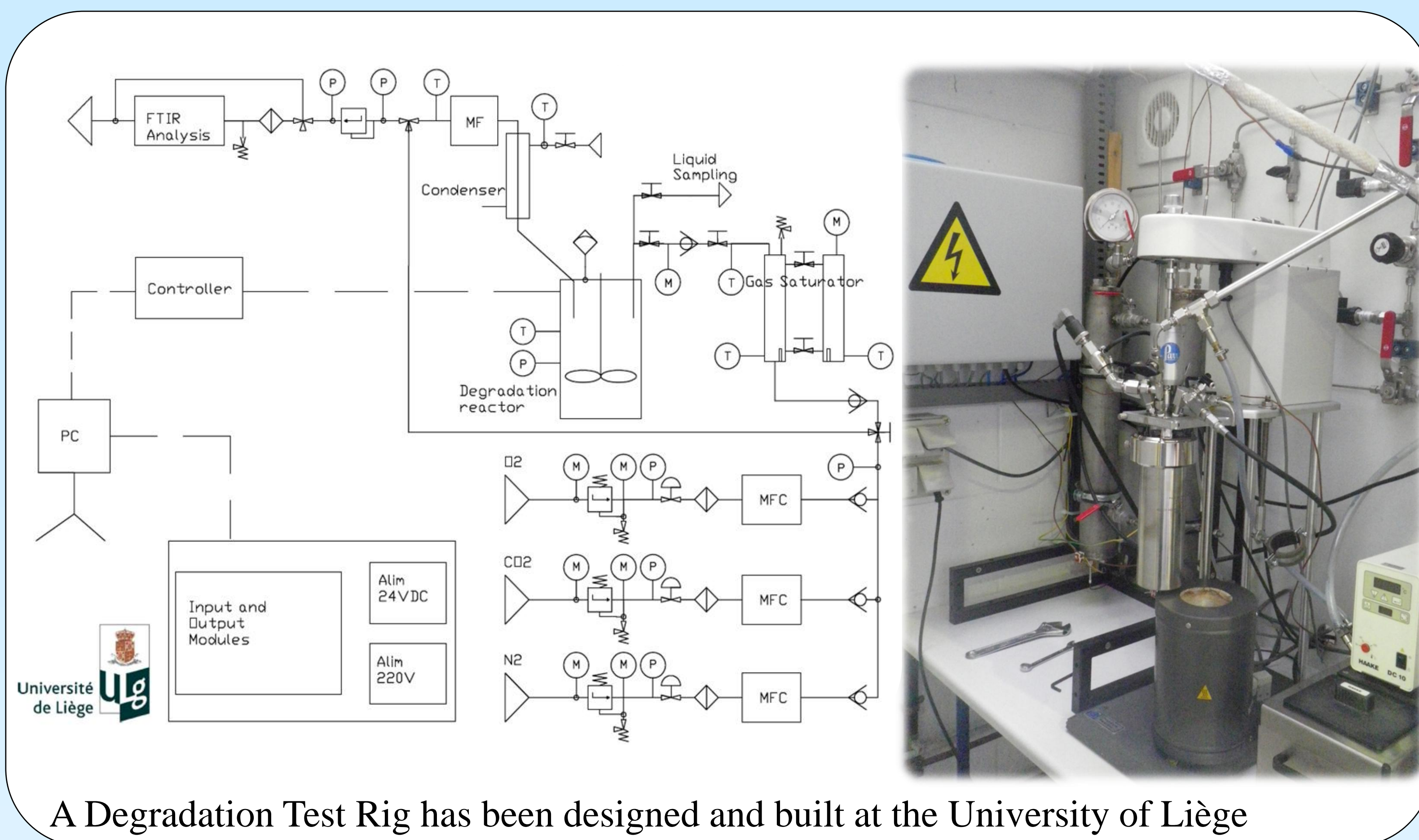
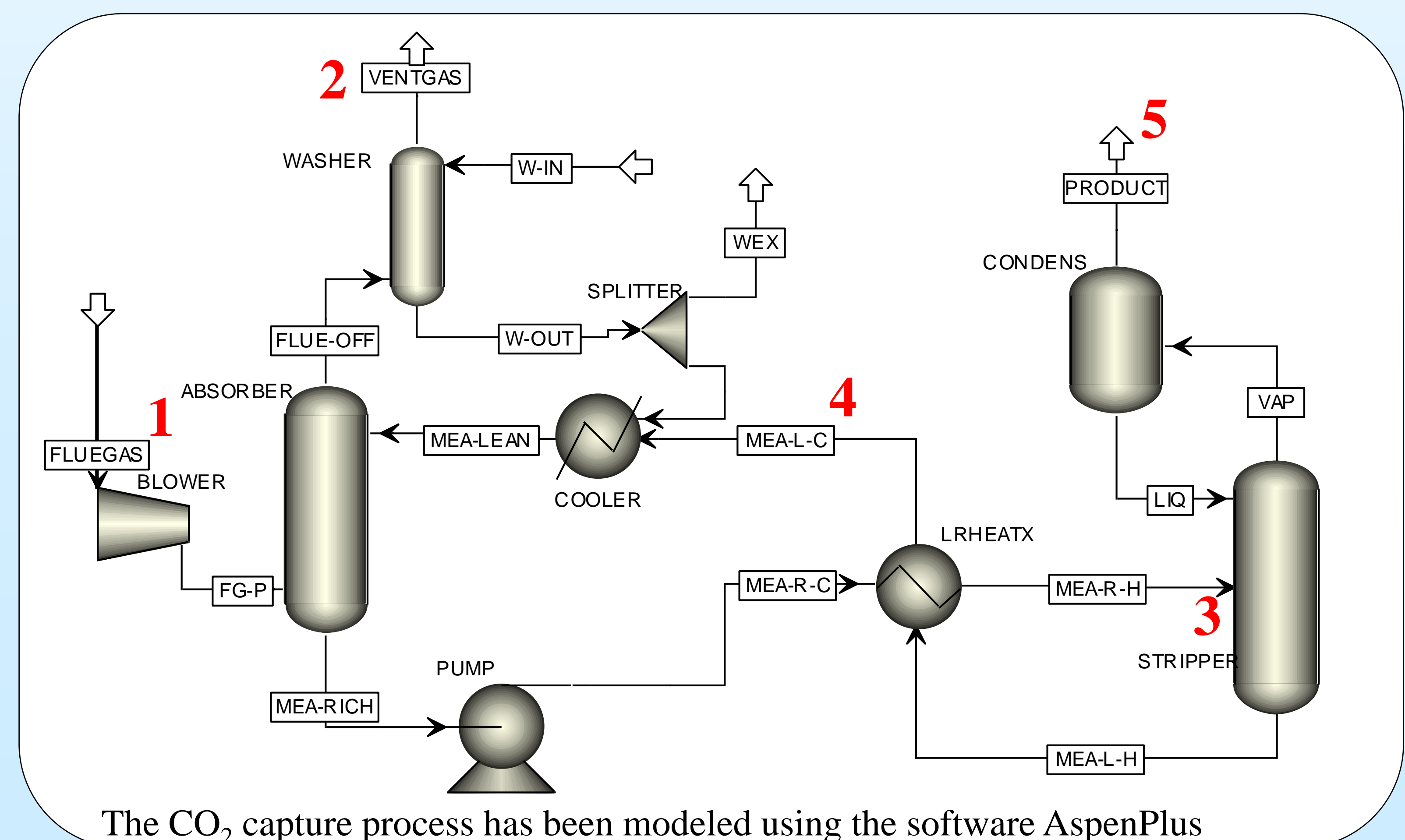


One of the biggest upcoming challenges concerning environmental and energy engineering is the limitation of greenhouse gas emissions due to human activity. In order to produce electricity, fossil fuels-fired power plants emit large amounts of CO₂. This work focuses on post-combustion CO₂ capture in coal power plants. The capture occurs by reactive absorption of CO₂ into aqueous amine solvents. Two main aspects are studied: process modelling and solvent degradation.

Model description

1. Flue gas from the power plant contains N₂, O₂, H₂O and CO₂. In the absorber, CO₂ chemically reacts with an amine solvent.
2. The flue gas emitted to the environment after absorption contains 90% less CO₂.
3. The CO₂-loaded solvent is pumped to a stripper and regenerated at higher temperature
4. The regenerated solvent flows back to the absorber.
5. The released CO₂ is almost pure and may be further valorized (alimentary applications, enhanced oil recovery), or stored underground.



Solvent degradation

Solvent make-up cost due to degradation may represent up to 22% of the CO₂ capture Operative Expenses^[1]! Solvent degradation reduces the process efficiency, increases corrosion, and implies additional cost for treatment of degradation products.

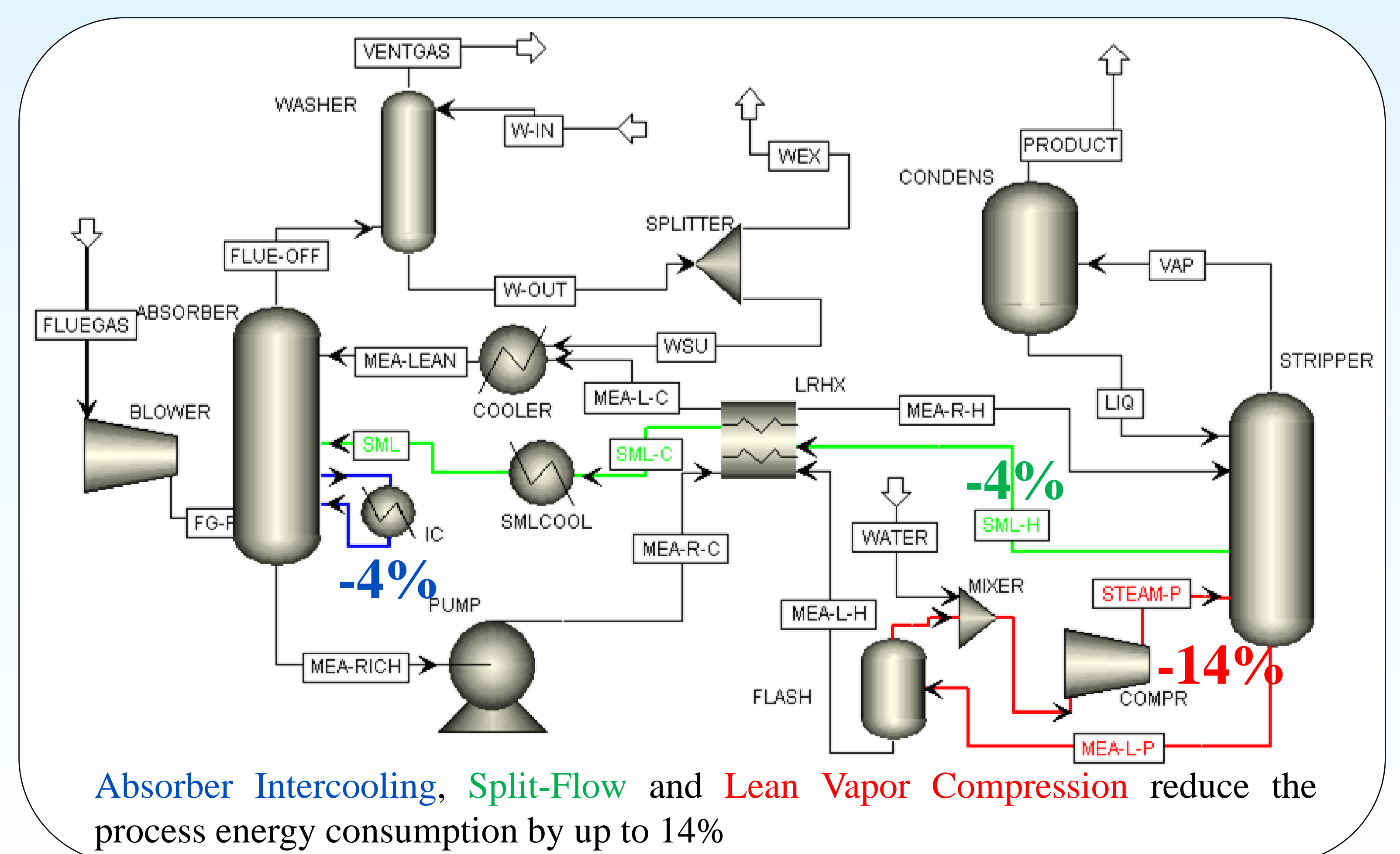
Solvent degradation under accelerated conditions is studied using an innovative degradation test rig at the University of Liège. Experimental results evidence the negative effect of temperature and oxygen on solvent degradation. Degradation inhibitors are currently being tested.



Process optimization

Simulation results show that optimizing process parameters like solvent flow rate and stripping pressure may reduce the process energy consumption by 17%. Moreover, process modifications reduce the energy consumption by up to 14% (see figure). However, solvent degradation was not considered in the model yet.

The final objective of this research is to make the link between solvent degradation and process simulation. A multi-objective optimization of the CO₂ capture process will be performed with a model considering both solvent degradation and energy consumption.



[1]: Abu Zahra M., 2009. Carbon dioxide capture from flue gas, PhD Thesis, TU Delft, The Netherlands.

Acknowledgements

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