

# UNION ENGINEERING CO<sub>2</sub> EXTRACTION PLANTS FOR BOILER SYSTEMS

## CO<sub>2</sub> EXTRACTION BOILER SYSTEM

CO<sub>2</sub> Extraction Plants (EBU) are based on importing flue gas from boilers fired with various fossil fuels such as diesel oil, heavy fuel oil, kerosene, natural gas, LPG or LNG. If steam and flue gas supply are continuously available significant energy savings up to 45% can be achieved with an CO<sub>2</sub> extraction plant compared with traditional combustion based plants.

Through appropriate scrubbing, stripping and separation technology, the CO<sub>2</sub> generating plants meet the strictest CO<sub>2</sub> quality requirements regardless of the fuel type. All Union generating plants are based on the latest technologies for amine plants, including NOxFlash and PUR-D.

**Extraction Plants** are based on absorption of CO<sub>2</sub> from flue gas into a monoethanolamine (MEA) based solution, which is subsequently heated by the steam heated reboiler to release the raw CO<sub>2</sub> gas. To achieve the best combination of performance and long life of the equipment, a 9% MEA / water solution is used. Under this condition, the optimal balance between CO<sub>2</sub> load in the solution and avoidance of the corrosive effects of MEA are met.

**The NOxFlash** technology is the result of innovative research and has been proven in our installations since 2006. Among other advantages, the NOxFlash technology replaces the traditional use of scrubbing with PPM (potassium permanganate) solution, thereby reducing cost and environmental impact. Furthermore, the NOxFlash system acts as proven abatement of benzene (aromatic hydrocarbons) in the final product.

**The PUR-D technology** is the final purification step, consisting of a distillation column which enables separation/blow-off of noncondensable gasses, thereby reducing the O<sub>2</sub> content in the final product to max. 5 ppm (v/v) and obtaining corresponding CO<sub>2</sub> purity of min. 99.99% (v/v).



The electrical system for the CO<sub>2</sub> generating plant consists of a local control panel and a LV (low voltage) MCC panel. From the control panel, which comprises the latest PLC technology, the plant is operated and monitored on a touch colour TFT display, ensuring easy and continuous trouble-free operation.

The plant is started by an automatic start sequence and the operation is fully automatic. The entire process is easily surveyed on the operator panel, showing the status of all drives, readings of all transmitters and alarm warnings, which will also be indicated by audible alarm.

All instruments installed on the skids are wired to junction or remote I/O boxes prior to shipment, thus reducing installation and commissioning time on site.

The plants are designed for high efficiency, availability and reliability through components selected for long life and 24/7 operation.

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## GENERAL DESCRIPTION OF CO<sub>2</sub> EXTRACTION PLANTS

The plant is based on drawing flue gas from boiler exhaust systems. The flue gas will have a CO<sub>2</sub> content of 10-14% v/v and is directed to a flue gas scrubber, in which the gas is cooled and water condensed.

Any SO<sub>2</sub> present in the flue gas will be removed by means of a chemical reaction with sodium carbonate (soda ash). The soda ash is automatically added to the scrubbing water by means of pH control.

After cooling and scrubbing, the gas is led via an exhauster through an absorber, in which the gas flows counter-current with a MEA solution flow. By chemical reaction, the MEA solution absorbs the CO<sub>2</sub> from the flue gas.

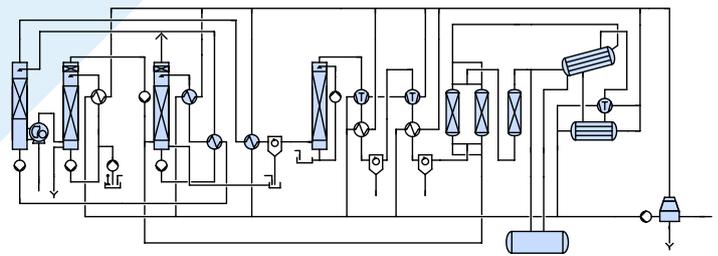
The MEA solution containing the absorbed CO<sub>2</sub> (referred to as rich MEA solution) is first pressurised and heated in the cross heater (lean/rich heat exchanger) and then led to the NOxFlash column. Here most of the contaminants are removed from the rich MEA solution by flashing to the absorber pressure.

Further heating is added to the bottom of the NOxFlash column for further reduction of the contaminants in the MEA solution. This optimises the process yield to the best possible CO<sub>2</sub> product without any use of expensive chemicals (Union patent pending).

Afterwards, the rich MEA solution is pumped to a stripper, where the CO<sub>2</sub> is released from the MEA solution by means of the steam heated MEA reboiler. The CO<sub>2</sub> depleted MEA solution (referred to as lean MEA solution) is recycled to the absorber.

After exiting the top of the stripper, the CO<sub>2</sub> rich gas is cooled in a gas cooler and washed in an after-scrubber for removal of potential MEA carry-over. The gas is then compressed in two stages to approx. 15-18 bar(g) by the CO<sub>2</sub> compressor.

Prior to liquefaction, the gas is dried to a dew point of approx. -60°C (10 ppm v/v H<sub>2</sub>O) in the dehydrator. Regeneration is done automatically by electrical heating and use of dry purge gas from the CO<sub>2</sub> condenser.



CO<sub>2</sub> Generating Plant standard sizes  
(measured as liquid food-grade CO<sub>2</sub>  
produced):

145 kg/hr
285 kg/hr
500 kg/hr
1000 kg/hr
1500 kg/hr
2000 kg/hr

- other sizes available on request.

Traces of acetaldehyde are also removed in the dehydrator. The CO<sub>2</sub> gas then passes through a carbon filter for removal of any odour substances.

To remove the last non-condensable gases, the CO<sub>2</sub> gas first passes a distillation process in the purification column (type PUR-D). It is then condensed at a temperature of approx. -27°/-23°C in a CO<sub>2</sub> condenser, where the non-condensed gases are purged off. Finally, the liquefied CO<sub>2</sub> is led to an insulated storage tank.

A refrigeration unit, controlled by the CO<sub>2</sub> pressure in the CO<sub>2</sub> condenser, supplies the required refrigeration capacity. The liquid CO<sub>2</sub> is stored under a pressure of approx. 15-18 bar(g) and a corresponding temperature of approx. -27°/-23°C. During a non CO<sub>2</sub> production period, the refrigeration unit is able to operate independently of the rest of the CO<sub>2</sub> plant in order to maintain the correct CO<sub>2</sub> storage tank temperature/pressure.

The CO<sub>2</sub> produced has a minimum purity of 99.99% (v/v) and fulfills quality standards for food/beverage ingredient purpose worldwide.



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Pentair Union Engineering's main activities are worldwide sales, engineering, installation and commissioning of modular and individually designed CO<sub>2</sub> plants. Union Engineering is headquartered in Denmark and belongs to Pentair plc ([www.pentair.com](http://www.pentair.com)).