



# Packinox raises the odds for cost-effective clean coal

## IGCC plants, United States

Efficient heat exchangers are fundamental to making carbon capture and storage plants commercially viable. Now the world's first large-scale sites are being built, and Alfa Laval's Packinox technology, with its unique combination of size and process performance, looks set to facilitate critically needed economies of scale.

**Author: Michael Lawton**



### Meeting the challenge of increasing CO<sub>2</sub> emissions

Coal-fired power plants produce about a third of the world's carbon dioxide emissions, and their share is expected to increase to about 45 percent in 2035, according to the International Energy Agency. While huge efforts are being expended on finding and developing renewable energy sources, it will be a long time before these technologies are sufficiently developed to provide a serious alternative to coal and other fossil fuels. Thus finding cleaner ways to burn coal is of critical importance.

Carbon capture and storage, or CCS, is a group of technologies for capturing, compressing and storing carbon dioxide as a way to alleviate the problem. In the past years, small-scale CCS plants have been built to evaluate CCS technologies, followed by first industrial scale units. A lot however remains to be done, as per 2020 figures only about 35 million tonnes of CO<sub>2</sub> equivalent out of 35 billion tonnes emitted are recaptured. The world's two largest users of coal for power production, the United States and China, both are striving to be global leaders in CCS.

### Two methods

The two most common technologies to capture the carbon dioxide are pre-combustion and post-combustion. In post-combustion the CO<sub>2</sub> is removed after the coal is burned. This technology is developed for conventional coal-fired power plants where the coal is used as a solid fuel to produce heat and electricity through combustion. This is the most common way of producing electricity from coal.

In pre-combustion plants the carbon dioxide is removed before combustion takes place. The technology is developed for integrated gasification combined-cycle (IGCC) plants where a gasification process transforms the coal into a synthetic gas that is used to fuel the power plant. IGCC maximizes electricity output and reduces emissions of air pollutants, mainly NO<sub>x</sub> and SO<sub>x</sub>.

The CCS removal technologies are similar in post- and pre-combustion. The gas that contains the CO<sub>2</sub> meets a solvent that first captures the CO<sub>2</sub> and then releases it, allowing the carbon dioxide to be compressed and stored.

Once the CO<sub>2</sub> is captured it can be stored in geological formations. It can also be used for enhanced oil recovery (EOR) – a method in which carbon dioxide mixed with water is pumped into old oil wells to assist in extraction of additional oil. According to the US Department of Energy, EOR technology has the potential to increase domestic oil recovery efficiency from about 30 percent to more than 60 percent.

### Minimizing energy costs with efficient heat transfer

In the CCS process a lot of cooling, heating, condensation and re-boiling steps are required, making the energy cost a large part of the CCS process cost. Efficient heat exchangers are a fundamental factor in reducing the cost of CCS, making the process commercially more viable.



Alfa Laval has been involved with heat exchanger technology in nearly half of the world's 30 to 40 small-scale CCS pilot plants. As the CCS technology moved into a new phase in which large-scale demonstration sites are being built, the Alfa Laval Packinox heat exchanger revealed itself as a valuable asset, especially for the pre-combustion process in IGCC plants.

**Packinox – the ideal heat exchanger for CCS applications**

The Alfa Laval Packinox represents the simplest plant layout on the market today. As an indication, a state-of-the-art IGCC-CCS of 600 MW only requires two Packinox exchangers, versus many times that many for shell-and-tube designs.

Consequently, Packinox has one of the lowest capital-cost and operating-cost solutions available because of its ability to provide a combination of high heat transfer coefficient and very large heat transfer surface area per heat exchanger, up to about 20,000 square metres. These two features are important for the heat transfer process, as it involves very small temperature differences between the fluids as well as large flow rates.

Additional savings using the Packinox come from the plate design, which has very low internal volume that minimizes the amount of solvent in the process loop. Moreover, the Packinox can operate at a pressure similar to that of the gasifier. For pre-combustion plants, where the gasifier operates at high pressure, this allows cleaning of the syngas without having to decompress it first, thereby contributing to major savings in CO<sub>2</sub> re-compression costs later on.

**Two installations in the US**

The US government claims to have made the world's largest investment in CCS, the Department of Energy using close to USD 4 billion in federal funds, matched by more than USD 7 billion in private investments, in the pursuit of multiple demonstration projects.

Alfa Laval has successfully equipped two carbon capture units of the largest, full-scale IGCC plants in the US: one as a retrofit to make the plant "carbon capture ready" in Edwardsport, Indiana, the other to the 600-MW Mississippi Power Plant – the world's first full-scale IGCC plant to capture CO<sub>2</sub> from the beginning of its operation. Both capture units, despite their large capacity, required only two very large size Packinox heat exchangers, and operate satisfactorily when active.



Alfa Laval Packinox plate-and-frame heat exchangers offer exceptional heat recovery and are the ideal choice for carbon capture and storage applications.



**Wide Opening Design**  
Maximum heat recovery



**Lifetime Follow-Up**  
Continuous monitoring and optimization



**Explosion Forming**  
High-strength plates with long, reliable lifetime



**ALOnsite**  
Qualified support at your facility

Learn more about Alfa Laval Packinox plate-and-frame heat exchangers at: [www.alfalaval.com/packinox-plate-and-frame](http://www.alfalaval.com/packinox-plate-and-frame). [Click here for more information about our carbon capture and storage solutions.](#)

**How to contact Alfa Laval**

Up-to-date Alfa Laval contact details for all countries are always available on our website at [www.alfalaval.com](http://www.alfalaval.com)

100003830-1-EN 2106