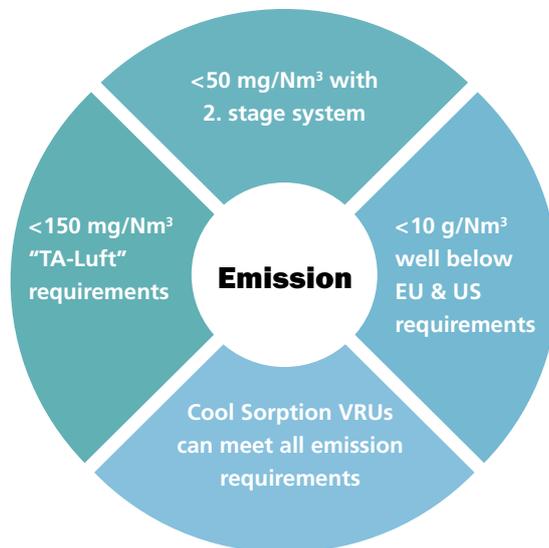
Transport and handling of crude oil and refined products creates enormous amounts of vapours, which must be handled and recovered - both from an environmental and an economic perspective.



Our emission reduction solutions

Cool Sorption is dedicated to VOC emission reduction and has an extremely high expertise in vapour processing, vapour treatment, vapour recovery and product recovery. Our understanding of the vapour generation and vapour treatment is unmatched. Both when it comes to on-shore and off-shore installations.

VRU systems are fundamental to ensure compliance with environmental rules and regulations. Since legislation was first put in place in the United States and the European Union, many other countries have set definitive limits on the emissions of VOC associated with the loading and transfer of gasoline, naphtha, crude oil and other oil-based products.



Return on Investment

A typical gasoline terminal has a recovery potential of 1500 litres for every 1000m³ of transferred product. It is not unusual for a VRU to pay itself back in 3-5 years.



As an example, the typical evaporation loss when filling a tanker truck with gasoline is 0,15 percent. That may not sound like much, but on a typical European road tanker holding 42 m³, this corresponds to over 60

litres or six buckets of gasoline being thrown into the air! And every day, thousands and thousands of trucks are being filled all over the world...

Vapour losses from crude oil

The volatility of crude oil varies a lot, but often emissions are higher than for gasoline. Typical sources of crude oil vapours are from filling or loading:

- Floating Storage and Offloading vessels (FSO/FSU) near the oil platform
- Shuttle vessels
- Crude oil tankers from land-based terminals
- Land-based tank farms and underground caverns

Emissions from crude oil tankers and shuttle vessels during transport can also be considerable.





Truck Filling Depot

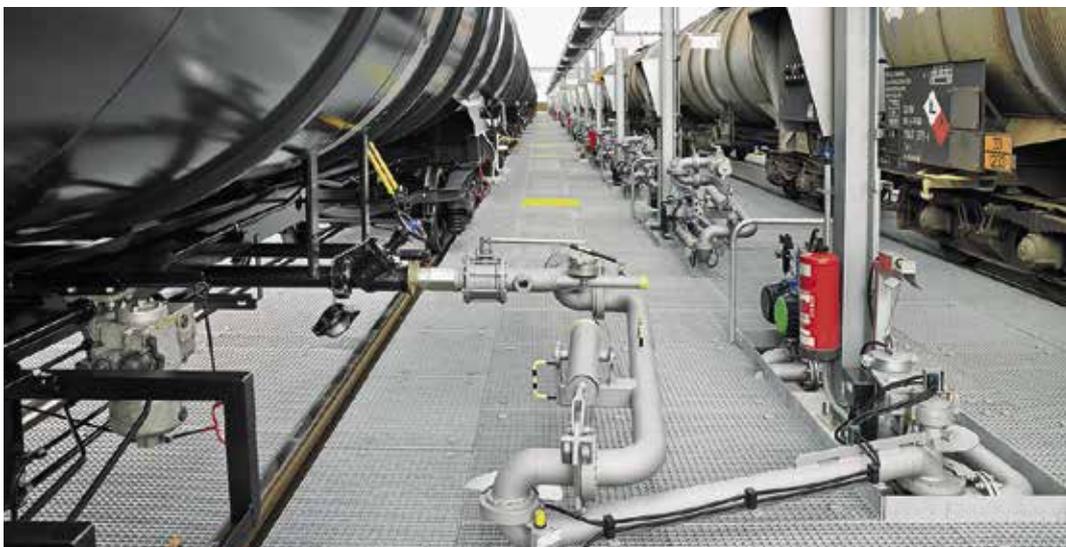
Vapour losses from refined products

The quantity of gasoline products being produced and distributed worldwide is enormous and the emissions must be kept to a minimum in order to reduce “greenhouse” gases and improve air quality.

Also emissions from storage tanks due to “breathing” (expansion from heating by the sun during day and contraction from cooling at night) and vapourization of products can be substantial.

Typical sources of Gasoline/Naphtha/ Condensate vapours are from filling of:

- Land-based tank farms and underground caverns from ship/pipeline/rail cars
- Tankers and barges from land-based tank farms
- Rail cars from land-based tank farms
- Trucks from land-based tank farms
- Service station underground tanks from trucks
- Cars from service stations



Filling of Railcars



Emissions from storage tanks due to "breathing"

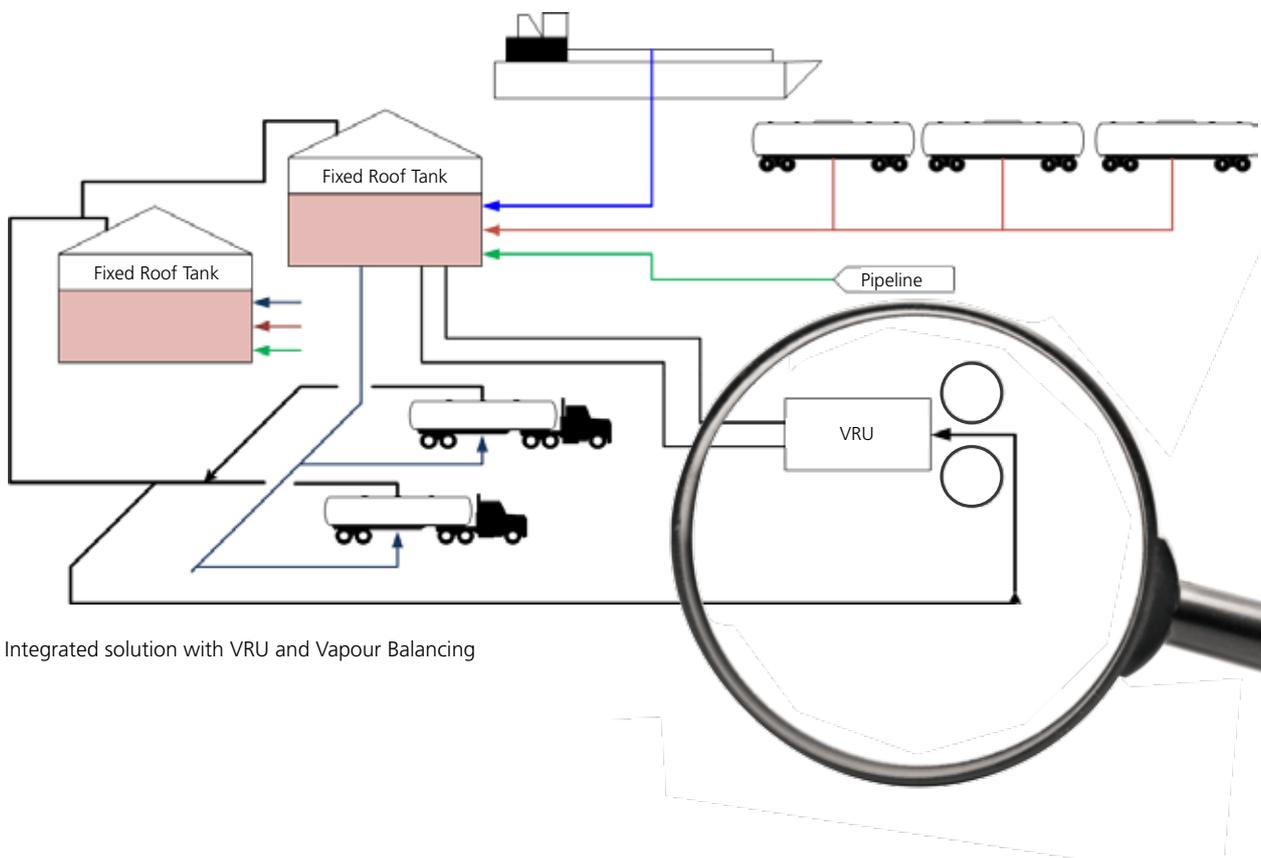


Small product tanker at pier

Bringing the vapours to the VRU

In a typical solution, vapours are routed from the ship, railcar or truck via a vapour arm or a vapour hose to the VRU via a piping system, often referred to as the “Vapour Collection System”.

The Vapour Collection System must be dimensioned correctly in regard to pressure loss, possible condensation of product, corrosion and with due regard to emergency pressure relief and fire safety. Cool Sorption has many years expertise and will be happy to advise.



Integrated solution with VRU and Vapour Balancing

If the Vapour Collection System is also connected to the storage tanks, the vapours emitted from the “receiver” will flow back to the tanks where the product is coming from.

When the storage tank is filled, the vapours will go to the VRU since they cannot be balanced back to the ship or pipeline from where the product is imported.



Depot Series™ VRU

Eliminating VRU pressure loss

Cool Sorption's VRUs are equipped with a built-in extraction fan, fully compensating for the pressure-loss through the VRU. In most cases this allows smaller dimensions of the vapour collection system, with considerable saving as consequence. In

some cases with very long vapour lines, the built-in extraction fan can even eliminate the need for an expensive zone 0 vapour transport blower between the vapour source and the VRU.

Different processes can be applied

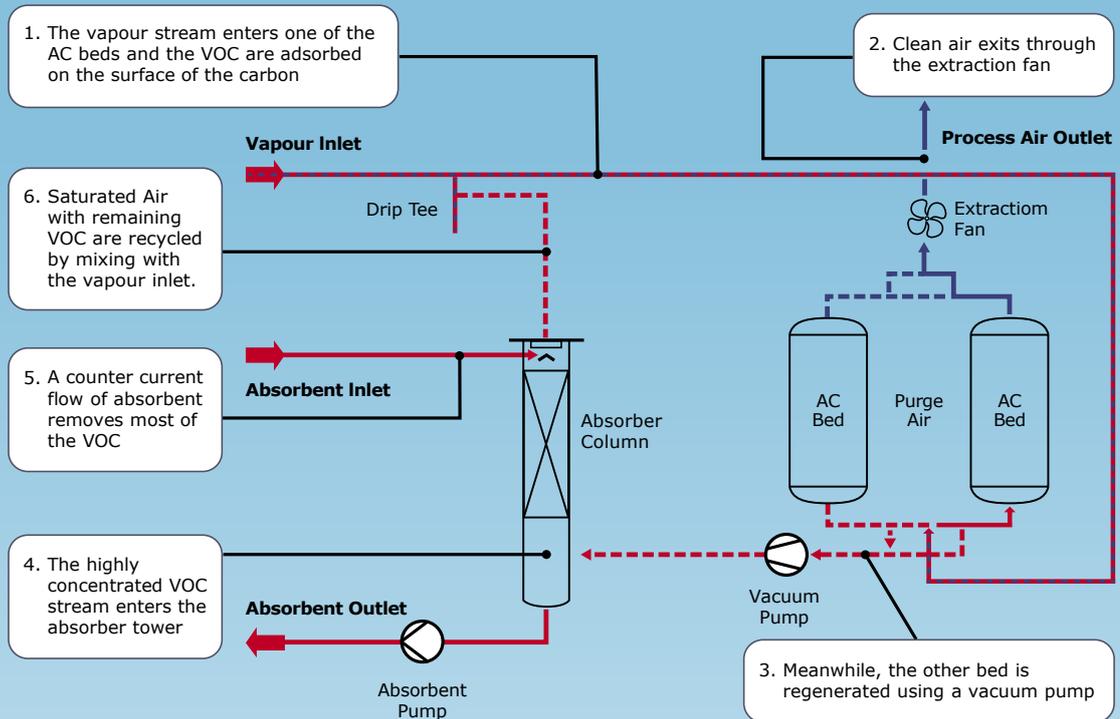
A number of different process technologies can be applied for vapour recovery, each having their individual advantages and draw-backs. The most widely used have been condensation by means of temperature and/or pressure, adsorption, absorption and membrane filtration, very often in different combinations.

Cool Sorption is dedicated to always presenting our customers with the best suited technology for the individual application. As a consequence, we continue to optimize and develop known solutions and also research, develop and apply other alternatives.

Carbon Vacuum Adsorption

For the vast majority of applications, we propose our Carbon Vacuum Adsorption (CVA) technology. The process is based on adsorption onto activated carbon, regeneration by vacuum and re-absorption of the recovered hydrocarbons in a steady flow

of fresh absorbent (typically gasoline). The process is straight forward and the many systems supplied by Cool Sorption over the last 25 years has proven it extremely safe, reliable and cost efficient.



The CVA process

Cooling and pressurisation

We regularly encounter applications where pressurization and/or cooling can be applied in different combinations with our CVA technology. It is a considerable advantage

and Cool Sorption has in recent years designed and commissioned several such systems with extremely good results.

Three variants of our CVA concept

Cool Sorption offers a range of standardized or pre-engineered solutions as well as customised or tailor-made units fitted to our customers needs.



Depot Series

The Depot Series™ vapour recovery units is a range of fully standardized units for small and medium sized installations, typically truck loading facilities. The extreme degree of standardization enables us to provide the client with detailed and comprehensive installation instructions at a very early stage. After delivery to site, the new vapour recovery unit can often be installed and commissioned in 8-10 working days.

Terminal Series

The Terminal Series™ is a range of pre-engineered vapour recovery unit systems for ship loading installations or large combined truck and rail loading facilities. That enables us to adapt each vapour recovery unit to the specific application in the most economic and reliable way. The Terminal Series™ is based on 3-bed technology which offers considerable advantages for larger systems.



Customized systems

Cool Sorption has supplied more specialized and more very large vapour recovery units than any other supplier in the world. Our success with these systems is based upon a profound understanding of volatile organic compounds, a scientific approach, state-of-the-art design tools and extensive experience with execution of large and customized vapour recovery unit projects.

Our 3-bed technology

For the continuous processing of high volume VOC vapours, Cool Sorption has developed its proprietary 3-bed technology, which is applied in our Terminal Series™. The 3-bed system has two beds in adsorption while one is undergoing regeneration. The cycle time is typically 7 minutes, however the beds spend 2 cycles in adsorption mode. After a bed has been regenerated under vacuum, the equalisation to atmospheric pressure is re-used to start the regeneration of the next bed. This gives a more efficient utilisation of vacuum capacity.

The main advantages are:

- Smaller VRU footprint and lower transport costs
- Less activated carbon
- Better use of vacuum giving lower energy consumption and lower operational costs
- Lower emission peaks



VRUs for extreme conditions

Besides VRUs for standard operational conditions, we design and supply VRUs for extremely high vapour concentrations, VRUs for extreme climatic conditions such as Siberia and the Middle East and VRUs

for installation onboard sea-going vessels operating in the North Sea and the Persian Gulf. For these extreme conditions, we often combine two or more of the technologies from our portfolio.

Other customized modules

- **Guard beds**, most often used to protect the active carbon of the downstream installed VRU against the harmful effects of H₂S and Sulphur in the vapours. Most of the time, guard beds are monitored and controlled by the VRU control system and an H₂S measurement system is installed at the output of the guard bed.
- **Dock Safety Units (DSU)**, in order to protect the connected ships against any effects from downstream incidents (Detonation arrester) and to treat (filters, KO-drum) and control (pressure sensors, valves) the vapour flow. DSU's are always monitored and controlled by the VRU control system.
- **Vapour Transport Blower**. In the rare cases where Cool Sorption's standard build-in extraction fan is not sufficient

and additional transport force is required, a Vapour Transport Blower (VTB) can be applied. Typically, such a blower is certified for ATEX zone 0 and will always be monitored and controlled by the VRU control system.

- **Second Stage Vapour Polishing**. All Cool Sorption VRU systems are designed to comply with Non-Methane VOC emission levels of <10 g/Nm³ or <150 mg/Nm³. In order to comply with the strictest regulations, such as <50 mg/Nm³ (non-Methane) VOC emission, Cool Sorption offers a second stage vapour polishing Regenerative Thermal Oxidizer (RTO). The operation of the RTO is fully integrated in the VRU functionalities. Both VRU and RTO are designed in such a way, that the RTO does not require any additional support energy during operation.

Safety

For Cool Sorption, safety has always been an integral part of every aspect of our business. Not only in terms of design, but also manufacture, installation, commissioning, mainte-

nance and eventually decommissioning. The total and undivided commitment to safety has so far paid off in over 20 years without any recorded safety incidents.



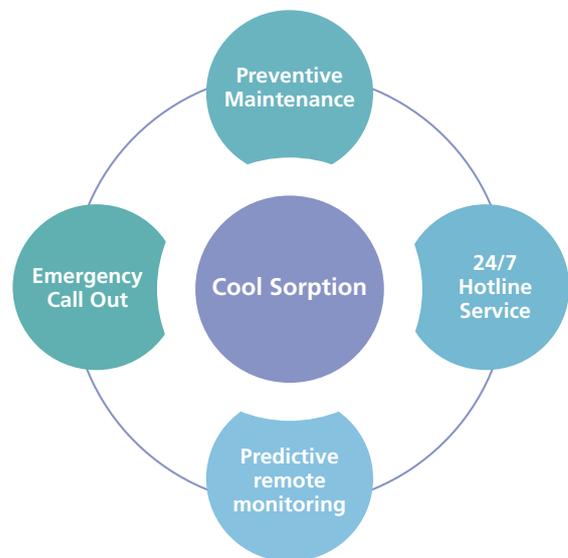
World-class service

For more than 35 years, Cool Sorption has been the largest and most agile service organization for VRUs in Europe. Service and maintenance are provided by our skilled and self-driven service engineers utilizing their collective competences.

We continue to develop our service concepts in order to support our customers throughout the lifetime of their VRU's and offer a range of after-sales service agreements for all types of vapour recovery units.

Most of our vapour recovery units are covered by service agreements for preventive maintenance, ensuring that emission limits are met and minimizing unplanned downtime and maximizing operational uptime.

- **Preventive Maintenance** contracts, tailored to meet your specific requirements, generally include 1 to 4 site visits per year, each with a full preventive maintenance check and a detailed service report.
- **24/7 Hotline Service**, covering technical phone support where our experienced service engineers are available to answer your questions. Our support for critical system problems is available 24/7/365.



- **Emergency Call Out**, guaranteeing the attendance of one of our service engineers at site within an agreed response time.
- **Predictive remote monitoring** in combination with Preventive Maintenance. With this service, Cool Sorption monitors your system 24/7 to proactively diagnose problems before they cause service outages.



Five good reasons for using Vapour Recovery

- Reduce VOC impact on the environment
- Comply with legislation on reduced emission
- Protect human health
- Increase the safety on the terminal
- Recover a valuable product

“ We have been trusting Cool Sorption for 15 years concerning our VRU. A sustainable design and a reliable service continuity are the key to operational success ”

SRPP, La Reunion Island

“ The VRU is excellent. We never had such good emission measurements ”

Circle K, Kristianstad, Norway

“ The unit is serving us well for nearly 20 years ”

Essar Oil, Stanlow, UK

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